BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

PW 2025-08

April 2025

Prepared for:

MUNICIPALITY OF BRIGHTON
35 Alice Street
PO Box 189
Brighton, ON
K0K 1H0

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
203-863 Princess Street, Kingston, ON K7L 5N4

JLR No.: 32296-001

MUNICIPALITY OF BRIGHTON

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

LIST OF APPENDICES

END OF SECTION

1.1 DESCRIPTION OF THE WORK

.1 The full scope of work is prescribed in detail in the attached tender documents. Without limiting the specifics of these requirements, the work generally consists of:

- .1 Construction of a new influent pumping station
- .2 Construction of a new headworks building housing the inclined auger screen and bypass manual screen, and exterior grit channels
- .3 Construction of a new extended aeration plant, consisting of three new aeration tanks, four new secondary clarifiers
- .4 Construction of a new Process Building housing blowers, sludge and scum pumps, chemical systems, main electrical room -
- .5 Construction of a new UV Building, housing UV channels and banks
- .6 Construction of a new outfall pipe connecting UV effluent to existing outfall chamber
- .7 Convert existing aeration lagoon into Waste Activated Sludge (WAS) Stabilization Lagoon
- .8 Convert existing facultative lagoon into Flow Equalization Lagoon; construct a decant pump station to return flow to head of the plant
- .9 Construction of a new Administration Building
- .10 Relocation of Arena Creek
- .11 Construct new outdoor generator, transformer and associated site-wide electrical, instrumentation and control upgrades
- .12 Various site-wide civil works for grading, yard piping, access/driveway

.2 The site for the work is located at 100 County Road 64, Lot 33 &34, Concession B, Municipality of Brighton, County of Northumberland.

.3 The Contract Time will be from August 15, 2025. No onsite work shall commence prior to receipt of the ECA. The Environmental Compliance Approval (ECA) for Sewage is anticipated by August 31, 2025.

.4 The Contractor shall have the works "Substantially Performed" by August 31, 2027.

1.2 OWNER AND CONSULTANT

.1 **Owner:** The Corporation of the Municipality of Brighton
35 Alice Street, PO Box 189
Brighton, Ontario
K0K 1H0

.2 **Consultant:** J.L. Richards & Associates Limited
203-863 Princess Street
Kingston, ON
K7L 5N4

1.3 CONTRACT DOCUMENT IDENTIFICATION

.1 Contract / Bid Documents are identified as Project No. PW 2025-08 as prepared by J.L. Richards & Associates Limited, located at 203-863 Princess Street, Kingston, ON and listed in Table of Contents.

1.4 INVITATION

.1 Bid Call:

.1 Bid documents may be obtained electronically through www.bidsandtenders.com (Website) under PW 2025-08 Brighton Wastewater Treatment System Upgrades. All Bidders must have a Bidding System Vendor account and be registered as a Plan Taker for this Bid opportunity, which will enable the bidder to download the tender Document, to receive Addenda notifications and download all documents without the watermark “preview” on them. To ensure receipt of the latest information and updates regarding this bid, the onus is on the Bidder to create a Bidding System Vendor account and be registered as a Plan Taker for the bid opportunity.

.2 Bid forms are to be executed, dated, and submitted electronically to the www.bidsandtenders.com submissions portal before 1:30 pm local time on June 10, 2025.

.3 Submit electronic bids via www.bidsandtenders.com submissions portal, as indicated above. Bids submitted to JLR’s or the Owner’s address / office will not be opened and will be declared noncompliant.

.4 Bids submitted after 1:30 pm local time will not be opened and will be declared noncompliant.

.5 Amendments to submitted bid forms will be permitted if received electronically prior to bid closing and if endorsed by same party or parties who signed the original bid.

.6 The Owner will not assume any risk, responsibility or liability whatsoever to any Bidder that submits a digital tender. The Owner makes no representation, warranty or condition that their email system will be uninterrupted, timely, secure, or error-free. Therefore, multiple emails are acceptable provided the subject line clearly indicates “1 of X submissions” and the last email is received before the tender closing time.

.7 The use of mail, courier, or fax other means not noted above for delivery of a bid will not be accepted.

.2 Municipality’s Purchasing Policy By-Law:

.1 Tenders shall be called, received, evaluated, accepted, and processed in accordance with the Municipality of Brighton’s Purchasing Policy By-law, including definitions and procedures (copy available upon request). By submitting a Tender, each Bidder agrees to be bound by the terms and conditions of that By-law and those Procedures and any amendments to them, as fully as if it were reproduced and attached to this Tender.

1.5 SUBMISSION / BID OPENING FORMAT

.1 Bidders shall be solely responsible for the delivery of their bids in the manner and time prescribed.

.2 Prior to bid closing time, submit digital forms required through www.bidsandtenders.com.

.3 Bidders are advised that there will be a public opening of the Bid Documents of this Tender.

.1 A public opening will be held for this Tender on June 10, 2025, at 2:00 pm at the Municipal Office located at 35 Alice Street, Brighton Ontario, Council Chamber.

.2 Preliminary results will be posted on the www.bidsandtenders.com within 48 hours.

1.6 INFORMAL OR UNBALANCED TENDERS

.1 Tenders that are incomplete, conditional, illegible or obscure, contain information not called for, reservations, erasures, alterations or irregularities of any kind may be rejected as informal.

.2 Tenders that contain prices which appear to be so unbalanced as to affect adversely the interests of the Owner or Tenders which are based upon an unreasonable period of time for the completion of the works may be rejected.

.3 The Owner reserves the right to waive any and all informalities, as the interests of the Owner may require, without stating the reasons, therefore.

.4 Tenders that do not exhibit an adequate "Proof of Ability" may be rejected.

1.7 TENDER INCONSISTENCIES

.1 In any instances where the total of individual prices of the Tender does not equal the total Tendered Price, the mathematical summation of the constituent tendered prices will be taken as the offered Tender Price.

.2 If amount tendered for an item does not agree with the extension of the estimated quantity and the Tendered Unit Price, the Unit Price is to govern and the item amount and Tender Price will be corrected accordingly.

1.8 SITE ASSESSMENT

.1 A mandatory site assessment has been scheduled for 10:00 am on May 26, 2025. Site visit will take place at the Brighton Wastewater Treatment System Site at 100 County Road 64, Lot 33 &34, Concession B, Municipality of Brighton.

.2 Each Bidder are to apprise themselves of the site before submitting their Tender and satisfy themselves by personal examination as to the local conditions affecting construction of the work.

.3 As Bidders have the opportunity to visit the site and make necessary examinations and investigations of the apparent and accessible conditions, the Successful Proponent shall not be entitled to subsequently claim any increase to the contract time or contract price resulting from any failure or omission to:

.1 Identify otherwise reasonably apparent or accessible conditions.

.2 Incorporate further investigative activities required into their proposal.

1.9 INQUIRIES AND ADDENDA

.1 If in doubt about meaning or intent of any part of Tender Documents, notify the Consultant and Owner in writing. If no questions are received, it will be assumed that work is clearly defined, and that Bidders are in no doubt as to meaning or intent of the Tender Documents.

.1 Questions shall be submitted via email to Susan Shi, P.Eng. at brighton@jlrichards.ca

.2 Contractor inquiries may be issued up to five (5) business days prior to bid close.

.3 Consultant replies to inquiries will be in the form of an addendum and will be uploaded to the website no later than two (2) business days before bid close.

.4 The Consultant and Owner will not provide oral responses to inquiries. The tender documents cannot be modified via oral response.

1.10 BID SECURITIES

.1 Security Deposit:
- .1 Bids are to be accompanied by a security deposit in the form of a Bid Bond (Electronic Bid Bond) from a surety company licensed to carry on business in the Province of Ontario in amount of 10% of the bid price.
- .2 Endorse Bid Bond in name of Owner as obligee, signed and sealed by principal (Contractor) and surety. A certified cheque payable to the Owner can be provided but must be arranged with the Owner.
- .3 Use bond forms in compliance with the Ontario Construction Act.
- .4 Security deposit will be retained without interest by Owner until the following, whichever occurs first:
  - .1 A Contract is entered into and, after delivery to Owner of required Performance and Labour and Materials Payment Bond(s) by accepted Bidder, or 60 days after Tender Closing.
  - .2 If no contract is awarded, security deposits will be returned.
- .5 Each Bidder understands and agrees that, if their Tender is withdrawn before Owner considers Tenders, or before they have been notified that their Tender has been accepted by Owner, or if they fail for any reason to execute an Agreement and provide other documents as specified herein, the Owner may retain their security deposit for the Owner's use.

.2 Consent of Surety/Agreement to Bond:
- .1 Tender submission must include a clear and unqualified commitment from a surety company licensed to carry on business in the Province of Ontario, to provide Labour and Material Payment and Performance Bonds, in a format acceptable to the Owner, if the Bidder is successful in their Tender to the Owner.
  - .1 Alternatively, the Consent of Surety/Agreement to Bond may be a letter from a financial institution licensed to carry on business in the Province of Ontario, advising they will provide a certified cheque or a clear and unqualified Irrevocable Letter of Credit to the Owner, in a format acceptable to the Owner, if the Bidder is successful in his Tender to the Owner.

.3 Include all associated costs of bonds, or certified cheque, or Irrevocable Letter of Credit in the Bid Price.

.4 If no contract is awarded, all security deposits will be returned.

.5 Required Bonds:
- .1 The following Bonds are required to be provided by the successful Bidder following execution of the Agreement.
  - .1 Labour and Material Payment Bond in the amount of 50% of the contract value.
  - .2 Performance Bond in the amount of 50% of the contract value.

.6 Insurance:
- .1 Provide a signed "Undertaking of Insurance" on a standard form provided or as provided by the Insurance Company stating their intention to provide insurance as identified in Section 00800 Supplementary Conditions.
- .2 Include the cost of insurance in the Bid Price.

.7 Submit a valid Workplace Safety and Insurance Board Clearance Certificate.

1.11 TECHNICAL REQUIREMENTS SUBMNISSION CONTENT AND SCORING:

.1 Rated Criteria

.1 The following sets out the categories, weightings, and descriptions of the rated criteria of the RFP.

Rated Criteria Category	Weighting (Points)	Minimum Threshold
Technical Requirements Submission		
General Contractor – Corporate Experience	6	14 of 20
General Contractor – Project Team	8	
Mechanical and Electrical Subcontractor Team and Corporate Experience	6	
Subtotal:	20	
Bid Price	80	N/A
Total Points:	100	N/A

.2 The Bidder shall complete the technical requirements submission in accordance with CCDC 11-2019 Contractor's Qualification Statement. The completed CCDC 11-2019 form shall be uploaded along with the bid submission. Note the following amendments to CCDC11-2019.

.1 Under "Project Experience", Article 1. "Key construction projects completed in the past five years", revise to read "Key projects completed in the past 10 years".

.2 The Bidder shall provide, for each of the Appendix A, B and C as outlined in CCDC 11-2019, two (2) reference projects for the purpose of evaluating the Contractor's ability, experience, and track record of success in construction projects involving similar construction in water/wastewater treatment facilities in Ontario.

.3 The Bidder shall provide key personnel's resumes as required under "Qualifications and Experience of Personnel" section.

.3 Bid Price Scoring

.1 Pricing is worth 80 points of the total score.

.2 Pricing will be scored based on a relative pricing formula using the Bid Price provided in the Bid Form (Section 00301). Each Bidder will receive a percentage of the total possible points, which will be calculated in accordance with the following formula:

$$Lowest\ Bid \div Bid\ Price \times weighting = Bidder's\ pricing\ score$$

1.12 CONTRACT AGREEMENT

.1 Agreement Form:

.1 The Owner/Contractor contract will be the CCDC 2 2020 Edition.

1.13 SUBSTITUTION AND ACCEPTANCE OF ALTERNATE PRODUCTS

.1 Requests for substitutions and alternate products will not be considered during the Tender Period. Such requests can be made following Contract Award in accordance with Section 01250 Substitution Procedures.

1.14 LOCAL TRADES, LABOUR AND SUPPLIERS

.1 Contractor and / or Subcontractors are encouraged to contract and employ local trades people, suppliers, labourers, machine operators and equipment in the construction of this facility and to purchase from local suppliers.

.2 Responsibility for the Work, construction schedule and supply of materials in employing local labourers, trades people, machine operators, equipment, suppliers, etc., remain solely with the Contractor.

1.15 WITHDRAWAL OR AMENDMENT OF BID DOCUMENTS

.1 Amendments to submitted bid forms will be permitted if received in writing prior to bid closing and if endorsed by same party or parties who signed the original bid.

.2 The last bid received will supersede and invalidate all bids previously submitted by the Bidder.

.3 A Bidder may withdraw or amend his bid amount at any time up to the official closing time by submitting a letter to this effect bearing the company's signature and/or seal.

1.16 OFFER ACCEPTANCE / REJECTION

.1 The Consultant, on behalf of the Owner, will issue to the successful Bidder a written letter of intent indicating that the Owner will enter into a CCDC 2 2020 Stipulated Price Contract with the Contractor.

.2 A bid is conditionally accepted by the Owner upon issuance of letter of intent.

.3 The acceptance of a bid is subject to the condition that the Owner receive a Performance Bond and a Labour and Material Payment Bond, as required herein, and in a form satisfactory to the Owner, within seven (7) working days after notification of contract award.

.4 The Consultant does not have the authority to make or accept an offer or to enter into a Contract on behalf of the Owner.

.5 The Consultant recommendation of a bid to the Owner for acceptance does not constitute acceptance of the bid by the Owner.

.6 The Owner will not be responsible for any liabilities, costs, expenses, loss or damage incurred, sustained or suffered by any Bidder prior to, subsequent to, or by reason of the acceptance or the non-acceptance by the Owner of any bid, or by reason of any delay in the acceptance of a Tender save as provided in the Contract.

.7 The Owner reserves the right to reject any or all bids without stating reasons.

.8 The Owner shall have the right to waive nonmaterial irregularities in a tender.

.9 The Owner reserves the right not to accept bids if two (2) or less bids are submitted.

1.17 IRREVOCABILITY OF BID

.1 The Bidder is to hold in force and may not revoke their bid for a period of 60 calendar days following the Bid Opening.

.2 If the Bidder revokes their offer within this period, the Bidder will forfeit their Bid Security. This does not prohibit the Owner from pursuing other legal means for damages.

1.18 PROOF OF ABILITY

.1 The Bidder shall be competent and capable of performing the Work. The Bidder will be rated by the Owner and Consultant based on the Form of Tender and CCDC 11-2019 Contractor's Qualification Statement.

.2 The Bidder will complete the following statement sheets:

.1 Statement 'A' - Giving a list of the Tenderer's senior supervisory staff to be employed on the Contract with a summary of the experience of each.

.2 Statement 'B' - Giving the location and description of the construction equipment which the Tenderer proposes to use.

.3 Statement 'C' - Giving the list of proposed subcontractors.

.4 Statement 'D' - Giving a breakdown of items and prices.

.5 Statement 'E' - Giving the contact information for each Tenderer.

.6 Statement 'F' – Giving the acknowledgement of accessibility requirements.

.3 The Tenderer may, if prefers, in lieu of completing and submitting the above-mentioned statement sheets, submit the information required by the said sheets on similar forms prepared in the Tenderer's own office, provided that the said forms bear the Tenderer's name and the date of preparation and contain up-to-date information.

END OF SECTION

TENDERER'S CHECK SHEET

Tenderer is to complete and submit this Check Sheet with its Tender.

Before submitting your Tender, check the following points (which is a non-exhaustive list):

Is your tender in ink or typed?..... ☐

Is your tender complete? ..... ☐

Is your tender irrevocable for sixty (60) days?..... ☐

Has your tender been signed and your seal affixed? ..... ☐

Have you enclosed the required Security? ..... ☐

Have you enclosed the required Agreement to Bond signed and sealed by your proposed surety?..... ☐

Have you completed and included the Statutory Declaration Form?..... ☐

Have you completed and included Statements A, B, C, D, E, F? ……..... ☐

Have you acknowledged the number of Addenda received where required to do so, and where appropriate, including the information included in Addenda in your total Tender Price? ..... ☐

Have you completed and included CCDC11-2019 Contractor's Qualification Statement? ……..... ☐

Have you initialed erasures, overwriting or strikeouts, if any? ..... ☐

Confirm that your tender is not made conditional by a statement added to the Tender Form or by a covering letter, by checking this box: ..... ☐

Confirm that you were able to access and download the following files from www.bidsandtenders.com website as it relates to this Tender:

Drawings ……..... ☐
Specifications ……..... ☐

Checklist Form (to be completed by Tenderer)

COMPANY: _____

NAME: _____

TITLE: _____

SIGNATURE: _____

DATE: _____

MUNICIPALITY OF BRIGHTON

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES
TENDER No. PW 2025-08

From: .....

.....

.....

.....

(Name and Address of Tenderer)

To: Municipality of Brighton

35 Alice Street

Brighton, Ontario K0K 1H0

1. I/We, the undersigned, hereby offer and agree to furnish all required labour, materials, equipment and supervision and to execute the work set out in the Tender Documents, including all Addenda, and including all fees, permits, and taxes, but excluding HST, for the Stipulated Price of the core bid. (This number shall match line A in Schedule 1 – Schedule of Items and Prices).

.....

..... DOLLARS $(.....)

2. .1 I/We acknowledge receipt of and have included for in our Stipulated Price the requirements of the following Addenda:

Addendum No. .....dated .....

Addendum No. .....dated .....

Addendum No. .....dated .....

Addendum No. .....dated .....

Addendum No. .....dated .....

Addendum No. .....dated .....

Addendum No. .....dated .....

Addendum No. .....dated .....

.2 I/We have included for in our Stipulated Price the following Allowances as set out in the Schedule of Items and Prices.

.1 Cash Allowance for materials testing.
.2 Cash Allowance for Designated Substance Survey and Removal of Designated Substances.
.3 Cash Allowance for Furniture.
.4 Cash Allowance for System Integration with Harbour Street Sewage Pump Station.

.5 Contingency Allowance.

3. .1 I/We declare that this Tender is made without knowledge, comparison of figures or arrangement with any other Company, Firm or Person making a Tender for this same work and that no officer or employee of the Owner has any direct or indirect interest in the performance or work of this Contract.

.2 I/We further declare that no member of the Municipal Council and no officer or employee of the Ministry or of the Crown or of the Consultant is or will become interested directly or indirectly as a contracting party, partner, surety or otherwise in or in the performance of the Contract or in the supplies, work or business to which it relates, or in any portion of the profits thereof, or in any of the monies to be derived therefrom.

.3 I/We recognize the right of the Owner to reject any or all Tenders and to waive informalities as the interests of the Owner may require.

.4 I/We have visited and carefully examined the site of the work and have satisfied and informed myself/ourselves as to all the existing conditions, limitations and difficulties which may arise and govern the completion of the work.

4. I/We agree that, if this Tender is accepted by the Owner,

1) I/We will carry out any additional or extra work (including the supplying of any additional materials or equipment pertaining thereto) or will delete any work as may be required by the Owner in accordance with the Contract;

2) the carrying out of any work referred to in paragraph 1) above or the issuance by the Owner of a Contract Change Order relating to such work or the acceptance by the Tenderer of such Contract Change Order shall not, except as expressly stated in such Contract Change Order, waive or impair any of the terms of the Contract or of any Contract Change Order previously issued by the Owner or any of the rights of the Owner or of the Consultant under the Contract;

3) I/We will pay to the Owner the sum specified in the Contract as liquidated damages for each calendar day that the work under the Contract as expressly modified by all Contract Change Orders issued by the Owner remains uncompleted after the expiry of the Time for Completion specified in the Contract or the extended time for completion allowed in writing by the Owner.

The prices applicable to work referred to in paragraph 1) above shall be determined as follows:

(a) The Schedule of Items and Prices shall apply where applicable;

(b) If the above Schedule is inapplicable the prices shall be determined in accordance with the General Conditions.

I/We agree that we are not entitled to payment of the Contingency Allowance except for additional work carried out in accordance with the Contract and only to the extent of such additional work, as authorized by the Owner in writing.

5. .1 I/We include herewith the following documents:

.1 I/We agree to furnish to the Owner copies of all required Subcontractor Performance

Bonds and Labour and Material Payments Bonds forthwith upon execution of subcontracts with our Owner-approved subcontractors and further agrees that no payment will be due and payable for work done by any subcontractor whose work is required to be bonded until such time as the required bonds have been filed with the Owner.

.2 I/We agree that, if so requested in writing by the Owner, we will enter into a Contract with the Owner based upon our Tender but jointly in the names of the Tenderer and the Tenderer's parent company, if any. I/We further agree that any request by the Owner as indicated above is not and shall not be deemed to be a counteroffer by the Owner.

.3 A Bid Bond or Certified Cheque in the amount of 10% of the Bid made payable to the Owner. I/We understand that this Bid Security will be returned to me/us following the award of a Contract, if this Tender is not accepted by the Owner, or, if this Tender is accepted by the Owner, following my/our execution of the Agreement.

.4 An Agreement to Bond from an approved surety company licensed to carry on business in the Province of Ontario.

.2 I/We agree to submit a List of Proposed Subcontractors (Statement 'C'), as specified, within 24 hours of Tender closing.

6. .1 I/We agree to hold this Tender in full force and effect for a period of 60 days from the closing date for Tenders and agree that if my/our Tender is revoked during this period, my/our Bid Security will be forfeited to the Owner to use for his purposes.

.2 I/We agree, if this Tender is accepted, to execute the specified Agreement and provide the specified Bonds within ten (10) days of notification by the Owner to do so.

.3 I/We agree that within seven (7) days after written authorization from the Consultant to proceed, I/We will commence the work, assembling all necessary labour forces and equipment on the site, and will continue the work with the utmost diligence until completion.

I/We agree to have the works "Substantially Performed" by August 31, 2027, based on an award date that is no later than August 15, 2025. Should the award be issued following August 15, 2025, the date of Substantial Performance shall be extended by the same number of days.

I/We agree that we will furnish the Owner a copy of the latest financial statement within 4 days after being requested to do so by the Owner.

The "Agreement to Bond" of the ....., a company lawfully doing business in the Province of Ontario, to furnish a performance bond and a labour and material payment bond in the form acceptable to the Owner Performance Bond and Labour and Material Payment Bond each in an amount equal to 50% of the Contract price, or in such greater amount as may be required by the Owner, if this Tender is accepted, is enclosed herewith.

Dated at ..... this ..... day of

....., 20....

....

....

Signature of Witness Signature of Tenderer

Note: If the Tender is submitted by or on behalf of a corporation, it must be signed in the name of such corporation by the duly authorized officers and the seal of the corporation, or wafer seal, must be affixed. If the Tender is submitted by or on behalf of an individual or a partnership a seal must be affixed opposite the signature of the individual or of each partner and each signature shall be witnessed.

Signed, sealed and submitted on behalf of:

.....

.....

.....

.....
(Name and Address of Tenderer)

.....
(Signature of Tenderer)

.....
(Name and Title) Corporate Seal

.....
(Signature of Witness)

Dated at ....., ... this ..... day of .....20...
(Town/City) (Province)

SCHEDULE 1

SCHEDULE OF ITEMS AND PRICES

Item	Description	Amount
1.	Mobilization and demobilization at the job including temporary offices and conveniences, other temporary facilities, hoarding, reinstatement and other items not required to form part of the permanent works (60% to be paid upon complete mobilization and 40% to be paid upon complete demobilization).	$.....
2.	Lump Sum for the upgrades, excluding Items 1. All Tenderers will be requested to submit a breakdown of this item as per the attached Breakdown of Items and Prices Tables 1 per the Information for Tenderers.	$.....
3.	Bonding per Instructions to Bidders.	$.....
4.	Insurance per Instructions to Bidders.	$.....
5.	Cash allowance for materials testing.	$ 20,000.00
6.	Cash allowance for designated substance survey and removal of designated substances.	$ 35,000.00
7.	Cash allowance for furniture.	$ 10,000.00
8.	Cash allowance for system integration with Harbor Street SPS.	$ 20,000.00
9.	Contingency Allowance.	$ 3,500,000.00
	(A) Total stipulated lump sum – Core Bid	**$.....**
	(B) HST (13%)	**$.....**
	(C) Total Price Including HST	**$.....**

AGREEMENT TO BOND

**……..……..

……..……..

Date: ..... 20....

Municipality of Brighton

35 Alice Street

Brighton, Ontario K0K 1H0

To Who It May Concern:

Re: Brighton Wastewater Treatment System Upgrades

In consideration of the Municipality of Brighton's (hereinafter referred to as "the Owner") accepting the Tender of and executing and Agreement with: .....(hereinafter referred to as "the Tenderer") for the construction of: Brighton Wastewater Treatment System Upgrades subject to the express conditions that the Owner receive the Performance Bond and the Labour and Material Payment Bond in accordance with the said Tender, we the undersigned hereby agree with the Owner to become bound to the Owner as surety for the Tenderer in a Performance Bond and a Labour and Material Payment Bond each in an amount equal to 50% of the Contract price or other such greater amount as may be determined by the Owner, in the forms of Performance Bond and Labour and Material Payment Bond and in accordance with the said Tender, and we agree to furnish the Owner with said Bonds within ten (10) days after notification of the acceptance of the said Tender and execution of the said Agreement by the Owner has been mailed to us.

Yours very truly,

.....

(Seal)

NOTE: This Agreement to Bond must be executed on behalf of the Surety Company by its authorized officers under the company's corporate seal. Of the two forms bound herein, one shall become a part of the Tender and the other shall be retained by the Surety Company.

** **Enter the name and address of the Surety Company at the top of the page.**

STATUTORY DECLARATION RE: TENDER

JLR PROJECT NO. JLR 32296-001

DOMINION OF CANADA

IN THE MATTER of a Proposed Contract
for the Construction of:
Municipality of Brighton
Brighton Wastewater Treatment System Upgrades
in the ***Municipality of Brighton***
in the Province of Ontario.

TO WIT

..... DO SOLEMNLY SWEAR THAT the several matters stated in the foregoing Tender are in all respects true, AND ..... make this solemn declaration, conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath, and by virtue of "The Canada Evidence Act".

DECLARED before me at

the .....)
.....)
.....)
of .....)
in the County of .....)
.....)
this ....., day of)
.....20 ….)

.....
Tenderer

.....
Commissioner, etc., (or Notary Public)

Section 2 of the General Conditions requires that the Tenderer complete and submit this declaration with his Tender. Failure of the Tenderer to include the properly completed Statutory Declaration with his Tender may result in the Tender being ruled invalid by the Owner.

STATEMENT 'A'

QUALIFICATIONS OF TENDERER'S SENIOR SUPERVISORY STAFF TO BE EMPLOYED ON THIS CONTRACT.

Name	Appointment	Qualifications and Years of Experience
General Contractor's Project Manager		
General Contractor's Site Foreman		
Mechanical Contractor's Project Manager		
Mechanical Contractor's Site Foreman		
Electrical Contractor's Project Manager		
Electrical Contractor's Site Foreman		
Civil Contractor's Project Manager		
Civil Contractor's Site Foreman		
Systems Integrator's Project Manager		
Systems Integrator's Site Foreman		
Commissioning Manager		

STATEMENT 'B'

PROPOSED MAJOR CONSTRUCTION EQUIPMENT TO BE UTILIZED ON THIS CONTRACT.

EQUIPMENT/AVAILABLE: .....

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EQUIPMENT/TO BE RENTED: .....

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EQUIPMENT/TO BE PURCHASED: .....

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STATEMENT 'C'

LIST OF PROPOSED SUBCONTRACTORS

The information for Tenderers requires the Tenderer to list on this Statement Sheet the name of each proposed subcontractor. For the Tenderer's convenience and to ensure that a complete list is submitted with the Tender, a list of possible subtrades has been printed below. The Tenderer shall make an entry against each possible subtrade listed either by naming the proposed subcontractor or by entering "by own forces", whichever applies. No blank spaces are to be left.

If, in addition, the Tenderer proposed to sublet a part of the work which is not listed below, the Tenderer shall add the subtrade and the proposed subcontractor's name to the list.

FAILURE BY A TENDERER TO COMPLY WITH THE FOREGOING REQUIREMENTS MAY RESULT IN THE TENDER BEING DISQUALIFIED BY THE OWNER.

SUBTRADE SUBCONTRACTORS	PROPOSED (1)	VALUE OF SUBCONTRACT (2)
Concrete		
Civil		
Mechanical		
Electrical		
Instrumentation		
By-Pass Pumping System		
Other		

(1) Enter full legal name of subcontractor.
(2) Value of Subcontract entered shall be for the core bid only.

STATEMENT 'D'

BREAKDOWN OF ITEMS AND PRICES

The following tables (Table 1, 2 and 3) shall be submitted **within 24 hours of tender closing to brighton@jlrichards.ca**. A further possible breakdown of these items will be determined with the successful Contractor after execution of the Contract for the purpose of progress payment certificates.

The Total at the end of the Table 1 should equal Item (A) Core Bid (in Schedule 1) for all associated works as identified in Schedule of Items and Prices in Form of Tender.

TABLE 1 – TENDER BREAKDOWN

Item	Description	QTY	Units	Total Amount
1	Division 1 – General	1	LS	
2	Division 2 - Site Works	1	LS	
3	Division 3 - Concrete	1	LS	
4	Division 4 – Masonry	1	LS	
5	Division 5 – Metals	1	LS	
6	Division 6 – Wood and Plastics	1	LS	
7	Division 7 – Thermal and Moisture Protection	1	LS	
8	Division 8 – Doors and Windows	1	LS	
9	Division 9 – Finishes	1	LS	
10	Division 10 – Specialties	1	LS	
11	Division 11 - Equipment	1	LS	
12	Division 12 (Furnishings)	1	LS	
13	Division 13 (Special Construction)	1	LS	
14	Division 14 (Conveying Systems)	1	LS	
15	Division 15A (Mechanical Process)	1	LS	
16	Division 15B (Mechanical HVAC)	1	LS	
17	Division 16 (Electrical)	1	LS	
18	Division 17 (Instrumentation, Control)	1	LS	
19	Bonding	1	LS	
20	Insurance	1	LS	
21	Cash Allowance – Material Testing	1	LS	$20,000
22	Cash Allowance – Designated Substance Survey and Removal of materials	1	LS	$35,000
23	Cash Allowance – Furniture	1	LS	$10,000
24	Cash Allowance – System Integration with Harbour St SPS	1	LS	$20,000
25	Contingency Allowance	1	LS	$3,500,000
26	**TOTAL (Excl. HST)**	**-**	**-**	

TABLE 2 – UNIT PRICE BREAKDOWN

	Estimated Quantity (m^3)	**Unit Price ($/m^3$)**	**Total Amount ($)**
Rock Excavation			
Lean Concrete Fill			

TABLE 3 – MAJOR EQUIPMENT SUPPLY COST BREAKDOWN

	Supplier	**Unit Price - Supply Only ($/ unit)**
11240/11253 – Ferric System		
11304 – Sludge Pump		
11306 – Raw Sewage Pump		
11306 – Decant Pump		
11312 – Prefabricated Pump Station		
11330 – Mechanical Screen		
11347 – UV Disinfection		
11375 – Surface Aspirator		
11378 – Fine Bubble Diffuser System		
11380 – Clarifier Equipment		
11427 – Rotary Lobe Blower		
11581 – Odour Control System		
16276 – Pad Mounted Transformer TX0001		
16414 – Automatic Transfer Switch ATS0001		
16445 – Switchboard SEB0001		
16622 – Standby Power GEN0001		
16800 – MCC6000A Process Building		
16800 – MCC6000B Process Building		
16800 – MCC5000 UV Building		
16471- Panelboards DP-2001 Headworks Building		

STATEMENT 'E'

RESPONDENT IDENTIFICATION

RESPONDENT:

_____
Company Name

_____
Address

_____

_____

_____
Telephone Number

_____
Fax Number

_____
Email Address

_____
Name of Person Signing

_____
Position of Person Signing

_____
Signature

Person signing must be authorized to sign on behalf of the Company/Individual represented, and to bind the Company/Individual to statements made in response to this Contract.

STATEMENT 'F'

ACCESSIBILITY ACKNOWLEDGEMENT FORM

In accordance with Ontario Regulation 429/07, Accessibility Standards for Customer Service, every provider of goods and services shall ensure that every person who deals with a member of the public or participates in the developing of the Municipality's policies, practices and procedures governing the provision of goods and services to members of the public, shall be trained as follows:

1. How to interact and communicate with persons with various types of disability.
2. How to interact with persons with disabilities who use assistive devices or require the assistance of a guide animal, or a support person.
3. How to use equipment that is available on the premises that may help in the provision of goods or services.
4. What to do if a person with a particular type of disability is having difficulty accessing the provider's goods or services.
5. Information on the policies, practices and procedures governing the provision of goods and services to people with disabilities.

Proponents are required to complete the attached Accessibility Form. Contract employees, third party employees, agents and others who deal with members of the public on behalf of the Municipality of Brighton must also meet the requirements of Ontario Regulation 429/07 with regard to training.

If a training policy is not yet in place, please go to the Ontario Access Forward Website: https://accessforward.ca/ and complete the free training modules found therein. Certificates for competent and supervisory staff certifying that accessibility training has been completed shall be provided to the Municipality before the provision of goods and services. Certificates may be from inhouse O.Reg 429/07 compliant programs or from modules found on accessforward.ca.

Accessibility for Ontarians with Disabilities Act (AODA)

Accessible Customer Service Training

Company Name: _____

I acknowledge that all staff employed by _____ who may undertake any duties and interact with any persons with disabilities, in the course of this company's contractual obligations with The Municipality of Brighton, have received adequate instruction pertaining to the Accessibility for Ontarians with Disabilities Act (AODA) regulations.

As a principle of the contractor employed by The Municipality of Brighton, I understand the Municipality's requirements to comply with the Customer Service Standard. I will ensure that all future staff hired to assist with this company's contractual obligations will receive similar training as soon as they are hired, to meet these ongoing requirements.

Name: _____

Signature: _____

Date: _____

1.1 AMENDMENTS

.1 The General Conditions of Contract, as outlined in CCDC2 2020, are amended as noted hereafter.

.2 The Standard Construction Document for Stipulated Price Contract, CCDC2 2020 English version, consisting of the Agreement between Owner and Contractor, Definitions, and General Conditions of the Stipulated Price Contract, Parts 1 to 13 inclusive, governing same is hereby made part of these Contract Documents, with the following amendments, additions and modifications. Where these amendments, additions, and modifications specifically reference a change to the Agreement, Definitions, or General Conditions, these amendments, additions and modifications shall govern.

.3 Where a General Condition or a paragraph of the General Conditions of the Stipulated Price Contract is deleted by these Supplementary Conditions, the numbering of the remaining General Conditions or paragraphs shall remain unchanged, and the numbering of the deleted item will be retained, unused.

1.2 ARTICLE A-6 – RECEIPT AND ADDRESSES FOR NOTICES IN WRITING

.1 Delete and replace Article A-6.1 with the following:

"6.1 Notices in Writing between the parties or between them and the Consultant shall be considered to have been received by the addressee on the date of delivery if delivered by hand, email, or by commercial courier, or if sent during normal business hours by fax and addressed as set out below. Such Notices in Writing will be deemed to be received by the addressee on the next Working Day if received (by Consultant) by fax or email after 3:59pm of any day or if sent by overnight commercial courier. Such Notices in Writing will be deemed to be received by the addressee on the fifth Working Day following the date of mailing, if sent by pre-paid registered post, when addressed as set out below. An address for a party may be changed by Notice in Writing to the other party setting out the new address in accordance with this Article."

1.3 DEFINITIONS

.1 Add the following new definitions:

"27. "Submittals"

Submittals are documents or items required by the Contract Documents to be provided by the Contractor, such as:

- Shop Drawings, samples, models, mock-ups to indicate details or characteristics, before the portion of the Work that they represent can be incorporated into the Work; and
- As constructed drawings and manuals to provide instructions to the operation and maintenance of the Work.
- All other items identified within the Contract Documents to be submitted by the Contractor.

28. "Proper Invoice"

Proper invoice means a written bill or other request for payment for services and/or materials comprising the work performed under the Contract issued by the Contractor which document shall include the following:

.1 All information and requirements set out in section 6.1 of the Construction Act, which for the sake of clarity and certainty includes the following: The Contractor's name and address;

.2 The date of the "Proper Invoice" and the period during which the services and/or materials were supplied;

.3 Information identifying the authority, whether in the Contract or otherwise, under which the services or materials were supplied;

.4 A description, including quantity where appropriate, of the services or materials that were supplied;

.5 The amount payable for the services or materials that were supplied, and the payment terms;

.6 The name, title, telephone number and mailing address of the person to whom payment is to be sent;

.7 Any other information that may be prescribed by the Construction Act and any regulation thereto.

29. “Application for Progress Payment”

Application for Progress Payment shall mean the delivery of a “Proper Invoice”.

30. “Adjudication”

Adjudication shall have the meaning as set out in Part II.1 of the Construction Act.

31. “Construction Act or Act”

Construction Act or Act shall mean the Construction Act, R.S.O. 1990, c. C.30, as amended and its regulations thereunder as may be amended from time to time.”

1.4 GC1.1 - CONTRACT DOCUMENTS

.1 Add the following to the end of subparagraph 1.1.9:

“No claims will be considered or accepted relating to the disputes between the Contractor and/or Subcontractors regarding responsibilities of the *Subcontractors* for the completion of the divisions of work, including tie-in of the work between different trades, spatial interferences, cutting and patching and the like.”

1.5 GC 2.2 - ROLE OF THE CONSULTANT

.1 Add the word “schedules” after the word “techniques” in paragraph 2.2.5.

.2 Add to the end of the second sentence of paragraph 2.2.5:

“or to adhere to the construction schedule.”

1.6 GC 2.3 - REVIEW AND INSPECTION OF THE WORK

.1 Add the following to the end of paragraph 2.3.2:

“2.3.2 Should a designated test or inspection fail, the Contractor shall promptly correct and retest the work within 5 Working Days of the failed test or inspection using the designated testing/inspection agency. The Contractor shall be responsible for all costs associated with retesting or reinspection.”

.2 Add the following new paragraph 2.3.8:

"2.3.8 Notwithstanding the conduct of periodic reviews of the work in progress by the Consultant, the purpose of which is solely to determine general conformance with the requirements of the Contract Documents, the Contractor remains solely and exclusively responsible and liable for the means, methods, techniques, sequences and procedures for the completion of the Work and in connection with construction Safety at the Place of the Work."

1.7 GC 2.4 - DEFECTIVE WORK

.1 Replace the period "." at the end of paragraph 2.4.1 with a colon ":" and add new sub-sentences .1 and .2

"2.4.1.1 The Contractor shall correct, in a manner acceptable to the Owner and the Consultant, all defective work and deficiencies in the Work, whether or not they have been identified by the Consultant."

"2.4.1.2 The Contractor shall prioritize the correction of any defective work or deficiencies in the Work which, in the sole discretion of the *Owner*, adversely affects the day to day operation of the Owner."

1.8 GC 3.1 - CONTROL OF WORK

.1 Add the word "schedules" after the word "techniques" in paragraph 3.1.2.

.2 Add new paragraph 3.1.3:

"3.1.3 Prior to commencing individual procurement, fabrication and construction activities, the Contractor shall verify, at the Place of the Work, all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the Work and shall further carefully compare such field measurements and conditions with the requirements of the Contract Documents. Where dimensions are not included or exact locations are not apparent, the Contractor shall immediately notify the Consultant in writing and obtain written instructions from the Consultant before proceeding with any part of the affected work."

1.9 GC 3.4 - CONSTRUCTION SCHEDULE

.1 Delete sub-sentence .1 of paragraph 3.5.1 and replace with the following:

".1 Prepare and submit to the Owner and the Consultant prior to the first application for payment, a construction schedule that indicates the timing of major activities of the Work, including items called for under GC 4.1 – CASH ALLOWANCES and the timing of when Owner purchased items are required to be delivered to the Place of the Work for installation or hook-up by the Contractor, and provides sufficient details of the critical events and their inter-relationship to demonstrate that the work will be performed in conformity with the Contract Time."

.2 Add new sub-sentence .4 to paragraph 3.5.1:

".4 Commence the Work immediately upon award of the Contract and provide sufficient labour for the steady progress of the Work including overtime work, if required to meet the scheduled date of completion."

1.10 GC 3.5 - SUPERVISION

.1 Delete the period "." at the at the end of paragraph 3.5.1 and add:

"and not without prior consultation and agreement by the Consultant and Owner, which agreement shall not be unreasonably withheld."

1.11 GC 3.6 - SUBCONTRACTORS AND SUPPLIERS

.1 Amend paragraph 3.6.2 as follows:

.1 After the word "indicate" in the first line delete the words "in writing, if requested by the Owner", and add the words "on the applicable 'Bid Supplementary Form' form".

.2 Add the following sentence to the end of the paragraph: "The Contractor agrees not to change subcontractors and/or suppliers without the prior written consent of the Owner and the Consultant, which consent shall not be unreasonably withheld."

.2 Delete the words "through the Consultant" in paragraph 3.6.6.

1.12 GC 3.7 - LABOUR AND PRODUCTS

.1 Add new paragraph 3.7.4:

"3.7.4 The Contractor is responsible for the safe on-site storage of Products and their protection (including Products supplied by the *Owner* and Other Contractors to be installed as part of the Work). The Contractor is responsible to store and secure the Products in a location and in such ways as to avoid dangerous conditions or contamination of the Products and so as to avoid injury, damage or contamination of persons or property at the Place of the Work to the satisfaction of the Owner and the Consultant. The Owner shall provide all relevant information on the Products to be supplied by the Owner."

.2 Add new paragraph 3.7.5:

"3.7.5 Whenever more than one Product is specified for one use, the Contractor may select for this use any of the Products so specified unless the Specifications or the Drawings indicate otherwise."

1.13 GC 3.8 - SHOP DRAWINGS

.1 Add the words "AND OTHER SUBMITTALS" to the Title after SHOP DRAWINGS.

.2 Add "and Submittals" after the words "Shop Drawings" in paragraphs 3.8.1, 3.8.2, 3.8.3, 3.8.3.2, 3.8.5, 3.8.6, and 3.8.7.

1.14 GC 5.3 – PAYMENT

.1 Add new paragraph 5.3.2 as follows:

"5.3.2 In the event a construction lien is registered against the Place of the Work in circumstances where the Owner is not in breach of its payment obligations under this Contract, then the Contractor shall, within seven (7) days of receiving notice of the construction lien, have the lien removed by way of discharge, settlement, or posting security to vacate the registration of the lien. In the event that the Contractor fails to take the necessary steps to have the construction lien removed from title then, without prejudice to any other right or remedy it may have, the Owner may see to the removal of the construction lien by payment into court or otherwise and the costs of so doing shall be to the Contractor's account."

.2 Add new paragraph 5.3.3 as follows:

"5.3.3 All progress payments are not conclusive as to the value or quality of services provided and are subject to further evaluation and readjustment on future and final progress payments. The submission of monthly applications for progress payments by the Contractor and Subcontractors must reflect accurate valuations for work completed and installed. The Contractor shall review and evaluate all Subcontractors work and be responsible for verifying the monthly applications for progress payments claimed."

1.15 GC 6.2 CHANGE ORDER

.1 Add new paragraph 6.2.3:

"6.2.3 All written descriptions or quotations submitted to support a proposed change to the Work and Change Orders must include all associated adjustments to the Contract Time and shall not be qualified as subject to future discussion or determination. All approved Change Orders must account for all prior and current adjustments to the Contract Time. Change Orders approved without indication of a change to the Contract Time will be deemed to have no impact to the Contract Time and may not be contested after execution."

.2 Add new paragraph 6.2.4:

"6.2.4 The foregoing GC 6.2.3 shall not prevent the Contractor from submitting a claim for cumulative time impact associated with multiple changes. If the Contractor can demonstrate that the cumulative impact of multiple individual Change Orders has or will result in a real and material change to the Work or Contract Time which cannot reasonably be mitigated and the claim can be supported with clear supporting documentation of the impact, then the Contractor is entitled to submit a proposed change to the Work pursuant to GC 6.2.1."

.3 Add new paragraph 6.2.5:

"6.2.5 The adjustment in the Contract Price for a change carried out by way of a Change Order or a Change Directive as provided in GC 6.2 CHANGE ORDER and CG 6.3 CHANGE DIRECTIVE, shall be determined in accordance with the following calculations, rates, conditions, and terms:

.1 All labour, equipment, rental of equipment or tools, materials, subcontracts and outside services to be charged as a result of changes to the scope of the Work will be subject to prior authorization by the Owner.

.2 The Owner will reimburse the Contractor for "Field Labour Costs" as the actual direct wages or salaries of the workers, up to and including working foremen, plus actual Payroll Burdens (see below). The foregoing shall not include additional costs for a full time site superintendent unless it is clearly demonstrated that additional time is required because of a contemplated extension to the Contract Time.

.3 "Payroll Burden" means the payments in respect of workers compensation insurance, vacation pay, unemployment insurance, public liability, and property damage insurance, sickness and accident insurance, pension fund and such other welfare and benefit payments as form part of the Contractor's normal base labour costs and may also include any applicable required cost or expense which has been incurred by the Contractor for food, lodging and similar items.

.4 The Contractor will provide the Owner with the information required to calculate Field Labour Costs within 14 days of commencement of the Contract.

.5 Field Labour Costs for premium portion overtime will be fixed and remain firm for the duration of this Contract and will not be subject to escalation unless prior written approval is obtained from the Owner, and such approval will not be unreasonably withheld.

.6 Only labour personnel up to and including working foremen will be chargeable on additional work and then only to the extent such personnel are directly engaged on the additional work. The Owner will not pay for supervision beyond the working foreman level, nor will it pay for administration or management time spent on additional work.

.7 The Owner will pay the Contractor for only for the cost of materials installed or used directly in connection with the Work (excepting materials supplied by the Owner) which are supported by invoices from delivery companies or transporters delivered with the Contractor's billing.

.8 The Owner will pay for the cost of rentals at the Place of the Work which are required to be used as part of the Work and shall also pay for Contractor's owned equipment at the Place of the Work which are required to be used as part of the Work, each based on the actual time such equipment is used beyond the period the equipment was expected to be at the Place of Work, exclusive of operators time, and on the following basis:

(i) At commercially reasonable established hourly, daily, weekly or monthly rental rates for the local market.
(ii) The stipulated rental rates will apply when the number of hours the equipment is operated does not exceed 175 hours in any one month or does not exceed 40 hours in any one week or does not exceed 8 hours in any one day.
(iii) For rental rates quoted, no differentiation will be made between equipment owned by Contractor or rented by Contractor from third parties.
(iv) For equipment not already on site, rental agreements and copies of invoices from equipment Rental Company must be submitted by the Contractor.

.9 Where the Contractor arranges for work to be carried out by a Subcontractor or the Contractor’s own forces, the Owner shall as applicable:

(i) Pay the Contractor the approved cost of a Subcontractor's work or the Contractor’s own forces, plus a 10% mark-up to the Contractor which shall be considered fair and full compensation for the Contractor’s administration, supervision, record documentation, overheads and profits.
(ii) Pay the Subcontractor via the Contractor for actual Field Labour, material and equipment costs of work performed plus a 10% mark-up to cover the cost of small tools, expendables and consumables (which shall include all items which are consumed in the performance of the Work), field overhead, supervision above working foreman level and all other indirect labour and materials costs not defined as reimbursable.
(iii) Pay an additional 5% mark-up to the Subcontractor via the Contractor for the profit and overhead associated with Change Orders and Change Directives that are a result of the of a Subcontractor’s necessity to further subcontract out a portion of the work to a third party.

.10 Notwithstanding the foregoing, the maximum mark-up permitted on any Change Order or Change Directive will not exceed an aggregate total of 25%.

.11 The costs for the following items are included in the allowance for overhead and profit:
(i) Contractor's head office expenses.
(ii) Wages of project managers, superintendents, assistants, safety, watchpersons and administrative personnel.
(iii) Temporary site office expenses, including costs for telephone and facsimile machine.
(iv) As constructed drawings.
(v) Time for estimating changes in the Work.

.12 When Change Orders or Change Directives are agreed by the Owner to proceed on a time and material basis the Contractor must:
.1 Maintain detailed daily records of the work performed by the Contractor. Contractor to report the labour and equipment employed and the material used on any specific portion of the Work, including the names, occupations and hours worked of all personnel employed that performed work on a time and material basis, the material supplied, and the description and hours of use for equipment and tools employed.
.2 Maintain and keep complete and accurate books, payrolls, accounts, and records relating to the Work or any extensions or additions thereto or claims arising therefrom to permit the verification and audit thereof and the Contractor will have no claim for repayment or any nature and kind whatsoever therefore, unless such books, payrolls, accounts and records have been so maintained and kept.
.3 Permit the Owner, its Consultant, or their agents to inspect and audit the books, payrolls, accounts, and records of the Contractor at any time during the period of the Contract and at any time thereafter at their discretion and upon written notice to the Contractor, and the Contractor will cooperate and promptly supply any records required by the Owner or Consultant as applicable.

1.16 GC 6.3 - CHANGE DIRECTIVE

.1 Add the following to the end of paragraph 6.3.1:

"6.3.1 The Contractor shall not be entitled to submit a claim or receive payment for any addition or revision to the Work without having first obtained written approval to proceed with the addition or revision by way of an approved Change Order or a written Change Directive. For greater clarity, the Contractor shall be precluded from making a claim for an adjustment in Contract Price or an extension of time to the Contract and shall be deemed to have waived any entitlement to such a claim if the addition or revision to the Work is commenced and/or completed without a written and accepted Change Order or Change Directive."

1.17 GC 6.5 - DELAYS

.1 In paragraph 6.5.1, Delete the words "or indirectly".

.2 Delete the last sentence of paragraph 6.5.1 and replace with the following:

"The Contractor shall be reimbursed by the Owner for reasonable direct costs, excluding any consequential, indirect or special damages, incurred by the Contractor as a result of such delay."

.3 Delete the last sentence of 6.5.2 and replace with the following:

"The Contractor shall be reimbursed by the Owner for reasonable direct costs, excluding any consequential, indirect or special damages, incurred by the Contractor as a result of such delay."

.4 Add new subparagraph 6.5.6:

"6.5.6 If the Contractor is delayed in the performance of the Work by an act or omission of the Contractor or anyone employed or engaged by the Contractor directly or indirectly, or by any cause within the Contractor's control, then the Contract Time shall be extended for such reasonable time as the Consultant may decide in consultation with the Contractor. The Owner shall be reimbursed by the Contractor for all reasonable costs incurred by the Owner as the result of such delay, including all services required by the Owner from the Consultant as a result of such delay and, in particular, the cost of the Consultant's services required during the period between the date of Ready-for-Takeover stated in Article A-1 herein and, the actual date of Ready-for-Takeover achieved by the Contractor."

.5 Add new subparagraph 6.5.7:

"6.5.7 For greater certainty, extensions of time shall be granted to the Contractor for any delays that result from a government order or action under the Emergency Management and Civil Protection Act, and such delays shall be deemed to be a valid order not issued as the result of an act or fault of the Contractor for the purpose of section 6.5.2., and a cause beyond the Contractor's control for the purpose of section 6.5.3. "

.6 Add new subparagraph 6.5.8:

"6.5.8 The Contractor acknowledges and agrees that it shall make reasonable efforts to mitigate any additional costs and time delays incurred in completing the Project as a result of any delay in the Work, regardless of the cause of such a delay."

.7 Add new subparagraph 6.5.9:

"6.5.9 If a delay that is not caused by the action or omission of the Owner, Consultant, or anyone employed or engaged by them directly, persists for more than 30 days, the Owner may elect, at its sole discretion, to suspend or terminate the Project and:

(a) if the delay is due to factors outside the Contractor's reasonable control, the amount for work due and payable to the Contractor will be apportioned in the ratio that the Work has been completed to the date of termination, subject to and in consideration of any advance payments made by the Owner; and

(b) if the delay is due to factors reasonably within the Contractor's control, the Contractor shall not be entitled to any further payments, unless otherwise agreed to by the Owner, in respect of the work performed by the Contractor in respect to the Project and the Contractor shall indemnify the Owner for all losses suffered by the Owner as a result of such delay and resulting from those further delays and expenses which the Owner may incur in finding a replacement for the Contractor for the Work and the Project, but excluding any consequential, indirect or special damages."

.8 Add new subparagraph 6.5.10:

"6.5.10 Upon of the occurrence of any delay pursuant to GC 6.5 the Contractor shall demonstrate the impact of the delay on each subsequent schedule update."

1.18 GC 9.2 - TOXIC AND HAZARDOUS SUBSTANCES

.1 Add to paragraph 9.2.6 after the word "responsible" in the second line of the paragraph, the following new words:

"or whether any toxic or hazardous substances or materials already at the Place of the Work (and which were, when encountered by the Contractor, harmless, stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were subsequently dealt with by the Contractor or anyone for whom the Contractor is responsible, in such a manner which is contrary to legal and regulatory requirements, renders them harmful, or causes them to become a threat to human health and safety or the environment, or material damage to the property of the Owner or others,"

.2 Add to paragraph 9.2.8 after the word "responsible", the following new words:

"or that any toxic or hazardous substances or materials already at the Place of the Work (and which were, when encountered by the Contractor, harmless, stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were subsequently dealt with by the Contractor, or anyone for whom the Contractor, is responsible, in such manner which is contrary to legal and regulatory requirements, renders them harmful, or causes them to become a threat to human health and safety or the environment, or material damage to the property of the Owner or others,"

.3 Add new paragraph 9.2.10:

"9.2.10 For the purposes of this General Condition the terms "toxic and hazardous substances and materials" shall be taken to mean and shall be limited to only substances as currently defined in the applicable statutory, regulatory and municipal requirements."

1.19 GC 10.2 - LAWS, NOTICES, PERMITS AND FEES

.1 Delete and replace paragraph 10.2.1 with the following:

"The laws and regulation applicable in the Province of Ontario shall govern the Work, including the Construction Act as it is in force."

.2 Delete from the first line of paragraph 10.2.2 the words, "building permit".

1.20 GC 10.4 - WORKERS' COMPENSATION

.1 Delete and replace paragraph 10.4.1, with the following:

"Prior to commencing the Work, and with each application for payment, and again with the Contractor's application for payment of the holdback amount following Substantial Performance of the Work and again with the Contractor's application for final payment following Ready-for-Takeover, the Contractor shall provide evidence of compliance with workers' compensation legislation at the Place of the Work, including payments due thereunder."

1.21 GC 12.3 - WARRANTY

.1 Add new paragraph 12.3.7:

"12.3.7 Carrying out of replacement work and making good of defects as described in the Contract Documents shall be executed at times convenient to the Owner. Such work may be required to be performed outside normal working hours at no additional cost to the Contract."

1.22 PART 14 – MISCELLANEOUS

.1 Add PART 14- MISCELLANEOUS as follows:

"PART 14 – MISCELLANEOUS

GC 14.1 - GENERAL

14.1.1 The Contractor acknowledges that during the term of the Contract, the Place of the Work and the area in the vicinity of the Place of the Work is, and will be, occupied by the Owner and others and that they will continue to carry out their normal operation and use of Place of the Work which includes continuous water treatment.

GC 14.2 - WARRANTY SECURITY

14.2.1 The Contractor will provide to the Owner for the duration of the period of the warranty obligations under GC 12.3 (the "**Warranty Period**") a financial amount to act as security for the fulfillment of the Contractor's warranty obligations (the "Warranty Security"), the value of which will be calculated based on the following table:

Contract Price (m = $1,000,000)		
Less than 0.1M		Value of Warranty Security 4% of Final Contract Price
0.1M	0.5M	4,000 on first 0.1M + 3.0% on next 0.4M
0.2M	1.0M	16,000 on first 0.5M + 2.4% on next 0.5M
1.0M	2.0M	28,000 on first 1.0M + 2.2% on next 1.0M
2.0M	4.0M	50,000 on first 2.0M + 2.0% on next 2.0M
4.0M	6.0M	90,000 on first 4.0M + 1.8% on next 2.0M
6.0M	10.0M	126,000 on first 6.0M + 1.5% on next 4.0M
Over 10.0M		186,000 on first 10.0M + 1.0% on balance

14.2.2 In addition to any holdback required to be retained by the Construction Act and in addition to any other holdback as may otherwise be agreed to by the Parties, the Owner will retain, until expiry of the Warranty Period, the Warranty Security, calculated in accordance with paragraph 14.2.1. The Parties agree and acknowledge that the Owner may apply the Warranty Security in whole or in part in order to reimburse the Owner for losses, costs incurred, or funds expended by the Owner as a result of default by the Contractor to fulfill the warranty obligations as set out in the Contract. Warranty Security.

14.2.3 The Warranty Security holdback shall be retained by the Owner in the increments calculated in accordance with paragraph 14.2.1 from the monies that would otherwise be payable to the Contractor, commencing at 70% completion of the Contract, so that by the date of Substantial Performance of the Contract the full value of the required Warranty Security has been retained. The Contractor shall be required to show the amount to be retained by the Owner on the Proper Invoice submitted by the Contractor and calculated in accordance with the increments in paragraph 14.2.1. The requirement to show the amount to be retained for the Warranty Security shall commence when the Contractor submits its first Proper Invoice once the Work has been completed to the value of 70% of the Contract Price has been performed.

14.2.4 The Warranty Security holdback is in addition to any other rights or remedies of the Owner in respect to the correction of the Contractor's default of the Contractor's warranty and maintenance obligations.

14.2.5 The Contractor may apply in writing to the Consultant and the Owner at the time of Substantial Performance to substitute for the monies retained as the Warranty Security for an alternative Warranty Security of equivalent or greater value comprising:
(a) one or more irrevocable letters of credit, or
(b) another readily negotiable security.

Acceptance of any such alternative shall be at the sole discretion of the Owner.

Following receipt and acceptance of any such alternative, the Owner will release to the Contractor the monies previously retained for Warranty Security purposes.

14.2.6 At the end of the Warranty Period, the Contractor may apply for a Final Acceptance Certificate by submitting to the Consultant and the Owner:
(a) A Statutory Declaration in a form acceptable to the Consultant and the Owner, signed by the Contractor stating that all accounts for labour, subcontracts, Products, Construction Equipment and other indebtedness which may have been incurred by the Contractor in connection with the Contract, have been paid in full;
(b) Provide evidence of compliance with workers' compensation legislation at the Place of the Work, including payments due thereunder; and
(c) The final deficiency list issued by the Consultant, completed with the date when each deficiency was corrected.

14.2.7 Any amounts retained by the Owner in accordance with this GC 14.2, which have not been used shall be returned to the Contractor, without interest, ten (10) Working Days after the later of:
(a) the date on which the Final Acceptance Certificate is issued by the Consultant following the Contractor's application for same in accordance with the requirements of paragraph 14.2.6
(b) the end of the Warranty Period; and
(c) the correction of any defective or deficient work which the Owner has notified the Contractor of prior to the end of the Warranty Period.

14.2.8 Upon expiration of the Warranty Period, the Consultant may endorse the release of the Warranty Security to the Contractor on such terms and conditions as the Consultant deems advisable notwithstanding that the Final Acceptance Certificate has not been issued and all deficiencies and incompletions have not been rectified in accordance with the requirements of the Contract.

GC 14.3 - LIQUIDATED DAMAGES-SUBSTANTIAL PERFORMANCE

14.3.1 If the date of Substantial Performance of the Work is delayed past the scheduled date for Substantial Performance of the Work set out in paragraph 1.3 of the Agreement, subject to any agreed adjustment in Contract Time as provided for in the Contract Documents (the "Scheduled Date"), the Contractor shall pay to the Owner as its sole and exclusive remedy for a failure to timely achieve Substantial Performance of the Work, liquidated damages in the amount of five thousand dollars ($5,000) per day for each day of delay after the Scheduled Date until the Contractor has attained Substantial Performance of the Work. The Contractor shall make payment of liquidated damages on a weekly basis as they accrue.

14.3.2 If there is a delay in attaining Substantial Performance of the Work, and regardless of any payment of liquidated damages in accordance with paragraph 14.3.1, the Contractor shall continue to perform and expedite the Work in accordance with the Contract.

14.3.3 The parties agree that it is difficult to calculate the damages which would result from the Contractor's failure to attain Substantial Performance of the Work by the Scheduled Date; and the parties agree that the liquidated damages payable in accordance with paragraph 14.3.1 are not intended to be a penalty but rather represent the parties' best estimate of, and are a genuine pre-estimate of, the damages resulting from the delay in attaining Substantial Performance of the Work by the Scheduled Date. Actual costs arising from the work required beyond the Scheduled Date will be determined after the date of Substantial Performance, and the amount of Liquidated damages paid shall be adjusted accordingly.

14.3.4 For greater certainty, the payment of liquidated damages shall not limit or otherwise affect any obligation or responsibility of the Contractor, or any right or remedy of the Owner, that does not relate to the Contractor's delay in attaining Substantial Performance of the Work by the Scheduled Date."

1.23 CCDC 41 - CCDC INSURANCE REQUIREMENTS

.1 Delete and replace the first sentence of Paragraph 2 with the following:
“Automobile liability insurance in respect of vehicles that are required by law to be insured under a contract by a Motor Vehicle Liability Policy, shall have limits of not less than $5,000,000 inclusive per occurrence for bodily injury, death and damage to property, covering all vehicles owned or leased by the Contractor.”

.2 Delete and replace the first sentence of Paragraph 3 with the following:
“Aircraft and watercraft liability insurance with respect to owned or non-owned aircraft and watercraft (if used directly or indirectly in the performance of the Work), including use of additional premises, shall have limits of not less than $8,000,000 inclusive per occurrence for bodily injury, death and damage to property including loss of use thereof and limits of not less than $8,000,000 for aircraft passenger hazard. Such insurance shall be in a form acceptable to the Owner.”

.3 Delete and replace Paragraph 8 with the following:
“Environmental Impairment Liability (Pollution Liability) with a limit of not less than $5,000,000 per occurrence and $5,000,000 in the aggregate. Coverage shall include Third Party Bodily Injury and Property Damage including on-site and off-site clean-up. Such insurance shall be issued on a claims made basis, and shall be maintained for a period of two years subsequent to conclusion of services provided.”

.4 Add new Paragraph 9 with the following:
Crane Liability policy with a limit of not less than $1,500,000 per occurrence and $1,500,000 in the aggregate. The Owner is to be an additional insured arising out of the operations of the Named Insured.

END OF SECTION

1.1 SUMMARY

.1 This section specifies general requirements relating to commissioning of all components, equipment, sub-systems, systems and integrated systems.

1.2 CONTRACTOR RESPONSIBILITIES

.1 The Contractor will:

- .1 Prepare each system ready for commissioning. Verify systems installation is complete and in operation.
- .2 Coordinate commissioning with and assist commissioning manager.
- .3 Coordinate commissioning manager's involvement in Shop Drawing review process.
- .4 Perform and document verification, performance testing, adjusting, and balancing operations.
- .5 Cooperate with commissioning manager and provide access to equipment and systems.
- .6 Provide personnel and operate systems at designated times, and under conditions required for proper commissioning.
- .7 Assign additional commissioning staff and resources as required to maintain project timelines.
- .8 Contractor to ensure that instrumentation is available and operational for commissioning manager to facilitate spot checks during commissioning.
- .9 Participate in and assist in the coordination of commissioning meetings. Invite Subcontractors, Suppliers, Manufacturers, etc. as requested to attend as needed.
- .10 Complete commissioning forms as requested by commissioning manager.
- .11 Correct deficiencies identified in commissioning process.
- .12 Incorporate commissioning data into operation and maintenance manual.
- .13 Ensure that commissioning manager participates in demonstration and training as specified in Section 01790 Demonstration and Training.

1.3 COMMISSIONING MANAGER RESPONSIBILITIES

.1 The commissioning manager will:

- .1 Prepare a commissioning plan, including systems to be commissioned, forms, checklists and responsibilities of commissioning team members.
- .2 Implement the commissioning plan and lead the commissioning team through start-up, verification, performance testing, training, and document preparation.
- .3 Review and provide comment on completed commissioning sheets. Identify if commissioning testing is acceptable or if re-testing is required due to deficiencies or non-conformances.
- .4 Review the draft and subsequent revisions of the commissioning schedule and provide comment.
- .5 Maintain involvement in and awareness of construction activities to assure compliance with system commissioning requirements.
- .6 Attend and participate in construction progress meetings.
- .7 Develop a working knowledge of the operation of the existing facility through reviewing the design drawings and specifications, visiting the facility with operations staff, reviewing other available information such as the operation and maintenance manuals, Environmental Compliance Approval, etc.
- .8 Convene, chair, prepare and distribute minutes of commissioning meetings.
- .9 Supervise commissioning activities and witness inspections and tests.
- .10 Make periodic site visits for the purpose of selective checking of accuracy of commissioning form submissions and witness testing.

.11 Review and provide comment on content of operations and maintenance and commissioning manuals.
.12 Prepare and issue a system verification report.

1.4 CONSULTANT RESPONSIBILITIES

.1 The Consultant will:
.1 Participate in commissioning meetings and witnessing of FAT.
.2 Review verification and performance test results and direct Contractor to correct defects or deficiencies in the Work.
.3 Issue Supplemental Instructions or Change Directives identified as necessary by the commissioning process.
.4 Review final commissioning report.

1.5 OWNER RESPONSIBILITIES

.1 The Owner will:
.1 Assign operations and maintenance personnel to participate in meetings, witnessing of demonstration, and training.
.2 Designate a person to acknowledge receipt of reports.
.3 Review and comment on the contractor's Commissioning Plan and Schedule as needed.
.4 Approve various testing/commissioning milestones as outlined above and identified in the technical specification sections.
.5 Operate equipment, process units, and devices manually and/or from SCADA, when required, with the support of contractors and the Control Systems Specialist.

1.6 MANUFACTURER RESPONSIBILITIES

.1 The Manufacturer will:
.1 Be an authorized representative, trained and certified in the installation, operation, and maintenance of specified equipment and systems.
.2 Be available for on-site testing, inspection, or other manufacturer on-site services as identified in Division 01 or the technical specification sections.
.3 Provide manufacturers installation, start-up and operation instructions prior to start-up of components, equipment and systems. Review with Commissioning manager and Consultant.
.4 Provide assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of the Contractor's assembly, erection, installation, or application procedures.
.5 Inspect, check, and adjust as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
.6 Review start-up procedures with Contractor and identify concerns related to equipment performance. Modify procedure as per Manufacturer recommendations.
.7 Provide copies daily of all manufacturers' representatives' field notes and data to the Consultant.
.8 Revisit the project site as required to correct problems until installation and operation are acceptable to the Consultant.

.9 Resolve assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.

.10 Provide assistance during functional and performance testing and facility start-up and evaluation including establishing initial set points, operational ranges and tolerances.

.11 Train the Owner's personnel in the operation and maintenance of equipment.

.2 Integrity of Warranties:

.1 Use manufacturers' trained start-up personnel as recommended by Manufacturer or as specified.

.2 Verify with manufacturer that performance testing as specified will not void warranties.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Request in writing to Commissioning Manager and Consultant for changes to submittals and obtain written approval at least eight (8) weeks prior to start of Commissioning.

.2 Submit proposed Commissioning procedures to Commissioning Manager and Consultant where not specified and obtain written approval at least eight (8) weeks prior to start of Commissioning.

1.8 COMMISSIONING PLAN

.1 Provide a detailed Commissioning Plan in accordance with Section 01021 Equipment Testing and Commissioning.

1.9 COMMISSIONING SCHEDULE

.1 Provide a detailed Commissioning schedule in accordance with Section 01320 Construction Progress Documentation.

1.10 COMMISSIONING MEETINGS

.1 Participate in Commissioning Meetings in accordance with Section 01319 Project Meetings.

1.11 CHEMICAL SUPPLY

.1 The Contractor shall use potable water in lieu of chemicals for testing and commissioning. The Contractor is to advise the Consultant in cases where the use of potable water is not appropriate for initial testing and start-up procedures.

.2 Once the Trial Operation Period is successfully completed per Section 01021 Testing, Commissioning and Trial Operation, the Owner will arrange and pay for any chemicals required when the system is put into permanent operation.

.3 The delivery of the chemical supply will follow the successful commissioning by the Contractor.

.4 Contractor is responsible for coordination with the Owner on the delivery of the chemical supply to meet the commissioning schedule.

1.12 WATER SUPPLY FOR TESTING

.1 Plant effluent water may be used for leakage and pressure testing of liquid retaining vessels and systems, with the exception of all “separated” systems. Contractor shall be responsible for and provide all temporary piping and equipment required to transfer plant effluent water to testing locations.

.2 Water used for testing of “separated” water, potable water, process air, or heating line systems to be from municipal water (i.e., potable water).

.3 Should the General Contractor require testing water prior to the connection to the Municipality’s distribution system or the municipal water supply is deemed insufficient for testing purposes, then it shall be at the General Contractor’s expense at no charge to the Owner.

.4 Disposal, including de-chlorination of test water shall be the responsibility of the General Contractor.

.5 Contractor to provide reduced pressure backflow prevention prior to connecting to municipal water supply. Contractor’s backflow preventer to be tested on-site by a certified company at installation and at no greater than six month intervals.

1.13 FUEL SUPPLY

.1 Provide and pay for any temporary fuel required to accommodate start-up, testing, and commissioning of equipment and systems.

1.14 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer. Maintain a log of maintenance work as it is completed and submit to the Owner prior to final acceptance.

.2 After completion of commissioning, operate and maintain systems until Consultant provides written confirmation that the system is ready for operation by the Owner.

.3 Following trial operation period, replace all lubricants in equipment supplied in the Contract.

1.15 START OF COMMISSIONING

.1 Notify Commissioning Manager and Consultant at least twenty-one (21) days prior to start of Commissioning.

1.16 PERFORMANCE VERIFICATION

.1 Commissioning to be carried out in all modes of operation: regular, emergency, day, night, heating and cooling. Conduct commissioning:

.1 Under actual operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

1.17 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance, and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to Commissioning Manager and Consultant.

1.18 COMMISSIONING CONSTRAINTS

.1 Refer to Section 01810 – Construction Sequencing

1.19 NON-CONFORMANCE RELATED TO COMMISSIONING PROTOCOL

.1 All costs related to deficient or non-conforming work including but not limited to corrective work, testing, inspections and commissioning including related personnel to determine acceptability and proper performance of equipment or systems is by the Contractor.

.2 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Consultant. Corrective actions will be based on recommendations of independent testing agency report and upon approval of Commissioning Manager and Consultant.

.1 If equipment or system has been compromised and the warranty is no longer valid with the Manufacturer, the Commissioning Manager and Consultant shall reject equipment. The following actions shall be taken by the Contractor:

.1 Remove and dispose from site rejected equipment. Replace with new equipment.

.2 Perform all procedures as identified in Section 01021 Equipment Testing and Commissioning.

1.20 TRAINING

.1 Provide training in accordance with Section 01790 Demonstration and Training.

1.21 COMPLETION OF COMMISSIONING

.1 Upon completion of Commissioning leave systems in normal operating mode.

END OF SECTION

1.1 DEFINITIONS

.1 Factory Acceptance Testing (FAT): FAT is the testing and validation of operation of newly manufactured and packaged equipment by the Manufacturer at their facility to verify that the equipment meets the project specifications and all other requirements. Functional issues that are discovered during the testing are to be corrected and the equipment retested until all issues are successfully resolved.

.2 Equipment Installation and Start-up: The physical installation of the equipment in accordance with the manufacturer's recommendations and the Contract Documents. This step verifies that the equipment is ready for commissioning and can include but not be limited to verification of items such as overall condition of equipment, free rotation of moving parts, safety devices are in place, accessories have been installed, verification of belts and chains adjustment, etc. Refer to technical specification sections for additional requirements.

.3 Equipment and Subsystem Functional Performance Testing: The initial operation after Installation and Startup by the Contractor to demonstrate and confirm that the device, equipment, or subsystem meets manufacturer's installation, calibration and adjustment requirements and prove the functionality of the equipment or device in all modes of operation fit for it's intended purpose. Refer to technical specification sections for functional attributes.

.4 Systems Functional Performance Testing: The operation of a complete system, including all its related equipment, devices, instrumentation and subsystems, to prove the functionality of the system in accordance with the manufacturer's calibration and setpoint adjustments for all modes of operation. During performance testing, equipment is operated as an integral component within the related system, in order that operation responds to varying inputs that may occur. Refer to technical specification sections for system requirements.

.5 Training: Training as identified in Section 01790 and as required in relevant technical specification sections. Training shall take place prior to completing any performance trial operation.

.6 Performance Trial Operation: A continuous fourteen (14) calendar day full-scale in-service test of all systems within a facility, operated as a whole and integrated with existing equipment or systems. Several trial operations may be required depending on the nature and sequencing of the project as well as the type and severity of any automated operational errors or failure events.

.7 Operating Authority: Owner's agency responsible for the control, monitoring and operation of the overall treatment and/or pumping system.

.8 Systems Integrator: Trained personnel in SCADA/PLC programming responsible for testing, commissioning and integrating devices, equipment, and systems together as a whole, that allows operators to have control and monitoring of the system, so that the system can operate in all modes of operation.

.9 Manufacturers Representative: Factory trained technical representatives or manufacturer's certified representatives. This person must be experienced in the operation and calibration of the equipment. The manufacturer's representative must be equipped with the necessary tools and equipment to successfully complete start-up activities per the manufacturer's recommendations and per any additional requirements indicated in technical specifications. The manufacturer's representative must be capable of disassembling related equipment to make repairs and/or adjustment.

.10 Commissioning: Inspect installation, calibrate as per contract, and program as per contract. The manufacturer's representative shall be present for the commissioning of equipment. During commissioning, equipment is operated and set-up to operate as an integral component within the related system, in order that operation responds to variances and changes that may occur in the system operation.

1.2 GENERAL

.1 Provide all labour and material to plan, organize, and implement the commissioning process for systems and equipment.

.2 Carry out initial commissioning and follow-up seasonal commissioning.

.3 Coordinate commissioning activities with all trades, suppliers, and contractors.

1.3 SUBMITTALS

.1 Prepare a commissioning plan including systems to be tested and commissioned, performance trial operation, forms, checklists, training, and responsibilities of commissioning team members. The draft commissioning plan is to be submitted within sixty-five (65) working days of commence work date.

.1 Updated documents to be submitted fourteen (14) working days prior to related testing except for the 14-Day Test Plan.

.2 Fourteen-Day Test Plans: Submit at least thirty (30) working days prior to commencement of 14-Day test for each Facility.

.2 Prior to the start of the commissioning process, provide certification of mechanical and electrical systems support, anchorage, and seismic restraint and certification of calibration for testing equipment, where specified.

.3 Manufacturer’s FAT testing documentation as required by technical specification sections.

.4 Installation certificates, accepted and executed by Contractor and Manufacturer, as required by technical specification sections.

.5 Start-up test sheets accepted and executed by Contractor, Manufacturer, Owner and Consultant as required by technical specification sections.

.6 Start-up reports for stand alone devices or equipment. Start-up Reports to include approved shop drawing information. Append a copy of the approved shop drawing to the report.

.7 Training Plan for all equipment and devices, indicating proposed dates and time slots.

.8 Functional Verification Reports for each piece of equipment.

.9 A System Functional Verification Report including a performance testing completion sign-off form.

.10 Fourteen-Day Facility Performance Test Completion sign-off form.

1.4 TESTING, COMMISSIONING AND PERFORMANCE TRIAL OPERATION OVERVIEW

.1 Coordinate equipment testing with Instrumentation and Controls Testing, as specified in Division 17.

.2 Step 1 – Factory Acceptance Testing (FAT):
- .1 Commissioning Manager and Consultant to be present for factory acceptance testing.
- .2 Coordinate time and location of testing.
- .3 Coordinate and pay for travel, transportation to and from test site, and lodgings for the Commissioning Manager and one (1) Owner representative as required.
- .4 Submit testing documentation to Commissioning Manager and Consultant for approval.
- .5 Obtain written approval of test results and documentation from Commissioning Manager and Consultant before manufacturer release of equipment and delivery to site.

.3 Step 2 – Installation and Startup:
- .1 Installation to be completed, inspected, and accepted by the Contractor and Manufacturer.
- .2 Contractor and Subcontractor to correct deficient work prior to proceeding to Step 3.
- .3 Prerequisite to Functional Performance Tests:
  - .1 Prior to Functional Performance testing of each equipment and subsystem, observe and verify that the physical installation of components and systems being tested is ready for Functional Performance Tests.
  - .2 Receive and verify documentation of testing indicating readiness for Functional Performance
  - .3 Tests.
  - .4 Provide a manufacturers certificate of installation free of deficiencies.
  - .5 Provide a start-up report indicating the adequacy of the installation, set points for any adjustable components and programmable parameters.
  - .6 Make available for Consultant's review, the functional verification report template, with all applicable and available information completed.

.4 Step 3 – Equipment and Subsystem Functional Performance Testing:
- .1 Functional Performance Testing to be completed and accepted by the Contractor and Manufacturer, as required. Refer to Division 11.
- .2 Notify Owner, Consultant, and manufacturer's representative in writing at least ten (10) working days prior to scheduled date of functional performance verification.
- .3 Owner and Consultant are to verify functional test with Contractor.
- .4 Operate equipment and subsystems through all specified modes of control and sequences of operation. Include full and part load and emergency conditions.
- .5 Functionally verify operation of all safety limits and related alarming/monitoring.
- .6 Contractor and Subcontractor to correct deficient work. The Contractor may not proceed to systems functional performance testing until equipment and subsystem functional performance testing is approved by the Consultant and Owner.
- .7 Revise and submit functional test sheets for subsequent functional tests.

.5 Step 4 – Systems Functional Performance Testing:
- .1 Systems Functional Performance Testing to be completed by the Contractor and accepted by the Consultant and Owner.
- .2 Notify Owner and Consultant in writing at least ten (10) working days prior to scheduled date of systems functional performance testing.
- .3 Owner and Consultant to verify systems functional testing with Contractor.

.4 Operate each system through all modes of operation (e.g., seasonal, occupied/unoccupied, warm-up/cool down, start-up/shutdown, etc.,) including every interlock and conditional control logic, all control sequences, both full and part load conditions and simulation of all abnormal conditions for which there is a specified system or control response.

.5 Impose temporary upsets of systems, such as power failure, distribution fault, control loss, set-point change, and component failure to determine system stability and recovery time.

.6 Contractor and Subcontractor to correct deficient work. The Contractor may not proceed to Step 5 - Training until functional performance testing is approved by the Consultant and Owner.

.7 Revise and submit functional test sheets for subsequent functional test reviews.

.6 Step 5 – Training:

.1 Training is to be completed by the Manufacturer and System Integrator.

.2 Training on systems operation is to occur following systems functional performance testing.

.3 Training on equipment may be scheduled the day after the successful start-up of equipment. Do not schedule training on the same day as the start-up of equipment.

.4 Refer to technical sections for additional requirements.

.7 Step 6 – Performance Trial Operation:

.1 Performance Trial Operation to be completed by the Contractor and Manufacturer and accepted by the Consultant and Owner.

.2 Performance Trial Operation to be assisted by the Contractor per Item 1.7.

.3 Prerequisite to Performance Trial Operation:

.1 Steps 1 to 5 must be successfully completed and accepted by Consultant and Owner.

.2 Notify Owner and Consultant in writing at least seven (7) working days prior to scheduled date of performance trial operation. Obtain written approval from Consultant and Owner that the Performance Trial Operation may proceed.

.4 A written report of each specified trial operation will be required from the Contractor and will include items such as Contractor/Manufacturer statement of the results and acceptance of the trial operation, SCADA reports, SCADA trends, written notes, diary logs, performance testing data, summary documentation, etc.

.5 If a significant interruption occurs, regardless of the cause, the 14-day period shall be re-started. However, if the interruption is a result of owner supplied equipment or services, the Contractor may request a continuation of the 14-day test instead of a re-start. Acceptance of this continuation is at the discretion of the Owner, Consultant and Operating Authority. Any continuation/re-start can only occur when the reason for the interruption has been corrected to the satisfaction of the Owner/Consultant.

.6 Device and equipment functionality that cannot be completed due to seasonal conditions are to be noted in the test plan and scheduled when conditions are suitable for this purpose.

1.5 LEAKAGE, PIPE TESTING, AND OTHER TESTS

.1 Refer to Technical Sections for requirements related to leakage, pipe pressure testing, and other relevant testing to be completed prior to the commencement of testing and commissioning activities. Provide a checklist or form in the Commissioning Plan. Include the final document in the Commissioning Manual.

.2 Upon completion of structural and mechanical work, carry out the following tests:

.1 Leakage and/or pressure test all retaining vessels, concrete tanks and chambers, in accordance with Divisions 03 and 11.

.2 Leakage and/or pressure test all piping and equipment as specified in this section and in Division 02 through 16.

.3 Provide all necessary labour, testing equipment, gauges, temporary caps, plugs, valves, etc., to complete the tests as specified.

1.6 FUNCTIONAL PERFORMANCE TESTING

.1 Demonstrate to the Owner and/or Consultant the successful operation of equipment, system, and subsystems including normal and upset condition operating scenarios.

.2 Upset conditions to include the following, as a minimum:

.1 Power failure.

.2 Component failure

.3 Process variable(s) above and below normal operating range.

.3 Document Functional Performance with test checklists approved in Commissioning Plan. For each individual check or test, observe physical responses of system and compare them to the specified requirements to verify test results are acceptable.

.4 Carry out Functional Performance testing for all equipment, subsystems, systems and system interfaces and provide separate checklists for each.

.5 Deferred Functional Performance Tests:

.1 Identify any check or test which cannot be completed due seasonal restrictions, lack of occupancy, or any operational constraints and provide an alternative testing schedule.

.2 If any check or test cannot be completed due to construction of the works or other contract related deficiencies outside the scope of the systems start-up, these deficiencies should be corrected by the appropriate parties before completion of the commissioning process.

.3 Every check or test for which acceptable performance was not achieved should be repeated after the necessary corrections have been made.

.6 Sequence Functional Performance testing starting from components progressing to complete systems.

.7 Demonstrate operation of all alarms and remote signals. Verification to be completed under actual operating conditions or by simulating the same. Jumpering of contacts (e.g., permitting two contacts to connect so that an alarm will occur), will not be acceptable.

.8 Simulate analog inputs or outputs where a functional simulation is not practical. Generally, functional tests are considered practical for level, pressure, and temperature.

.9 Prior to any new systems and/or temporary systems being put into operation, related alarms and controls are to be tested and verified.

.10 Verification process is complete when every mode of systems operation, all system equipment, components and zones, and every item in the control sequence description is proved operational under all normal operational modes, including part and full load, and under abnormal or emergency conditions.

1.7 PERFORMANCE TRIAL OPERATION

.1 Refer to Technical Sections for additional prerequisite requirements to proceed with performance trial operation.

.2 Assist the Owner during continuous twenty-four (24) hour performance trial operations of the facility for fourteen (14) calendar days.

.3 Competent personnel are to be on-site or available to be on-site within two (2) hours from receiving a request from the Owner. This includes the General Superintendent, Mechanical and Electrical Superintendents, subtrades, and applicable equipment suppliers and system integrators.

.4 The period of the trial operation will be extended or restarted at the Contractor's expense if the performance trial operation does not meet the project requirements. The performance trial operation will be deemed complete upon receiving written acceptance from the Consultant and Owner.

1.8 PRODUCTS

.1 Water Supply for Testing - Refer to Section 01020.

.2 Supply of Chemicals for Trial Operation - Refer to Section 01020.

1.9 ACCEPTANCE PROCEDURES

.1 Prerequisite to Functional Performance Testing:
- .1 Prior to Functional Performance testing of each system, observe and verify that the physical installation of components and systems being tested is ready for Functional Performance Tests.
- .2 Receive and verify documentation of testing indicating readiness for Functional Performance Testing.
- .3 Make available for Consultant’s review, the functional performance report template, with all applicable and available information completed.

.2 Equipment and Subsystem Functional Performance Testing:
- .1 Operate equipment and subsystems through all specified modes of control and sequences of operation. Include full and part load and emergency conditions.
- .2 Functionally verify operation of all safety limits and related alarming/monitoring.

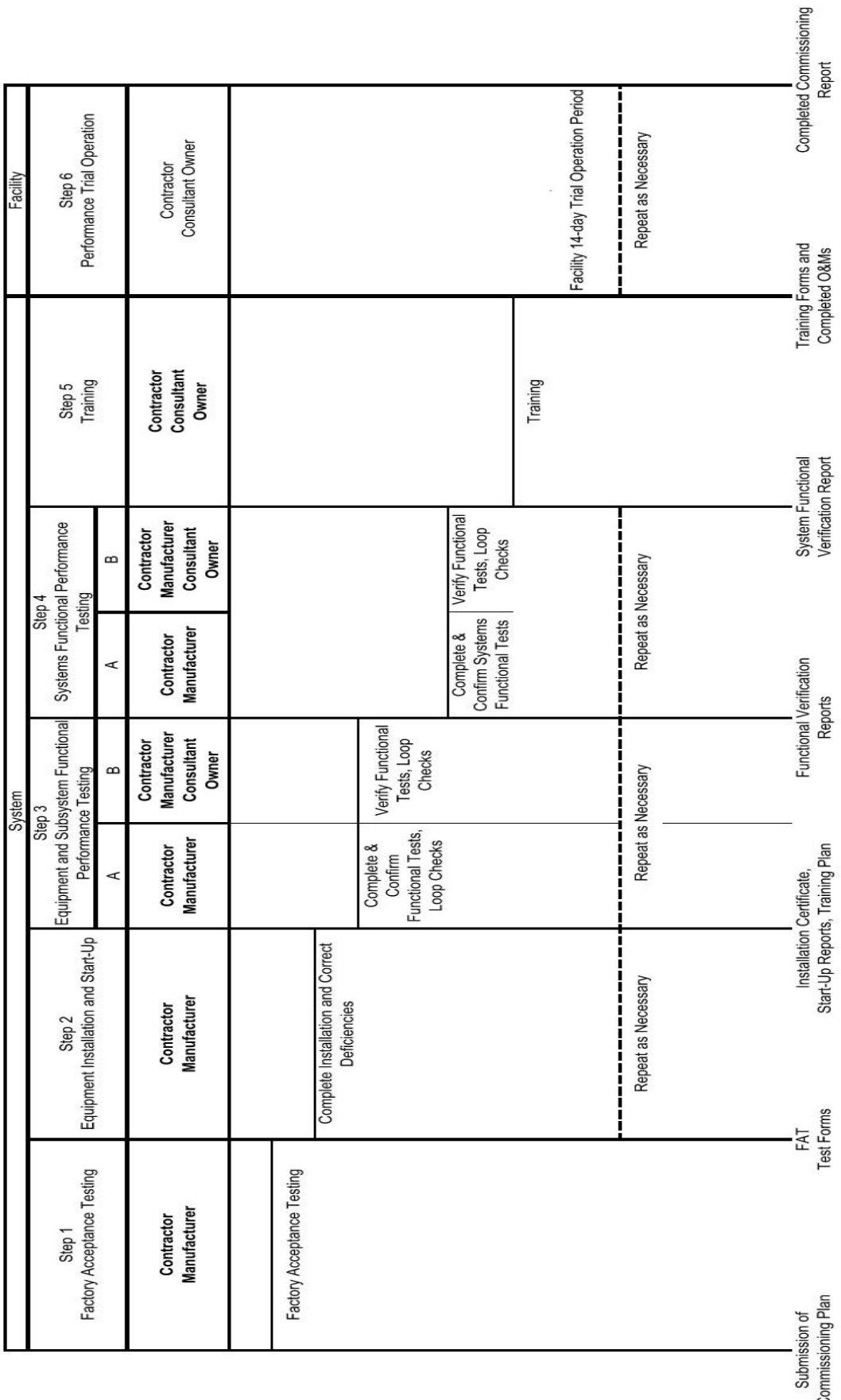
.3 Systems Functional Performance Testing:
- .1 Operate each system through all modes of operation (e.g., seasonal, occupied/unoccupied, warm-up/cool down, start-up/shut-down, etc.,) including every interlock and conditional control logic, all control sequences, both full and part load conditions and simulation of all abnormal conditions for which there is a specified system or control response.
- .2 Impose temporary upsets of systems, such as power failure, distribution fault, control loss, set-point change, and component failure to determine system stability and recovery time.
- .3 Acceptance Documentation:
  - .1 Include Commissioning Plan and Functional Performance test results with the final Commissioning Manual (refer to Section 01780).

1.10 ACCEPTANCE OF SYSTEMS

.1 System acceptance is not achieved until the requirements of the Commissioning Plan have been achieved, documented by the Contractor, and accepted by the Consultant and Owner.

END OF SECTION

Commissioning Flow Chart



1.1 DEFINITIONS

.1 Designated Substances: Are those substances designated as hazardous by the Ministry of Labour under the Occupational Health and Safety Act. The following substances have been identified as designated substances:

- .1 Acrylonitrile
- .2 Arsenic
- .3 Asbestos
- .4 Benzene
- .5 Coke Oven Emissions
- .6 Ethylene Oxide
- .7 Isocyanates
- .8 Lead
- .9 Mercury
- .10 Silica
- .11 Vinyl Chloride
- .12 Polychlorinated Biphenyls (PCBs)
- .13 Halocarbons
- .14 Mould and Water Damage
- .15 Other Hazardous Materials, such as formaldehyde, cadmium, styrene, nickel and coal tar products

.2 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities, and hazardous products, including but not limited to: corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.

.3 Polychlorinated Biphenyls (PCBs): includes chlorobiphenyls referred to in Column I of item 1 of the List of Toxic Substances in Schedule I of Canadian Environmental Protection Act (CEPA).

.4 Toxic: substance is considered toxic if it is listed on Toxic Substances List found in Schedule 1 of CEPA.

.5 List of Toxic Substances: found in Schedule 1 of CEPA, lists substances that have been assessed as toxic. Federal Government can make regulations with respect to a substance specified on List of Toxic Substances. Column II of this list identifies type of regulation applicable to each substance.

1.2 REFERENCE STANDARDS

.1 Refer to laws, by laws, ordinances, rules, regulations and orders of authority having jurisdictions, and other legally enforceable requirements applicable to Work at that area; or become in force during Work performance.

1.3 RESPONSIBILITY

.1 A Designated Substances Report shall be completed by the Contractor for this project to fulfill the Owner's requirements under Section 18, An Act to Amend the Occupational Health and Safety Act and the Workers Compensation Act, June 1990 (Bill 208).

.2 Contractor shall be responsible for reading and evaluating the information provided in DSR for the Site.

.3 Contractor shall incorporate any recommendations in the Site DSR as they pertain to the health and safety of workers on Site, in accordance with Section 01350 - Health and Safety Requirements and in compliance with authority having jurisdictions for that area.

.4 Contractor shall exercise every reasonable precaution for the protection of each worker on Site.

.5 Contractor shall furnish the Site specific DSR to all subcontractors who will be performing work on Site.

.6 Prior to beginning the Work, confirm with the Owner that additional designated substances have not been brought to project site, since the date on which the Designated Substances Report was completed.

.7 Various chemicals and hazardous substances may be used in the process and are not identified within the scope of the Designated Substances Report. Refer to the WHMIS/Manuals on-site.

1.4 ACTION AND INFORMATION SUBMITTALS

.1 Include in the site-specific Health and Safety Plan a list of relevant hazardous or contaminated materials or substances required by the authority having jurisdiction which need to be included in the Contractor's Health and Safety Plan.

END OF SECTION

1.1 WORK OF THE PROJECT

.1 Work of the Project, of which Work of this Contract is a part, comprises the following, but is not limited to:

- .1 New Raw Sewage Influent Pump Station.
- .2 New Headworks Building c/w Grit Channels.
- .3 New Aeration Tanks.
- .4 New Secondary Clarifiers.
- .5 New UV Disinfection Building.
- .6 New Process Building and Tunnel.
- .7 New Administration Building.
- .8 New Decant / Equalization Pumping Station, including new Decant Inlet Structure.
- .9 New Buried Fire Water Reservoir.
- .10 New Outdoor Odour Control Unit.
- .11 New Outdoor Ferric Tank.
- .12 New Generator
- .13 Arena Creek Relocation
- .14 Various siteworks including precast sanitary structures, forcemains, gravity sewers, and utilities.
- .15 Various new Electrical Components.
- .16 Other works as notes.

1.2 WORK OF THIS CONTRACT

.1 The Work of this Contract is comprised of the Work as defined and detailed in the CCDC2 2020 entered into among Owner and Contractor (where the definitions of terms therein shall apply to this document), the Contract documents, and any amendments thereto.

1.3 DIVISION OF WORK

.1 Division of the Work among Subcontractors and Suppliers is solely the Contractor's responsibility. The Consultant and Owner assume no responsibility to act as an arbiter to establish subcontract limits between Sections or Divisions of the Work.

1.4 SPECIFICATIONS LANGUAGE AND STYLE

.1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.

.2 Complete sentences by reading "shall", " Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.

.3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.

.4 When used in the context of a Product, read the word “provide” to mean “supply and install to result in a complete installation ready for its intended use”.

.5 Read the word “Section” to mean “Specification Section”.

1.5 CONTRACT DOCUMENTS FOR CONSTRUCTION PURPOSES

.1 Owner will supply Contractor with a complete set of Contract Documents in electronic form before commencement of the Work. Contractor may print hard copies for construction purposes as required.

.2 The Consultant shall provide AutoCAD project files to the Contractor upon receipt of a request in writing, subject to the requirement that the Contractor and/or their Subcontractors execute and return a release letter in the form provided by the Consultant.

.3 The Consultant will provide Issued for Construction design documents for this project. The provision of Issued for Construction documents shall not be a requirement to commence the Work or represent grounds for a change in schedule.

1.6 DOCUMENTS AT THE SITE

.1 Keep the following documents at Place of the Work, stored securely and in good order and available to Owner and Consultant in hard copy and electronic form:

- .1 Current Contract Documents, including Drawings, Specifications and addenda.
- .2 Change Orders, Change Directives, and Supplementary Instructions.
- .3 Reviewed Shop Drawings, Product data and samples.
- .4 Field test reports and records.
- .5 Construction progress schedule.
- .6 Meeting minutes.
- .7 Manufacturer’s certifications.
- .8 Permits, inspection certificates, and other documents required by authorities having jurisdiction.
- .9 Current as-built drawings.
- .10 Safety Data Sheets (SDS) for all controlled Products.
- .11 Deficiency and Punchlist Logs.

1.7 CONTRACTORS USE OF PREMISES

.1 Except as otherwise specified, Contractor has restricted use of Place of the Work from time of Contract award until Ready-for-Takeover.

.2 Confine Construction Equipment, Temporary Work, storage of Products, waste products and debris, and all other construction operations to limits required by laws, ordinances, permits, and Contract Documents, whichever is most restrictive. Do not unreasonably encumber Place of the Work.

.3 Owner will occupy premises during entire construction period for plant operation and maintenance activities. Cooperate with Owner in scheduling activities to minimize disruptions and to facilitate Owner usage.

1.8 REMOVED/SALVAGED EQUIPMENT AND MATERIAL

.1 Except if expressly stated otherwise, materials which must be removed to perform the Work, or are indicated for removal, shall become the Contractor's property and shall be taken from project site and disposed of at no additional cost to the project.

.2 The following Items removed as part of the Demolition and Removal activities shall be salvaged and turned over to the Owner:

- .1 All instrumentation.

.3 The Contractor shall provide written notice to the Owner two (2) weeks in advance of demolition and

removal. The Owner reserves the right to visit the project site within the two (2) week period and identify additional items to be salvaged and turned over to the Owner.

.4 Materials to be salvaged and turned over to the Owner shall remain onsite, or as directed by the Consultant/Owner.

1.9 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures, and outlets indicated or specified shall be considered as approximate.

.2 Locate equipment, fixtures, and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access, and maintenance.

.3 Inform the Consultant of impending installation and obtain their approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by the Consultant.

.5 Provide detailed interference and coordination drawings when required by Specification Sections.

1.10 SECURITY

.1 Comply with all Workplace policies on Criminal Background Checks of Offence Declarations on Service Providers including, but not limited to the following:

.1 Contractor to submit a signed letter of attestation that staff and subcontractors working on site have passed a recent criminal background check. Contractor to maintain compliance throughout the contract duration.

1.11 PRECONSTRUCTION SURVEY

.1 A pre-construction survey shall be prepared by the Contractor for all utilities, structures, surfaces, facilities, and equipment on or near the project site likely to be used or potentially impacted due to the proposed construction activities

.2 The pre-construction survey means a detailed record in written form accompanied by photographs and/or video of the condition of private and public property prior to the commencement of any construction activities. All existing structural and cosmetic damage or defects shall be clearly documented.

.3 The pre-construction survey for adjacent facilities and surfaces shall include the following:

.1 Buildings, surfaces, and structures within the WWTS Site.

.2 Buildings, surfaces, and structures within a 125 m radius of the WWTS Site.

.3 Any other potentially affected buildings, surfaces, or structures found on surrounding neighborhood streets, if applicable.

.4 The Contractor shall review the Pre-Construction Survey Report and submit it to the Consultant within two (2) weeks of completing the survey prior to starting enabling work or construction activities.

.5 The pre-construction survey will be considered the basis by which claims for damages caused by construction activities will be evaluated.

1.12 FEES, PERMITS AND CERTIFICATES

.1 Pay all fees and obtain all required approvals and permits unless otherwise indicated. Provide authorities with plans and information for acceptance certificates. Furnish inspection certificates as evidence that work conforms to requirements of authority having jurisdiction.

.2 Contract shall apply for, obtain, and pay for the EASR for dewatering. The Contractor shall comply with the requirements of the EASR.

.3 Contractor will obtain and pay for building permit. A building permit application has been submitted to the Municipality of Brighton.

.4 Apply for, obtain, and pay for Technical Standards & Safety Authority (TSSA) Certificate of Authorization for gas piping systems, chemical piping, and other systems.

.5 Contractor shall apply for, obtain, and pay for Electrical Safety Authority (ESA) Inspections and Permit for all applicable electrical works.

.6 Owner will apply for, obtain, and pay for the Environmental Compliance Approvals (Sewage and Air/Noise).

.7 Contractor shall pay for advertisement of substantial completion.

.8 Work is subject to the approval, inspection, by-laws and regulations of all municipal, provincial, federal and other authorities having jurisdiction.

1.13 PUBLIC NOTIFICATIONS

.1 Notice must be provided to the public in advance of the following occurrences

- .1 Notice of Construction: Advertised on the Municipal website and physically delivered to affected residents no later than one week in advance of starting the work.
- .2 Water or Sanitary Service Interruptions: Physically delivered to affected residents no later than 48hours in advance of the service interruption. A copy of this notice and a list of residents the notice was delivered to shall be provided to the owner.
- .3 Road and Lane Closures: Notice of the closure and available detour routes shall be provided to the Municipality one week in advance of the closure so the 511-notice system may be updated.

.2 All Notices shall be reviewed by the Owner or Consultant prior to distribution. Notices delivered directly to residents shall contain the contact information of the contractors site representative, the contract administrator and the Municipal employee identified as the project lead.

1.14 TIMING CONSTRAINTS – SPECIAL FESTIVALS

.1 The following special events are expected to occur within the Municipality.

.1 Brighton Street Dance – August 2, 2025
Main Street from Young Street to Division Street North will be inaccessible from 4pm to 10pm. Works which interfere with this location and the identified detour routes are not permitted from 12pm to 12am the day of the event

.2 Applefest – September 27 and 28, 2025
Main Street from Young Street to Maplewood Avenue will be inaccessible the weekend of September 27, 2025. No construction works are permitted within town proper the weekend of Applefest. A Limited scope of work may be approved by the Municipality if works do not interfere with the festival or primary routes into and out of the town.

.3 Santa Clause Parade – November 21, 2025
Main Street, Maplewood Avenue, Chapel Street and portions of Young Street, Elizabeth Street, Dundas Street and Prince Edward Drive will be closed November 21 from the Hours of 5:00pm to 9:00pm. All roads identified as the parade route must be restored to a suitable driving surface and all asphalt lips be ramped prior to the parade.

.4 Canada Day Celebrations – July 1, 2025
Main Street, Park Street, Elizabeth Street and Prince Edward Drive north of the CP/CN Railway will be host to various Canada day activities from 6:00am-10:30pm. No construction works are permitted within town proper on Canada Day. A Limited scope of work may be approved by the Municipality if works do not interfere with the festival or primary routes into and out of the town

.2 Future special events will be communicated with the General Contractor in advance.

END OF SECTION

NO: _____

CONTRACTOR: _____ CONTRACT NO: _____

PROJECT: _____ SPEC SECTION: _____

OWNER: _____

ENGINEER: _____

CONTRACTOR/SUBCONTRACTOR: _____ DATE: _____
yyyy/mm/day

FOREMAN IN CHARGE: _____ CREW SIZE: _____

FACILITY/AREA AFFECTED: _____

SYSTEM/EQUIPMENT AFFECTED: _____

DATE OF SHUTDOWN: _____ TIME: _____

DURATION OF SHUTDOWN: _____

.1 WORK TO BE ACCOMPLISHED:

_____

_____

_____

.2 SHUTDOWN ACTIVITIES:

Activity	**Start Time / Stop Time**	**Special Requirements**

.3 APPROVAL AND COMMENTS:

_____

_____

_____

END OF SECTION

1.1 CASH ALLOWANCES

.1 Amount of each cash allowance includes:
- .1 All costs related to the services, excluding Value Added Taxes.
- .2 All costs to provide specified products, including supply, installation, and related costs, excluding Value Added Taxes.

.2 Amount of each cash allowance does not include costs of the following items, which costs shall be included in the Contract Price and not in the cash allowance:
- .1 Contractor, Subcontractor, and sub-Subcontractors overheads and profits related to the cash allowance.
- .2 Unloading, handling and storage on site.

.3 Allow the stipulated sum of $20,000 for materials testing.

.4 Allow the stipulated sum of $35,000 for the completion of a Designated Substance Survey, preparation of associated report, and for unforeseeable site conditions relating to the removal of Designated Substances, as defined in O. Reg. 490/09 discovered during the course of the Work. This allowance is only for materials not identified in the Designated Substances Survey Report.

.5 Allow the stipulated sum of $10,000 for supplying various furniture as required by the Owner.

.6 Allow the stipulated sum of $20,000 for system integration work related to connecting Harbour Street Sewage Pump Station to the Brighton Wastewater Treatment Plant.

1.2 EXPENDITURE OF CASH ALLOWANCES

.1 Owner, through Consultant, will provide Contractor with documentation required to permit pricing of a cash allowance item.

.2 Owner, through Consultant, may request Contractor to identify potential Suppliers or Subcontractors, as applicable, and to obtain at least three competitive prices for each cash allowance item.

.3 Owner, through Consultant, may request the Contractor to disclose originals of all bids, quotations, and other price related information received from potential Suppliers or Subcontractors.

.4 Owner, through Consultant, will determine by whom and for what amount each cash allowance item will be performed. Obtain Owner's prior written approval in the form of a Change Order before entering into a subcontract, amending an existing subcontract, or performing own forces work included in a cash allowance. Upon issuance of the Change Order, the Contractor's responsibilities for a cash allowance item shall be the same as for other work of the Contract.

1.3 CONTINGENCY ALLOWANCE

.1 Include in the Contract Price a contingency allowance in the amount of $3,680,000.

END OF SECTION

1.1 DEFINITION

.1 In this Section “Substitution” means a Product, a manufacturer, or both, not originally specified in Contract Documents by proprietary name but proposed for use by Contractor in place of a Product, a manufacturer, or both, specified by proprietary name.

1.2 SUBSTITUTION PROCEDURES

.1 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.

.2 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s) and accompanied by language such as "or equal", "or approved equal", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without Consultant’s prior acceptance in writing. Do not order or install any Substitution without a Supplemental Instruction or Contract Change Order.

.3 Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements for Proposed Substitutions, Consultant will review and accept or reject the proposed Substitution.

.4 Allow for a minimum of ten (10) Working Days for Consultant evaluation. The minimum duration is subject to change dependent on the complexity of the substitution request.

.5 Consultant may accept a Substitution if satisfied that:

.1 the proposed substitute Product is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product,

.2 the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and

.3 the Substitution provides a benefit to Owner.

.6 If Contractor fails to order a specified Product or order a Product by a specified manufacturer in adequate time to meet Contractor’s construction schedule, Consultant will not consider that a valid reason to accept a Substitution.

.7 If Consultant accepts a Substitution and subject to Owner’s agreement, the change in the Work will be documented in the form of either a Supplemental Instruction or Change Order as specified in Section 01260 Contract Modification Procedures.

.8 If a Substitution is accepted in the form of a Supplemental Instruction or Contract Change Order, Contractor shall not revert to an originally specified Product or manufacturer without Consultant’s prior written acceptance.

1.3 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

.1 Include with each proposed Substitution the following information:

.1 The submission form as provided in Section 01250A as the cover sheet for the proposed substitution information.

.2 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.

.3 Reason(s) for proposing the Substitution.

.4 A statement verifying that the Substitution will not affect the Contract Price and Contract Time or, if applicable, the amount and extent of a proposed increase or decrease in Contract Price and Contract Time on account of the Substitution.

.5 A statement verifying that the Substitution will not affect the performance or warranty of other parts of the Work.

.6 Manufacturer's Product literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.

.7 Product samples as applicable.

.8 A summarized comparison of the physical properties and performance characteristics of the specified Product and the Substitution, with any significant variations clearly highlighted.

.9 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.

.10 If applicable, estimated life cycle cost savings resulting from the Substitution.

.11 Details of other projects and applications where the Substitution has been used.

.12 Identification of any consequential changes in the Work to accommodate the Substitution and any consequential effects on the performance of the Work as a whole. A later claim for an increase to the Contract Price or Contract Time for other changes in the Work attributable to the Substitution will not be considered.

END OF SECTION

1.1 SUBSTITUTION CHECKLIST FORM

.1 Specification Section Reference: _____
  .1 Product Name: _____
  .2 Equipment Tag No.: _____

.2 Manufacturer/Supplier:
  .1 Name: _____
  .2 Address: _____
  .3 Website: _____
  .4 Product Representative:
    .1 Contact Name: _____
    .2 Telephone: _____
    .3 Email: _____
  .5 Proposed Substitution:
    .1 Model _____ Size _____ Type _____

.3 Reasons for substitution. Yes__ No__

.4 Statement on change to Contract Price. Yes__ No__

.5 Statement on change to Contract Time. Yes__ No__

.6 Statement verifying substitution will not affect performance or warranty. Yes__ No__

.7 Manufacturers literature. Yes__ No__

.8 Product samples (if applicable). Yes__ No__

.9 Comparison of physical properties and performance characteristics. Yes__ No__

.10 Maintenance services; sources of replacement parts/materials. Yes__ No__

.11 Life cycle costing savings. Yes__ No__

.12 Changes in the Work to accommodate the Substitution. Yes__ No__

.13 List three (3) recent Canadian projects where above equipment has been used. Provide Owner references.

Project Name	Location	Equip. Start-up/ Installation Date
_____	_____	_____
_____	_____	_____
_____	_____	_____

Signed: _____ Contractor's Name: _____

Date: _____ Title: _____

END OF SECTION

1.1 SCHEDULE OF LABOUR RATES

.1 Prior to the first application for payment, submit for the Consultant's review a schedule of labour rates for all trades and classifications of trades, such as journeymen, apprentices, and foremen that will be employed in the Work. Provide a breakdown of the payroll burden component of labour rates.

.2 Labour rates shall reflect the salaries, wages, and benefits paid to personnel in the direct employ of the Contractor, Subcontractors, and sub-Subcontractors, stated as hourly rates, that will be used when:

.1 preparing price quotations for Change Orders, and

.2 determining the cost of work attributable to Change Directives.

.3 Labour rates stated in the schedule of labour rates shall be consistent with rates that will actually be paid, and payroll burden costs that will actually be incurred, in the normal performance of the Work, during regular working hours. Labour rates shall not include any additional overhead and profit component.

.4 Where collective agreements apply, the labour rates shall not exceed those established by collective agreement.

.5 Obtain the Owner's written acceptance of the schedule of labour rates before submitting the first Change Order quotation.

.6 Accepted schedule of labour rates will be used solely for evaluating Change Order quotations and cost of performing work attributable to Change Directives.

.7 The Contractor may request amendments to the accepted schedule of labour rates if changes in the labour rates that will actually be paid, or payroll burden cost that will actually be incurred, in the normal performance of the Work can be demonstrated. Obtain the Owner's written acceptance of such changes.

1.2 SCHEDULE OF EQUIPMENT RATES

.1 Prior to the first application for payment, submit for the Consultant's review a schedule of equipment rates for Contractor owned Construction Equipment.

.2 Equipment rates shall reflect the rates that will be used when:

.1 preparing price quotations for Change Orders, and

.2 determining the cost of work attributable to Change Directives.

.3 Equipment rates stated in the schedule shall be consistent with local equipment rental market rates and shall not include any additional overhead and profit component.

.4 Obtain the Owner's written acceptance of the schedule of equipment rates before submitting the first Change Order quotation.

.5 Accepted schedule of equipment rates will be used solely for evaluating Change Order quotations and cost of performing work attributable to Change Directives.

.6 The Contractor may request amendments to the accepted schedule of equipment rates if changes in local equipment rental market rates can be demonstrated. Obtain the Owner's written acceptance of such changes.

1.3 VALUATION OF CHANGES BASED ON AGREED UNIT PRICES

.1 The Consultant may, at the outset of the Contract or at any other time, request the Contractor to submit unit prices anticipated to be required in valuing changes in the Work.

.2 The Contractor shall submit such unit prices promptly upon request.

.3 The unit prices shall be valid for a specified duration.

.4 The unit prices shall exclude all fees for overhead and profit and shall be subject to the percentage fees specified in Section 00800 Supplementary Conditions under GC 6.2 Change Order.

.5 The Consultant will evaluate the Contractor's quoted unit prices and, if accepted by the Owner in writing, the agreed unit prices shall be used to value subsequent proposed changes in the Work wherever they are applicable.

1.4 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE ORDERS

.1 Unless otherwise agreed, the adjustment of the Contract Price on account of a proposed change in the Work shall be based on a quotation for a fixed price increase or decrease to the Contract Price regardless of the Contractor's actual expenditures and savings.

.2 If unit prices included in the stipulated price contract are applicable to the proposed change, the adjustment of the Contract Price shall be based on those unit prices, to the extent they apply.

1.5 CHANGE ORDER PROCEDURES

.1 Upon issuance by the Consultant to the Contractor of a proposed change in the Work, and unless otherwise requested in the proposed change or unless otherwise agreed:
  .1 Submit to the Consultant a fixed price quotation for the proposed change in the Work within five (5) days after receipt of the proposed change in the Work.
  .2 Provide a detailed breakdown of the price quotation including the following to the extent applicable, with appropriate supporting documentation:
    .1 Estimated labour costs, including hours and applicable hourly rates based on the accepted schedule of labour rates.
    .2 Estimated product costs, including supplier quotations, estimated quantities and unit prices.
    .3 Estimated construction equipment costs.
    .4 Enumeration of all other estimated costs included in the price quotation.
    .5 Estimated credit amounts for labour and products not required on account of the proposed change.
    .6 Fees, not exceeding the applicable percentages for overhead and profit as specified in Section 00800.
    .7 Where applicable, Subcontractor quotations, also including a detailed breakdown of all the above.

1.6 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE DIRECTIVES

.1 Unless the Owner and the Contractor reach an earlier agreement on the adjustment to the Contract Price by means of a Change Order that cancels the Change Directive, the adjustment in the Contract Price for change carried out by way of a Change Directive shall be determined as specified in the General Conditions of Contract after the change in the Work is completed.

1.7 CHANGE DIRECTIVE PROCEDURES

.1 If a Change Directive is issued for a change in the Work for which a proposed change was previously issued, but no Change Order has yet been signed, the Change Directive shall cancel the proposed change, and any Contractor quotations related to that change in the Work.

.2 The Contractor will provide written notice to the Consultant and Owner prior to the start date of the Change Directive work.

1.8 SUPPLEMENTAL INSTRUCTIONS

.1 The Consultant may issue Supplemental Instructions to provide clarifications to the Contract Documents, provide additional information, or make minor variations in the Work not involving adjustment in the Contract Price or Contract Time.

.2 If the Contractor considers a Supplemental Instruction to require an adjustment in Contract Price or Contract Time, the Contractor shall promptly notify the Consultant and the Owner in writing and shall not proceed with any work related to the Supplemental Instruction pending receipt of a Change Order, a Change Directive, or, in accordance with the dispute resolution provisions of the General Conditions of Contract, a Notice in Writing of a dispute and instructions to proceed.

END OF SECTION

1.1 SCHEDULE OF VALUES

.1 A minimum of fifteen (15) working days prior to the first application for progress payment, submit for Consultant's review an initial schedule of values. Modify the initial schedule of values if and as requested by Consultant. Obtain Consultant's written acceptance of the initial schedule of values prior to the first application for progress payment.

.2 Together with the first and all subsequent applications for progress payment, submit updated versions of the schedule of values to indicate the values, to the date of application for progress payment, of work performed and Products delivered to Place of the Work.

.3 Provide a schedule of values that is sufficiently detailed and comprehensive to facilitate Consultant's evaluation of applications for progress payment at an appropriate level of detail. The work breakdown structure should consist of:

- .1 All material, labour, and equipment required as identified in the contract documents. To be identified by Division 01 through 17.
- .2 Division 01 should identify the following subheadings and costs at a minimum:
  - .1 Mobilization
  - .2 Project Staffing
  - .3 Site Traile.
  - .4 Sanitation
  - .5 Insurance
  - .6 Bonding
  - .7 Daily Clean
  - .8 Final Clean
  - .9 Closeout Documentation
  - .10 Commissioning
  - .11 Commissioning Plan
  - .12 Demobilization.

.4 All other divisions to separate activities into material, labour, large equipment supply and install, mobilization/demobilization, commissioning (as required), and closeout documentation.

.5 All forms of submittals as identified in the specifications and/or the design drawings will not be paid for in advance of the approved products being delivered to the Place of Work. Earlier payment of specialized equipment may be approved by Owner subject to prior submittal review and approval and at its discretion.

.6 The commissioning plan will be paid when the plan is 100% completed and agreed upon by the Contractor, Owner and Consultant. Contractor may not request interim payments for percentage of completeness.

.7 Application for progress payment for Products manufactured but not yet delivered to the Place of the Work will not be considered.

.8 Products delivered to the site significantly in advance of being required for installation in the orderly process of construction will not be eligible for payment, unless approved in writing by the Consultant prior to delivery.

.9 If requested by the Consultant, applications for progress payment from allowances shall be substantiated by copies of all invoices and statements from suppliers or Sub-Contractors furnishing products, etc., purchased under a cash allowance.

.10 The schedule of values must reflect Change Orders and allowances and include a breakdown that adds up to the current total Contract Price. The estimated value of Change Directives should also be included within the schedule of values but may be listed separately from the current total Contract Price.

.11 For each item in the work breakdown structure, provide as a minimum the following information, under headings as indicated:

.1 Breakdown Amount: A dollar amount, including an appropriate pro rata portion of Contactor's overhead and profit.

.2 Performed to Date: The value of Work performed, and Products delivered to Place of the Work up to the date of the application for payment, stated as a percentage of the Contract Price and in dollars.

.3 Previously Performed: The value of Work performed, and Products delivered to the Place of the Work for which payment has been previously certified, stated in dollars.

.4 Current Period: The value of Work performed, and Products delivered to Place of the Work for which Contractor is currently applying for payment, stated in dollars.

.5 Balance to Complete: The value of Work not yet performed, and Products not yet delivered to Place of the Work, stated in dollars.

1.2 APPLICATION FOR PROGRESS PAYMENT AND CERTIFICATION

.1 The Consultant, Owner and Contractor will participate in a monthly pre-screening meeting to be held seven (7) working days prior to the submission of a Proper Invoice to review the particulars, details, information and documentation, including the breakdown of the schedule of values, and the proposed percentage of completion for each division of Work, which are proposed to constitute the basis of the Contractor's Proper Invoice, so as to assist the Contractor with the preparation and submission of its Proper Invoice on a monthly basis.

.2 An application for progress payment is to be submitted on the first Tuesday of the month following the month for which the invoice period pertains.

.3 Consultant will issue to Owner, no later than ten (10) calendar days after receipt of an application for progress payment a certificate for payment in amount applied for or in such other amount as Consultant determines to be due. If Consultant amends application, Consultant will give notification in writing giving reasons for amendment.

.4 Include with each application for payment except the first, a statutory declaration in the form CCDC Document 9a, and such additional supporting documents as the Consultant may reasonably require.

1.3 CASH FLOW PROJECTION

.1 A minimum of ten (10) working days prior to submission of the first application for progress payment, provide a forecast of approximate monthly progress payments for each month of the Contract Time.

.2 Submit revised cash flow forecasts monthly and incorporate approved change orders and change directives.

1.4 WORKERS' COMPENSATION CLEARANCE

.1 Submit proof of workers' compensation clearance with each application for payment.

1.5 PAYMENT FOR PRODUCTS STORED OFF SITE

.1 Owner may, due to extraordinary circumstances and at Owner's sole discretion, make payments for Products delivered to and stored at a location other than Place of the Work, subject to:
- .1 a request submitted by Contractor in writing, with appropriate justification, and
- .2 whatever conditions Owner or Consultant may establish for such payments, as required to protect Owner's interests.

1.6 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

.1 After issuance of certificate of Substantial Performance of Work:
- .1 Submit application for payment of holdback amount including:
  - .1 Statutory Declaration.
  - .2 Workers' Safety and Insurance Board clearance certificate.
  - .3 Copy of publication notice declaring substantial performance.

.2 Consultant will issue a certificate for payment of holdback amount to the Owner no later than ten (10) working days following receipt of approved application for payment.

1.7 FINAL PAYMENT

.1 When the Consultant determines that the Work has been completed, the Contractor shall:
- .1 Submit application for final payment and application for release of finishing holdback amount including:
  - .1 Declaration of Last Supply.
  - .2 Statutory Declaration.
  - .3 Workers' Safety and Insurance Board clearance certificate.

.2 Consultant will issue a final certificate for payment to the Owner no later than ten (10) working days following receipt of approved application for final payment and finishing holdback from the Contractor.

END OF SECTION

1.1 ADMINISTRATIVE

.1 The Consultant will schedule, chair and distribute the project meeting minutes.

.2 Meetings can be conducted on site if Contractor is following health and safety regulations for all government orders regarding social distancing and pandemic protocols.

.3 Meetings may be conducted using Microsoft Teams, Zoom or other similar virtual platform that has audio and visual capability.

.4 The Contractor is to preside at meetings.

.5 The Consultant shall record the minutes.

.6 The purpose of the meeting minutes is to document significant proceedings and decisions and identify actions by parties.

.7 The Consultant shall produce and issue meeting minutes electronically within five (5) Calendar Days after each meeting to the Owner, Contractor, Consultant and all parties in attendance. Meeting minutes are to include all meeting documents reviewed at the meeting including project schedule, logs, etc. Within two (2) Working Days of receipt of the meeting minutes, the Consultant shall be notified of any noted errors and/or omissions. Consultant will revise the meeting minutes if deemed appropriate and return the revised meeting minutes to the Owner, Contractor, Consultant and all parties in attendance.

.8 The Contractor shall be responsible for distribution of meeting minutes to their Subcontractors.

.9 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRE-CONSTRUCTION MEETING

.1 Promptly after Contract award, the Consultant shall establish the time and location of a construction start-up meeting to review and discuss administrative procedures and responsibilities.

.2 Senior representatives of the Owner, Consultant, and Contractor, including Contractor's project manager and site superintendent, and major Subcontractors if requested, shall be in attendance.

.3 Agenda will include the following:

- .1 Project stakeholders including official representatives of the Owner, Contractor, Consultant, and Subconsultants.
- .2 Building permit status.
- .3 Project communication protocol.
- .4 Construction progress schedule.
- .5 Request for information process.
- .6 Change management process.
- .7 Submittals schedule and procedures.
- .8 Quality requirements including testing and inspection procedures.
- .9 Billing and payment procedures.

.10 Construction facilities including temporary and existing utilities, cleaning and waste management, temporary barriers, enclosures, site controls, site safety, and site security.
.11 Work restrictions.
.12 Documents to be maintained at the site.
.13 Take-over procedures, acceptance, warranties and O&M manuals.
.14 Construction progress meeting frequency, meeting minutes, and meeting documents.
.15 Other business.

1.3 PROGRESS MEETINGS

.1 Schedule regular bi-weekly construction progress meetings for the duration of the Work. The Consultant shall prepare meeting agendas, chair the meetings, and record and distribute the minutes.

.2 Consultant shall record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.

.3 Ensure that Subcontractors (if requested), attend as and when appropriate to the progress of the Work.

.4 Agenda for each meeting shall include the following, as a minimum:
.1 Review of action item status from previous meeting.
.2 Construction progress schedule including review of Work progress since previous meeting.
.3 Field observations including any problems, difficulties or concerns.
.4 Submittals schedule and status of pending or outstanding items.
.5 Change management log and status of pending or outstanding items.
.6 Request for information log and status of pending or outstanding items.
.7 Site safety.
.8 Quality Control/Quality Assurance concerns.
.9 Billing and payment.
.10 Commissioning
.11 Other business.

1.4 COMMISSIONING MEETINGS

.1 Schedule regular bi-weekly commissioning meetings starting 2 (two) months prior to the commencement of the commissioning process.

.2 The Commissioning Manager shall prepare meeting agendas, chair the meetings, and record and distribute the minutes.

.3 Commissioning meetings to be held until all equipment and systems are fully commissioned and accepted by the Owner.

.4 The Commissioning Manager shall record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.

.5 Ensure that Subcontractors, Suppliers, and Manufacturers (if requested), attend as and when appropriate to the progress of the Work.

.6 Agenda for each meeting shall include the following, as a minimum:

.1 Review of action item status from previous meeting.

.2 Commissioning schedule including review of Work progress since previous meeting.

.3 Field observations including any problems, difficulties or concerns.

.4 Submittals, change management, or request for information items related to commissioning activities.

.5 Site safety issues.

.6 Quality Control/Quality Assurance concerns.

.7 Shutdowns or closure activities.

.8 Other business.

1.5 SPECIALIZED MEETINGS

.1 Schedule specialized meetings as needed for the duration of the Work. Specialized meetings shall be for specific topics that require a longer duration for discussion and cannot be accommodated in the progress meetings. This can include but not be limited to site issues, change management, schedule, quality, etc.

.2 The Contractor shall prepare meeting agendas, chair the meetings, and record and distribute the minutes.

.3 Contractor shall record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.

.4 Ensure that Subcontractors (if requested), attend as and when appropriate to the progress of the Work.

END OF SECTION

1.1 SUMMARY

.1 This Section specifies Contractor responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.

.2 The purpose of submitting progress schedules is to:
- .1 inform Owner and Consultant of actual progress versus planned progress, and
- .2 provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.

1.2 CONSTRUCTION PROGRESS SCHEDULE

.1 Format and Content:
- .1 Prepare schedule in the form of a Critical Path Method (CPM) Gantt chart using Microsoft Project or equivalent approved by the Consultant.
- .2 Provide a work breakdown structure identifying key activities, work packages, and major milestones, including long lead deliveries of products or equipment, inspection and testing activities, preparation and review of mock-ups, shutdown or closure activities, and similar items, at a sufficient level of detail to effectively manage construction progress.
- .3 To contain the following information:
  - .1 Data Date.
  - .2 Project Name.
  - .3 Client Name.
  - .4 Schedule Name.
  - .5 Work Breakdown Structure with the minimum headings:
    - .1 Contract Tender and Award.
    - .2 Procurement (broken down by division and contract packages).
    - .3 Submissions (broken down by division and contract packages).
    - .4 Construction (broken down by phases, interior/exterior work areas and floor level).
    - .5 Commissioning.
    - .6 Closeout.
  - .6 Contract milestones.
  - .7 Activities identified as Owner allowances.
    - .1 Cash allowance authorization date by Owner.
    - .2 All activities related to cash allowance work.
  - .8 A complete listing of schedule activities needed to perform the Work.
  - .9 No activity durations shall exceed 10 days.
  - .10 Activity Attributes to be included: Activity Number, Activity Description, Original Duration, Actual Duration, Baseline Start and Finish, Actual Start and Finish, Predecessor, and Successor.
  - .11 Identify the critical path(s).

.2 Submission:
- .1 Submit initial schedule to Owner and Consultant within ten (10) Working Days after Contract award.
- .2 Submit schedule via e-mail as .pdf and native files.
- .3 Consultant will review format and content of initial schedule and request necessary changes, if any, within ten (10) Working Days after receipt.

.4 If changes are required, resubmit finalized initial schedule within five (5) Working Days after return of review copy.
.5 Submit updated progress schedule monthly (or as requested by the Consultant and Owner) to Owner and Consultant.
.6 The progress schedule submission is to include a Schedule Narrative indicating changes to actual and projected start and finish dates, activity relationships, critical path, float, and baseline comparison to current progress. The Schedule Narrative should include project risk items including but not limited to procurement, fabrication, deliveries, labour, change management, requests for information, etc.
.7 Construction schedule updates to include as a minimum:
  .1 Data date to be identified.
  .2 No dates shall be pushed by the data date.
  .3 All activities that have not been completed by the data date are to be re-forecasted and updated in the schedule.
  .4 All activities are to have predecessor(s) and successor(s) except for the first and last activity in the schedule and milestone activities.
  .5 The project schedule logic is to be correctly linked to predecessor(s) and successor(s) in the order of build sequencing to properly identify the critical path(s) for the project.
  .6 All completed activities to be identified as actualized. This includes start and finish dates.
  .7 Identify the critical path(s).
  .8 Approved changes that contain duration increases or decreases are to be incorporated into the schedule.
  .9 Incorporate RFI's that impact the work.

1.3 4-WEEK LOOK AHEAD SCHEDULE

.1 Provide a 4-Week Look Ahead Schedule as requested by the Consultant to show all activities that started, progressed or finished one (1) week back and all activities starting or progressing within the next four (4) weeks.

.2 The 4-Week Look Ahead Schedule activities and dates are to align with the Construction Progress Schedule and Commissioning Schedule.

.3 The 4-Week Look Ahead Schedule is a planning aid and does not replace the requirement for the Construction Progress Schedule.

1.4 COMMISSIONING SCHEDULE

.1 Format and Content:
  .1 Prepare schedule in the form of a Critical Path Method (CPM) Gantt chart using Microsoft Project or equivalent approved by the Consultant.
  .2 The commissioning schedule is intended to be a separate document from the overall Construction Schedule, but shall be linked such that commissioning activities, deliverables and milestones are tied to the overall construction schedule, deliverables and milestones.
  .3 Provide a work breakdown structure by Building and system identifying activities, sequence of activities, interrelationships, and party responsibilities including major milestones, long lead deliveries of products or equipment, inspection and testing activities, shutdown or closure activities, and similar items, at a sufficient level of detail to effectively manage the commissioning progress.
  .4 To contain the following information:

.1 Data Date.
.2 Project Name.
.3 Client Name.
.4 Schedule Name.
.5 Work Breakdown Structure with the minimum headings:
  .1 Submissions (broken down by division and contract packages).
    .1 Equipment Fabrication
    .2 Equipment Delivery
  .2 Building Name.
    .1 Building System Name.
    .1 Testing and Inspection.
      .1 Factory Witness Testing.
      .2 Functional testing for each piece of equipment.
      .3 Preliminary balancing.
      .4 Control system start-up tests.
      .5 Control system detail verification of sequence of operation where automatic control and logic is included in Contractor scope.
      .6 Functional verification procedures and reports.
      .7 Performance Testing procedures and reports.
    .2 Balancing.
      .1 Preliminary.
      .2 Final.
    .3 Training and instruction of Owner operational staff.
    .4 Seasonal testing/balancing/commissioning.
    .5 Operation and Maintenance Manuals
  .3 Facilities 14 Day Performance Tests.
.6 Contract milestones.
.7 Activities for construction by Owner or Other contractors.
  .1 Equipment or material submittals for site coordination purposes.
  .2 Delivery dates to site of Owner/Other Contractor supplied materials and equipment.
  .3 Installation dates of material and equipment that is by the Owner/Other Contractor
  .4 Commissioning dates for equipment or systems that is by the Owner/Other Contractor.
.8 A complete listing of schedule activities needed to perform the Work.
.9 No activity durations shall exceed ten (10) days.
.10 Activity Attributes to be included: Activity Number, Activity Description, Original Duration, Actual Duration, Baseline Start and Finish, Actual Start and Finish, Predecessor, and Successor.
.11 Identify the critical path(s).

.2 Submission:
  .1 Submit initial commissioning schedule to Owner and Consultant within sixty-five (65) Working Days after commence work date.
  .2 Submit schedule via e-mail as .pdf and native files.
  .3 Consultant will review format and content of initial commissioning schedule and request necessary changes, if any, within ten (10) Working Days after receipt.
  .4 If changes are required, resubmit finalized initial commissioning schedule within five (5) Working Days after return of review copy.
  .5 Submit updated commissioning schedule monthly (or as requested by the Consultant and Owner) to Owner and Consultant.

.6 The commissioning schedule submission is to include a Schedule Narrative indicating changes to actual and projected start and finish dates, activity relationships, critical path, float, and baseline comparison to current progress. The Schedule Narrative should include project risk items including but not limited to procurement, fabrication, deliveries, labour, change management, requests for information, etc.

.7 Commissioning schedule updates to include as a minimum:

.1 Data date to be identified.

.2 No dates shall be pushed by the data date.

.3 All activities that have not been completed by the data date are to be re-forecasted and updated in the schedule.

.4 All activities are to have predecessor(s) and successor(s) except for the first and last activity in the schedule and milestone activities.

.5 The project schedule logic is to be correctly linked to predecessor(s) and successor(s) in the order of build sequencing to properly identify the critical path(s) for the project.

.6 All completed activities to be identified as actualized. This includes start and finish dates.

.7 Identify the critical path(s).

.8 Approved changes that contain duration increases or decreases are to be incorporated into the schedule.

.9 Incorporate RFI's that impact the work.

1.5 SUBMITTALS SCHEDULE

.1 Format and Content:

.1 Prepare schedule identifying all required Shop Drawing, Product data, and sample submissions, including samples required for testing.

.2 Prepare schedule in electronic format as identified in Section 01320A.

.3 Provide a separate line for each required submittal, organized by Specifications section names and numbers, and further broken down by individual products and systems as required.

.4 For each required submittal, show planned earliest date for initial submittal and latest date for return of reviewed submittal without causing delay.

.5 For each required submittal, show fabrication duration, order date, and planned delivery date.

.6 Allow time in schedule for resubmission of submittals, should resubmission be necessary.

.2 Submission:

.1 Submit initial schedule to Consultant within ten (10) Working Days after Contract award.

.2 Submit schedule via e-mail as .pdf and native files.

.3 Consultant will review format and content of initial schedule and request necessary changes, if any, within ten (10) Working Days after receipt.

.4 If changes are required, resubmit finalized schedule within five (5) Working Days after return of review copy.

.5 Submit updated submittals schedule bi-monthly to Owner and Consultant.

1.6 SCHEDULE MANAGEMENT

.1 A schedule submitted as specified and reviewed by Consultant shall become the baseline schedule and shall be used as the baseline for updates.

.2 At each regular progress meeting, review and discuss current construction progress and submittals schedules with Consultant and Owner, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path.

.3 Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

.4 The project substantial completion date may only be changed by contract change order.

.5 Time extensions presented by the Contractor in the monthly update of the construction schedule that is not approved by Change Order by the Owner is subject to the Contractor providing a mitigation plan to realign the project with the contract time for the Work. This includes but is not limited to all necessary efforts such as overtime, additional labour resources, transportation premiums, expedited fabrication for material/equipment, night work, and weekend work.

1.7 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS

.1 Obtain from Consultant an electronic copy of the construction Drawings for the purpose of creating as-built drawings. Record information in electronic form, clearly identifying as-built deviations from the originally obtained construction Drawings.

.2 Clearly label each drawing as “AS-BUILT DRAWING”. Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.3 Record actual construction including:

- .1 Measured depths of elements of foundation in relation to finish first floor datum.
- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by Change Orders and Supplemental Instructions
- .6 References to Shop Drawings, where Shop Drawings show more detail.

1.8 PROGRESS PHOTOGRAPHS AND VIDEOS

.1 Arrange for digital photography to document and provide a photographic record of the progress of the Work.

.2 Arrange for final photographs.

.3 Identify each photograph by project name and date taken.

.4 Submission: Submit .jpg format files in standard resolution via project file transfer (FTP) site weekly with application for payment. All items requested for payment shall be included.

.5 Do not use progress or any other Project photographs or videos for promotional purposes without Owner’s written consent.

END OF SECTION

Project:											
Contractor:											
Date:											
Contractor Submission No.	Rev. No.	Specification Section	Subsection	Description	Contractor Submission Date	Consultant Return Date	Status	Order Date	Fabrication Duration	Planned Delivery Date	Actual Delivery Date

1.1 SUBMITTAL REVIEW DEFINITIONS

.1 The following terms shall bear the noted meaning in relation to the review of submittals by the Consultant:

.1 Reviewed: Contractor need take no further action and may order the product(s) or equipment. The document is ready for inclusion in the Operation and Maintenance Manual (O&M).

.2 Reviewed as Noted (Resubmission Not Required): Contractor shall incorporate the comments marked on the "reviewed" submittal by the Consultant. The Contractor shall promptly notify the Consultant if any of the comments noted cannot be incorporated with an explanation. The Contractor may only order the product(s) or equipment using a clean updated copy of the submittal which incorporates all of the Consultant's comments, and the document may be incorporated into the O&M.

.3 Reviewed as Noted (Resubmission Required): Contractor shall incorporate the comments marked on the "reviewed" submittals by the Consultant and submit new copies of the submittals to show compliance with the Contract Documents. Contractor is not to order the product(s) or equipment until the Consultant returns the document "Reviewed" or "Reviewed as Noted (Resubmission Not Required).

.4 Revise and Resubmit: The submittal contains multiple errors and is not compliant with the Contract Documents. Contractor to submit new copies of the submittals revised to show compliance with the Contract Documents. The Contractor is not to order the product(s) or equipment until the Consultant returns the document "Reviewed" or "Reviewed as Noted (Resubmission Not Required).

1.2 ADMINISTRATIVE

.1 Submit to Consultant specified submittals listed for review. Submit promptly and in orderly sequence to not cause a delay in the Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time or for Product substitutions or other deviations from the Drawings and Specifications.

.2 The Contractor shall deliver submittals and review comment sheets to the Consultant by email or by an alternative electronic delivery method provided by Contractor. If the Contractor intends to use an alternative electronic delivery method, it shall be conditional upon approval of such alternative method by the Consultant (which may be withheld at the Consultant's discretion) and must include a method for promptly notifying the Consultant of new submittals by email.

.3 All submittals are to be accompanied by a Contractor transmittal summarizing the contents of the submittal.

.4 The Contractor is responsible for identifying the order of priority of submittals pending Consultant Review in order to prevent any delays related to ordering of products or equipment to meet the Contract Time.

.5 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.

.6 Present shop drawings, product data, and samples in SI Metric units.

.7 Verify field measurements and affected adjacent Work is coordinated.

.8 Submit shop drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada as required.

.9 Review submittals, provide verified field measurements where applicable, and affix Contractor's review stamp prior to submission to Consultant. The Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the Work and Contract Documents.

.10 Notify Consultant, in writing at time of submission, if the submittal is a deviation from the Contract Documents. If the submission has not been previously accepted by the Consultant as an approved deviation, then the document will be returned "Not Reviewed".

.11 Do not propose Substitutions or deviations from Contract Documents via Shop Drawing, Product data and sample submittals. Refer to Section 01250 Substitution Procedures.

.12 Reproduction of construction Drawings to serve as background for Shop Drawings is permitted. If construction Drawings are used for this purpose, remove references to Consultant.

.13 Keep one (1) reviewed copy or one (1) electronic copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Indicate Products, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work.

.2 Where Products attach or connect to other Products, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to Drawings, Specifications and other already reviewed Shop Drawings.

.3 Accompany submittals with a transmittal information including:
- .1 Date
- .2 Project title and number
- .3 Contractor's name and address
- .4 Identification of each submittal item and quantity
- .5 Specification Section
- .6 Location of equipment
- .7 Other pertinent data.

.4 Shop Drawing submittals shall include:
- .1 Date and revision dates
- .2 Project title and number
- .3 Name and address of:
  - .1 Subcontractor
  - .2 Supplier
  - .3 Manufacturer
- .4 Contractor's stamp, date, and signature of Contractor's authorized representative responsible for Shop Drawing review, indicating that each Shop Drawing has been reviewed for compliance with Contract Documents and, where applicable, that field measurements have been verified.
- .5 Details of appropriate portions of the Work as applicable:
  - .1 Fabrication
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details
  - .4 Capacities
  - .5 Performance characteristics

.6 Standards
.7 Operating weight
.8 Wiring diagrams
.9 Single line and schematic diagrams
.10 Equipment/Device Tag No., if applicable
.11 Relationships to other parts of the Work.

.5 Product data submittals shall include Safety Data Sheets (SDS) for all controlled Products.

.6 Submit manufacturers storage, installation, and start-up instructions with shop drawings.

.7 Submit electronic copy of Shop Drawings where specified in the technical Specifications.

.8 Submit electronic copy of Product data sheets or brochures where specified in the technical Specifications.

.9 Where a submittal includes information not applicable to the Work, clearly identify applicable information and strike out non-applicable information.

.10 Supplement standard information to include details applicable to Project.

.11 Do not proceed with any component of the Work nor provide Products without reviewed shop drawings being accepted and returned to the Contractor. Should Work commence, or Products be procured prior to Contractor's receipt of reviewed shop drawings, the Contractor shall be liable for all corrections and costs incurred.

.12 Allow 14 days for Consultant's review of each submittal and incorporate in submittals schedule specified in Section 01320 – Construction Progress Documentation. Allow additional seven (7) Working Days where Subconsultant or Commissioning Agent review is required.

.13 If upon Consultant's review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of Work may proceed.

.14 If upon Consultant's review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.

.15 Consultant's notations on submittals are intended to ensure compliance with Contract Documents and are not intended to constitute a change in the Work requiring change to the Contract Price or Contract Time. If Contractor considers any Consultant's notation to be a change in the Work, promptly notify Consultant.

.16 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the Work proceeds. Illustrate all revisions from previous submissions by highlighting or bubbling the changes. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.

1.4 SAMPLES

.1 Submit samples for Consultant's review in triplicate where specified in the technical Specifications. Label samples as to origin, Project name, and intended use.

.2 Deliver samples prepaid to Consultant's business address.

.3 Notify Consultant in writing, at time of submission, of any deviations in samples from requirements of Contract Documents.

.4 Where a required colour, pattern or texture has not been specified, submit full range of available Products.

.5 Consultant selection from samples is not intended to change Contract Price or Contract Time. If a selection would affect the Contract Price or Contract Time, notify Consultant in writing prior to proceeding with the Work.

.6 Resubmit samples as required by Consultant to comply with Contract Documents.

.7 Reviewed and accepted samples will establish the standard against which installed Work will be reviewed.

1.5 MOCK-UPS

.1 Erect mock-ups in accordance with Section 01430 - Quality Requirements.

END OF SECTION

PROJECT:	**DATE: ……**
	SHOP DRAWING NO: ……
CONTRACT NO:	**REVISION: ……**
JLR PROJECT NO:	**SPECIFICATION SECTION: ……**
	TAG NO: ……

GENERAL CONTRACTOR:	**SUBCONTRACTOR:**
……	……
Address:	**Address:**
……	……
……	……
……	……

EQUIPMENT I.D.: ……

DESCRIPTION: ……

INSTALLATION LOCATION: ……

MANUFACTURER: ……

MODEL: ……

LIST DEVIATIONS FROM SPECIFICATION:

……

……

……

……

Site installation requirements reviewed by Contractor: **YES** ☐ **NO** ☐

Related subcontractors advised:

Mechanical ☐

Electrical ☐

Controls and Instrumentation ☐

Other: …… ☐

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 The successful proponent shall provide the Owner and Consultant with a copy of their health and safety policy prior to execution of the contract. The Contractor shall execute the terms of the Contract in strict compliance with the requirements of the Occupational Health and Safety Act, R.S.O. 1990, c.O.1, as amended, (the "Act") and Ontario Regulation 213/91, as amended, (that regulates Construction Projects) and any other regulations as amended under the Act (the "Regulations") that may affect the performance of the Work, as the "Constructor" or "Employer," as defined by the Act, as the case may be.

Following the decision of “R. v. Greater Sudbury (City). 2023 SCC 28,” the Municipality will be taking a proactive approach in ensuring the proponent adheres to both their Health and Safety Policy and their obligations under the Occupational Health and Safety Act. This will include issuing of both verbal and written warnings, which will escalate to the issuing of a stop work order if critical issues are not resolved.

.2 Submit site-specific Health and Safety Plan within five (5) working days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include as applicable to the Work:

- .1 Company policy statements (Health and Safety, Environmental, Violence and Harassment, Alcohol, Tobacco and Other Drugs, etc.).
- .2 Project Team and role and responsibilities.
- .3 Emergency contact.
- .4 Identification of daily and weekly health and safety paperwork to be completed and submitted by the Contractor and Trade Contractors.
- .5 Visitor sign in protocol.
- .6 Enforcement of Health and Safety and Environmental.
- .7 Site orientation protocol and frequency.
- .8 Personal protective equipment requirements.
- .9 Fall protection plan.
- .10 First aid.
- .11 Accident and incident reporting requirements.
- .12 Emergency response plan including procedures and evacuation plan.
- .13 Pandemic response and operating plan.
- .14 Hospital information.
- .15 Designated substances.
- .16 Other.

.3 Submit one (1) electronic copy of Contractor's authorized representative's work site health and safety inspection reports to Consultant, Owner, and or authority having jurisdiction, as per their request.

.4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS SDS - Safety Data Sheets.

.7 Consultant and Owner review of Contractor’s site-specific Health and Safety plan should not be construed as approval and does not reduce the Contractor’s overall responsibility for construction Health and Safety.

1.2 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

.2 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.3 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:
- .1 Raw sewage, including equipment, piping and channels used to process and convey raw sewage.
- .2 Active equipment/processes.
- .3 High voltage electrical equipment.
- .4 Working from heights.
- .5 Process Chemicals.
- .6 Owner staff and other external personnel/vehicles required to facilitate operation of the plant.

1.4 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

.3 The Contractor is responsible to take every reasonable precaution to protect the health and safety of workers including hazards posed by infectious disease. The costs associated with providing health and safety documentation, policies, procedures, training, personal protective equipment, signage, handwashing stations, sanitizer, products and labour for increased sanitation cleaning and sterilization, products and labour for increased site or trailer cleaning and sterilization, including all other requirements are by the Contractor.

.4 The Contractor is responsible for the costs associated with tools, site supplies, office supplies, elevating platforms, trailers, etc. as needed to maintain social distancing requirements as mandated by all authorities having jurisdiction.

1.5 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.6 UNFORESEEN HAZARDS

.1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety Coordinator or Safety Officer and follow procedures in accordance with Acts and Regulations of Ontario having jurisdiction and advise Consultant verbally and in writing.

1.7 TREATMENT CHEMICALS AND VARIOUS OTHER POTENTIAL HAZARDS

.1 Be aware that various potential hazardous chemicals and materials are used in and are inherent to the sewage pumping and treatment process. In addition, various potential hazards such as sewage, methane gas, confined spaces, etc., will be present.

.2 Prior to commencing work on-site, the Contractor shall meet with the Owner to familiarize themselves with substances on-site, and location and requirements of WHMIS Data Sheets.

.3 The Contractor is responsible to determine all necessary precautions, establish its own safety plan, and train its workers.

1.8 HOT WORK PERMIT

.1 All contractors must have an established procedure in place requiring the issuance of a Hot Works Permit prior to engaging in any work involving open flames, sparks, or other activity that could cause combustion.

.2 Provide a copy of the Hot Works Permit procedures for the Consultant’s review.

1.9 HEALTH AND SAFETY COORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-coordinator. Health and Safety Co-coordinator must:

- .1 Have site-related working experience specific to activities associated with the Work.
- .2 Have working knowledge of occupational safety and health regulations.
- .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
- .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
- .5 Be on site during execution of Work and report directly to and be under direction of the site supervisor.

1.10 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Consultant.

1.11 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Owner.

.2 Provide Owner with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Owner may stop Work if non-compliance of health and safety regulations is not corrected.

1.12 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

END OF SECTION

1.1 REFERENCES

.1 Definitions:

.1 Approved/Authorized Recycling Facility: waste recycler approved by applicable provincial authority or other users of material for recycling approved by the Owner.

.2 Class III: non-hazardous waste - construction renovation and demolition waste.

.3 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition, and/or renovation activities.

.4 Inert Fill: inert waste - exclusively asphalt and concrete.

.5 Waste Source Separation Program (WSSP): implementation and coordination of ongoing activities to ensure designated waste materials will be sorted into pre-defined categories and sent for recycling and reuse, maximizing diversion and potential to reduce disposal costs.

.6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.8 Recycling: process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.10 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.11 Returning reusable items including pallets or unused products to vendors.

.12 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.13 Separate Condition: refers to waste sorted into individual types.

.14 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.

.15 Waste Audit (WA): detailed inventory of estimated quantities of waste materials that will be generated during construction, demolition, deconstruction and/or renovation. Involves quantifying by volume/weight amounts of materials and wastes that will be reused, recycled, or landfilled.

.16 Waste Diversion Report: detailed report of results, quantifying cumulative weights and percentages of waste materials reused, recycled, and landfilled over course of project. Measures success against Waste Reduction Workplan (WRW) goals and identifies lessons learned.

.17 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials generated by project. Specifies diversion goals, implementation and reporting procedures, anticipated results, and responsibilities. Waste Reduction Workplan information acquired from Waste Audit.

.2 Reference Standards:

.1 Ministry of the Environment, Conservation and Parks:

.1 Ontario Regulation 347 General Waste Management

.2 Ontario Regulation 102/94 Waste Audits and Waste Reduction Work Plans.

.3 Ontario Regulation 103/94 Industrial, Commercial, and Institutional Source Separation Programs for Northern Ontario

.4 Ontario Environmental Protection Act (EPA)

.5 Canadian Construction Association (CCA):

.1 CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.

1.2 WASTE MANAGEMENT GOALS

.1 Prior to start of Work, conduct a meeting with the Owner/Consultant to review and discuss the Owner/Consultant waste management goal and the Contractor's proposed Waste Reduction Workplan.

.2 Minimize amount of non-hazardous solid waste generated by project to accomplish maximum source reduction, reuse, and recycling of solid waste activities.

1.3 WASTE PROCESSING SITES

.1 Contractor is responsible to research and locate waste diversion resources and service providers. Salvaged materials are to be transported off site to approved and/or authorized recycling facilities or to users of material for recycling.

1.4 SALVAGED AND RECYCLED MATERIALS

.1 Store, materials to be reused, recycled, and salvaged in locations as directed by Owner.

.2 Protect, stockpile, store, and catalogue salvaged items.

.3 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.4 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.

.5 Materials reused on-site are diverted from landfill and as such are to be included in all reporting.

1.5 DISPOSAL OF WASTES

.1 Keep records of construction waste including:
- .1 Number and size of bins.
- .2 Waste type of each bin.
- .3 Total tonnage generated.
- .4 Tonnage reused or recycled.
- .5 Reused or recycled waste destination.

.2 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

.3 Do not bury rubbish and waste materials on-site.

.4 Do not dispose of waste or volatile materials, such as mineral spirits, oil, or paint thinner into waterways, storm, or sanitary sewers.

END OF SECTION

1.1 REFERENCE STANDARDS

.1 "Reference standards" means consensus standards, trade association standards, guides, and other publications expressly referenced in Contract Documents.

.2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However, if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.

.3 Reference standards establish minimum requirements. If Contract Documents call for requirements that differ from a referenced standard, the more stringent requirements shall govern.

.4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Consultant for clarification.

1.2 INDEPENDENT INSPECTION AND TESTING AGENCIES

.1 Except as otherwise specified, Owner will retain and pay for independent inspection and testing agencies to inspect, test, or perform other quality control reviews of parts of the Work.

.2 Retain and pay for inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.

.3 Inspection and testing services retained by the Owner excludes any inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.

.4 Employment of inspection and testing agencies by Contractor or Owner does not relieve Contractor from responsibility to perform the Work in accordance with Contract Documents.

.5 Allow and arrange for inspection and testing agencies to have access to the Work, including access to off site manufacturing and fabrication plants.

.6 For inspection and testing required by Contract Documents or by authorities having jurisdiction, provide Consultant and inspection and testing agencies forty-eight (48) hours minimum notice or as required to ensure timely notification in advance of required inspection and testing.

.7 Submit test samples required for testing in accordance with submittals schedule specified in Section 01320 Construction Progress Documentation.

.8 Provide labour, Construction Equipment, and temporary facilities to obtain and handle test samples on site.

1.3 INSPECTION AND TESTING AGENCY REPORTS

.1 For inspection and testing required by Contract Documents or by regulatory requirements, and performed by Contractor retained inspection and testing agencies, submit to Consultant copies of reports. Submit within seven (7) days after completion of inspection and testing.

.2 For inspection and testing performed by Owner retained inspection and testing agencies, copies of inspection and testing agency reports will be provided to Contractor.

1.4 MOCK-UPS

.1 Prepare mock-ups of Work as specified in the technical specification sections. If a mock-up location is not indicated in the Drawings or Specifications, locate where directed by Consultant. Issue Request for Information (RFI) to determine location.

.2 Modify mock-up as required until Consultant approval is obtained.

.3 Approved mock-ups establish an acceptable standard for the Work.

.4 Protect mock-ups from damage until the Work they represent is complete.

.5 Unless otherwise specified in the technical specification sections, approved mock-ups forming part of the Work may remain as part of the Work.

.6 Remove mock-ups only when the Work they represent is complete or when otherwise directed by Consultant.

END OF SECTION

1.1 TEMPORARY UTILITIES – GENERAL

.1 Provide temporary utilities as specified and as otherwise necessary to perform the Work expeditiously.

.2 Remove temporary utilities after use.

1.2 TEMPORARY WATER SUPPLY

.1 Arrange and pay for a temporary supply of water required during construction.

.2 Arrange and pay for necessary water supply connections and disconnections.

.3 The Contractor must provide an adequate supply of potable water for decontamination showers during asbestos removal if applicable.

.4 Provide, install and maintain temporary reduced pressure backflow preventer where connecting to the municipal water supply.

1.3 TEMPORARY HEATING AND VENTILATION

.1 Arrange and pay for temporary heating and ventilation required during construction.

.2 Vent construction heaters in enclosed spaces to the outside or use flameless type of construction heaters. Solid fuel salamanders are not permitted.

.3 Provide temporary heat for the Work as required to:

- .1 Facilitate progress of Work.
- .2 Protect the Work against dampness and cold.
- .3 Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored Products.
- .4 Maintain specified ambient temperatures and humidity levels for storage, installation and curing of Products.
- .5 After building is enclosed, maintain interior temperature of minimum 10 degrees C. Review technical sections and Manufacturer recommendations for more stringent interior minimum heating requirements.

.4 Provide temporary ventilation for the Work as required to:

- .1 Prevent accumulations of fumes, exhaust, vapours, gases or other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe work environment meeting applicable regulatory requirements.
- .2 Ensure that hazardous, noxious, or volatile substances do not migrate to Owner occupied spaces.
- .3 Ventilate temporary sanitary facilities.
- .4 Do not use permanent building heating and ventilation systems during construction.

1.4 TEMPORARY ELECTRICAL POWER AND LIGHTING

.1 Arrange and pay for temporary power and lighting required during construction.

.2 Arrange and pay for necessary connections and disconnections of temporary power and lighting in accordance with regulatory requirements.

1.5 FUEL SUPPLY

.1 Provide and pay for any temporary fuel required to accommodate testing.

1.6 TEMPORARY TELECOMMUNICATIONS

.1 Arrange and pay for temporary telecommunications as required during construction.

1.7 TEMPORARY BYPASS PUMPING

.1 This project is anticipated to require temporary bypass pumping system to facilitate the completion of the works.

.2 The temporary bypass pumping system is anticipated to be used to bypass raw sewage flow from existing MH 31 into the aeration lagoon. Contractor shall submit a temporary bypass pumping plan at least three (3) weeks in advance of the planned connections.

.3 Refer to Section 01810 for General Construction Sequence for the requirements.

END OF SECTION

1.1 CONSTRUCTION FACILITIES – GENERAL

.1 Provide temporary construction facilities as necessary for performance of the Work and in compliance with applicable regulatory requirements.

.2 Maintain temporary construction facilities in good condition for the duration of the Work.

.3 Remove temporary construction facilities from Place of the Work when no longer required.

1.2 SITE LOGISTICS PLAN

.1 Prepare a site logistics plan indicating proposed location and dimensions of area to be fenced including gate locations. The plan should include, but not be limited to, the Contractor, Subcontractor, and Consultant trailers, travel path of construction vehicles, parking lot, temporary sanitary facilities, garbage bins, security measures, crane location including swing radius, storage and laydown areas, temporary utilities, and all other relevant information to complete the plan. If the site logistics plan is subject to change during the project, provide phased site logistics plan with planned dates for site changes.

1.3 CONSTRUCTION PARKING

.1 Visitor and Consultant parking spaces to be provided. Allow for four (4) parking spaces.

1.4 CONTRACTOR LAYDOWN AREA

.1 The location of the Contractor’s construction facilities is limited to within the site boundary.

.2 Laydown areas and other construction facilities shall be prepared as per 02370 - Erosion and Sedimentation Control.

.3 Planned or unplanned relocation of construction facilities due to the Contractor’s or subcontractor’s construction activities shall be done at no additional cost to the Owner.

.4 Laydown area and other construction facilities shall not impede the Municipality’s operations of the facility

.5 Laydown area shall be restored to existing or better conditions, or as per the Contract Documents.

1.5 VEHICULAR ACCESS

.1 Provide and maintain adequate access to Place of the Work.

.2 Build and maintain temporary access roads as required or where indicated on Drawings.

.3 Existing roads at Place of the Work may be used for access to Place of the Work, provided Contractor assumes responsibility for any damage caused by construction traffic, and prevents or promptly cleans up any mud tracking or material spillage.

.4 Contractor shall not drive heavy vehicles and equipment around the existing aeration and facultative

lagoons berm. Approval from Owner and Consultant for temporary access around lagoon berm is required.

.5 For construction access to Arena Creek relocation, coordinate with Owner and Consultant prior to making plans. Generally, temporary construction equipment access can be granted from the neighboring industrial property to the north of the site.

.6 Maintain access to property including overhead clearances for use by emergency response vehicles.

.7 The Contractor shall ensure that access to site hydrants and fire access entrances are always maintained and free of obstruction.

.8 Due to the volume of construction that is anticipated and the ongoing facility operations, maintaining traffic flow into, around, and out of project site will be critical. Employ traffic control personnel and measures, as required, in order to ensure traffic always continues to flow safely through the project site.

.9 Provide signage and maintain competent, trained signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform the Work in a safe and controlled manner.

.10 The Contractor may not park, store, or operate equipment or material within the public right-of-way except for the work specifically indicated to take place within the right-of-way.

.11 The Contractor shall ensure that site deliveries necessary for the operation of the facility are not restricted by the Work and that facility vehicles always have site access. Always maintain access in order to permit these deliveries to take place.

.12 Construction deliveries are to be restricted to normal working hours and shall always be via the existing site entrance.

.13 The Contractor shall ensure that all vehicles used on-site are properly maintained, licensed, and insured.

1.6 SITE OFFICES

.1 Provide a temperature controlled and ventilated office, with suitable lighting, of sufficient size to accommodate Contractor’s Site Superintendent and construction staff.

.2 Consultant's Site Trailer:

- .1 Provide temporary office trailer for Consultant. Trailer to be new or in good condition.
- .2 Provide a 40’ x 10’ temporary office trailer with metal stairs, windows, and a minimum of one lockable door dependent on trailer size.
- .3 Insulate building and provide heating system to maintain 22 degrees C inside temperature at -20 degrees C outside temperature. Trailer to be skirted.
- .4 Trailer to be skirted.
- .5 Interior finishes to include acoustic ceiling tile or gypsum ceiling, paneled walls, and vinyl tile flooring.
- .6 Install electrical lighting system to provide min 750 lx using surface mounted, shielded commercial fixtures with 10 % upward light component.

.7 Provide private washroom facilities adjacent to office complete with flush or chemical type toilet, lavatory and mirror and maintain supply of paper towels and toilet tissue.

.8 Equip office with 1 x 2 m / 3’ x 6’ table, two (2) office chairs, 6 m / 20’ of shelving 300 mm / 12” wide, one (1) 3-drawer filing cabinet, one (1) plan rack and one (1) coat rack, shelf, paper towels, waste baskets, first aid kit, fire extinguisher, and water cooler.

.9 Provide a meeting room of sufficient size to hold meetings for up to 10 individuals. Supply a conference table and 10 chairs. Provide one phone line capable of conference calling. Supply and install a white board – minimum size of 4’ x 8’. This meeting room is for the Consultant’s sole use.

.10 All equipment provided will be new or like new in appearance and condition. Any equipment not meeting this requirement will be removed at Consultant’s instruction and replaced with satisfactory equipment.

.11 Provide water service to deliver and collect water bottles and to maintain water cooler. Cooler to be capable of producing both hot and cold water. Paper cup dispenser and cups to be provided.

.12 Maintain trailer in clean condition.

.13 Contractor to arrange and pay for installation and ongoing charges for:

- .1 High speed internet.
- .2 Telephone.
- .3 Printer/fax/scanner/copier machine with black and white and colour capability for 8 ½ x 11 inch and 11 x 17 inch paper. Comes with automatic document feeder, duplex printing/copying and standard tray configuration. Maintenance contract with provider to be included. All consumables including but not limited to paper, ink, and toner to be included.
- .4 Long-distance charges.

1.7 SANITARY FACILITIES

.1 Provide sanitary facilities for workers.

.2 Do not use permanent washroom facilities during construction.

.3 Keep sanitary facilities clean and fully stocked with the necessary supplies.

1.8 FIRE PROTECTION

.1 Provide and maintain temporary fire protection systems and equipment during construction.

1.9 SECURITY

.1 Where security has been reduced by work of the Contract, provide temporary means to maintain security.

END OF SECTION

1.1 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK

.1 Submit written request in advance of cutting, coring, or alteration which affects or is likely to affect:
- .1 Structural integrity of any element of the Work.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of any operational element.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or other contractors.
- .6 Warranty of Products affected.

.2 Include in request:
- .1 Identification of Project.
- .2 Location and description of affected work, including drawings or sketches as required.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed work, and Products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on work of Owner or other contractors.
- .7 Written permission of affected other contractors.
- .8 Scanning or ultrasound, radar, etc. dependent on thickness of concrete slab/wall, etc.
- .9 Post tension tendon – no magnetic scan; fibre optic.
- .10 Date and time work will be executed.

1.2 PRODUCTS

.1 Unless otherwise specified, when replacing existing or previously installed Products in the course of cutting and patching work, use replacement Products of the same quality or better as those being replaced.

.2 If an existing or previously installed Product must be replaced with a different Product, submit request for substitution in accordance with Section 01250 - Substitution Procedures.

1.3 PREPARATION

.1 Inspect existing conditions in accordance with Section 01710 - Examination and Preparation.

.2 Provide supports to ensure structural integrity of surroundings; provide devices and methods to protect other portions of the Work from damage. Design of all temporary supports to be sealed by a Professional Engineer, licenced in the province of Ontario.

.3 Provide protection from elements for areas that may be exposed by uncovering work.

1.4 EXISTING UTILITIES

.1 When breaking into or connecting to existing services' utilities, execute the Work at times directed by local governing authorities, with a minimum of disturbance to the Work, pedestrian and vehicular traffic, and ongoing Owner operations.

.2 Where the Work involves breaking into or connecting to existing services, give authority having jurisdiction, Owner, and Consultant 48 hours notice for necessary interruption of mechanical or electrical services.

.3 If Work requires a facility, system, or equipment to be isolated or shut down, submit an Isolation Request Form located in Section 01114. The Isolation Request Form is to be submitted a minimum of five (5) working days in advance of the Work. The Work is not to proceed until the Isolation Request Form is approved by the Consultant and Owner.

.4 Maintain excavations free of water.

.5 Keep duration of interruptions to a minimum.

.6 Carry out interruptions after regular working hours of occupants, preferably on weekends, unless Owner's prior written approval is obtained.

.7 Protect and maintain existing active services. Record location of services, including depth, on as-built drawings.

.8 Construct or erect barriers in accordance with Section 01560 - Temporary Barriers and Enclosures as required to protect pedestrian and vehicular traffic.

1.5 CUTTING, PATCHING, AND REMEDIAL WORK

.1 Coordinate and perform the Work to ensure that cutting and patching work is kept to a minimum.

.2 Perform cutting, fitting, patching, and remedial work including excavation and fill, to make the affected parts of the Work come together properly and complete the Work.

.3 Provide openings in non-structural elements of the Work for penetrations of mechanical and electrical work.

.4 Perform cutting by methods to avoid damage to other work

.5 Provide proper surfaces to receive patching, remedial work, and finishing.

.6 Perform cutting, patching, and remedial work using competent and qualified specialists familiar with the Products affected, in a manner that neither damages nor endangers the Work.

.7 Do not use pneumatic or impact tools without Consultant's prior approval.

.8 Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.

.9 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.

.10 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.

.11 Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

END OF SECTION

1.1 BARRIERS AND ENCLOSURES - GENERAL

.1 Provide temporary barriers and enclosures necessary to protect the public and building occupants and to secure Place of the Work during performance of the Work.

.2 Separate parts of the facility required to remain in use from parts of the plant under construction.

.1 Build suitable floor to ceiling lumber or metal stud framing, cover with polyethylene sheeting sealed with tape, and apply 9 mm minimum thick plywood. Seal all joints between plywood sheets and between plywood and adjacent materials with surface film forming type sealer, to create an airtight barrier.

.2 Provide access doors equipped with latches to ensure that access is maintained for plant operation, exiting, safety, and firefighting.

.3 Comply with applicable regulatory requirements.

.4 Maintain temporary barriers and enclosures in good condition for the duration of the Work.

.5 Remove temporary barriers and enclosures from Place of the Work when no longer required.

1.2 FENCING

.1 Erect temporary security and safety site fencing, minimum 3 m high, using self-supporting wire fence sections enclosing entire site. Maintain site fencing in good repair until removed.

.2 Provide lockable access gates as required to facilitate construction access.

1.3 WEATHER ENCLOSURES

.1 Provide weather tight enclosures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Provide weather enclosures to protect floor areas where walls are not finished and to enclose work areas that require temporary heating.

.3 Design weather enclosures to withstand wind pressure and snow loading requirements.

1.4 DUST TIGHT SCREENS AND PARTITIONS

.1 Provide dust tight polyethylene screens and wood stud with plywood partitions where required to localize interior building from dust and noise generating activities.

.2 Temporary partitions shall be constructed using metal studs and gypsum board construction to create two (2)-hour fire separation in areas where the construction area must be isolated from the remainder of the floor area.

.3 Erect, maintain and relocate screens and partitions as required to facilitate construction operations and Owners operational requirements.

1.5 FIRE ROUTES

.1 Maintain fire access routes, including overhead clearances, for use by emergency response vehicles.

1.6 PROTECTION OF BUILDING FINISHES

.1 Provide necessary temporary barriers and enclosures to protect existing and completed or partially completed finished surfaces from damage during performance of the Work.

END OF SECTION

1.1 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

.3 Debris: includes both combustible and non-combustible wastes, such as leaves and tree trimmings that result from construction or maintenance and repair work.

.4 Hazardous Materials: includes pesticides, biocides, and carcinogens, as listed by recognized authorities.

.5 Sediment: soil and other debris that has been eroded and transported by storm or well production runoff water.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review by Consultant.

.2 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.

.3 To comply with municipal, federal, and provincial policies, programs, and legislation.

.4 To comply with all requirements related to authority’s having jurisdiction.

.5 Environmental Protection Plan to include:

- .1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan.
- .2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from site.
- .3 Name(s) and qualifications of person(s) responsible for training site personnel.
- .4 Description of environmental protection personnel training program.
- .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements.
- .6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .7 Tree protection plan, including measure to protect trees not designated for removal in accordance with OPSD 220.010.
- .8 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Ensure plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.

.9 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Ensure plan includes measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.10 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.11 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.12 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site. To include measures for control of interior air pollution such as volatile organic compounds.

.13 Contaminant Prevention Plan: identifying potentially hazardous substances to be used on job site and the planned storage, handling, and actions to prevent the introduction of such materials into air, water, or ground.

.14 Waste Water Management Plan: identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

.15 Storm Water Pollution Prevention Plan (SWPPP).

.16 Historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.

1.3 FIRES

.1 Fires and burning of rubbish on-site not permitted.

1.4 EROSION AND SEDIMENT CONTROL

.1 Refer to Section 02370 Erosion and Sediment Control.

1.5 POLLUTION CONTROL

.1 Take measures to prevent contamination of soil, water, and atmosphere through uncontrolled discharge of noxious or toxic substances and other pollutants, potentially causing environmental damage.

.2 Be prepared, by maintaining appropriate materials, equipment, and trained personnel on site, to intercept, clean up, and dispose of spills or releases that may occur.

.3 Promptly report spills and releases that may occur to:

.1 authority having jurisdiction,

.2 person causing or having control of pollution source, if known, and

.3 Owner and Consultant.

.4 Contact manufacturer of pollutant, if known and applicable, to obtain Safety Data Sheets (SDS) and ascertain hazards involved and precautions and measures required in cleanup or mitigating actions.

.5 Take immediate action to contain and mitigate harmful effects of the spill or release.

1.6 DEWATERING

.1 Refer to Section 02140 Dewatering.

1.7 SITE DRAINAGE

.1 Maintain grades to ensure proper site drainage.

.2 Prevent surface water runoff from leaving the site.

.3 Prevent precipitation from infiltrating or from directly running off stockpiled materials. Cover stockpiled materials with an impermeable liner during periods of work stoppage including at end of each Working Day.

.4 Control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas as required to prevent erosion and sedimentation.

.5 Control surface drainage by ensuring that gutters are kept open and water is not directed across or over pavements or sidewalks, except through pipes or properly constructed troughs. Ensure that runoff from unfinished areas is intercepted and diverted to suitable outlets.

1.8 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and other plant material designated to remain on site and on adjacent properties where indicated on Drawings.

.2 Minimize stripping of topsoil and vegetation.

.3 No site clearing may commence until:
- .1 The Environmental Plan is approved by the Consultant.
- .2 All protective measures identified in the Environmental Plan have been installed or actioned.
- .3 A pre-site clearing meeting has been held with the Subcontractor responsible for the scope of work to review the approved plans. Meeting minutes to be taken and issued to the Subcontractor, Owner, and Consultant.

.4 Owner/Consultant has retained Cambium Inc. to undertake various natural heritage and impact assessment within the site boundary. These reports have been included in the Appendix and shall be reviewed by the Contractor during work planning.

.5 No tree removals may occur between April 15th and August 15th without a qualified biologist survey 72 hours prior to removals identifying if nesting birds are present. The biologist survey is to identify the species of bird and any related municipal and federal legislation that applies to the species and the actions of nest removal. No tree removals are to occur until the biologist report is submitted, reviewed, and recommended actions approved by the Consultant.

1.9 WORK ADJACENT TO WATERWAYS

.1 To comply with Ministry of the Environment, Conservation and Parks (MECP), municipal, provincial and federal by-laws, policies, and legislation including but not limited to:
- .1 Cutting of timber or timber management on Crown land.

.2 Construction of water crossing.
.3 Any activity on Crown land during the forest fire season.
.4 Construction near a body of water that could have a detrimental effect on fish habitat or water quality.
.5 Development and operation of a borrow pit or gravel pit.
.6 Road construction.
.7 Dam construction.

1.10 DUST AND PARTICULATE CONTROL

.1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.

.2 Execute Work by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.

.3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

.5 Use appropriate covers on trucks hauling fine, dusty, or loose materials Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.

1.11 NOISE CONTROL

.1 Noise By-laws:
  .1 All local noise by-laws must be recognized and adhered to.
    .1 Unless the Municipality provides the contractor a waiver, the Municipal Noise By-Law (#118-2017) shall be adhered to.
    .2 Construction works are only permitted during the times of 7:00am-9:00pm, Monday through Saturday.
    .3 Works are not permitted on Sundays or Statutory Holidays unless advance permission is obtained.

.2 Mufflers:
  .1 All vehicles and equipment shall be equipped with efficient muffling devices to minimize noise levels in the project site area.

.3 Noise Attenuation:
  .1 Where necessary, noise-attenuating devices (barriers) shall be placed around stationary pumps and compressors.

1.12 CONTAINMENT

.1 Provide full containment equal to no less than one hundred and twenty-five percent (125%) of maximum stored volume for all hazardous substances required on-site for construction. Maintain containment areas free of all surface water, ice, and snow.

.2 Store all hazardous materials subject to potential leakage in contained areas.

.3 Ensure that a minimum one hundred and twenty-five percent (125%) of maximum stored volume containment is always maintained for permanent or temporary treatment chemical storage.

1.13 EQUIPMENT FUELING, MAINTENANCE AND STORAGE

.1 All equipment refueling and maintenance shall be done on asphalt surfaces, or in lieu of asphalt surfaces, in areas that are fully contained and above the Ministry of Natural Resources or Conservation Authority designated flood elevation, as deemed suitable by the Consultant.

.2 Contractor is to prepare a spill response plan and maintain onsite the means for the interception and rapid cleanup and disposal of spillages on land and/or water that do occur. Any spills causing impairment to the natural environment must be reported to the local MECP District Office immediately.

.3 The emptying of fuel, lubricants, and pesticides into watercourses is prohibited. All construction debris must be contained and disposed of in an approved location.

.4 Construction equipment shall be cleaned prior to entering public roadways.

.5 Construction equipment shall not be cleaned where the debris can gain access to storm sewers or watercourses.

1.14 QUALITY CONTROL

.1 Consultant will notify Contractor in writing of observed noncompliance with municipal, federal, and provincial environmental laws or regulations, permits, and other elements of Contractor's approved plans.

.2 Contractor to stop work and provide proposed corrective action to Owner, Consultant, and Authority Having Jurisdiction within 24 hours of notice.

.3 Contractor to not implement corrective measures until receipt of written approval by Authority Having Jurisdiction.

END OF SECTION

1.1 GENERAL

.1 Provide Products that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by Consultant, furnish evidence as to type, source and quality of Products provided.

.2 Unless otherwise specified, maintain uniformity of manufacture for like items throughout.

.3 Permanent manufacturer's markings, labels, trademarks, and nameplates on Products are not acceptable in prominent locations, except where required by regulatory requirements or for operating instructions, or when located in mechanical or electrical rooms.

1.2 PRODUCT AVAILABILITY AND DELIVERY TIMES

.1 Promptly upon Contract award and periodically during construction, review and confirm Product availability and delivery times. Order Products in sufficient time to meet the construction progress schedule and the Contract Time.

.2 If a specified Product is no longer available, promptly notify Consultant. Consultant will act as required.

.3 If delivery delays are foreseeable, for any reason, promptly notify Consultant.

.1 If a delivery delay is beyond Contractor's control, Consultant will provide direction.

.2 If a delivery delay is caused by something that was, or is, within Contractor's control, Contractor shall propose actions to maintain the construction progress schedule for Consultant's review and acceptance.

1.3 PRODUCT OPTIONS

.1 Subject to the provisions of Section 01250 –Substitution Procedures:

.1 Wherever a Product or manufacturer is specified by a single proprietary name, provide the named Product only.

.2 Wherever more than one Product or manufacturer is specified by proprietary name for a single application, provide any one of the named Products.

.3 Wherever a Product is specified by reference to a standard only, provide any Product that meets or exceeds the specified standard. If requested by Consultant, submit information verifying that the proposed Product meets or exceeds the specified standard.

.4 Wherever a Product is specified by descriptive or performance requirements only, provide any Product that meets or exceeds the specified requirements. If requested by Consultant, submit information verifying that the proposed Product meets or exceeds the specified.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Store, handle and protect products during transportation to Place of Work and before, during, and after installation in a manner to prevent damage, adulteration, deterioration, and soiling.

.2 Comply with manufacturer's instructions for storage, handling, and protection.

.3 Store packaged or bundled products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in Work.

.4 Store products subject to damage from weather in weatherproof enclosures.

.5 Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of Safety Data Sheets (SDS).

.6 Store sheet products on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Remove and replace damaged products.

.8 Touch-up damaged factory finished surfaces to Consultant’s satisfaction. Use touch-up materials to match original. Do not paint over name plates.

END OF SECTION

1.1 SURVEYOR QUALIFICATIONS

.1 Engage a registered land surveyor, licensed to practice in Place of the Work.

1.2 SUBMITTALS

.1 Submit name and address of registered land surveyor performing survey work.

.2 Submit documentation to verify accuracy of field engineering work upon request of Consultant.

.3 Submit to Consultant the survey of the Work prepared and issued by a registered land surveyor on completion of the building footings and foundations, as required by authorities having jurisdiction and on completion of the Work.

1.3 SURVEY REFERENCE POINTS

.1 Locate and confirm permanent reference points prior to starting site work. Preserve and protect permanent reference points on site during construction.

.2 Do not change or relocate reference points without prior written notice to Consultant.

.3 Report to Consultant when a reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.

.4 Require registered land surveyor to replace reference points in accordance with original survey.

1.4 EXISTING UTILITIES AND STRUCTURES

.1 Before commencing excavation, drilling, or other earthwork, establish or confirm location and extent of all existing underground utilities and structures in work area.

.2 Promptly notify Consultant if underground utilities, structures, or their locations differ from those indicated in Contract Documents or in available project information. Consultant will provide appropriate direction.

.3 Where the Work involves breaking into or connecting to existing services or utilities, carry out the Work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.

.4 Submit schedule to and obtain approval from the Consultant for any shut-down or closure of active service. Adhere to approved schedule and provide notice to affected parties. Allow for forty-eight (48) hrs. to receive Owner approval for shut down or closure of active service.

.5 Be responsible to implement temporary measures to maintain normal facility operations if a utility or service is damaged by construction. Coordinate and be responsible for costs to repair damaged service.

.6 Record locations of maintained, re-routed and abandoned utility lines.

.7 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Consultant.

1.5 VERIFICATION OF EXISTING CONDITIONS

.1 Where work specified in any Section is dependent on the work of another Section or Sections having been properly completed, verify that work is complete and, in a condition, suitable to receive the subsequent work. Commencement of work of a Section that is dependent on the work of another Section or Sections having been properly completed, means acceptance of the existing conditions.

.2 Verify that ambient conditions are suitable before commencing the work of any Section and will remain suitable for as long as required for proper setting, curing, or drying of Products used.

.3 Ensure that substrate surfaces are clean, dimensionally stable, cured, and free of contaminants.

.4 Notify Consultant in writing of unacceptable conditions.

END OF SECTION

1.1 SUMMARY

.1 Except where otherwise specified in technical Specifications or otherwise indicated on Drawings, comply with requirements of this Section.

1.2 MANUFACTURER'S INSTRUCTIONS

.1 Install, erect, or apply Products in strict accordance with manufacturer's instructions.

.2 Notify Consultant, in writing, of conflicts between Contract Documents and manufacturer's instructions where, in Contractor's opinion, conformance with Contract Documents instead of the manufacturer's instructions may be detrimental to the Work or may jeopardize the manufacturer's warranty.

.3 Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.4 Provide manufacturer's representatives with access to the Work at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.3 CONCEALMENT

.1 Conceal pipes, ducts, and wiring in floors, walls and ceilings in finished areas:
- .1 after testing
- .2 after Contractor quality control and quality assurance inspection
- .3 after review by Consultant and authority having jurisdiction, and;
- .4 where locations differ from those shown on Drawings, after recording actual locations on as-built drawing.

.2 Provide incidental furring or other enclosures as required.

.3 Notify Consultant in writing of interferences before installation.

1.4 FASTENINGS – GENERAL

.1 Refer to Technical Sections for fastening requirements. Contractor to adhere to more stringent requirements.

.2 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.

.3 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.

.4 Use non-corrosive fasteners and anchors for securing exterior work and in spaces where high humidity levels are anticipated.

.5 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.

.6 Keep exposed fastenings to a minimum, space evenly and install neatly.

.7 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

1.5 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Bolts shall not project more than one diameter beyond nuts.

1.6 FIRE RATED ASSEMBLIES

.1 When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

1.7 LOCATION OF FIXTURES OUTLETS AND DEVICES

.1 Consider location of fixtures, outlets, and devices indicated on Drawings as approximate.

.2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.

.3 Promptly notify Consultant in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

1.8 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

.1 Adequately protect parts of the Work completed and in progress from any kind of damage.

.2 Promptly remove, replace, clean, or repair, as directed by Consultant, work damaged as a result of inadequate protection.

.3 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the safety or integrity of the Work.

1.9 REMEDIAL WORK

.1 Notify Consultant of, and perform remedial work required to, repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

END OF SECTION

1.1 REGULATORY REQUIREMENTS

.1 Comply with applicable regulatory requirements when disposing of waste materials.

.2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

.1 Provide adequate ventilation during use of volatile or noxious substances. Do not rely on building ventilation systems for this purpose.

.2 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.3 Prevent cross-contamination during the cleaning process.

.4 Notify the Consultant of the need for cleaning caused by Owner or other contractors.

1.3 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

.1 Maintain Work in a tidy and safe condition, free from accumulation of waste materials and construction debris.

.2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables.

.3 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each Working Day. Collect packaging materials for recycling or reuse.

.4 Remove waste materials and recyclables from Place of the Work weekly.

.5 Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.

.6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.

.7 Obtain permits from authorities having jurisdiction for disposal of waste and debris.

.8 Dispose of waste materials and debris off-site, in accordance with authorities having jurisdiction.

.9 Store volatile waste in covered metal containers and remove from premises at end of each working day.

.10 Clear snow and ice as required to facilitate the Work. This shall include snow removal, sanding, and de-icing activities. Transport snow from site to designated areas as per the requirements of local authorities having jurisdiction as needed.

1.4 FINAL CLEANING

.1 Before final cleaning, arrange a meeting at Place of the Work to determine the acceptable standard of cleaning. Ensure that Owner, Consultant, Contractor and cleaning company are in attendance.

.2 Remove from Place of the Work surplus Products, waste materials, recyclables, Temporary Work, and Construction Equipment not required to perform any remaining work.

.3 Provide professional cleaning by a qualified, established cleaning company.

.4 Lock or otherwise restrict access to each room or area after completing final cleaning in that area.

.5 Re-clean as necessary areas that have been accessed by Contractor's workers prior to Owner occupancy.

.6 Remove stains, spots, marks, and dirt from finished surfaces, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.

.7 Wax, seal, shampoo or prepare floor finishes as recommended by manufacturer.

.8 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and all other finished surfaces, including mechanical and electrical fixtures. Replace broken, scratched or otherwise damaged glass.

.9 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.

.10 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres and screens, etc.

.11 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.

.12 Remove waste material and debris from crawlspaces and other accessible concealed spaces.

.13 Remove stains, spots, marks, and dirt from exterior facades.

.14 Clean exterior and interior window glass and frames.

.15 Clean and sweep roofs, clear roof drains, clean gutters and downspouts, sunken wells.

.16 Power wash exterior sidewalks, steps, driveways, roads, parking lots, and other paved surfaces.

.17 Use leaf blowers to clean landscaped surfaces.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.

.2 Do not burn or bury waste materials at Place of the Work.

.3 Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from Place of the Work, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.

.4 Cover or wet down dry waste materials to prevent blowing dust and debris.

.5 Separate waste materials for reuse and recycling in accordance with Section 01355 - Waste Management and Disposal.

END OF SECTION

1.1 OPERATION AND MAINTENANCE MANUAL

.1 Prepare a comprehensive operation and maintenance manual, in the language of the Contract, using personnel qualified and experienced for this task.

.2 Submit an initial digital draft of the operation and maintenance manual six (6) weeks prior to application for Substantial Performance or prior to placing equipment into operation, for Consultant's review. If required by Consultant's review comments, revise manual contents and resubmit for Consultant's review. If required, repeat this process until Consultant accepts the draft manual in writing.

.3 Consultant acceptance and Owner receipt of the final version of the operation and maintenance manual is a requirement to apply for Substantial Performance.

.4 Submit final version to Owner in hard copy and electronic format. Provide 4 (four) hard copies and two (2) electronic copies on USB drives.

1.2 OPERATION AND MAINTENANCE MANUAL FORMAT

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, 75mm, three D-rings, loose leaf, 216 x 279 mm, with spine and face pockets. Binder content to be filled to 2/3 of the binder.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine. Provide separate binders for Division 15, 16, and 17.

.4 Cover: Identify each binder with typed title "Operation and Maintenance Manual", name of Project or Facility, name of Owner, contract name and number, and subject matter of contents. Handwritten or laser originals are unacceptable. Owner and Facility name to be in all caps. Facility name to have the largest and boldest print.

.5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.

.6 Provide mylar tabbed fly leaf for each separate Product or system, with typed description of Product and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide electronic copy of manual in PDF format.

.10 Provide electronic copy of Shop Drawings in manual as .pdf files and 1:1 scaled CAD files in .dwg format on USB flash drive.

1.3 OPERATION AND MAINTENANCE MANUAL – GENERAL CONTENT

.1 Table of contents for each volume.

.2 Introductory information including:
- .1 Date of manual submission.
- .2 Complete contact information for Consultant, subconsultants, other consultants, and Contractor, with names of responsible parties.
- .3 Schedule of Products and systems indexed to content of volume.

.3 For each Product or system, include complete contact information for Subcontractors, Suppliers and manufacturers, including local sources for supplies and replacement parts.

.4 Product Data: mark each sheet to clearly identify specific products, options, and component parts, and data applicable to installation. Delete or strike out inapplicable information. Supplement with additional information as required.

.5 Reviewed Shop Drawings.

.6 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.

.7 Warranties.

.8 Operating and maintenance procedures, incorporating manufacturer's operating and maintenance instructions, in a logical sequence.

.9 Training materials as specified in Section 01790 - Demonstration and Training.

1.4 OPERATION AND MAINTENANCE MANUAL - EQUIPMENT AND SYSTEMS CONTENT

.1 Each Item of Equipment and Each System: include description of unit or system and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance and/or engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include testing and balancing reports.

.15 Include additional content as specified in technical Specifications sections.

1.5 OPERATION AND MAINTENANCE MANUAL - PRODUCTS AND FINISHES CONTENT

.1 Include Product data, with catalogue number, options selected, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured Products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Include an outline of requirements for routine and special inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.

.4 Include additional content as specified in technical Specifications sections.

1.6 OPERATION AND MAINTENANCE MANUAL - WARRANTIES CONTENT

.1 Separate each warranty with index tab sheets keyed to Table of Contents listing.

.2 List each warrantor with complete contact information.

.3 Warranties are to be executed by warrantor. Co-execute submittals where applicable.

.4 Provide two (2) copies of each warranty.

.5 Verify that documents are in proper form and contain full information. Ensure that warranties are for the correct duration and are in Owner’s name.

.6 Include maintenance bond(s).

1.7 WARRANTY MANAGEMENT PLAN

.1 Develop and submit warranty management plan for Consultant approval.

.2 Warranty management plan information to include:

- .1 The role and responsibilities of personnel associated with warranty process including contact information.
- .2 A communication procedure for the Owner to notify the Contractor of construction warranty defects and assign a priority level for corrective action.
- .3 A monitoring and reporting process to log, schedule corrective action, and obtain acceptance of correction from Owner for each warranty item.
- .4 A procedure and status of tagging of equipment covered by extended warranties.
- .5 Provide list for each warranted equipment, item, feature of construction or system indicating:
  - .1 Name of item.
  - .2 Model and serial numbers.
  - .3 Location where installed.
  - .4 Organization, name and phone numbers of manufacturers or suppliers.
  - .5 Organization, names and phone numbers of persons to call for extended warranty service.
  - .6 Names, addresses and telephone numbers of sources of spare parts.
  - .7 Warranties and terms of warranty: include one (1) year warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
  - .8 Status of receipt of warranty submission.
  - .9 Warranty certificate number as applicable.
  - .10 Start date and duration of warranty period.
  - .11 Summary of maintenance procedures required to maintain warranty. Identify if copies of maintenance instructions are posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
  - .12 Cross-reference to specific pertinent Operation and Maintenance manuals.

.3 Thirty (30) days prior to expiry of the standard warranty period, Contractor is to schedule a joint warranty inspection to include the Owner and their representatives and the Consultant.

.4 Contractor to promptly coordinate with Owner, schedule, and correct all warranty items noted in warranty inspection.

1.8 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by Consultant.

.2 Attach tags with copper wire and spray with waterproof silicone coating.

.3 Do not fill out date of acceptance until project achieves occupancy.

.4 Indicate following information on tag:

- .1 Type of product/material.
- .2 Model number.
- .3 Serial number.
- .4 Contract number.

.5 Warranty period.
.6 Inspector's signature.
.7 Contractor name.

1.9 COMMISSIONING MANUAL

.1 Prepare a separate comprehensive commissioning manual, in the language of the Contract, using personnel qualified and experienced for this task documenting start-up reports, testing and commissioning activities, and performance testing.

.2 Submit draft format of the commissioning manual for Consultant's review. If required by Consultant's review comments, revise manual contents and resubmit for Consultant's review. If required, repeat this process until Consultant accepts the draft manual in writing.

.3 Submit the final commissioning manual two (2) weeks prior to application for Substantial Performance for Consultant's review. If required by Consultant's review comments, revise manual contents and resubmit for Consultant's review. If required, repeat this process until Consultant accepts the draft manual in writing.

.4 Format binders in a manner similar to the Operation and Maintenance Manual format.

.5 Commissioning Manual to include all paperwork related to equipment start up, equipment and material testing, commissioning documents, performance testing, and operator training records.

.6 Consultant acceptance and Owner receipt of the final version of the commissioning manual is a requirement to apply for [Substantial Performance] [Ready-for-Takeover].

.7 Submit final version to Owner in hard copy and electronic format. Provide 4 (four) hard copies. Provide two (2) electronic copies on USB drives.

1.10 CONTRACTOR'S AS-BUILT DRAWINGS

.1 Submit final as-built drawings in the form specified in Section 01320 – Construction Progress Documentation to Consultant.

1.11 FINAL SURVEY

.1 Submit final site survey certificate in accordance with Section 01710 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.12 PROGRESS PHOTOGRAPHS

.1 Consolidate and submit progress photographs on USB drive.

.2 Progress photographs on the USB drive to be organized by folder and date of submission.

1.13 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

.1 Supply spare parts, maintenance materials, and special tools in quantities specified in technical Specifications sections.

.2 Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed Products.

.3 Provide tags for spare parts and special tools identifying their function and associated Product.

.4 Deliver to and store items at the WWTS in a location as directed by Owner. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.

.5 Catalogue all items and submit to Consultant an inventory listing organized by Specifications section. Include Consultant reviewed inventory listing in operation and maintenance manual.

END OF SECTION

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate and provide training to Owner's personnel on operation and maintenance of equipment and systems two (2) weeks prior to scheduled date of Equipment Startup.

.2 Owner will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.

.3 Coordinate and schedule demonstration and training provided by Subcontractors and Suppliers.

.4 Attendance sheet to be provided by Contractor for training session. All Owner personnel to sign attendance sheet. Provide copy to Owner.

1.2 PREREQUISITES TO DEMONSTRATION AND TRAINING

.1 Testing, adjusting, and balancing has been performed in accordance with Contract Documents.

.2 Equipment and systems are fully operational.

.3 Copy of completed operation and maintenance manual is available for use in demonstration and training.

.4 Conditions for demonstration and training comply with requirements specified in technical Specifications.

1.3 SUBMITTALS

.1 Submit schedule of time and date for demonstration of each item of equipment and each system thirty (30) Working Days prior to designated dates, for Owner approval. Training schedule to allow for and accommodate Owner's staff availability.

.2 Provide training plan for each Manufacturer training session containing the following minimum information:

- .1 Title and objectives.
- .2 Recommended attendees (e.g., Managers, Engineers, Operators, Facility Maintenance, etc.)
- .3 Course description and syllabus.
- .4 Training materials and equipment requirements.
- .5 Resumes of Manufacturer representatives providing the training.

.3 Provide copies of completed operation and maintenance manuals and training materials for use in demonstrations and instructions.

.4 Provide attendance sheet identifying the time and date of each demonstration and list of persons present.

.5 Provide training certificates after each training session for each attendee.

.6 Submit a Training Manual including training materials, reports, and operator training certificates within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

1.4 DEMONSTRATION AND TRAINING

.1 Demonstrate start up, operation, control, adjustment, troubleshooting, servicing, and maintenance of each item of equipment and system.

.2 Identify acceptable tolerances for system adjustments in all operating modes.

.3 Provide procedures for dealing with abnormal conditions and emergency situations for which there is a specified system response.

.4 Complete specific equipment training as prescribed in technical specification sections. Training to include classroom and field training, including troubleshooting and operation of equipment under non-typical operating conditions.

.5 Allow for each training session to be completed two (2) times to accommodate multiple staff shifts.

.6 Allow for multiple trips to conduct training.

.7 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.

.8 Review operation and maintenance manual in detail to explain all aspects of operation and maintenance.

.9 Prepare and insert additional information in operation and maintenance manual if required.

END OF SECTION

1.1 INTENT OF SECTION

.1 This Section provides the basis for the development of construction sequencing and identifies scheduling and plant operational constraints that must be taken into account by the Contractor when performing the work.

.2 Alternative sequencing and methods proposed by the Contractor will be considered subject to approval of the Owner and the Consultant and provided that ongoing plant operation can be maintained continuously at all times.

.3 All affected parties will be involved in reviewing and optimizing the overall Construction Sequence with a view of facilitating construction in an efficient, safe, coordinated, and timely fashion that maintains operation of all existing systems throughout. The Contractor shall however be solely responsible for the overall coordination and sequencing of all construction activities in accordance with the Contract requirements and subject to the Consultant's review and approval.

1.2 GENERAL OUTLINE OF PROCEDURES

.1 The following general construction sequence is intended to identify potential constraints to the construction schedule, in order that risks to the existing facility and building support systems are reduced and that the existing performance is maintained during the entire construction and commissioning period. The intent of this section is not to identify every constraint that will potentially affect the Contractor's flow of work.

.2 Construct all new works in a manner that minimizes interference with existing processes.

.3 Modifications can proceed with controlled interference to the operation of the existing facility. Flows will continue through the existing facility while proposed new works are under construction. Bringing new works into operation will affect certain operational procedures and these must be discussed with and approved by the Owner and Consultant before proceeding.

.4 Contractor supplied backup equipment is to be available at all times, unless risk of non-availability has been properly assessed and has been accepted in writing by the Owner and the Consultant. Verify backup equipment operation prior to proceeding with related shutdowns. Documented contingency plans must be in place prior to any operations that may affect existing systems.

.5 Contractor shall ensure standby power is available continuously. Interruptions to standby power availability to new or existing process equipment of very short durations (e.g., less than one hour) may be permitted, but only under specified conditions and prior approval from the Owner and Consultant.

.6 Maintain automatic monitoring and alarm systems during off-hours, or provide on-site, competent off-hours supervision.

1.3 RESPONSIBILITIES

.1 Operations staff will only take over responsibility for operating new equipment and systems that have been properly and successfully started up, tested, commissioned and trial operated, including operator training, and accepted in writing by the Consultant and Owner.

.2 Reliance on and acceptance of responsibility for new automatic controls by Owner will occur only after the system is properly and fully commissioned (refer to Section 01021 – Testing, Commissioning, and Trial Operation).

.3 Contractor is to maintain all new equipment in accordance with the manufacturer's latest written instructions until Substantial Performance. Contractor must keep a maintenance log indicating when required maintenance has been completed. Breakdowns of new equipment followed by failure of backup equipment due to faulty installation or lack of due diligence, resulting in spills or unacceptable sewer backup and/or sewage bypassing before Substantial Performance, will be the Contractor's responsibility.

1.4 COORDINATING CONSTRUCTION WITH OPERATION OF EXISTING FACILITIES

.1 Closely coordinate all activities on site and in the existing buildings including pipe connections, building connections, electrical connections, and all other interfaces with existing infrastructure with Owner and/or designated representative.

.2 Recognize that the existing facility operates 24 hours per day, seven days per week, 365 days per year. In the event of conflict between construction operations and routine facility operations, facility operations shall always have priority. Avoid interfering with routine facility operations and maintenance. Reschedule construction activities, if required, at no change in Contract price.

1.5 SCHEDULING

.1 Contractor to prepare a preliminary schedule of activity that could have an impact on the existing plant processes and building systems. Note that this scheduling requirement is in addition to requirements outlined in Section 01320 – Construction Progress Documentation.

.2 The 4-week rolling schedule is to be updated weekly and include a detailed schedule of activities for the four (4) weeks following.

.3 During critical activities, meet each day prior to commencing work to review the day's scheduled activities.

.4 Identify temporary shutdowns or requested operational changes a minimum of thirty (30) days in advance. Fourteen (14) days before the intended shutdown or operational change, define a specific date. Confirm the date and time 72 hours in advance. Owner will review the proposed temporary shutdown or operational change.

.5 For each temporary shutdown, or requested operational change, provide a written plan identifying:

- .1 Length of shutdown.
- .2 Manpower assignment and contact list.
- .3 Material and equipment resources required.
- .4 Contingency plans for equipment or component failure.
- .5 Contingency plans for foreseeable conditions such as power failure, component failure, higher or lower than expected process variables.
- .6 List of all related items to be completed prior to proceeding with the shutdown or process disruption.

.6 Review plan with Owner and Consultant and incorporate comments and required changes.

.7 Prior to commencing work, review plan and inform Consultant and Owner that all required resources are available. Submit plan as noted in Article 1.5.4 to allow sufficient time for Owner to submit to MECP for review, where there is a risk that facility performance may be impaired.

1.6 NORMAL PLANT DELIVERIES AND ACCESS

.1 Contractor to maintain Owner's access to existing facilities at all times.

.2 Periodic delivery of materials and equipment and/or regular maintenance activities may take place over the duration of the Contract. The Contractor will cooperate with operations staff in facilitating access for these deliveries.

1.7 EXISTING FACILITIES

.1 Existing isolation valves and gates may be considered for use by the Contractor to isolate sections of the works.

.2 Owner provides no guarantee that existing equipment is adequate for tight shutoff or suitable for health and safety requirements. The Contractor is to provide additional devices such as blind flanges, sandbagging, etc., as necessary to complete the work.

.3 All valves, gates, etc., are to be operated by Owner staff in cooperation with the Contractor. Both the Contractor and Owner are to provide separate lock out devices on actuators, disconnects, etc. Provide written notice to Owner prior to requesting opening/closing valves or installing/removing gates.

1.8 OFF-HOURS SUPERVISION

.1 The facility is attended by operations staff Mondays to Fridays, from 8:00 a.m. to 4:00 p.m. The facility is generally unattended on weekends and holidays, but operations staff may visit the site if required due to normal or emergency operations.

.2 Essential existing equipment functions are monitored and alarmed. Operations staff respond to alarms.

.3 Existing annunciator and alarm system is to be maintained at all times. Temporary similar systems may be used where acceptable to Owner and Consultant.

.4 Prior to putting new equipment or systems into service, connect, verify and demonstrate to Owner and the Consultant remote alarming/annunciation to the SCADA system, following all required procedures for acceptance of demonstration.

.5 Following disruption of existing systems and/or equipment, re-verify that alarms and monitoring devices are functioning correctly, following all required procedures for re-verification acceptance.

.6 Where critical functions are not monitored to the satisfaction of the Owner, provide competent supervision until such time that work and controls, and monitoring are complete.

.7 Contractor to have senior staff on-call to respond immediately during critical shutdowns or initial operation of equipment where there is a risk to facility operations.

1.9 TEMPORARY ELECTRICAL SERVICES

.1 Refer to Section 01510 – Temporary Utilities for additional information.

.2 In order to provide temporary power required during construction, the Contractor shall provide their own temporary power and will be responsible for all permits that may apply. Contractor shall prepare a temporary power plan and submit a copy to the Consultant for review and approval. Contractor to coordinate with the local Utility, as required, for construction power.

1.10 GENERAL CONSTRUCTION SEQUENCE

.1 The following construction sequence information is not intended to provide a complete and exhaustive list of the tasks to be undertaken to complete the works, but rather is intended to offer some suggestions on how the work could proceed and to assist the Contractor in understanding the complexity of the overall project. Other variations and options are likely available and can be suggested by the Contractor in order to expedite schedule, reduce costs, minimize disruption, reduce risk, etc. It is, however, paramount that the existing plant and all associated building systems remain in operation throughout all of the construction period or until such a time as replacement systems are in place and commissioned and with an appropriate amount of continued redundancy.

.2 The General Construction Sequence may not outline the specific equipment testing, commissioning, and operator training requirements. Refer to Section 01021 – Equipment Testing Commissioning and Operator Training for related requirements.

.3 Unless noted elsewhere, Contractor to provide all temporary services required, including but not limited to diversion pumping, ventilation, power, fibre, programming and automation, as may be required to facilitate the Work. The following sequence and constraints does not include all temporary work that may be required.

.4 Possible Sequence (other options can be suggested by the Contractor):

- .1 The existing aerated lagoon and facultative lagoon shall remain in operation while the new mechanical treatment plant and its associated buildings are being constructed.
- .2 Prior to the start of construction of the new plant, the following steps should be considered:
  - .1 Construct the new gravity overflow pipe from as close to MH 02 as possible, without interfering existing gravity pipe, along MH03, MH05 to MH 18. This pipe can be used as temporary bypass.
  - .2 Bypass raw sewage out of existing MH 31 into aeration lagoon.
  - .3 Complete installation and tie-in at MH 02 and MH 31. Block raw sewage feed into the influent pumping station. Block inlet pipe into aeration lagoon. Install MH 18 and make connection to existing lagoon influent pipe. Allow raw sewage flow to go around the new plant.
- .3 Construct new raw sewage pumping station, headworks, grit channels, aeration tanks, secondary clarifiers, process building, UV disinfection building.
- .4 Construct new outfall sewer to connect the UV Disinfection effluent to the existing facultative lagoon outfall chamber prior to the new plant being commissioned.
- .5 The existing building will be powered from the new plant. Construct new poles, trenches, wires to connect existing building to the new plant. Once electrical is commissioned at the new plant, shut down and demolish related electrical services in the existing building.
- .6 Seed the extended aeration plant using sludge from existing aeration lagoon or elsewhere. Contractor shall work with the Owner, Consultant and Operator to develop the biological commissioning plan, in accordance with requirements with Specification 01021.

.7 WAS storage lagoon (previously aeration lagoon) draining shall not occur until after new mechanical plant is operational. The liquid in WAS lagoon and facultative lagoon shall be pumped back to MH 02 (flow paced) to receive treatment after new plant is commissioned.

.8 Construct the newly converted equalization lagoon (previously facultative lagoon) return pipe and decant structure/pipe into the decant pump station. Commission the decant pump station.

.9 MH 19 may be constructed at the same time as the decant pump station.

.10 Arena Creek Relocation shall not commence earlier than summer 2026, outside of the natural heritage permitting windows.

.11 Existing lagoon de-sludging is not required. However, localized sludge relocation may be necessary to facilitate construction. Sludge can be relocated within the existing lagoon cells.

1.11 TIE-INS AND DIVERSION PUMPING

.1 Construction of the works will include a number of process and electrical tie-ins. Operations staff will need to be consulted a minimum of 30 days in advance of any intended tie-ins and/or shutdowns, unless noted elsewhere herein. Contractor to provide estimated time required for any shutdowns and abide by all operator instructions regarding duration and timing of shutdowns.

.2 Temporary diversion pumping may be required during the following operating scenarios. Contractor to consider other scenarios where bypass pumping is deemed necessary to execute the Work.

.1 To facilitate construction of the temporary sanitary bypass pipe from influent manhole to aeration lagoon, temporary bypass pumping is required from existing MH31 to aeration lagoon. Provide sufficient pumping capacity to accommodate a range of flows.

.2 The plant influent flows vary significantly throughout the year, with the highest flow generally occurring in March and April. Contractor shall select pump sizes based on when bypass pumping will occur and submit a bypass pumping plan for approval by Consultant and Owner.

.3 The range of flow for the temporary bypass pumping station, based on plant historic flow data, is as follows:

	Average Day Flow (m3/d)	**Peak Monthly Flow (m3/d)**	**Peak Instantaneous Flow (m3/d)**
January	3583	8533	16842
February	3519	7601	16539
March	4020	8352	18892
April	4466	8953	20989
May	3253	6672	15289
June	2604	4347	12240
July	2750	7158	12925
August	2487	6009	11689
September	2075	3237	9751
October	1885	4058	8860
November	1960	3193	9214
December	2885	8659	13558

.3 Contractor to submit a plan for proposed flow management. This plan shall be submitted at least three weeks in advance on the planned connections. Contractor to consider completing work in dry weather and after hours to reduce volume of flow to be managed. Contractor to consider use of bypass pumps, vacuum truck or other methods for flow management.

END OF SECTION

PART 1 - GENERAL

1.1 SETTING OUT

.1 Be responsible for vertical and horizontal control by setting centrelines, batter boards and grade pickets from reference points and benchmarks provided by Consultant. Employ a qualified surveyor to set out and confirm grid lines, elevations, levels, squareness, etc.

1.2 SURVEY PINS

.1 Have property markers, iron pins and square iron bars, disturbed or lost in the course of construction replaced by an Ontario Land Surveyor at no cost to the Owner.

1.3 MINOR LOCATION CHANGES

.1 The Consultant, at their discretion, may direct or approve minor changes requested by Contractor in route or location of new utilities or structures during construction. However, any such change in location shall not be considered as a basis for a claim for extra compensation regardless of reason for changing location.

1.4 EXISTING UTILITIES

.1 Assume full responsibility for protection of known under and above ground utilities, such as water, sewer and gas mains and house connections, hydro and telephone poles, wires and conduits, whether or not they are shown on the plans. Where depth or location of any of these utilities has been shown on the plans, such information is not guaranteed. The Contractor shall be responsible for location of all utilities. All utilities are not necessarily shown on Contract Drawings.

.2 Items encountered below grade not shown on Contract Drawings shall be immediately brought to the attention of the Consultant and/or the Owner.

1.5 OBSTRUCTIONS

.1 Obtain direction from the Owner of utility before exposing, moving or supporting utilities.

.2 Exercise proper caution in excavation and repair and make good at own expense any and all damage done to existing services, provided their location has been shown or staked out substantially correctly.

.3 No payment shall be made for additional work or delays resulting from the presence of structures including pipes, conduits, poles and overhead wires that are known to exist but do not require permanent realignment or relocation, although they may require temporary relocation, support or protection.

.4 No extra compensation shall be made for crossing under or over existing mains or services known to exist that do not require realignment.

1.6 DUST AND DIRT CONTROL

.1 When so requested by Consultant, scrape on-site roads and off-site roadways leading to site clean of earth tracked by construction traffic and hose down. Refer to Section 02370 - Erosion and Sedimentation Control.

1.7 MAINTENANCE OF TRAFFIC

.1 Maintain traffic thoroughfares on construction site including access and route to site.

.2 Bridge open excavations where necessary to maintain traffic on roads and driveways and provide every facility for pedestrian traffic across and around the excavations.

.3 Maintain traffic on public roadways at all times unless Municipality's permission is obtained to close a road. Notify Police and Fire Department of blockage and detour roads prior to closing road.

.4 All traffic control shall be provided in accordance with Book 7 of the Ontario Highway Traffic Manual. Traffic plan shall be provided to the Consultant and Owner for approval prior to any work commencing on municipal roads.

.5 Refer to Division 1 for Construction Facilities and Temporary Controls.

1.8 OPSD AND OPSS

.1 Various Ontario Provincial Standards (OPSD) and Ontario Provincial Specifications (OPSS.MUNI) form part of this Contract but are not reproduced herein. The Contractor shall obtain and have a copy of these Drawings and Specifications available on-site for execution of the Work.

.2 All references to measurement for payment in the OPSD and OPSS.MUNI documents do not apply to this Contract.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE.

.1 Not Applicable.

PART 3 - EXECUTION

3.1 NOT APPLICABLE

.1 Not Applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

.1 Comply with all requirements of applicable Construction Safety Act and Occupational Health and Safety Act.

.2 Comply with all requirements of the Ontario Provincial Standard Specifications, Sections 510 and 902.

.3 Visit and examine the site and note all characteristics and features affecting the Work.

.4 Prior to demolition, clearly mark equipment, piping, wiring to be removed and review with Owner and Consultant prior to proceeding with work. Demolish existing services and/or equipment to be made obsolete by new installation. Remove associated piping back to mains. Remove all anchors, bolts, etc. and make good on all concrete repairs.

1.2 PROTECTION OF EXISTING CONSTRUCTION AND OPERATIONS

.1 Take all available measures to protect the existing construction, finishes, etc. Make good all damage to existing construction to the satisfaction of the Consultant at no cost to the Owner.

.2 Do not interfere with use of adjacent properties and roadway.

1.3 PROTECTION OF EXISTING OPERATIONS

.1 Complete demolition in a manner that does not disrupt the Owner’s existing operations and in-service infrastructure.

.2 Protect process equipment and tankage from damage due to demolition. Take all necessary precautions to ensure debris does not enter process tankage or impact process equipment.

1.4 CLEANOUT

.1 Unless indicated otherwise, the Contractor is responsible to flush all material from piping systems and drain. Piping to be abandoned in place is to be capped and/or sealed. Piping to be demolished is not to be removed until flushed and cleaned.

1.5 DESIGNATED SUBSTANCES

.1 Refer to Division 1.

1.6 DEMOLITION

.1 Carry out demolition in an orderly and careful manner.

.2 Carry out demolition in accordance with municipal, local, provincial authorities and the O.P.S.S.

.3 Keep work wetted down to prevent dust.

.4 Refer to contract drawings and related specification sections for demolition work.

.5 The Contractor must submit a demolition plan clearly showing sequencing, method of demolition, temporary supports, etc. All drawings for structural elements must bear the signature and stamp of a Professional Engineer licensed in the Province of Ontario.

.6 Only non-explosive demolition techniques are permitted.

1.7 CLEAN-UP

.1 Except as noted on drawings, demolished materials become the property of the Contractor. Remove from site and dispose of as per Division 1.

.2 Upon completion, fully clear and clean the grounds to pre-construction condition and make good all damage.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

.1 Not Applicable.

PART 3 - EXECUTION

3.1 NOT APPLICABLE

.1 Not Applicable.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements.

.2 Section includes:

.1 Control of groundwater and surface runoff.

.2 Pumping, handling, water quality clarification, and discharge of drainage water from construction site.

.3 Coordinating dewatering work with requirements of other trades and units of work affected by dewatering operations.

.4 Design, labour, products, equipment and services necessary for dewatering Work in accordance with the Contract Documents.

1.2 REFERENCES

.1 Ontario Provincial Standard Specifications

.1 OPSS 517 – Construction Specifications for Dewatering for Excavations.

1.3 DEFINITIONS

.1 Subgrade:

.1 Surface to which excavations are made for the purpose of construction of the Work in accordance with the Contract Documents. Subgrade as defined does not include additional depths of excavation that may be required or ordered to obtain suitable foundation conditions.

1.4 SYSTEM DESCRIPTION

.1 Design and Performance Requirements:

.1 The Contractor shall retain a Professional Hydrogeologist and/or Geotechnical Engineer licensed in the Province of Ontario to design, prepare and oversee the construction and operation of a suitable dewatering system to control ground water and surface run-off on the site to allow for efficient and safe installation of the permanent Works (as necessary to complete the work). Cambium Inc. is precluded from being retained by the Contractor.

.2 The Contractor and Contractor's Hydrogeologist and/or Geotechnical Engineer are to review the Geotechnical Investigation Report (Cambium Inc., December 18, 2024), the Hydrogeological Assessment Report (Cambium Inc., March 7, 2025).

.3 The Contractor's Hydrogeologist and/or Geotechnical Engineer shall take full responsibility for the review and interpretation of the factual results of the available Technical Reports and shall determine if any further investigative work is required to prepare a suitable dewatering system. Additional investigation shall beat the Contractor's expense.

.4 Consider the lateral tracking of groundwater underneath existing structures.

.5 Select and design dewatering system to control groundwater flows to allow construction to proceed under substantially dry subgrade conditions.

.6 Design dewatering system so that settlement is not caused by extraction of fine particles from soil during dewatering. Demonstrate to acceptance of consultant that discharge to surface water meets the required regulations (i.e. Provincial Water Quality Objectives, etc.).

.7 Coordinate the Dewatering Program with the requirements of Section 02315 – Excavation, Trenching and Backfilling, which may include the design and construction of excavation shoring systems, excavation strategies, and backfilling operations. Consider challenges of control of water at the soil-rock interface, where applicable.

.8 Prevent any surface run-off from entering excavations. Construct ditches, berms, extended shaft sheeting, or collar and similar items or other means, as required, to divert water away from excavations. Do not allow silt laden runoff water to enter watercourses or treatment facility. Direct runoff flows to siltation ponds or catchment areas before discharging.

.9 Maintain groundwater level at a minimum depth below subgrade level as directed by the Contractor's Hydrogeologist and/or Geotechnical Engineer, to permit placing geotextiles, underdrains, concrete mud mat, Granular Engineered Fill, concrete, and similar items on firm, dry, undisturbed subgrade.

.10 Maintain groundwater at required levels until:

.1 Structure is completely built where designed self-weight of structure resists the buoyancy forces.

.2 Leakage testing is successfully completed for liquid retaining structures, in accordance with applicable specifications and to the satisfaction of the Consultant.

.3 Backfilling to final grade is complete.

.4 Underdrains and other permanent devices which protect the structures against buoyancy are operational.

.11 Prevent destabilization, heaving, or shear failure of the sides and bottom of excavation.

.12 Prevent damage to or displacement of structures from groundwater pressures.

.13 Obtain Consultant's written consent prior to allowing a rise in groundwater level or prior to shutting down of a dewatering operation.

.14 Repair or replace any structure or Works damaged due to dewatering at no expense to the Owner.

.15 Supply standby equipment and power to ensure no disruption to dewatering operations.

.16 Electrically operate equipment, except standby power equipment, to minimize noise impact on adjacent properties.

.2 Dewatering Discharge Requirements:

.1 Discharge water must comply with the MECP PTTW/EASR prior to release.

.2 Contractor to determine any requirement for additional treatment prior to discharge.

.3 Have dewatering systems, including discharge and abandonment, comply with requirements of Ontario Water Resources Act (OWRA) and other relevant legislation.

.4 The Contractor shall be responsible for monitoring all construction dewatering activities and complying with all MECP PTTW/EASR requirements.

.5 The Contractor shall comply with the applicable Fisheries Timing Windows where no in-stream works or discharging to the creek shall be conducted outside of the approved window.

.6 Under no circumstances is the dewatering discharge to be directed to the sanitary sewer system or WWTS.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Dewatering Program:

.1 The Contractor's Hydrogeologist and/or Geotechnical Engineer shall be responsible for the preparation of the Dewatering Program which will be submitted in the form of a Plan document.

.2 The Dewatering Program must be stamped by a Professional Engineer and/or Hydrogeologist licenced in the province of Ontario.

.3 The Dewatering Program must outline location and dimensions of the Contractor's proposed pre-treatment measures, such as fractionation tanks, dewatering bags, settling basins, or other treatment facilities to remove suspended solids before discharging to municipal storm sewers, watercourses, or drainage areas.

.4 The Dewatering Program must include a proposed layout of the pre-treatment measures, as well as a maintenance schedule.

.5 Demonstrate to acceptance of Consultant that dewatering system is functioning in accordance with design requirements in advance of excavation.

.6 The Dewatering Program must include a contingency plan that will be implemented if the proposed pre-treatment measures fail to adequately remove suspended solids.

.7 The Dewatering Program must indicate the location of generators and other noise-producing equipment with anticipated decibel levels, dewatering discharge and monitoring points, groundwater observation wells, and siltation ponds with dimensions and filter media specifications, as required.

.8 The Dewatering Program shall be coordinated with the Contractor's Settlement and Groundwater Monitoring Plan prepared in accordance with Section 02450.

.9 The Dewatering Plan must demonstrate that it will meet the requirements of the MECP PTTW/EASR, specifically but not limited to the quantity of dewatering.

.10 The Dewatering Program submitted in the form of a Plan document must be approved by the Consultant, prior to the Contractor mobilizing to site. Allow a minimum of 14 days for review of the Dewatering Program submittal.

.11 The Dewatering Program must include the following:

.1 The definition of turbid water as any discharge water or diverted water with a maximum increase of 5 nephelometric turbidity units (NTUs) above the receiving watercourse's background levels. Where no background sample is available, turbid water shall be defined as any discharge water with a total suspended solids (TSS) concentration of 25 mg/L for watercourses.

.2 The Contractor's commitment not to discharge turbid water to any watercourse, municipal sewer, WWTS. In addition, if the discharge water appears turbid, dewatering operations must cease immediately, and pre-treatment measures must be modified to enhance settling and filtration of suspended sediment, in accordance with the Contractor's contingency plan.

.3 The Contractor's Hydrogeologist and/or Geotechnical Engineer's acknowledgement that it has read, and that the Dewatering Program will comply with, all terms and conditions of the MECP MECP PTTW/EASR. Contractor to include cost for any additional on-site investigation required to prepare the Dewatering Program Plan.

.4 Turbidity sampling locations and frequency (minimum of once per day at discharge point and background sampling location during active dewatering). Discharge water to watercourse must be shown to be within the limits for all parameters listed in the PTTW/EASR. All sampling and laboratory analysis will be conducted at the Contractor's own expense. All test results will be provided to the Consultant for review as soon as they are available.

.2 Pre-Condition Survey

.1 Perform a pre-condition survey, in accordance with Section 01110 – Summary of Work, of all existing structures located within 125 metres of any well used to temporarily control groundwater levels. The survey is to document with photographs, drawings and measurements, the condition of existing structures. This survey will be used for assessment of any damage to existing structures.

.3 Reports:

.1 Measure and record, on a form accepted by the Consultant, total daily groundwater and drainage water discharge to each municipal sewer and/or watercourse resulting from temporary dewatering activities. Submit copies of records to the Consultant on a weekly basis.

.4 Permits:

.1 Contractor shall not draw water in excess of 50,000 L/d unless it is monitored according to MECP PTTW/EASR requirements.

.2 The Contractor shall apply and pay for an EASR for construction dewatering purposes and review the Hydrogeological report on recommendations for dewatering. If a PTTW is necessary, the Contractor must inform the Consultant and Owner during the tender period to discuss this option.

.3 Comply with requirements with respect to discharge sampling, testing, flow measurement, record keeping, and other requirements required by the MECP. Submit copies of records to the Consultant. Contractor is responsible for measuring and recording quantity of water taken from the site.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 The Contractor shall engage the services of a specialist dewatering contractor who has a minimum of 8 years of experience in the design and construction of dewatering systems for projects of similar size and complexity.

.2 The Contractor, the Contractor's Hydrogeologist and/or Geotechnical Engineer, and the dewatering contractor shall be responsible for the design, supply, installation and overall operation of the dewatering program and shall demonstrate sufficient previous project experience to suit the site-specific constraints associated with this project. To meet this requirement, the Contractor and their design engineers shall provide a minimum of (3) project examples in the past ten years from municipal water or wastewater facilities with dewatering rates ±25% of the anticipated rates for this project.

1.7 SITE CONDITIONS

.1 Examine the Geotechnical Investigation Report and Hydrogeological Investigation Report by Cambium Inc. and included in the tender package.

.2 Determine if additional on-site investigation is required and include costs for such investigations and time within schedule.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Dewatering Equipment:

.1 Supply all temporary pipes, wells, deep wells, well-points, pumps, electrical generators, and other equipment required to facilitate Dewatering Program.

.2 Supply treatment equipment as required to comply with the discharge water quality requirements from the MECP PTTW/EASR.

.3 Supply all temporary standby pumps and a generator with effective muffling devices to keep noise levels within limits acceptable to the Owner required to facilitate Dewatering Program.

PART 3 - EXECUTION

3.1 GENERAL CONSTRUCTION AND EXCAVATION SEQUENCE

.1 Sequencing of excavation activities shall proceed in accordance with Division 1 and the Contractor's Excavation and Backfilling Plan prepared in accordance with Section 02315.

.2 Contractor shall prevent inflow from sewer and yard piping excavations into the excavation.

.3 All excavation, trenching, installation and backfilling shall proceed in sections, in order to limit dewatering inflow.

.4 Install clay trench barriers as indicated on the Civil Drawings, to mitigate groundwater inflow in the trenches.

3.2 PREPARATION

.1 Intercept and direct surface water away from excavations and monitoring equipment by use of dikes, curb walls, ditches, pipes, sumps or other means to existing storm drainage system to Consultant's and local authorities' acceptance.

3.3 INSTALLATION

.1 Install dewatering equipment and dewater to required levels before proceeding to excavate.

.2 When required to sub-excavate because of unsuitable subgrade condition, dewater and monitor effectiveness of dewatering before proceeding to sub-excavate.

.3 Take corrective measures as required to maintain groundwater at a sufficiently low level to meet performance requirements.

.4 For installations outside of excavations, install dewatering system in covered trenches. Install shored trenches for pipes, headers and other dewatering equipment and cover if necessary, or protect by acceptable means.

.5 Cover shored trenches and/or chambers constructed to house dewatering equipment with firmly secured steel plates matching existing adjacent surface grades to withstand construction loads. Maintain installation for the duration of the work.

.6 During duration of operation, maintain dewatering systems safely to prevent hazard to public and in accordance with regulations and requirements of authorities having jurisdiction.

.7 Ensure dewatering systems are sufficiently insulated and protected for winter operation, if required by the Construction Schedule.

.8 Clearly identify dewatering equipment locations and provide barricades as required to ensure worker and public safety.

.9 Locate existing underground utilities and make provisions in dewatering system installation to accommodate any utility conflicts or interferences.

.10 Coordinate work with relevant utility companies and authorities having jurisdiction.

.11 Remove covers and shoring from trenches and chambers for dewatering operation, promptly backfill and restore surfaces to original condition. Match adjacent surfaces, in accordance with requirements of authorities having jurisdiction.

.12 If sewer becomes blocked or has its capacity restricted as a result of dewatering operation, arrange and pay for cleaning with jurisdictional agency.

.13 Flotation of Structures:

.1 Maintain groundwater at sufficiently low levels to prevent damage or displacement of structures by groundwater pressures.

.2 Protect completed structures or part of completed structures which would suffer displacement or other damage as a result of dewatering equipment failure by providing:

.1 Standby dewatering equipment, connected directly to electrical generators, engaging automatically in case of power failure.

.2 A positive means by which the structures may be flooded with water to neutralize exterior hydraulic pressures.

.3 A combination of the two alternatives above.

.14 Design and Operate Dewatering Systems:

.1 To prevent loss of ground as water is removed.

.2 To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.

.3 To relieve artesian pressures and resultant uplift of excavation bottom.

.15 Standby power and equipment:

.1 Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

3.4 DEWATERING

.1 Supply, install and operate additional dewatering measures necessary to carry out work.

.2 Install filters, settling ponds, or similar installations to remove particulate matter. Until clearance of soil particles occurs, store water to allow sedimentation prior to discharge into appropriate sewer.

.3 Dispose of precipitation and drainage water away and clear of Work area. Keep excavation dry.

.4 Maintain continuous and complete effectiveness of installation including taking measures to prevent clogging of suction screens. Supply and install sufficient back-up pumping and power equipment to maintain uninterrupted operation.

.5 During backfilling maintain water level at such elevations to prevent flotation of structure. Continue with temporary dewatering measures until permanent drainage system is working and operational to the satisfaction of the Consultant.

3.5 DRAINAGE AND EXCAVATED AREAS

.1 Supply, install and maintain ditches of adequate size to intercept and collect surface and subsurface water and seepage which may enter excavations and divert water into sump to be drained or pumped into drainage channels or storm sewers as indicated on shop drawings.

.2 Grade bottom of excavation for water to flow to filtered sumps and prevent water from ponding on excavation bottom.

.3 Pre-filter groundwater before discharge. Filter at bottom of well to prevent pumping of fines. Perform additional surface filtering where necessary to limit particulates being discharged to Sewer Use By-Law requirements.

3.6 MONITORING GROUNDWATER WELLS

.1 Four nested monitoring wells are available for use by the Contractor as determined by Dewatering Program. Refer to Hydrogeological Report for approximate locations of the monitoring wells.

.2 Install and monitor observation wells as required by Dewatering Program. Construct wells in accordance with Ontario Regulation 903. Measure water levels observed in each observation well as per Dewatering Program and at least weekly and whenever system or component failures are discovered and whenever any event, including but not limited to flood, storms, changes in water surface elevation of nearby water bodies, may have caused a change in the groundwater elevation.

.3 After groundwater level observation wells are no longer needed for monitoring groundwater levels, observation wells are to be properly decommissioned. The well abandonment method must satisfy the minimum requirements of Ontario Regulation 903 as amended by Ontario Regulation 128/03. The Contractor shall provide a copy of the written well record (for the abandonment) to the Consultant.

.4 After groundwater level observation wells are no longer needed for monitoring groundwater levels, abandon observation wells, as required by regulations.

3.7 DISPOSAL OF WATER

.1 Discharging any surface water or groundwater into the facility shall not be permitted.

.2 Treat water collected by dewatering operations, as required by the MECP PTTW/EASR, prior to discharge to watercourse. If water does not meet regulatory limits additional treatment of water on-site or off-site is required.

.3 Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

.4 Remove solids from temporary treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.8 PROTECTION OF PROPERTY

.1 Monitor for settlement of nearby structures in accordance with Section 02450 – Settlement, Vibration and Groundwater Monitoring.

.2 Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches, and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.

.3 Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

END OF SECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

.1 This section pertains to the rock breakage by mechanical means for the construction of new buildings, tanks and installation pumping station foundations.

.2 The contractor shall supply personnel, equipment, materials, services and supervision required to excavate bedrock, using mechanical methods, for site services, conduit trenches, building and tank foundations, slabs-on-grade, and other requirements, as necessary to complete the Work described by the plans and specifications.

.3 Blasting is not permitted. It is expected that rock excavation will be completed using a hoe ram or rock splitters in conjunction with line drilling and/or pre-drilling.

.4 The work of this section shall be completed in accordance with section 02315 Excavation, Trenching and Backfilling and Section 02450– Settlement, Vibration and Groundwater Monitoring.

1.2 DEFINITIONS

.1 Rock: any solid material in excess of 0.5 m^3 and which cannot be removed by means of heavy duty mechanical excavating equipment with 1.15 m^3 bucket. Frozen material is not classified as rock.

.2 Hoe-Ram: A powerful percussion hammer fitted to an excavator for demolishing concrete structures or rock.

.3 Line-drilling: A single row of unloaded, very closely spaced holes drilled along the perimeter of the excavation.

1.3 REFERENCE STANDARDS

.1 OSHA, R.R.O. 1990, Regulation 854 Mines and Mining Plants.

.2 Union Gas Construction and Maintenance Manual Sections 3.10, 11.3, 12.6, 17.5 and 17.11

1.4 GEOTECHNICAL REPORT

.1 Examine the Geotechnical Report prepared by Cambium Inc. for the preparation of mechanical rock breakage.

1.5 PRICE AND PAYMENT PROCEDURES

.1 Rock removal will be paid at the unit rate established in the form of Tender.

.2 Should the final quantity of rock removal be less than 90% of the quantity shown in the Form of Tender the Contractor shall be entitled to adjust their unit rate. No rate changes will be permitted for additional rock removal.

.3 Prior to commencing rock removal, Contractor to excavate down to bedrock surface and provide a survey of the rock profile for the purpose of determining rock quantities. Depending on the Contractor's project sequencing, multiple surveys may be required to capture the full site. Where multiple surveys are undertaken, the survey data should be compiled into a single document for completeness.

1.6 QUALITY ASSURANCE

.1 Contractor shall retain a vibration-monitoring Consultant to establish and implement vibration monitoring criteria associated with rock excavation operations before construction in accordance with Section 02450 – Vibration, Settlement and Groundwater Monitoring.

.2 The Contractor shall maintain complete and accurate records of rock excavation operations. Submit records to the Consultant upon request.

1.7 SUBMITTALS

.1 Submittals in accordance with Division 01.

.2 Submit written proposal of operations for removal of rock by mechanical methods to Consultant. This should be included as part of the Excavation and Backfill Plan submission under Section 02315.

.3 Submit Vibration Monitoring Plan under Section 02450.

.4 Submit pre-excavation survey of rock profile to determine rock quantities for payment.

.5 Submit results of pre-condition survey in accordance with Division 01.

.6 Submit post-excavation survey of rock profile.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.9 PROTECTION OF EXISTING FEATURES

.1 Protect existing features in accordance with applicable local regulations.

.2 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.2 Prior to commencing excavation work, notify applicable owner or authorities having jurisdiction to establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.

.3 Confirm locations of buried utilities by careful test excavations.

.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.5 Where utility lines or structures exist in area of excavation, obtain direction of Consultant before removing or re-routing.

.6 Record location of maintained, re-routed and abandoned underground lines.

.3 Existing buildings and surface features:

.1 Protect existing buildings, services and surface features from damage while Work is in progress. In the event of damage, immediately make repair to Consultant's satisfaction.

.2 Perform a pre-condition survey of all existing structures located within 125 metres of the site in accordance with Division 01. The survey is to document with photographs, drawings and measurements, the condition of existing structures. This survey will be used for assessment of any damage to existing structures.

PART 2 - PRODUCTS

2.1 ROCK REMOVAL PRODUCTS

.1 Rock removal shall be completed via non-explosive methods.

.2 Select equipment to carry out the rock removal to ensure that vibration levels (PPVs) are less than those stipulated in Section 02450.

PART 3 - EXECUTION

3.1 DRILLING

.1 The drilling sub-contractor shall control their drilling operations, through the use of proper equipment and techniques in order to space and align drill holes. The drill pattern is to be designed for the rock geology identified in the geotechnical report. No hole shall deviate from the plane of the planned backslope by more than 150 mm.

.2 The depth of holes shall be established to respect the final grade and/or design lines. The costs related to overdrilling shall be the responsibility of the contractor.

.3 The drilling pattern shall be adopted to the varying geological conditions and the type of excavation.

3.2 ROCK REMOVAL

.1 Perform excavation in accordance with Contractor's Erosion and Sedimentation Control Plan, Excavation Backfill Plan, Dewatering Plan and Vibration Monitoring Plan.

.2 Coordinate this Section with the health and safety requirements of Division 01.

.3 Remove rock to alignments, profiles, and cross sections as indicated.

.4 Explosive blasting is not permitted.

.5 Use rock removal procedures to produce uniform and stable excavation surfaces. Minimize overbreak and avoid damage to adjacent structures.

.6 Where the excavation extends deeper than 1.8 metres into the bedrock, near vertical walls shall be reviewed by the Contractor's Geotechnical Engineer for any sign of unstable pillars or slabs that should be removed or stabilized.

.7 Excavate trenches to lines and grades to accommodate the specified minimum bedding requirements for each particular service.

.8 Cut trenches to widths as indicated.

.9 Remove boulders and fragments which may slide or roll into excavated areas.

.10 Correct unauthorized rock removal at no extra cost, in accordance with backfilling requirements specified in Section 02315 – Excavating, Trenching and Backfilling.

3.3 ROCK RE-USE

.1 Contractor to submit to Consultant, for review and approval, a plan to re-use any rock on site in accordance with the Geotechnical Report. Provide details on how rock will be processed to become an acceptable fill material. Indicate where fill will be used on the site, including proposed volumes.

3.4 CLEANING

.1 Clean in accordance with Division 01

.2 Rock Disposal:
- .1 Unless approved for re-use, dispose of removed rock off site in accordance with Division 01.
- .2 Do not dispose removed rock into landfill. Send material to appropriate location as approved by Consultant.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Division 01.

END OF SECTION

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Close cut clearing consists of cutting off or removing at or near flush with original ground surface standing trees, brush, scrub, roots, stumps and embedded logs and disposing of fallen timber and surface debris.

.2 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees and disposing of felled trees and debris.

.3 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of all fallen timber and surface debris.

.4 Grubbing consists of excavation and disposal of stumps and roots, boulders and rock fragments to not less than a specified depth below original ground surface.

1.2 STORAGE AND PROTECTION

.1 Prevent damage to fencing, trees, landscaping, natural features, benchmarks, existing buildings, existing pavement, utility lines, site appurtenances, root systems of trees which are to remain. Restore any damage to existing or better condition.

.2 Do not apply tree paint to cuts or scars suffered by vegetation designated to remain.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Equipment appropriate to perform work as specified.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Inspect site and verify with Consultant, items designated to remain.

.2 Locate and protect above and below grade utility lines. reserve in operating condition active utilities traversing site.

.3 Notify utility authorities before starting.

.4 Unless otherwise noted, Contractor is responsible for obtaining permits required for clearing and grubbing works. Contractor to coordinate the completion of the work with all affected parties and conform to all requirements identified in the permit.

.5 The timing of clearing and grubbing works shall comply with applicable timing windows per Division 1, or as per MNRF, MECP, and local conservation authority requirements, as well as those specifically indicated in the Natural Heritage Memorandum, prepared by Cambium Inc.

3.2 CLEARING

.1 Clear brush and trees not designated to remain on site.

.2 Cut off trees, to a height of 300 mm above ground.

.3 Remove trees and shrubs to extents to permit the Works.

3.3 GRUBBING

.1 Grub out stumps and roots to not less than 200 mm below existing grade.

3.4 REMOVAL AND DISPOSAL

.1 Remove and dispose of cleared and grubbed materials off site per Section 01355 Waste Management and Disposal.

3.5 FINISHED SURFACE

.1 Leave ground surface in condition suitable for construction operation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 02311 – Site Grading.

.2 Section 02370 – Erosion and Sedimentation Control.

1.2 REFERENCES

.1 Ontario Provincial Standard Specifications (OPSS):
- .1 OPSS 805 Construction Specification for Temporary Erosion and Sediment Control Measures.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Erosion and Sedimentation Control (ESC) Materials:
- .1 All ESC materials (e.g., stakes, anchors, etc.), as per Contractor's Erosion and Sediment Control Plan and Minimum requirements of OPSS 805 and Section 02370.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties in accordance with OPSS 805 and Section 02370.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

.1 Remove topsoil before construction procedures commence to avoid compaction of topsoil.

.2 Handle topsoil only when it is dry and warm.

.3 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by composting.

.4 Remove brush from targeted area by non-chemical means and dispose of through mulching.

.5 Strip topsoil to depths as directed by Contractor' Geotechnical Engineer.
- .1 Do not mix topsoil with subsoil.

.6 Pile topsoil in berms as directed by Contractor' Geotechnical Engineer.
- .1 Stockpile height not to exceed 1.5 m without a break in grade.

.7 Dispose of unused topsoil off site, refer to Section 02315 Excavation, Trenching and Backfilling for excess soil removal requirements.

.8 Protect stockpiles from contamination and compaction.

.9 Cover topsoil that has been piled for long term storage, with trefoil or grass to maintain agricultural potential of soil.

3.3 PREPARATION OF GRADE

.1 Verify that grades are correct and notify Consultant if discrepancies occur.
- .1 Grade area only when soil is dry to lessen soil compaction.
- .2 Grade soil establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3.4 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D6938-17, Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow depth).

1.2 EXISTING CONDITIONS

.1 Known underground and surface utility lines and buried objects are to be assumed as indicated on site plan.

.2 Contractor to obtain utility locates at time of construction, prior to any excavation.

1.3 PROTECTION

.1 Protect and/or transplant existing trees, benchmarks, buildings, surface or underground utility lines which are to remain as directed by Consultant. If damaged, restore to original or better condition unless directed otherwise.

.2 Maintain access roads to prevent accumulation of construction related debris on roads.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Fill material: Type in accordance with Section 02315 - Excavating, Trenching and Backfilling.

.2 Excavated or graded material existing on site may be suitable to use as fill for grading work if approved by Consultant.

PART 3 - EXECUTION

3.1 STRIPPING OF TOPSOIL

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

.2 Commence topsoil stripping of areas after area has been cleared of brush, weeds and grasses and removed from site.

.3 Strip topsoil to depths as indicated. Rototill weeds and grasses and retain as topsoil on site.

.4 Avoid mixing topsoil with subsoil.

.5 Stockpile in locations as directed by Consultant. Stockpile height not to exceed 3 m.

.6 Dispose of unused topsoil as directed by Consultant.

3.2 GRADING

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.

.2 Rough grade to following depths after compaction below finish grades unless otherwise noted:
- .1 100 mm for grassed areas.
- .2 250 mm for gravel paving.
- .3 350 mm for maintenance edge.

.3 Slope rough grade away from building 1:50 minimum.

.4 Grade ditches to depth as indicated.

.5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.6 Compact filled and disturbed areas to Standard Proctor maximum dry density, as follows (unless otherwise noted):
- .1 95% under landscaped areas.
- .2 100% under paved and walk areas.
- .3 If required per Contractor's Geotechnical Engineer, areas to be compacted to higher Standard Proctor maximum dry density.

.7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 TESTING

.1 Inspection and testing of soil compaction will be carried out by testing laboratory appointed by Owner. Costs of tests will be paid by Owner. Refer to Section 01430 – Quality Requirements.

3.4 SURPLUS MATERIAL

.1 Refer to Section 02315 – Excavation, Trenching and Backfilling

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 OPSS.MUNI 180 Management of Excess Materials

.2 American Society for Testing and Materials (ASTM)
  .1 ASTM D6938-15, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

.3 Geotechnical and Hydrogeological Investigation prepared for the project (Cambium Inc., 2024).

.4 Ontario Regulation 406/19: On-site and Excess Soil Management as amended by Ontario Regulation 775/20: On-site and Excess Soil Management.

.5 Ministry of the Environment, Conservation and Parks (MECP): Rules for Soil Management and Excess Soil Quality Standards (Soil Rules).

1.2 EXCAVATION AND BACKFILLING PLAN

.1 Contractor to retain a Professional Geotechnical Engineer licensed in the Province of Ontario to plan and design all required site excavations, temporary granular pads for equipment, temporary support systems, and backfilling operations to facilitate proper installation of the required Works and in accordance with the Contract Documents.
  .1 The following firm is precluded from being retained by the Contractor: Cambium Inc.

.2 The Contractor's Geotechnical Engineer is to review and understand the factual results of the existing available Technical Reports, assess the adequacy of the information and undertake additional field investigations, if required and at the Contractor's expense.

.3 The Excavation and Backfilling Plan shall include, as a minimum:
  .1 A description of construction techniques, slope protection measures, equipment, schedule and sequencing.
  .2 Design excavation drawings, stamped by a Professional Engineer licensed in the Province of Ontario, indicating excavation footprints, excavation grades and elevations, erosion and sedimentation control measures, backfill material profiles and elevations, pipe bedding and insulation details, and shoring and bracing designs, all as required to facilitate installation of the required Works
  .3 Contractor shall include a description of cold weather procedures to protect earthworks including verification of temperature.

.4 The Excavation and Backfilling Plan shall address all requirements of the current Occupational Health & Safety Act (OHSA) Regulations.

.5 The Excavation and Backfilling plan shall be coordinated with the Contractor's Settlement and Vibration Monitoring plan prepared as per Section 02450.

.6 The Excavation and Backfilling plan shall be coordinated with the Contractor's Dewatering plan prepared as per Section 02140.

.7 The Excavation and Backfilling plan shall be submitted for review and approval by the Consultant at least twenty-one (21) days prior to any excavation work proceeding.

1.3 OFF-SITE EXCAVATED SURPLUS MATERIAL DISPOSAL

.1 All excess soils will remain onsite for beneficial reuse as directed by the Owner and Contract Administrator.

1.4 QUALITY ASSURANCE TESTS AND INSPECTIONS

.1 Quality Assurance Testing and Inspection of materials and compaction of backfill and subgrades will be carried out by testing laboratory designated by the Owner and coordinated by the Contractor. Contractor to ensure own Quality Control for all compaction and materials prior to requesting Quality Assurance testing by Owner.

.2 Do not begin backfilling or filling operations until material has been approved for use by Consultant.

.3 Not later than 48 hours before backfilling or filling with approved material, notify Consultant and coordinate designated Testing agency so that compaction tests can be carried out.

.4 Before commencing work, conduct, with Consultant, condition survey of existing structures, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey benchmarks and monuments which may be affected by work. Prepare report and submit prior to undertaking Works.

.5 Shoring and Bracing

.1 The Contractor is responsible for reviewing the installation of the temporary shoring and bracing system. The Contractor is also responsible for monitoring the performance of the shoring and bracing system during use Contractor shall make any adjustments, repairs or replacement of the shoring and bracing system to ensure a stable excavation is maintained.

.6 Management of Liquids

.1 Groundwater removed from excavations shall not be allowed to discharge, either directly or via overland flow, to water bodies, or to any street or storm sewer without prior written approval from the Environment Inspector.

.2 All liquid waste materials transported off-site for disposal must be appropriately manifested as per applicable law.

.7 Spills and Encountering of Unexpected and Hazardous Conditions

.1 The Contractor shall take all reasonable precautions to prevent spills and shall maintain spill response supplies and ability commensurate with the fuels, oils and other construction materials in use or stored on site during the projectNo storage of fuels, hydraulic oils or lubricants, or fuelling or maintenance of equipment shall be permitted within 10 metres of any open water or a storm sewer catch basin.

.2 If a spill occurs the Contractor must take all reasonable actions to prevent migration and notify the Ministry of Ministry of the Environment, Conservation and Parks Spills Action Centre (SAC) at 1-800-268-6060 and the Environmental Inspector or other representatives of the City as soon as possible.

1.5 BURIED SERVICES

.1 Before commencing work, verify and establish the location of all buried services on and adjacent to the site.

.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work. Pay costs of relocating services.

.3 Remove obsolete buried services within 2 m of foundations. Cap cut-offs.

.4 Record location and elevation of all existing services exposed during execution of the Works.

1.6 PROTECTION OF EXISTING FEATURES

.1 Protect existing features in accordance with applicable local regulations.

.2 Existing buried utilities and structures:
- .1 Size, depth, and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
- .2 Prior to commencing excavation Work, notify applicable Owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.
- .3 Confirm locations of buried utilities by careful test excavations.
- .4 Maintain and protect from damage, water, sewer, gas, electric, telephone, and other utilities and structures encountered.
- .5 Record location of maintained, re-routed, and abandoned underground lines.
- .6 Confirm locations of recent excavations adjacent to area of excavation.

.3 Existing buildings and surface features:
- .1 Protect existing buildings and surface features from damage while Work is in progress. In the event of damage, immediately make repair to Consultant's approval.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Granular 'A' with properties to Section 02701 - Aggregates.

.2 Granular 'B' (Type I) with properties to Section 02701 - Aggregates.

.3 Granular 'B' (Type II) with properties to Section 02701 - Aggregates.

.4 Geotextiles: Terrafix 400R or approved equivalent, as per Section 02948 - Geotextiles.

.5 Service Marker Tape:
- .1 Tape to be detectable poly tape with aluminum backing, SETON Tape product numbers.
- .2 Product Numbers to match service:
  - .1 Sewers: product number 85502.
  - .2 Watermain: product number 85504.
  - .3 Electrical cables: as per Division 16.
  - .4 Gas: product number 85499.

.6 Type ML Clay Soil: Fine Grained soil (>50% No. 200 US Sieve size with liquid limit <50) made up of inorganic silts, silty, or clayey fine sands, with slight plasticity (<20 plasticity index). Type ML Soil as per the Unified Soil Classification System. This soil is also to meet requirements of Inert fill as described by current Provincial legislation (granulars, clean concrete, clean limestone rock).

.7 Engineered Fill: Imported well-graded, crushed, compactable, granular soils, free of organics and other deleterious materials. Granular 'A' or 'B' as described above would qualify as suitable materials.

.8 Clean Fill: Soil, sampled and analyzed in accordance with the requirements of Schedule E of O.Reg. 153/04, as amended, under the supervision of a Qualified Person. As specified by the Regulation, samples shall be collected and analyzed at a frequency of one sample per 160 cubic metres of soil for the first 5,000 cubic metres to be brought to the site, and one sample for each additional 300 cubic metres of soils. Documentation of soil sampling and analyses shall be provided to the Owner at least 10 Working Days prior to importing the soil. The documentation shall be in the form of a written report signed and sealed by the Qualified Person who supervised the work. The Owner may, at its sole discretion, reject the proposed soil imports. Imported Soil must meet the current "Table 1" MECP background standards (most recently published), as the "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act.

.9 Lightweight Cellular Fill: Refer to 03400 – Lightweight Cellular Concrete

.10 Mudslabs/Lean Concrete Fill/Unshrinkable Concrete Fill: Refer to Division 3 and Structural Drawings.

PART 3 - EXECUTION

3.1 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

.3 Establish all required temporary measures for Erosion and Sedimentation Control for the work intended and include in the Excavation and Backfilling Plan.

3.2 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Construct temporary works to depths, heights and locations as per approved Excavation and Backfilling Plan and Dewatering Program.

.2 Excavation and backfilling operations to be carried out under the supervision of the Contractor's Geotechnical Engineer.

.3 During backfill operation:
- .1 Unless otherwise as indicated or as directed by Contractor's Geotechnical Engineer, remove sheeting and shoring from excavations.
- .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
- .3 Pull sheeting in increments that will ensure compacted backfill is maintained at an elevation at least 500mm above toe of sheeting.
- .4 When sheeting is required to remain in place, cut off tops at elevations as indicated in the Contractor's Excavation and Backfilling Plan. Record location and elevation of remaining sheeting.
- .5 Upon completion of substructure construction:
  - .1 Remove cofferdams, shoring and bracing.
  - .2 Remove excess materials from site and restore water courses as indicated and as directed by Contractor's Geotechnical Engineer.

3.3 CLEARING AND GRUBBING

.1 Refer to Section 02231 – Clearing and Grubbing.

3.4 GENERAL EXCAVATION

.1 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil. Stockpile topsoil for later use. Topsoil is not suitable as engineered fill and should only be re-used for landscaping applications.

.2 Excavate for slabs and paving to subgrade levels in accordance with the approved Backfilling and Excavation Plan. In addition, remove all topsoil, organic matter, debris, and other loose and harmful matter encountered at subgrade level.

.3 Excavate to lines, grades, elevations, and dimensions as required to facilitate construction of the works and as per the Excavation and Backfilling plan.

.4 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.

.5 Excavation must not interfere with bearing capacity of adjacent foundations.

.6 For trench excavation, unless otherwise authorized by Consultant in writing, do not excavate more than 20m of trench in advance of installation operations and do not leave open more than 10m end of day's operation.

.7 Keep excavated and stockpiled materials a safe distance away from edge of trench in accordance with OHSA requirements and the Contractor’s Geotechnical Consultant.

.8 Restrict vehicle operations directly adjacent to open trenches.

.9 Dispose of surplus and unsuitable excavated material off site.

.10 Do not obstruct flow of surface drainage or natural watercourses.

.11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.12 Notify the Contractor’s Geotechnical Engineer when bottom of excavation is reached. Contact testing and inspection agency to provide quality assurance of subgrades prior to placement of material.

.13 Obtain the Contractor’s Geotechnical Engineer’s approval of completed excavation.

.14 Contractor shall employ appropriate methods to protect the approved subgrade from disturbance of any kind, including from freezing.

.15 Remove unsuitable material from trench bottom to extent and depth as directed by the Consultant.

.16 Correct unauthorized over-excavation as follows:

- .1 All costs resulting from unauthorized over-excavation are entirely the responsibility of the Contractor.
- .2 Unless otherwise noted below or elsewhere, unauthorized over-excavation is to be corrected through the placement of compacted Granular ‘B’, to the approval of the Contractor’s Geotechnical Engineer.

.3 For service trenching, over-excavation is to be corrected with Granular 'A' compacted to 100% Standard Proctor maximum dry density in maximum 150mm lifts.

.17 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

.18 If, during grading or temporary excavation activities, evidence of unknown conditions or environmental contamination is identified, the Contractor shall cease work in the area and notify the Owner. The area must be assessed under the supervision of the Owner or Consultant to determine if additional soil, groundwater, or sediment testing is required in accordance with governing regulations and standard industry practices. Evidence of environmental contamination includes such observations as:

.1 soil staining or other unnatural soil colours.

.2 unusual odours emanating from soil, groundwater or sediment.

.3 petroleum sheen or free product on the surface of water; and

.4 previously unidentified buried debris.

3.5 FILL TYPES AND COMPACTION

.1 Unless noted otherwise, use fill types and compaction rates as specified below. Compaction densities are percentages of Standard Proctor maximum dry densities obtained from ASTM D 2922.

.1 Exterior side of foundations, retaining and tank walls: use Granular 'B' fill to subgrade level. Compact to 95% under landscaped areas or 98% under pavement or exterior slabs.

.2 Within building area: use Granular 'A' or 'B' to underside of base course for floor slabs. Compact to 100%.

.3 Under concrete slabs: provide 200mm compacted thickness base course of 19mm diameter crushed clear stone fill. Compact base course to 100%.

3.6 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact fine aggregates for bedding and surround of underground services as indicated and as specified.

.2 Place bedding and surround material in unfrozen condition.

.3 Place marker tape as detailed on drawings on top of bedding.

3.7 BACKFILLING

.1 Do not proceed with backfilling operations until Contractor's Geotechnical Engineer has inspected and approved installations and quality assurance is completed by Testing and Inspection agency.

.2 Areas to be backfilled to be free from debris, snow, ice, water, and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow, or debris.

.4 Place backfill material in uniform layers not exceeding 200mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 Backfilling around installations.
  .1 Place bedding and surround material as specified elsewhere.
  .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
  .3 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
    .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Consultant or Geotechnical Engineer:

.6 Install drainage system in backfill as indicated.

.7 Contractor shall employ appropriate methods to protect the engineered fill from disturbance of any kind, including from freezing.

3.8 EROSION AND SEDIMENTATION CONTROL

.1 Refer to Section 02370 – Erosion and Sedimentation Control

.2 The Contractor shall create and maintain records and submit them monthly to the Owner all activities related to soil movements at the site including:
  .1 dates and duration of work.
  .2 weather and site conditions.
  .3 location and depth of excavation activities.
  .4 erosion and sediment control measures employed.
  .5 dust control measures employed.
  .6 stockpile management and drainage.
  .7 soil characterization results.
  .8 names of any involved Qualified Persons, Subcontractors, haulers and receiving sites for any soil removed from the Property; and
  .9 any complaints received relating to site activities.

3.9 RESTORATION

.1 Upon completion of Work, remove waste materials, and debris. Trim slopes and correct defects as directed by Consultant.

.2 Replace topsoil as indicated.

.3 Reinstate lawns to elevation which existed before excavation, unless specified otherwise.

.4 Reinstate pavements disturbed by excavation to thickness, structure, and elevation which existed before excavation, unless specified otherwise.

.5 Clean and reinstate areas affected by Work to satisfaction of Owner.

END OF SECTION

PART 1 - GENERAL

1.1 OBJECTIVES OF EROSION AND SEDIMENTATION PLAN

.1 Prevent the loss of soil during construction by stormwater runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.

.2 Prevent the sedimentation of storm sewers and receiving streams during construction.

.3 Prevent air pollution from dust and particulate matter during construction activities.

1.2 SUBMISSIONS

.1 Contractor to submit an Erosion and Sedimentation Control (ESC) Plan in advance of all site excavations, including control type, placement, installation/removal sequence. The Plan is to include provisions for dust control, administrative controls for all sources of sediment movement, and collection and disposal of captured sediment.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Silt Fence Fabric:
  .1 Fabric to be woven and comply with OPSS.MUNI 1860.07.05.03

.2 Geotextile
  .1 Geotextile to be Nonwoven, Class II according to OPSS 1860, with an FOS of 75-150 µm (Terrafix 400R or approved equivalent).

.3 Miscellaneous ESC Material
  .1 Other miscellaneous ESC materials as per OPSS 805.MUNI or approved ESC Plan.

PART 3 - EXECUTION

3.1 SITE-WIDE PRACTICES

.1 Contractor is to keep the main access road clear of any mud or earth tracked from vehicles.

.2 All vehicles moving granular, earth, rock, or topsoil materials are to have their loads covered prior to leaving the site.

.3 No mud or earth may be tracked onto public roads or the site access road(s)at any time.

.4 Where possible, avoid construction activities that may produce dust on windy days.

.5 All stockpiles of excavated materials or imported granular materials are to be stabilized according to the expected length of time without disturbance as detailed in this section and as per OPSS.MUNI 805.

.6 Dust Control:
- .1 Dust Control measures are to be as per OPSS.MUNI 506.
- .2 Dust suppressants other than water or calcium chloride (flake or solution) require prior approval. Provide data as per OPSS.MUNI 506.04.01

3.2 INSTALLATION OF ESC MEASURES

.1 Installation of the ESC measures is to be conducted in such a way that downstream measures (those measures closest to watercourse to be protected) are to be installed prior to upstream measures.

.2 All Structural Measures for a given work area are to be installed prior to any construction work.

.3 Structural Measures
- .1 Structural measures are to be installed as per the Contract Drawings.
- .2 Silt Fence
  - .1 Silt fence to be installed as per OPSD 219.110.
  - .2 Contractor may elect to place 200 mm of granular material on the upstream side to anchor the foot of the silt fence as opposed to excavating to secure the foot.
  - .3 Contractor to ensure that the foot of the silt fence is secured throughout the silt fence length.
- .3 Straw Bale Flow Check
  - .1 Straw Bale Flow Checks to be installed as per OPSD 219.180.
  - .2 Contractor to ensure that the flow check is seated a minimum of 75 mm below the surrounding surface.
  - .3 All excavated materials to be placed upstream of the flow check.
- .4 Stabilization Measures
  - .1 Cleared and graded areas that will undergo no further construction are to be stabilized within 14 days. Where possible, final planting should progress as soon as conditions permit. Temporary stabilization measures are to be used until final planting is conducted.
  - .2 Cleared and graded areas where construction activities will cease for at least 21 days are to be stabilized no later than 14 days after the last activity using temporary stabilization measures.
  - .3 All areas of final planting are to be protected similarly to existing tree protection. Any loss of tree material is to be replaced.
  - .4 All onsite areas to be used for Contractor laydown, trailers, or parking, are to be cleared, stripped topsoil to be removed. The area is to be covered with geotextile and a minimum surface of 150 mm Granular ‘A’ compacted to 95% of Standard Proctor Maximum Dry Density. Geotextile and Granular ‘A’ to be removed as part of the Contractor’s restoration activities. Exposed soils to be finish graded as per construction drawings.
- .5 Temporary Stabilization Measures
  - .1 Contractor is to be aware that any contamination of stockpiled material or of graded surfaces by temporary stabilization method is to be resolved at the Contractor’s expense.
  - .2 Temporary Seeding
    - .1 Temporary Seeding is to be performed as per permanent hydraulic seeding.
    - .2 Areas to be temporarily seeded are to have the soil surface loosened prior to seeding.
    - .3 Mulch is to be used to cover the seed as directed by the Consultant.
  - .3 Mulching
    - .1 Mulching can be used to stabilize areas with steeper gradients.
    - .2 Hay, straw, woodchips can be used as mulch for temporary seeding, or as a stabilization method.
  - .4 Covering

.1 Areas can be covered by tarps or other fabric materials to prevent dust and erosion.
.2 Contractor is responsible to ensure that any covering material remains whole and is securely fastened down.

.6 Sedimentation Prevention Measures
.1 Catch Basin Lid Filter Cloth
.1 All catch basins and catch basin manholes are to have a double layer of geotextile placed under their lids to prevent sedimentation of the storm sewer system.
.2 Construction activities are to minimize disturbance to grassed areas. Any grassed areas to be used for construction activities are to be cleared and stripped and topsoil is to be stockpiled. Areas are to be stabilized after construction activities are complete.

3.3 INSPECTION OF ESC MEASURES

.1 Once a week, or immediately after any rainfall event of at least 12 mm, each ESC measure onsite is to be inspected in its entirety. All ESC measures are to be maintained in good working order.

.2 Contractor shall complete the ESC Inspection Forms in Section 02370A during each inspection.

.3 If any maintenance, repairs or replacement are to be made to an ESC measure, the work is to be initiated within 24 hours of report.

.4 Inspection of Structural Measures
.1 Silt fence
.1 Silt fence is to be inspected for: depth of embedment, tears or holes, erosion around or under the fence, sagging or collapse.
.2 Sediment accumulation reaching 1/3 fence height is to be removed and relocated to areas onsite of low erosion potential.
.2 Rock or Straw Bale Flow Checks
.1 Flow Checks are to be inspected for: collapse, rotting bales, exposed geotextile, erosion underneath or around the check, and sediment accumulation.
.2 Sediment accumulation reaching 1/2 height is to be removed and relocated to areas onsite of low erosion potential.

.5 All stormwater system structures (ditch inlets, catch basins, manholes, oil/grit separators) are to have the geotextile inspected for tears, holes and the structure sumps (if applicable), are to be inspected for accumulated sediment. Sediment to be removed if more than 1/3 full of sediment. Collected sediment is to be properly disposed of offsite.

.6 All geotextiles are to be inspected for tears and holes. Where used in contact with the soil, the matting is to be in continuous contact with the soil.

.7 All seeded or planted areas are to be inspected to ensure vegetative growth. Where vegetation has washed away, or died off, additional seeding is to be applied. Ensure area has sufficient water to promote growth.

.8 Material stockpiles are to be reviewed to ensure that erosion and dust control measures are in place and in good material condition. Make repairs as required.

3.4 ESC MEASURE REMOVALS

.1 After all upstream construction work has been completed, including the removal of upstream ESC measures, all areas have been permanently stabilized according to the Drawings and if approved by the Consultant, the ESC measure may be removed.

.2 All accumulated sediment at the ESC measure is to be removed.

END OF SECTION

SCHEDULE A: EROSION AND SEDIMENTATION CONTROL (ESC) INSPECTION CHECKLIST

Project Name: _____

Completed By: _____

Date: _____

During Construction: Complete this checklist on a weekly basis as per Section 02370. For each measure, check the “OK” box if there are no repairs or maintenance required; check the “Not OK” box if attention is required as per the inspection/maintenance procedures in the specification. For all measures marked as “Not OK”, the Inspection Log must be completed. List the measures that are deficient in the “Deficiencies” column on the Log, and record the maintenance performed. Submit both the checklist and the log to the Consultant on a monthly basis after all maintenance activities have been completed and recorded.

ESC MEASURE	Location on Site	OK	Not OK

SCHEDULE B: EROSION AND SEDIMENTATION CONTROL (ESC)
Weekly Inspection Log

Log Start Date: _____

Log End Date: _____

Log Complete By: _____

Project Name: _____

Company: _____

Telephone No: _____

Inspection Date	General Observations (e.g., Seasonal Conditions)	Location and Deficiency of ESC Measure	Corrective Measures	Initials

I hereby certify that the information provided is complete, correct, and complies with the requirements of Section 02370.

Signature	Title	Date

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCE

.1 OPSS.MUNI 1004 – Material Specification Aggregates – Miscellaneous.

.2 OPSS.MUNI 1860 – Material Specification for Geotextiles

PART 2 - PRODUCTS

2.1 STONE

.1 Hard, dense, durable quarry stone, free from seams, cracks or other structural defects, to meet following size distribution:

.1 R-10 Gradation (Table 8, OPSS.MUNI 1004)

100%	<15 kg
70-90%	<10 kg
40-55%	<5 kg
0-15%	<0.5 kg

2.2 GEOTEXTILE FILTER

.1 Refer to Section 02948 – Geotextiles.

PART 3 - EXECUTION

3.1 PLACING

.1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated.

.2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable material and compact to provide firm bed.

.3 Place geotextile on prepared surface as indicated and per Section 02948 - Geotextiles.

.1 Geotextile shall be fixed to prevent movement during installation. Geotextile shall be wrapped down to the ground by 300 mm minimum at termination points. Avoid puncturing or folding geotextile. Vehicular traffic over geotextile not permitted

.4 Place rip-rap to thickness and details as indicated.

.5 Place stones in manner approved by Consultant to secure surface and create a stable mass. Place larger stones at bottom of slopes.

.6 Hand placing:

.1 Use larger stones for lower courses and as headers for subsequent courses.

.2 Stagger vertical joints and fill voids with rock spalls or cobbles.

.3 Finish surface evenly, free of large openings and neat in appearance.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 CSA International
- .1 CSA W47.1-09 (R2014), Certification of companies for fusion welding of steel.
- .2 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding),

1.2 QUALITY ASSURANCE

.1 Comply with the requirements of the Ontario Building Code, Ontario Occupational Health and Safety Act Canada and all other Standards and Regulations noted.

.2 All Work performed and materials used shall be of the same standard of quality as that of the existing finished building as a minimum.

.3 Any welding shall be performed by Welders certified in accordance with CSA W47.1 and shall conform to CSA W59.

.4 Patch and extend work using only skilled mechanics capable of matching the existing quality or workmanship and as otherwise indicated. The quality of patched or extended Work to be performed as specified in the Sections of the product and execution Specifications which follow these General Requirements.

.5 Pre-Installation Meetings: convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation, with contractor's representative and Consultant in accordance with Section 01319 Project Meetings.

1.3 SECURITY

.1 Make provision to maintain the existing site security in a manner acceptable to the Owner during construction and after normal working hours.

1.4 ENVIRONMENTAL REQUIREMENTS

.1 Suppress all dust and dirt. Coordinate with Division 1.

.2 Prevent occurrence of unsanitary conditions, flooding or leaking.

.3 Do not allow dirt, debris or discarded materials to accumulate on site. Remove promptly each day.

.4 Refer to Section 01065 Designated Substances as applicable.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 1.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

.1 Not Applicable.

PART 3 - EXECUTION

3.1 ALTERATIONS, CUTTING AND PROTECTION

.1 Extent:
- .1 Perform cutting and removal work so as not to cut or remove more than is necessary and so as not to damage adjacent Work.

.2 Responsibility and Assignment of Trades:
- .1 Assign Work of moving, removal, cutting and patching and repair to trades under his/her supervision so as to cause the least damage to each type of Work encountered, and so as to return the building as much as possible to the appearance of new Work.
- .2 Assign only skilled tradesmen to perform patching and finishing Work.

.3 Protection:
- .1 Protect remaining finishes, equipment and adjacent Work from damage caused by cutting, moving, removal and patching operations. Protect surfaces to remain as part of the finished Work.

.4 Debris:
- .1 Remove debris promptly from the site each day. Removed material, except that listed or marked by Consultant for retention, becomes the property of the Contractor. Dispose of removed material legally. Do not burn on site. Do not allow debris to enter sewers. Refer to Division 1.
- .2 Do not let piled material endanger structure.
- .3 Suppress dust. Prevent occurrence of unsanitary conditions, dirt or debris on the site and neighboring property.
- .4 As directed by Owner, deliver and store and/or dispose of any salvaged items left over after completion of the Work

3.2 PATCHING, EXTENDING AND MATCHING

.1 Patching:
- .1 In areas where any portion of an existing finished surface is damaged, lifted, stained, peeling, cracked, or otherwise made or found to be deficient, patch or replace deficient surfaces with matching material.
- .2 Do not incorporate salvaged material in new Work unless otherwise noted or approved by Consultant in writing.
- .3 Provide adequate support or substrate for patching and finishing.
- .4 For painted and/or coated deficient surfaces, remove loose material, patch, sand and repaint or recoat the patched portion to obtain a uniform colour and texture over the entire surface.
- .5 Repaint or recoat entire surface where surrounding and/or adjacent surfaces cannot be matched.

.2 Quality:

.1 This Section does not intend to describe each of the various existing products that must be used to patch, match, extend or replace existing Work. Refer to the appropriate Technical Specification or Contract Drawings. Obtain all such products in time to complete the Work on Schedule. Such products shall be provided in quality, which is in no way inferior to the existing products.

.2 The quality of the products that exist in the building, as apparent during pre-bid site visits, shall serve as the minimum specification requirement for strength, appearance and other characteristics, unless otherwise noted.

.3 Transitions:

.1 Where new Work abuts or finishes flush with existing Work, make the transition as smooth and workmanlike as possible. Perform patching Work to match existing adjacent Work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of one (1) meter.

.2 In cases of extreme change of level such as 50mm / or more, obtain instructions from Consultant as to method of making transition. Provide stepping, bulkheading, encasement, ramping, sloping or change of transition line, or any combination of these as directed in each case by Consultant.

.4 Matching:

.1 Restore existing Work that is damaged during construction to a condition equal to its condition at the time of the start of such Work.

.5 Overall Requirement That the Work be Complete:

.1 Where a product type of construction occurs in the existing building and is not specified as a part of the new Work, provide such products or types of construction as needed to patch, extend or match the existing Work.

.2 These Specifications are not intended to describe existing products or standards of execution, nor will they enumerate products, which are not part of the new construction.

.3 The Contractor shall perform patching, extending or matching to previous works on the altered surface as needed to maintain consistency, standards and workmanship of new work.

3.3 REPAIR

.1 Replace work damaged in the course of alterations, except at areas approved by Consultant in writing.

.2 Where full removal of extensive amounts of Work would be required to replace damaged portions, then filling, straightening and similar repair techniques, followed by full painting or other finishing, will be permitted.

.3 If the repaired Work is not brought up to the standard for new Work, Consultant will direct that it be removed and replaced with new Work at no additional cost to the Owner.

3.4 CLEANING

.1 Clean in accordance with Section 01741 – Cleaning.

.2 Each Successive Trade:

.1 Clean Work area and make Work surfaces ready for the Work of the succeeding trades as each trade finishes its Work on each part of the alterations Work and related new Work.

.2 Clean or remedy immediately spillage, overspray, collections of dust or debris, damage to Owner-occupied spaces made by any responsible trade.

.3 Each Area as it is Completed:

.1 Clean up all surfaces, remove equipment, salvage and debris and return in condition suitable for use by the Owner as quickly as possible as soon as Work in each area of the alterations is complete.

.2 Review final cleaning with Consultant prior to final acceptance.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 This section covers site-wide settlement and vibration for nearby structures which are either sensitive to settlement and vibrations during construction activities or which may be affected by construction activities (e.g., excavation and dewatering) or groundwater lowering during construction.

.2 The following existing structures shall be closely monitored given their proximity to the excavations:
- .1 Existing Lagoon Berms
- .2 Any Structure within 75m of excavation

.3 The Contractor shall be responsible for monitoring all new structures that are in place in proximity to demolition and excavation works.

1.2 REFERENCES

.1 Reference Standards:
- .1 Ontario Provincial Standard Specifications
  - .1 OPSS 539 – Construction Specifications for Temporary Protection Systems
- .2 Ontario Ministry of the Environment, Conservation and Parks (MECP) / Ontario Clean Water Agency (OCWA)
  - .1 O.Reg. 169/03 – Ontario Drinking Water Quality Standards
- .3 Canadian Foundation Engineering Manual, 2006.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Work Meetings:
- .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section with Owner and Consultant to:
  - .1 Verify project requirements.
  - .2 Verify existing site conditions adjacent to demolition work.
  - .3 Discuss the Settlement, Vibration, Groundwater Monitoring Plan and coordinate with Owner regarding locations of monitoring devices.
  - .4 Coordination with other construction sub trades.
- .2 Should alert levels be met, the Contractor shall convene a meeting to discuss rectification of the issue.
- .3 Ensure key personnel (site supervisor, Owner, Consultant, project manager and subcontractor representatives) attend.
- .4 Consultant will provide written notification of change to meeting schedule established upon contract award and 24 hours prior to scheduled meeting.

1.4 SUBMITTALS

.1 Submit in accordance with Division 01.

.2 Settlement, Vibration, Groundwater Monitoring Plan

.1 At least two (2) weeks in advance of construction, the Contractor shall submit a detailed Settlement, Vibration, Groundwater Monitoring Plan, sealed by a Professional Engineer licensed in the Province of Ontario, for review by Consultant. This plan must be implemented in advance of any construction or demolition work being undertaken. This shall include:

.1 A detailed pre-construction survey of structures in areas where settlement/vibration monitoring is required. Any existing interior/exterior structural deficiencies (such as cracks) in the structures shall be identified during this pre-construction survey as well as the methodology for how these will be monitored during construction.

.2 A description of the scope of the monitoring program and the methodology required to meet the plan's objectives.

.3 Communication methodology for exceedances.

.4 Settlement monitoring requirements:

.1 Locations of settlement monitors (with the types and locations of survey monuments used for the settlement monitoring specified).

.2 Location, description and elevation of settlement monitoring benchmarks.

.3 Survey staff and equipment for settlement monitoring (with achievable tolerances).

.4 Frequency of settlement readings and data logging, including approach for logging.

.5 Proposed monitor triggering and precautionary measures to be employed

.6 Approach if the settlement or vibration readings exceeds acceptable limits.

.5 Vibration monitoring requirements:

.1 Submit CVs of key individuals. Qualifications of the Specialist Sub-Contactor include five (5) years of experience completing projects of similar size, scope and complexity. A minimum of five (5) projects shall be identified.

.2 Identification of the individual(s), and their contact information, designated to oversee the vibration monitoring system(s); and the daily recording of activities required in this specification.

.3 Detailed description of the vibration monitoring system and if necessary, catalog cuts of monitoring equipment that will be used; how the equipment will be calibrated and recalibrated if necessary during the life of the project including calibration certificates; description and schematics if necessary of how the independent components will function as a system.

.4 Methodology confirming placement of vibration monitors relative to the construction (i.e., monitors which are relocated to follow current construction activities or the use of more monitors which do not need to be moved as often).

.5 Method of Instrumentation and installation on the site.

.6 Locations of vibration monitoring.

.7 Frequency of vibration readings and data logging, including approach for logging.

.8 Proposed monitor triggering and precautionary measures to be employed

.9 Proposed monitor triggering and precautionary measures to be employed

.10 Approach if the settlement or vibration readings exceeds acceptable limits.

.6 Included in the Settlement and Vibration Monitoring Plan shall be the Contractor's Contingency Plan which provides the mitigation and response plan for potential exceedances of the Review Limit assigned for total and differential settlement or the Vibration Limits specified. The Contingency plan shall include how the Contractor will first address the exceedance (such as immediately stopping all settlement/vibration inducing work and increasing monitoring frequency) and then how they will alter their construction methodology to ensure that no further settlement or vibration beyond the limit occurs.

.2 Once the plan has been implemented, the Contractor shall provide weekly monitoring reports to the Consultant detailing settlement and vibration readings. Reports shall be provided immediately if limits are exceeded. Information required to be required in the Monitoring Reports shall include:

.1 A written description of the monitoring activities completed that week.

.2 The date(s) and time(s) of all monitoring activities carried out.
.3 Survey grade control elevations taken that week on the settlement monitoring points including an historical tabulation of all shots taken since the establishment of the points.
.4 Changes to vibration monitoring locations to reflect construction progress.
.5 A statement indicating that the results of the monitoring show that the risks of settlement/vibration of adjacent structures are within acceptable tolerances and construction practices as established on site can continue.

1.5 QUALITY ASSURANCE

.1 Qualifications:
  .1 The settlement monitoring shall be conducted by a specialist sub-contractor with a minimum of five (5) years of experience in Ontario.
  .2 The vibration monitoring shall be conducted by a specialist sub-contractor with a minimum of five (5) years of experience in Ontario carrying out vibration monitoring and vibration studies.

1.6 MEASUREMENT FOR PAYMENT

.1 Measurement for payment for the Settlement, Vibration, and Groundwater Monitoring Plan shall be as a lump sum, all inclusive, in accordance with the following payment schedule:
  .1 25% upon submission and acceptance of the Monitoring Plan
  .2 50% upon completion of all construction work
  .3 25% upon receipt and acceptance of post-construction final reporting.

.2 Measurement for payment for Settlement, Vibration, and Groundwater Level Monitoring shall be per each week during which vibration, settlement and groundwater level monitoring is ongoing, and includes all equipment, material and personnel to perform the monitoring, as well as weekly reports to the Consultant.

.3 The installation and removal of settlement monitors (including reinstatement due to destructive monitoring techniques such as anchor pins in foundations – such as foundation patching and parging) is deemed incidental to the work and no separate payment will be made.

.4 The Contractor is responsible for notifying the Consultant of when settlement/vibration/groundwater level monitoring is ongoing and when settlement/vibration/groundwater level monitoring is not occurring. Note that payments for monitoring will be withheld until such time as all Reports have been provided up to the cut-off date for the progress payment.

PART 2 - PRODUCTS

2.1 VIBRATION MONITORING EQUIPMENT

.1 Vibration monitoring shall be carried out using an Instantel Minimate Plus seismograph or an approved equivalent capable of monitoring on a continuous basis and providing peak levels at regular intervals (no greater than five minutes), as well as full waveform data.

.2 The vibration monitoring equipment shall be capable of measuring vibration intensities up to 254 mm/s at a frequency response of 2 to 250 Hz.

.3 The vibration monitor shall be equipped with a real time warning system consisting of either a red flashing light or an air horn alert when the threshold value is reached.

.4 All vibration instruments shall be calibrated within the past six (6) months to ensure accurate and reliable instrument performance.

PART 3 - EXECUTION

3.1 SETTLEMENT MONITORING

.1 Each structure or service shall be provided with, at a minimum, three (3) monitors two (2) at the side of each structure closest to the excavations and one (1) at the side of each structure furthest from the excavations to monitor for potential differential movement.

.2 All elevations shall be monitored relative to a non-settling benchmark (e.g., a bedrock outcrop, a building located outside the influence of the project built on piles or bedrock, or an existing maintenance hole not impacted by construction). These benchmark monument(s) shall clearly be identified in the Contractor's Settlement Monitoring Plan, which shall also reference which structures are monitored relative to which benchmark. Survey reading for settlement monitoring will be completed with a tolerance of +/- 2 mm. Survey control shall be carried out by a third-party OLS-Certified Land Surveyor, not affiliated with the Contractor.

.3 Baseline elevations of each structures' survey monuments shall be established by taking three complete sets of readings in advance of any construction, completed on three separate days. The average of the three readings will be used as the baseline for subsequent readings.

.4 Subsequent readings should be taken weekly during all construction activities, which includes drilling, excavation, backfilling/compacting, demolition and paving, at all existing and new structures.

.5 The Consultant retains the discretion to increase the frequency of readings if measurements in excess of the review limit are recorded.

.6 A final set of readings shall be collected at six (6) months following completion of construction. The Contract Consultant shall receive a copy of all settlement monitoring for their reference immediately after the survey is completed.

.7 The movement limits at all locations shall be as follows:

.1 Review Limit: Total Settlement: 4 mm

.2 Alert Limit: Total Settlement 6 mm.

.8 The Consultant shall be notified immediately if the Review Limit for a structure or service is exceeded.

.9 If the Review Limit is exceeded, survey readings shall be taken hourly, during active work, until three (3) consecutive readings indicate that the movement magnitudes are not increasing (i.e., the movements have stopped or the rate of movement has slowed to a rate that does not indicate the Alert Level will be exceeded during the remaining work duration).

.10 If the Alert Limit is exceeded at any structure, construction shall cease immediately until a plan is developed by the Contractor to proceed safely without causing additional settlement to the building or service.

3.2 VIBRATION MONITORING

.1 No vibration producing construction activities including demolition can begin until the vibration monitoring system is verified to be operating by the Vibration Monitoring Specialist.

.2 The Vibration Monitoring Specialist will furnish, maintain and operate (amplitude and frequency sensitive) vibration monitoring system during any vibration producing activities completed. The system shall be installed and maintained in accordance with manufacturer's recommendations, calibration standards, and specifications. Sufficient monitors will be employed to accurately measure vibrations in the adjacent spaces.

.3 Construction activities shall be controlled to limit the peak particle velocities at all adjacent structures and services such that vibration induced damage will be avoided.

.4 The following table defines the frequency dependent peak vibration limits for all construction activities (activities including piling, excavating, demolition and compacting are particularly vibration-inducive).

Element	Frequency (Hz)	Maximum Peak Particle Velocity, PPV (mm/sec)
Structures and Services	≤ 40	20
	> 40	50
Concrete and Grout < 72 hours from placement	N/A	10

.5 Vibration monitoring points shall be established as required and shall be monitored and maintained on a continuous basis over the entire construction duration.

.6 As a minimum, vibration monitoring shall be carried out, during all construction activities, at every structure and locations of critical equipment within 75 m of active work:

.7 The monitoring plan shall clearly identify all monitoring points and vibration monitoring equipment to be used. The monitoring shall include but not be limited to ground vibration, peak sound pressure level and water over pressure.

.8 All instrumentation shall have been calibrated annually and be capable of measuring and recording frequencies in three mutually perpendicular directions.

.9 Vibration intensive construction activities (e.g., piling, excavation, compaction, etc.,) shall commence at the furthest points of work from the closest structure or service to assess the ground vibration attenuation characteristics and to confirm the anticipated ground vibration levels based on the Contractor's proposal.

.10 If the vibration monitoring demonstrates that construction activities are resulting in vibrations that exceed the aforementioned vibration limits, the Contractor shall be required to stop and immediately adjust their operation including the use of different equipment until the construction vibrations are below the specified vibration limits.

.11 Vibration monitoring data shall be maintained throughout the demolition activities. Where 80% of the prescribed limit is met, the Contractor, Owner and Consultant shall be advised and adjustments should be completed to ensure exceedances do not occur. Should vibration exceedances be identified, then the work shall be adjusted to meet the vibration limits and all parties advised of the proposed adjustments.

.12 Following successful start-up of the vibration monitoring system, the Specialist shall carry out a site visit to assess the observed vibration producing construction activities activities along with the measured vibrations. The Specialist shall furnish a report identified corrective actions as required. Follow-up visits will be required if exceedances are identified.

END OF SECTION

PART 1- GENERAL

1.1 SECTION INCLUDES

.1 This section includes the requirements for the design, installation and testing of grouted rock anchors for the anchoring of the Clarifiers, Aerations Tanks, Tunnel, and Process Building against buoyancy uplift of the structures. The grouted rock anchors shall be designed for the tension loads, displacement criteria under this tension, as well as the noted compression loads obtained from compatibility between the rock and grout.

.2 The Contractor is responsible for furnishing all design, materials, products, accessories, tools, equipment, services, transportation, labour and supervision, and manufacturing techniques required for design, installation and testing of rock anchors and top attachments for this project.

.3 The Contractor shall select the rock anchor type, size, top attachment, bearing plate thickness, installation means and methods, estimate the ground-grout bond value and determine the required grout bond length and final rock anchor diameter. Contractor shall design and install rock anchors that will develop the load capacities indicated on the drawings.

.4 The rock anchor load capacities shall be confirmed via verification and proof load testing as specified herein and must meet the test acceptance criteria specified herein.

1.2 DEFINITIONS

Admixture: Substance added to the grout to control bleed and/or shrinkage, improve flowability, reduce water content, or retard setting time.

Alignment Load (AL): An initial load applied to rock anchor during testing to keep the testing equipment correctly positioned (Typically 5% maximum test load).

Bonded Length: The length of the rock anchor that is bonded to the ground and conceptually used to transfer the applied axial loads to the surrounding soil or rock. Also known as the load transfer length.

Bond-breaker: A sleeve placed over the steel reinforcement to prevent load transfer.

Casing: Steel tube introduced during the drilling process in overburden soil to temporarily stabilize the drill hole. This is usually withdrawn as the Rock Anchor is grouted, although in certain types of rock anchors, some casing is permanently left in place to provide added Rock Anchor reinforcement.

Centralizer: A device to support and position the reinforcing steel in the drill hole and/or casing so that a minimum grout cover is provided.

Class I Corrosion Protection – A Class I corrosion protection system encases the prestressing steel inside a plastic sheath filled with either grout or corrosion inhibiting compound.

Creep Movement: The movement that occurs during the creep test of a rock anchor under a constant load.

Design Load (DL): The maximum ULS factored load expected to be applied to the rock anchor during its service life.

Coupler: The means by which load capacity can be transmitted from one partial length of reinforcement to another.

Contractor: The person/firm responsible for performing the work.

Duplex Drilling: Means a drilling system involving simultaneous rotation and advancement of (inner) drill rod and (outer) drill casing in which the cuttings from the inner drill rod exit the borehole via the annulus between the rod and the casing.

Elastic Movement: Means the recoverable movement measured during rock anchor test.

Encapsulation: A corrugated or deformed tube protecting the reinforcing steel against corrosion.

Free (Unbonded) Length: The designed length of the rock anchor that is not bonded to the surrounding ground or grout.

Geotechnical Bond Design Strength: For Ultimate Limits States (ULS) or Load Factor Design (LFD), computed as the nominal grout-to-ground bond strength multiplied by a geotechnical resistance factor φ_g. Use:

.1 $\varphi_g = 0.6$ for compression loading
.2 $\varphi_g = 0.4$ for compression loading

Maximum Pre-production Anchor Test Load: The maximum load to which the rock anchor is subjected during pre-production testing. The maximum test load shall not exceed 0.8 x ultimate tensile strength of the rock anchor bar. Testing to be completed to the nominal grout-to-ground bond strength for the rock anchor configuration and dimensions.

Maximum Production Anchor Test Load: The maximum load to which the rock anchor is subjected to as part of production testing (Proof Load Test). Test shall not exceed 0.9 x DL for production load tests. The maximum test load shall not exceed 0.8 x ultimate tensile strength of the rock anchor bar.

Nominal Grout-to-Ground Bond Strength: The estimated ultimate geotechnical unit grout-to-ground bond strength selected for use in design.

Overburden: Material, natural or placed, that may require cased drilling methods to provide an open borehole to underlying strata.

Performance Load Test**:** Rock anchor load test performed to verify the design of the rock anchor system and the construction methods proposed, prior to installation of production rock anchors.

Post-grouting: The injection of additional grout into the load transfer length of a rock anchor after the primary grout has set. Also known as regrouting or secondary grouting.

Primary Grout: Portland-cement-based grout injected into the rock anchor hole prior to or after the installation of the reinforcement to direct the load transfer to the surrounding ground along the rock anchor.

Pre-Production Rock anchor: Means a sacrificial Rock anchor that is not part of the final foundation system and is subjected to load testing to verify the design and installation procedures.

Production Rock anchor: Means a Rock anchor that forms part of final foundation support system to structure.

Proof Load Test: Incremental loading of a production rock anchor, recording the total movement at each increment.

Reinforcement: The steel component of the rock anchor that accepts and/or resists applied loadings. This includes central steel bar and permanent steel casing used in this Contract.

Residual Movement: Means the non-elastic (non-recoverable) movement of a Rock anchor measured during load testing

Rock anchor: A small-diameter, bored, cast-in-place composite pile, in which the applied load is resisted by steel reinforcement, cement grout and frictional grout/ground bond.

Sheathing: Smooth or corrugated piping or tubing that protects the reinforcing steel against corrosion.

Spacer: A device to separate elements of a multiple-element reinforcement.

Ultimate Grout-To-Ground Bond Value: Means the estimated ultimate geotechnical unit grout-to-ground bond strength selected for use in design.

Ultimate Load (UL): Rock anchor load corresponding to the nominal grout-to-ground bond strength for the Rock Anchor configuration and dimensions.

Verification Load Test: Rock Anchor load test performed to verify the design of the rock anchor system and the construction methods proposed, prior to installation of production rock anchors.

1.3 REFERENCES

.1 Standards listed below govern minimum quality of work required under this Section:

- .1 American Society of Civil Engineering (ASCE):
  - .1 ASCE 20-96 “Standard Guidelines for the Design and Installation of Pile Foundations”
- .2 ASTM International Inc.
  - .1 ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products”
  - .2 ASTM A252/SA252 “Welded and Seamless Steel Pipe Piles”
  - .3 ASTM A 307-14 “Standard Specification for Carbon
  - .4 Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength”.
  - .5 ASTM A 325-14 “Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength”
  - .6 ASTM A 325M-14 “Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric)”
  - .7 ASTM A 490M-14a “Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)”
  - .8 ASTM A521/A521M-06 “Standard Specification for Steel, Close Impression Die Forgings for General Industrial Use”
  - .9 ASTM A572”High-Strength Low-Alloy Columbium-Vanadium Structural Steel”
  - .10 ASTM A615 “Deformed and Plain Billet Steel Bars for Concrete Reinforcement”
  - .11 ASTM A 722/A722M-07 “Standard Specification for Uncoated High Strength Steel Bar for Prestressing Concrete”
  - .12 ASTM A775 “Epoxy -Coated Reinforcing Steel Bars”
  - .13 ASTM A934 “Epoxy-Coated Prefabricated Steel Reinforcing Bars”
  - .14 ASTM A 1011/A 1011M-14 “Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength”
  - .15 ASTM C33 “Concrete Aggregates”
  - .16 ASTM C109 “Compressive Strength of Hydraulic Cement Mortar”

.17 ASTM C144 - Aggregate for Masonry Mortar
.18 ASTM C150 “Portland Cement”
.19 ASTM C188 “Density of Hydraulic Cement”
.20 ASTM C494 “Chemical Admixtures for Concrete”
.21 ASTM D1143D/D1143M “Standard Test Method for Deep Foundations under Static Axial Compressive Load”
.22 ASTM D 1748-22 “Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds”
.23 ASTM D3350 “Polyethylene Corrugated Tubing”
.24 ASTM D3689 “Standard Test Method for Deep Foundations Under Static Axial Tensile Load”
.25 ASTM D 3966/D 3966M-07(2013)E1 “Standard Test Methods for Deep Foundations Under Lateral Load”
.26 ASTM D 3689/D 3689M-07(2013)E1 “Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
.27 ASTM D 3740-12a “Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction”
.28 ASTM D 4945-12 “Standard Test Method for High-Strain Dynamic Testing of Deep Foundations”

.3 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-85.10-99, “Protective Coatings for Metals”

.4 Canadian Geotechnical Society Publications:
.1 CFEM, “Canadian Foundation Engineering Manual”

.5 Canadian Standards Association (CSA International)
.1 CSA A23.1/A23.2-14 “Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practice for Concrete.
.2 CSA A283 Qualification Code for Concrete Testing Laboratories
.3 CSA A3000-14 Cementitious Materials Compendium
.4 CSA G30.18-09 (R2014) “Carbon Steel Bars for Concrete Reinforcement”
.5 CSA G40.20-13/G40.21-13 “General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel”
.6 CSA-S16-14 “Limit States Design of Steel Structures”
.7 CSA W47.1-09 (R2014) “Certification of Companies for Fusion Welding of Steel”
.8 CSA W48-14 “Filler Metals and Allied Materials for Metal Arch Welding”
.9 CSA W59-13 “Welded Steel Construction (Metal Arch Welding)”
.10 CSA W186-M1990 (R2012) “Welding of Reinforcing Bars in Reinforced Concrete Construction”

.6 Deep Foundations Institute (DFI):
.1 Guide to Drafting a Specification for High Capacity Drilled and Grouted Rock anchors for Structural Support, 1st Edition, Copyright 2001 by the Deep Foundation Institute

.7 Master Painters Institute
.1 MPI-INT 5.1-08 “Structural Steel and Metal Fabrications”
.2 MPI-EXT 5.1-08 “Structural Steel and Metal Fabrications”

.8 Post Tensioning Institute Publications:
.1 Recommendations for Prestressed Rock and Soil Anchors

.9 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
.1 SSPC-SP 5/ NACE No.1-Latest Edition “White Metal Blast Cleaning”
.2 SSPC-SP 6/NACEN No.3-Latest Edition “Commercial Blast Cleaning”

.10 U.S. Department of Transportation, Federal Highway Administration (FWHA):

.1 FHWA-SA_97-070 “Rock anchor Design and Construction Guidelines Manual”
.2 NHI-05-039 “Rock anchor Design and Construction”.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: in accordance with Division 01, convene pre-installation meeting one (1) week prior to commencing installation of rock anchors.
  .1 Ensure key personnel, site supervisor, Owner, Consultant, Quality Assurance Geotechnical Engineer attend.
    .1 Verify requirements.
    .2 Coordinate construction schedule and activities.

1.5 SUBMITTALS

.1 Submit in accordance with Division 1.

.2 Project Team Experience:
  .1 At least 45 days before the planned start of rock anchor construction, the Contractor shall submit a completed project reference list and a personnel list for review.
    .1 The project reference list shall include:
      .1 A list of at least 5 similar projects that have been completed in the last 5 years involving construction of rock anchors of similar capacity to those required in these plans and specifications.
      .2 A brief description of each project with the Owner’s name and current phone number.
      .3 Construction details, structural details and load test results for at least 3 projects of similar scope.
    .2 The personnel list shall include:
      .1 Identification of the rock anchor system designer, supervising project engineer, drill rig operators and onsite foreman to be assigned to the project.
      .2 A Summary of each individual’s experience and qualifications including a list of at least 3 similar projects completed in the last 5 years by each of the listed personnel.
  .2 Acceptance of the Contractor’s qualifications is considered a prerequisite for commencing work of this section. The Consultant will approve or reject the Contractor’s qualifications within 15 days after receipt of a complete submission. All costs associated with incomplete or unacceptable submittals shall be borne by the Contractor.

.3 Design Submittals:
  .1 Submit complete design calculations and working drawings to the Consultant for review.
  .2 Include all details, dimensions, quantities, ground profiles and cross-sections necessary to construct the rock anchors. Verify the limits of the rock anchors and ground survey data before preparing the detailed working drawings.
  .3 Design calculations and working drawings to be signed and sealed by a Professional Engineer licensed in the Province of Ontario in the employ of the Contractor.
  .4 Design calculations shall include, but not be limited to, the following items:
    .1 A written summary report which describes the overall rock anchor design.
    .2 Applicable code requirements and design references.
    .3 Design calculation sheets with the project number, rock anchor structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page.

.4 Rock Anchor structure critical design cross-section(s) geometry including soil/rock strata and water levels and location, magnitude and direction of design applied loadings, including slope or external surcharge loads.

.5 Design criteria including, soil/rock shear strengths (friction angle and cohesion), unit weights, and ground-grout bond values and rock anchor drill-hole diameter assumptions for each soil/rock strata.

.6 Load and resistance factors used in the design on the ground-grout bond values, surcharges, soil/rock and material unit weights, steel, grout, and concrete materials.

.7 Design notes including an explanation of any symbols and computer programs used in the design.

.8 Rock anchor to foundation connection for steel bearing plate calculations.

.5 Working drawings shall include all information required for the construction and quality control of the piling. Working drawings shall include, but not be limited to, the following items unless provided in the contract plans:

.1 A plan view of the rock anchor layout(s) identifying:

.1 A reference baseline and elevation datum.

.2 The offset from the construction centerline or baseline to the face of the rock anchor structure at all changes in horizontal alignment.

.3 Beginning and end of rock anchor structure stations.

.4 Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned existing utilities, adjacent structures or other potential interferences. The centerline of any drainage structure or drainage pipe behind, passing through, or passing under the rock anchor structure.

.5 Subsurface exploration locations shown on a plan view of the proposed rock anchor structure alignment with appropriate reference base lines to fix the locations of the explorations relative to the rock anchor structure.

.2 An elevation view of the rock anchor structure(s) identifying:

.1 Elevation view showing rock anchor locations and elevations; vertical and horizontal spacing; batter and alignment and the location of drainage elements (if applicable).

.2 Existing and finish grade profiles both behind and in front of the rock anchor structure.

.3 Design parameters and applicable codes.

.4 General notes for constructing the rock anchor structure including construction sequencing or other special construction requirements.

.5 Horizontal and vertical curve data affecting the rock anchor structure and rock anchor structure control points. Match lines or other details to relate rock anchor structure stationing to centerline stationing.

.6 A listing of the summary of quantities on the elevation drawing of each rock anchor structure showing pay item estimated quantities (if applicable).

.7 Rock anchor typical sections including rock anchor spacing and inclination; minimum drillhole diameter; pipe casing and reinforcing bar sizes and details; splice types and locations; centralizers and spacers; grout bond zone and casing plunge lengths (if used); corrosion protection details; and connection details to the substructure footing, anchorage, plates, etc.

.8 A typical detail of verification and production proof test rock anchors defining the rock anchor length, minimum drillhole diameter, inclination, and load test bonded and unbonded test lengths (if applicable).

.9 Details, dimensions, and schedules for all rock anchors, casing and reinforcing steel, including reinforcing bar bending details.

.10 Revise the drawings when plan dimensions are changed due to field conditions or for other reasons.

.4 Construction submittals:

.1 Work other than pre-production test rock anchor installation shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Consultant.

.2 Work Plan: Detailed step-by-step description of the proposed rock anchor construction procedure, including personnel, testing and equipment to assure quality control. This step-by-step procedure shall be shown on the working drawings in sufficient detail to allow the Consultant to monitor the construction and quality of the rock anchors.

.3 Schedule: Proposed start date and time schedule and rock anchor installation schedule providing the following:

.1 Rock anchor number
.2 Rock anchor design load
.3 Type and size of reinforcing steel
.4 Minimum total bond length
.5 Total rock anchor length
.6 Rock anchor top footing attachment

.4 Welding procedure: If welding of casing is proposed, submit the proposed welding procedure, certified by a qualified welding specialist.

.5 Information on headroom and space requirements for installation equipment that verify the proposed equipment can perform at the site.

.6 Surface Water Control Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.

.7 Grouting Plan. The grouting plan shall include complete descriptions, details, and supporting calculations for the following:

.1 Grout mix design and type of materials to be used in the grout including certified test data and trial batch reports.
.2 Methods and equipment for accurately monitoring and recording the grout depth, grout volume and grout pressure as the grout is being placed.
.3 Grouting rate calculations, when requested by the Consultant. The calculations shall be based on the initial pump pressures or static head on the grout and losses throughout the placing system, including anticipated head of drilling fluid (if applicable) to be displaced.
.4 Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance and start of production work. During production, grout shall be tested in accordance with PART 3.
.5 Procedure and equipment for Contractor monitoring of grout quality.

.8 Pre-production Load Testing Plan: Detailed plans for the proposed rock anchor load testing method. This shall include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and rock anchor top movements in accordance with PART 3.

.9 Calibration reports and data for each test jack, pressure gauge and master pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Consultant has reviewed and accepted the jack, pressure gauge, master pressure gauge and electronic load cell calibration data.

.5 Rock anchor Installation Records

.1 Contractor shall prepare and submit to the Consultant full-length installation records for each rock anchor installed. The records shall be submitted within one work shift after that Rock Anchor installation is completed. The data shall be recorded on the rock anchor installation log included at the end of this specification. A separate log shall be provided for each rock anchor.

.6 Mill Certificates:

.1 Certified mill test reports for the reinforcing steel or coupon test results for permanent casing without mill certification. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.

.2 Provide mill reports as the work progresses for each delivery.

.7 Record Drawings:

.1 Within 30 days after completion of the work, submit as-built drawings to the Consultant. Provide revised design calculations signed by the approved Registered Professional Engineer for all design changes made during the construction of the rock anchor structure.

1.6 QUALITY ASSURANCE

.1 Contractor Qualifications:

.1 Contractor shall have a minimum of 5 years of demonstrated experience in the design, installation and load testing of rock anchors that are similar in size and scope of this project.

.2 Contractor shall have previous rock anchor drilling and grouting experience in soil/rock similar to project conditions.

.3 The on-site foreman and drill rig operators shall have experience on at least 3 projects over the past 5 years installing rock anchors of equal or greater capacity than required in these plans and specifications.

.4 The Contractor shall assign an Engineer to supervise the work with experience on at least 3 projects of similar scope to this project completed over the past 5 years.

.5 Rock anchors shall be designed by a Professional Engineer registered in the Province of Ontario with 5 years of demonstrated experienced in the design of rock anchors that are similar in size and scope of this project.

.2 The Owner will retain a Geotechnical Engineer to provide quality assurance review during the course of the rock anchor work in this section. This quality assurance review will involve periodic review of the testing and installation procedures and does not relieve the Contractor of their responsibility for Quality Control. This Geotechnical Engineer will be responsible for observing and reporting on the results of their reviews including witnessing of verification and proof load testing but will not include operation and testing of the rock anchor system.

1.7 EXISTING CONDITIONS

.1 Refer to Geotechnical and Hydrogeological Investigation Reports.

.2 The reports referenced above, including borehole logs listed therein, shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site. Said report shall be used as the basis for the design of the rock anchors using generally accepted engineering judgment and methods.

.3 Before bidding the work, the Contractor shall review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, and location of existing structures and above-ground facilities.

.4 The Contractor is responsible for field locating all utilities and verifying the location of all utilities shown on the plans prior to starting the Work. Maintain uninterrupted service for those utilities designated to remain in service throughout the Work.

.5 Notify Consultant in writing if subsurface conditions encountered at site differ from those indicated and await further instructions from Consultant.

.6 The production load testing of rock anchors is to be completed prior to the placement of the reinforcing and concrete base slab. The Contractor will be responsible for providing the associated provisions to allow for the test to be completed without reliance on the final structure.

1.8 ALTERNATES

.1 Alternative foundation system requests will be reviewed during the submittal process. A stamped engineered shop drawing must be submitted as part of the approval process. Alternative foundation system requests will be considered provided the following minimum requirements have been met.

- .1 The alternative system must meet the same performance requirements (ie. structural capacity, serviceability requirements, service life, etc.) as the specified rock anchor system.
- .2 The Contractor is responsible for assessing the risk with the proposed system relative to the on-site conditions.
- .3 Any required modifications to the foundations to suit the proposed system will be undertaken at no additional cost to the Owner.
- .4 The Contractor will compensate the Consultant for any re-design efforts required to modify the foundations to suit the proposed system. Compensation will be provided via a credit to the contract. The re-design level of effort will be negotiated between the Contractor, Owner, and Consultant using the Consultant's standard hourly rates.

1.9 ROCK ANCHOR DESIGN CRITERIA

.1 The rock anchors shall be designed to meet the specified loading conditions, as shown on the Contract Drawings and herein. Design the rock anchors and bearing plate connections using the Service Load Design (SLD) Procedures contained in the PHWA "Rock anchor Design and Construction Guidelines Manual", Report No. FHWA-SA-97-070.

.2 A minimum unbonded length of 1000 mm into confirmed bedrock shall be employed in the design of the rock anchor, and a minimum bonded length of 2100 mm shall be employed irrespective of design capacity.

.3 Rock anchors shall be located no closer than 1200 mm spacing.

.4 Rock anchor rock/grout design capacity shall be determined using a ULS rock to grout bond stress not to exceed 500 kPa in tension or compression.

.5 Rock anchors must be designed to support a factored compression load of 250 kN. Rock anchors shall be designed to meet the minimum tension loads identified on the Drawings.

.6 The design life of the rock anchor shall be (80) years minimum.

.7 The rock anchors are to be designed as non-prestressed rock anchors and sized to limit elastic movement of the rock anchor to less than 4 mm upwards under the factored design tension load (DL).

.8 Corrosion protection of the internal steel reinforcing bars, consisting of either encapsulation, epoxy coating, or hot dip galvanized finish, shall be provided. Corrosion system consisting of grout only will not be considered acceptable due to the potential for cracking under tensile loads.

.9 Steel pipe used for rock anchor permanent casing shall incorporate an additional 1.6 mm thickness of sacrificial steel for corrosion protection, unless specified otherwise. Where permanent casing is used for a portion of the rock anchor, encapsulation shall extend at least 1.5 m into the casing.

.10 Design of the rock anchors must consider the maximum pre-production test loads (UL) in their design.

1.10 PROTECTION

.1 Prevent damage to existing buildings, structures, landscaping, trees, fences, roads, and adjacent property. Make good any damage.

.2 Complete a preinstallation survey of existing buildings and properties. This should be completed as part of the Pre-Construction Survey in Division 1.

.3 Coordinate with the requirements outlined in 02450 – Settlement, Vibration and Groundwater Monitoring.

.4 Arrange sequencing of rock anchor installation and methods to avoid damage to adjacent existing structures. When damages occur, remedy damaged items to restore to original or better condition at Contractor's expense.

1.11 EXAMINATION

.1 Prior to commencement of any installation activities, carefully examine all Contract Documents and shop drawings which affect this work. Report any discrepancies to the Consultant for their direction.

.2 Examine all site conditions and work of other trades which may affect this work. Report any inconsistencies to the Consultant for their direction.

1.12 COORDINATION

.1 Cooperate with all other trades to fully coordinate all dimensions, etc. which may be required during installation.

1.13 STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's instructions.

.2 Protect rock anchors from damage due to excessive bending stresses, impact, abrasion, or other causes during delivery, storage, and handling.

.3 Replace damaged rock anchors as directed by Consultant at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Threaded reinforcing steel bar to ASTM A722, Grade 835/1030MPa. Threaded bars to be proof stressed and stress relieved post-tensioning threaded bar. Standard of Acceptance: Products by Dywidag International Inc.

.2 Structural steel plates and shape for rock anchor top attachments shall conform to CSA G40.21 Grade 350W. Minimum geometry is as shown on the drawings. Final sizing of the bearing plate is by the rock anchor designer.

.3 Anchor nut and splice couplers to be compatible with threaded reinforcing steel bar to ASTM A521 and be capable of developing 125% of the ultimate tensile strength of the bar.

.4 Permanent steel casing pipe to ASTM A252, Grade 3, except the yield strength shall be the minimum used in the design submittal.

.5 Grout to CAN/CSA-A3000 with Type 50 sulphate resistant cement for grouting in contact with in-situ rock and Type 20 cement for grouting within corrosion protection system encased by PVC. Minimum grout strength to be 40MPa at 28 days.

.6 Grout admixtures to ASTM C494 to manufacturer's recommendations. Non-chloride.

.7 PVC Casing/Corrosion Protection System to ASTM D1784.

.8 Cement shall be Portland cement conforming to ASTM C 150.

.9 Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube, steel, or material non-detrimental to the reinforcing steel. Centralizers and spacers shall be spaced no further than 3000 mm apart and 1500 mm from the bottom of the rock anchor. Centralizer/spacer shall be sized ensure the position of the rock anchor is within 10 mm of plan location from centre of Rock Anchor and sized to allow grout installations to occur starting at the bottom of the drill hole and flow freely up the drill hole.

.10 Encapsulation (double corrosion protection) shall be shop fabricated using high-density, corrugated polyethylene tubing conforming to the requirements of ASTM D3350/AASHTO M252 with a nominal wall thickness of 0.8 mm. The inside annulus between the reinforcing bars and the encapsulating tube shall be a minimum of 5 mm and be fully grouted with non-shrink grout.

.11 Epoxy coating shall be in accordance with ASTM A775 or ASTM A934, minimum thickness of coating applied electrostatically to the reinforcing steel shall be 0.3 mm. Bearing plates and nuts encased in the Rock Anchor concrete footing need not be epoxy coated.

.12 Fine Aggregate: If sand - cement grout is used, sand shall conform to ASTM C 144.

.13 Grout: Neat cement or sand/cement mixture with a minimum three (3)-day compressive strength of 14 MPa and a 28-day compressive strength of 28 MPa per ASTM C109. Final grout mix design shall be determined by the Contractor and their design engineer.

.14 Provide a minimum 25 mm grout cover over bare or epoxy coated bars (excluding bar couplers) or minimum 12 mm grout cover over the encapsulation of encapsulated bars.

.15 Sheathing: Smooth or corrugated plastic sheathing, including joints, shall be watertight. Polyvinyl chloride (PVC) sheathing shall conform to ASTM D1784, Class 13464-B.

.16 Water used in the grout mix shall be potable, clean, and free from substances that may be injurious to cement and steel.

2.2 EQUIPMENT

.1 All equipment for the installation, testing and monitoring of the pre-production (verification) and production rock anchors shall be suitable for the intended purposes and capable of working on the site under the prevailing access and clearance conditions.

.2 The equipment used shall be capable of installing and grouting the rock anchors to the prescribed depths or elevations without damage to the rock anchor materials or to the adjacent structures.

.3 Gas/Diesel-operated rigs will not be permitted indoors.

.4 All grout mixers, pumps and hoses shall be of an adequate capacity and shall be sized to enable the grout to be pumped in one continuous operation, while keeping the grout in constant agitation prior to pumping, and to allow continuous grouting.

.1 A high speed, high shear, colloidal grout mixer with a gauge to measure the quantity of water discharged into the mixer shall be used.

.2 A paddle mixer is not acceptable.

.3 The grout pump(s) shall be equipped with a pressure gauge to monitor grout pressures of at least 1MPa or twice the actual grouting pressures used, whichever is greater.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Do not commence production rock anchor installation until all required quality control tests have been completed and test results approved by Consultant.

.2 Review bedrock type and quality from geotechnical report and make appropriate judgement regarding quantities of grout required for consolidation and achieving grout bond to rock. No claims for compensation based on rock quality and volumes of grout will be considered.

.3 Carry out installation and testing in accordance with Recommendations for Prestressed Rock and Soil Anchors.

.4 Drill rock anchor holes using equipment suitable for the subgrade and site conditions in locations and depths as indicated on drawings and/or approved shop drawings. Drilling for rock anchors to be completed with percussive rotary equipment. Holes to be uniform in diameter and vertically aligned within +/- 75 mm.

.5 Provide temporary casing as required to ensure stability of drilled rock anchor holes.

.6 Thoroughly flush rock flour from holes and provide notification for inspection of holes by geotechnical engineer. All holes left ungrouted for more than twelve hours to be recleaned.

.7 Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment to avoid eccentricity. Threaded pipe casing joints shall be located at least two casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, bar splices shall be staggered at least 300 mm.

.8 Centralizers and spacers shall be securely attached to the reinforcement; sized to position the reinforcement within 10 mm of plan location from center of Rock Anchor; sized to allow grout tremie pipe insertion to the bottom of the drillhole; and sized to allow grout to freely flow up the drillhole and casing and between adjacent reinforcing bars.

.9 Install rock anchors in holes and fully grout. Ensure adequate grout pressure is applied to drive grout into rock and ensure that bond can be achieved. Grout to be mixed as per approved mix design, incorporating specified cement types.

.10 Damage to corrosion protection system will result in rejection. Ensure rock anchors are stored and placed with sufficient care to protect corrosion protection system.

.11 Perform initial grout and rock bond test on rock anchors and perform creep tests on select anchors as directed by geotechnical engineer. All testing to be completed prior to constructing raft slab.

.12 The Contractor shall control drill flush and construction related waste, including excess grout, during rock anchor installation and dispose of the same in accordance with Municipal, Provincial and Federal Laws.

.13 Rock Anchor Allowable Construction Tolerances

- .1 Centerline of installed rock anchors no more than 50 mm from that indicated on the Contract Drawings.
- .2 Rock anchor hole alignment within 2% of total-length plan alignment.
- .3 Top elevation of Rock Anchor shall be plus or minus 25 mm maximum from vertical elevation indicated.
- .4 Centerline of reinforcing steel shall not be more than 15 mm from indicated location.

.14 During construction, the Contractor shall observe the conditions in vicinity of the rock anchor construction site on a daily basis for signs of ground heave or subsidence. Contractor shall suspend operations and immediately notify the Consultant if signs of movements are observed.

3.2 MATERIAL TESTING

.1 Grout Testing

- .1 Grout within the rock anchor verification and proof test rock anchors shall attain the minimum required three (3)-day compressive strength of 14 MPa prior to load testing.
- .2 Previous test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production verification test rock anchors and initial production rock anchors.

.3 During production, rock anchor grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one set of three 50-mm grout cubes from each grout plant each day of operation or per every 10 rock anchors, whichever occurs more frequently. The compressive strength shall be the average of the 3 cubes tested.

.4 Grout consistency as measured by grout density shall be determined by the Contractor per ASTM C188/AASHTO T133 or API RP-13B-1 at a frequency of at least one test per Rock Anchor, conducted just prior to start of Rock Anchor grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout. The measured grout density shall be as indicated on working drawings provided by the Contractor.

.5 Grout samples shall be taken directly from the grout plant. Provide grout cube compressive strength and grout density test results to the Consultant within 24 hours of testing.

3.3 LOAD TESTS

.1 Perform verification and proof load testing of rock anchors at the locations specified herein or designated by the Consultant. Perform compression load testing in accordance with ASTM D1143 and tension load testing in accordance with ASTM D3689, except as modified herein.

.2 The maximum verification test loads applied to the rock anchor shall not exceed 80% of the structural capacity of the rock anchor structural elements, to include steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification test rock anchor elements above the strength required for the production rock anchors shall be provided for in the contractor’s bid price.

.3 The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required. When both compression and tension load testing is to be performed on the same rock anchor, the rock anchor shall be tested under compression loads prior to testing under tension loads.

.4 For convenience of testing and set-up, rock anchor testing may be performed in tension, regardless of the governing load.

.5 Testing Equipment and Data Recording

.1 Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The load cell is required only for the creep test portion of the verification test. The contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves in accordance with the Submittals Section.

.2 Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Align the jack, bearing plates, and stressing anchorage such that unloading and repositioning of the equipment will not be required during the test.

.3 Apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge shall be graduated in 500 kPa increments or less. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow the test to be done without resetting the equipment. Monitor the creep test load hold during verification tests with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test.

.4 Measure the Rock Anchor top movement with a dial gauge capable of measuring to 0.025 mm. The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge. Visually align the gauge to be parallel with the axis of the rock anchor and support the gauge independently from the jack, Rock Anchor or reaction frame. Use a minimum of two dial gauges when the test setup requires reaction against the ground or single reaction piles on each side of the test rock anchor.

.5 The required load test data shall be recorded by the Engineer.

3.4 PRE-PRODUCTION (VERIFICATION) LOAD TESTS

.1 Perform pre-production rock anchor load testing to verify the design of the rock anchor system and the construction methods proposed prior to installing any production rock anchors.

.2 Pre-production load tests shall be performed to verify that the Contractor installed rock anchors will meet the required tension load capacities and load test acceptance criteria and to verify that the length of the rock anchor load transfer bond zone is adequate. The rock anchor verification load test results must verify the Contractor's design and installation methods, and be reviewed and accepted by the Consultant prior to beginning installation of production rock anchors. Installation of production rock anchors should not proceed until all verification test results have been reviewed and accepted by the Consultant.

.3 Rock anchors used for pre-production testing should not remain in place for usage as production rock anchors unless reviewed and accepted by the Consultant. Test rock anchors to be removed or cut-off and abandoned following completion of testing.

.4 Pre-production Rock Anchor Test Configuration and Construction

.1 The drilling-and-grouting method, casing size, and drill size for the verification test rock anchor(s) shall be identical to those specified for the production rock anchors at the given locations. The verification test rock anchor structural steel sections shall be sized to safely resist the maximum test load.

.2 Test verification rock anchors must be full-scale (same configuration and dimensions as production rock anchors).

.5 Pre-Production Test Quantities and Location

.1 Two (2) sacrificial pre-production rock anchors shall be constructed in conformance with the approved Working Drawings for the purposes of pre-production verification.

.2 Pre-production rock anchors shall be installed at the locations proposed by the Contractor and approved by the Consultant. Test rock anchors are to be located such that their installation and performance is representative of production rock anchors, and in locations that will not interfere with production rock anchor installation.

.6 Verification Test Loading Schedule

.1 Test pre-production rock anchors to a maximum test load corresponding to the nominal grout-to-ground bond strength based on the test rock anchor configuration (full-scale) or Ultimate Load (UL).

.2 The pre-production rock anchor load tests shall be made by incrementally loading the rock anchor in accordance with the load schedule for the governing load(s):

LOAD	HOLD TIME
AL	1 min
0.10UL	1 min
0.15UL	1 min
0.20UL	1 min
0.25UL	1 min
0.30UL	1 min
0.35UL	1 min
0.40UL	1 min
0.45UL	1 min
0.50UL	1 min
0.55UL	1 min
0.60UL	1 min
0.65UL	1 min
0.70UL	1 min
0.75UL	1 min
0.80UL	1 min
0.85UL	1 min
0.90UL	1 min
0.95UL	1 min
1.00UL	CREEP TEST (10 min to 60 min)
0.80UL	1 min
0.60UL	1 min
0.40UL	1 min
0.20UL	1 min
AL	1 min

.3 The alignment load (AL) shall not exceed 5% of the UL. Dial gauges shall be reset to zero after the initial AL is applied.

.4 The test load shall be applied in increments of 10 percent of the UL. Each load increment shall be held for a minimum of 1 minute. Rock Anchor top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. Unloading shall be applied in decrements of 20% of the UL.

.5 The rock anchor shall be monitored for creep at the maximum test load (1.00UL): hold the Rock Anchor load for 10 min and record displacement at 0, 1, 2, 3, 4, 6, 10 minutes. If net creep from 1 to 10 minutes exceeds 1.0 mm, hold for additional 50 min with displacement readings at 20, 30, 50, and 60 minutes.

.7 The acceptance criteria for rock anchor pre-production load tests are:

.1 At the end of the creep test at the maximum test load, test Rock Anchors shall have a creep rate not exceeding 2.0 mm/log cycle time. The creep rate shall be linear or decreasing throughout the creep load hold period.

.2 Failure does not occur at the maximum test load. Failure is defined as load at which attempts to further increase the test load simply result in continued Rock Anchor movement.

.3 The Consultant will provide the Contractor written confirmation of the rock anchor design and construction within three (3) working days of the completion of the pre-production load tests. This written confirmation will either confirm the capacities and bond lengths specified in the Working Drawings for rock anchors or reject the Rock Anchors based upon the verification test results.

.8 Pre-production Rock Anchor Test Rejection

.1 If a verification tested rock anchor fails to meet the acceptance criteria, the Contractor shall modify the design, the construction procedure, or both. These modifications may include modifying the installation methods, increasing the bond length, or changing the rock anchor type.

.2 Any modification that necessitates changes to the structure shall require the Consultant's prior review and acceptance. Any modifications of design or construction procedures or cost of additional verification test Rock Anchors and load testing shall be at the Contractor's expense.

.3 At the completion of verification testing, test Rock Anchors shall be removed down to the elevation specified by the Consultant.

3.5 PROOF LOAD TESTS

.1 Perform proof load tests on the first two (2) production rock anchors installed, prior to the installation of the remaining production rock anchors.

.2 Proof testing shall be conducted at a frequency of 10% (1 in 10) of the subsequent production rock anchors installed beyond the first 2. Location of additional proof test rock anchors shall be as designated by the Consultant.

.3 Proof Test Loading Schedule

.1 Test rock anchors designated for tension proof load testing to a maximum test load of 100% of the factored rock anchor Design Load (DL) shown on the Plans or Working Drawings.

.2 Proof tests shall be made by incrementally loading the rock anchor in accordance with the following schedule:

LOAD	HOLD TIME
AL	1 min
0.20DL	1 min
0.40DL	1 min
0.60DL	1 min
0.80DL	1 min
1.00DL	CREEP TEST (10 min to 60 min)
AL	1 min

.3 The alignment load (AL) shall not exceed 5% of the DL. Dial gauges shall be reset to zero after the initial AL is applied.

.4 The test load shall be applied in increments of 20 percent of the DL. Each load increment shall be held for a minimum of 1 minute. Rock anchor top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. Unloading shall be applied in one decrement to the AL.

.5 The verification test rock anchor shall be monitored for creep at the maximum test load (1.00DL): hold the pile load for 10 min and record displacement at 0, 1, 2, 3, 4, 6, 10 minutes. If net creep from 1 to 10 minutes exceeds 1.0 mm, hold for additional 50 min with displacement readings at 20, 30, 50, and 60 minutes

.4 The acceptance criteria for rock anchor proof load tests are:

.1 At the end of the 1.00DL creep test load increment, test rock anchors shall have a creep rate not exceeding 1 mm/log cycle time. The creep rate shall be linear or decreasing throughout the creep load hold period.

.2 Failure does not occur at the 1.00DL maximum test load. Failure is defined as the load at which attempts to further increase the test load simply results in continued rock anchor movement.

.5 Proof Test Rock Anchor Rejection

.1 If a proof-tested rock anchor fails to meet the acceptance criteria, the Contractor shall immediately proof test another rock anchor within that footing.

.2 For failed rock anchors and further construction of other rock anchors, the Contractor shall modify the design, the construction procedure, or both. These modifications may include installing replacement rock anchors, incorporating rock anchors at not more than 50% of the maximum load attained, post grouting, modifying installation methods, increasing the bond length, or changing the rock anchor type.

.3 Any modification that necessitates changes to the structure design shall require the Consultant’s prior review and acceptance. Any modifications of design or construction procedures, or cost of additional verification test rock anchors and verification and/or proof load testing, or replacement production rock anchors, shall be at the Contractor’s expense.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

.1 This specification covers the requirements for design, construction, maintenance, monitoring and removal of the watertight interlocking steel sheet piling system to construct the new decant pump station on site.

1.2 REFERENCES

.1 Standards listed below govern minimum quality of work required under this Section:

.1 ASTM International Inc.

.1 ASTM A 307-14 “Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength”

.2 ASTM A 325-14 “Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength”

.3 ASTM A 325M-14 “Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric)”

.4 ASTM A 490M-14a “Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)”

.5 ASTM A 1011/A 1011M-14 “Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength”

.6 ASTM D 3966/D 3966M-07(2013) E1 “Standard Test Methods for Deep Foundations Under Lateral Load”

.7 ASTM D 3689/D 3689M-07(2013) E1 “Standard Test Methods for Deep Foundations Under Static Axial Tensile Load

.8 ASTM D 3740-12a “Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction”

.9 ASTM D 4945-12 “Standard Test Method for High-Strain Dynamic Testing of Deep Foundations”

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-85.10-99, “Protective Coatings for Metals”

.3 Canadian Standards Association (CSA International)

.1 CSA G30.18-09 (R2014) “Carbon Steel Bars for Concrete Reinforcement”

.2 CSA G40.20-13/G40.21-13 “General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel”

.3 CSA-S16-09 “Limit States Design of Steel Structures”

.4 CSA W47.1-09 (R2014) “Certification of Companies for Fusion Welding of Steel”

.5 CSA W48-14 “Filler Metals and Allied Materials for Metal Arch Welding”

.6 CSA W59-13 “Welded Steel Construction (Metal Arch Welding)”

.4 Master Painters Institute

.1 MPI-INT 5.1-08 “Structural Steel and Metal Fabrications”

.2 MPI-EXT 5.1-08 “Structural Steel and Metal Fabrications”

.5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International

.1 SSPC-SP 5/ NACE No.1-Latest Edition “White Metal Blast Cleaning”

.6 Ontario Provincial Standard Specifications

.1 OPSS 539 – Construction Specifications for Temporary Protection Systems.

.7 Canadian Foundation Engineering Manual (2006).

1.3 QUALIFICATIONS

.1 Piling Contractor must have a minimum of 8 years demonstrated expertise in projects similar in scope to this project. Provide a minimum of (3) projects of similar scope that have been completed in the last five years. The Contractor shall submit reference projects with contacts for the client's project manager on those projects.

.2 Sheet piling system is to be designed by a Professional Engineer registered in the Province of Ontario who is experienced in the design of this work.

1.4 SUBSURFACE CONDITIONS

.1 General description of the subsurface conditions encountered during the field investigation are summarized in the Geotechnical report prepared by Cambium Inc., dated December 18, 2024, reference File: 19712-001.

.2 Engineering guidelines on the geotechnical design aspects of the project are summarized in the Geotechnical design report prepared by Cambium Inc., dated December 18, 2024, reference File: 19712-001.

.3 Groundwater conditions and management recommendations are included in the Hydrogeological report prepared by Cambium Inc., dated October 15, 2024, reference File: 19712-001.

.4 Notify Consultant in writing if subsurface conditions at site substantially differ from those indicated in the above-referenced reports and await further instructions from Consultant.

1.5 QUALITY PLAN

.1 Develop and implement a Quality Plan that verifies the sheet pile installation meets the requirements of this section. The Quality Plan shall be of sufficient detail to demonstrate the performance requirements of the project have been met. The results of the Quality plan shall be communicated to the Consultant in a manner and frequency sufficient to facilitate the Owner's Quality Assurance program.

.2 Submit Quality Plan to the Consultant for review a minimum of 10 days in advance of starting work of this section.

.3 Provide samples of the Contractor's quality control inspection and data logging forms to be used on the project.

.4 The Quality Plan shall include review of the sheet pile installation by the Design Engineer. Submit Engineer's letter of general conformance for review by Consultant.

.5 The Owner will develop a Quality Assurance Plan for the purpose of verifying that the work of this

Section meets with the specific requirements of the project. The Owner's Quality Assurance Plan may include inspection or testing in addition to that implemented by the Contractor's Quality Plan. The results of these inspections and tests may be shared with the Contractor.

.6 The Owner will appoint a Geotechnical Consultant to review the installation of the sheet piles.

.1 Notify the Geotechnical Consultant a minimum of 2 business days prior to installation of the sheet piles. The Geotechnical Consultant shall have access to any and all field installation records and test reports.

.2 The Geotechnical Consultant appointed by the Owner will be paid for out of a cash allowance specified in Division 01.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Division 01.

.2 Submit schedule of planned sequence of sheet pile installation to Consultant for review, as specified.

.3 Format of shop drawings to be in accordance with Division 01. Multiple prints will not be reviewed. Reproductions of Contract Drawings will not be acceptable as shop drawings.

.4 Submit shop drawings in a single, complete set in order that all details may be read in conjunction with plans, elevations and all other dependent details.

.5 All submittals shall be made in English with any abbreviations clearly defined.

.6 Where shop drawings are re-submitted, clearly illustrate all revisions from previous submissions using revision marks and "bubbles".

.7 Sheet pile shop drawings are to be stamped and signed by the Professional Engineer registered in the Province of Ontario who is responsible for their design.

.8 Submit design calculations for the sheet pile system.

.9 Submit design details of splice connections.

.10 Submit manufacturer's printed product literature, specifications and datasheets.

.11 Submit list and details of equipment for use in installation of piles.

.12 Submit copies of certified test reports for sheet piles from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.13 Provide manufacturer's affidavit stating that materials and products used conform to specified performance characteristics and physical properties.

1.7 SCHEDULING

.1 Provide schedule of planned sequencing of sheet pile installation to Consultant for review, not less than two (2) weeks prior to commencement of installation.

1.8 DESIGN

.1 Sheet piling system is to be designed by a Professional Engineer registered in the Province of Ontario who is experienced in the design of this work. Provide submittals in accordance with this Section.

.2 The sub-surface investigation report listed elsewhere in this Section, including bore hole logs listed therein, shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site. Said sub-surface investigation report shall be used as the basis for the design of the sheet piles using generally accepted engineering judgment and methods.

.3 Design and installation of sheet piling is to be watertight and is to extend to bedrock elevation. Design to be in accordance with the Canadian Foundation Engineering Manual (CFEM).

1.9 PROTECTION

.1 Prevent damage to existing buildings, structures, landscaping, trees, fences, roads and adjacent property in the completion of this work.

.2 Arrange sequencing of pile driving operations and methods to avoid damages to adjacent existing structures.

.3 When damages occur, remedy damaged items to restore to original or better condition at Contractor’s expense.

1.10 EXAMINATION

.1 Prior to commencement of sheet pile installation, carefully examine all Contract Documents and shop drawings which affect this work. Report any discrepancies to the Consultant for their direction.

.2 Examine all site conditions and work of other trades which may affect this work. Report any inconsistencies to the Consultant for their direction.

1.11 COORDINATION

.1 Cooperate with all other trades to fully coordinate all dimensions, etc. which may be required during installation.

.2 Prior to installation, ensure all inspection processes have been carried out and documentation has been assembled to conform with the Quality Plan.

1.12 STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer’s instructions.

.2 Protect sheet piles from damage due to excessive bending stresses, impact, abrasion or other causes during deliver, storage, and handling.

.3 Replace damaged piles as directed by Consultant at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel sheet piles: to CAN/CSA-G40.21, including chemical and mechanical requirements, grade 350W and as follows:

.1 Section properties in accordance with the approved shop drawings.

.2 Provide fabricated special corners as specified by manufacturer for type of sheet piling supplied.

.3 Mark each piece of sheet piling legibly by stenciling or die-and-stamping the following information: heat number, manufacturer's name, length and section number.

.4 Structural steel for walers, bearing plates, wale splices, capping channels, support angles and miscellaneous steel: to CAN/CSA-G40.21, including chemical and mechanical requirements, grade 350W.

.5 Tie rods: to CSA G30.18, Grade 400.

.6 Sleeve nuts: to have load capacity in excess of capacity of tie rod.

.7 Hexagon nuts, bolts, and washers: to ASTM A 307.

.8 Supply or fabricate sheet piles in full length sections and provide equipment to hand full length sections without cutting and splicing.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Welding to be in accordance with CSA W59.

.2 Do not commence sheet pile installation until all required quality control measures have been completed and reviewed by Consultant.

.3 Submit full details of monitoring and method and sequence of installation of sheet piling to Consultant for approval prior to start of pile installation work. Details must include guide frames, bracing, setting and driving sequence and number of piles in panels for driving.

.4 Install sheet piles in accordance with procedures outlined on approved shop drawings.

.5 Hold sheet piles securely and accurately in position while driving. When installation is complete, face of wall at top of sheet piles to be within 75 mm of location as indicated and deviation from vertical not to exceed 1 in 100.

.6 Restrike already driven sheet piles lifted during driving of adjacent piles to confirm set.

3.2 OBSTRUCTIONS

.1 If obstruction encountered during driving, leave obstructed sheet pile and proceed to drive remaining sheet piles. Return and attempt to complete driving of obstructed sheet pile later.

.2 Advise Consultant immediately if impossible to drive sheet pile to full penetration. Submit alternate installation details to Consultant for review. Alternate installation details are to be engineered by a Professional Engineer registered in the Province of Ontario.

3.3 HOLES

.1 Patch holes in sheet pile wall, except where permanent holes are indicated. Use steel plate with thickness equal to that of piling to patch holes and overlap not less than hole diameter. Weld to develop full strength of plate.

.2 Drill any required holes in piling. Do not use flame cutting without permission of Design Engineer.

3.4 CUTTING & SPLICING

.1 When flame cutting tops of piles, and flame cutting of holes in piles is approved by Design Engineer.
- .1 Use torch guiding device to ensure smooth round holes or straight edges.
- .2 Make cuts smooth and free from notches throughout thickness. If grinding is employed to remove notch or crack, finished radius to be minimum 5 mm.

.2 Use full length piles, unless noted otherwise.

.3 Where cutting or splicing of sheet pile sections is required to suit field conditions, submit corresponding details to Consultant for review. Field cutting and splicing details are to be designed by a Professional Engineer registered in the Province of Ontario.

3.5 TIE ROD ANCHORAGE

.1 Do not place backfill behind anchored bulkhead or remove material from in front of bulkhead until piles have been completely driven, adjusted and secured in final position by anchorage system.

.2 Support tie rods at intervals along their length as indicated on shop drawings.

.3 Fit and adjust tie rod systems so that connections at waling and anchor end of tie rods are tight before backfilling.

.4 Brace steel sheet piles with waling strips in accordance with shop drawings. Make walers one length between corners and bolt to piles.

3.6 TOE PINNING

.1 Drive sheet piling at pinned sections to bedrock.

.2 Pin sheet piling at toe in accordance with approved shop drawings.

3.7 BACKFILLING

.1 Backfill in accordance with Section 02315 – Excavation, Trenching and Backfilling.

.2 Protect piling tie rods and anchorage systems from damage or displacement during backfilling operations.

3.8 REMOVAL

.1 Sheet pile sections are to be cut down a minimum of two (2) metres below finished grade around new structures, unless noted otherwise.

.2 Accurately record the top elevation and plan location of sheet pile sections left in place on the record drawings.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Refer to Division 1.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):
- .1 ASTM A 82/A 82M-05a, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .2 ASTM A 185/A 185M-05a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- .3 ASTM C 139-05, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
- .4 ASTM C 478/C 478M-06, Standard Specification for Precast Reinforced Concrete Manhole Sections.
- .5 ASTM D 1056-00, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

.2 Canadian Standards Association (CSA International):
- .1 CAN/CSA-A3000-03(R2005), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2 CSA-A3001-03, Cementitious Materials for Use in Concrete.
- .3 CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.

.3 Shop Drawings:
- .1 Submit shop drawings for precast manholes.

.4 Quality assurance submittals:
- .1 Test reports: submit certified test reports for specified materials from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Consultant to:
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 REGULATORY REQUIREMENTS

.1 Underground electrical installations shall be fully compliant with Ontario Electrical Safety Code (OESC) requirements and related bulletins. Installation dimensions shall comply with OESC diagrams D8 through D11, as is applicable. In the event of conflict, the more stringent shall apply to the satisfaction of the local hydro inspector.

PART 2 - PRODUCTS

2.1 PVC DUCTS

.1 PVC ducts, type DB2, encased in reinforced concrete.

2.2 PVC DUCT FITTINGS

.1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.

.2 Expansion joints.

.3 Rigid PVC 5 degree angle couplings.

2.3 MANHOLES

.1 Provide type indicated.

.2 Top, walls, and bottom: reinforced concrete.

.3 Walls and bottom: monolithic concrete construction.

.4 Locate duct entrances and windows near corners of structures to facilitate cable racking.

.5 Covers: fit frames without play.

.6 Form steel and iron to shape and size with sharp lines and angles.

.7 Castings: warp and blow hole free.

.8 Exposed metal: smooth finish without sharp lines and arises.

.9 Provide lugs, rabbets, and brackets.

.10 Set pulling-in irons and other built-in items in place before depositing concrete.

.11 Install pulling-in iron in wall opposite each duct line entrance.

.12 Cable racks, including rack arms and insulators: sized to accommodate cable.

2.4 PRECAST CONCRETE MANHOLES

.1 Precast concrete manholes and auxiliary sections fabricated in steel forms.

.2 Aggregates: to CSA A23.1/A23.2.

.3 Cement: CAN/CSA-A3001, Type GU.

.4 Steel welded wire fabric mesh reinforcing: to ASTM A 82/A 82M, ASTM A 185/A 185M, CAN/CSA - G30.18.

.5 Pulling inserts and bolts for racks integrally cast in concrete.

.6 Neoprene gasket seals between manhole sections: to ASTM D 1056.

.7 Size: 762 mm clear diameter.

.8 Precast Concrete Manholes: to ASTM C 478/C 478M.

.1 Manhole step and ladder rung spacing: 405.

2.5 DRAINAGE

.1 Floor drain fittings: consisting of floor drain, back water valve, trap and pipe connection to dry sump.

.2 Storm sewer connection: cast iron service saddle consisting of oil resistant gasket, stainless steel clamp and oil resistant 0 ring.

.3 Sump pit: 300 x 300 x 125 mm.

2.6 MANHOLE NECKS

.1 Concrete brick and mortar.

2.7 MANHOLES FRAMES AND COVERS

.1 Cast iron manhole frames and covers.

.2 Size: 762 mm clear diameter.

2.8 GROUNDING

.1 Ground rods: in accordance with Section 16045.

2.9 CABLE RACKS

.1 Hot dipped galvanized cable racks and supports.

.2 12 x 100 mm preset inserts for rack mounting.

2.10 CABLE PULLING EQUIPMENT

.1 Pulling iron: galvanized steel rods, size and shape as indicated.

.2 Pull rope: 6 mm stranded nylon, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.11 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100 mm, with words: "Cable", "Joint", "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

.2 Warning Tape:

.1 Red Vinyl Tape marked “ĐANGER – ELECTRICAL CABLES” for ducts intended to carry voltages above 50 V.

.2 Orange vinyl tape marked “Caution – Buried Telecommunication Cables” for ducts intended to carry voltages below 50 V.

.3 Tape to be complete with tracer wires.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION – GENERAL

.1 Install underground duct banks and manholes including formwork.

.2 Build duct bank and manholes on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.

.3 Open trench completely between manholes before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

.4 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.

.5 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.

.6 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between as indicated horizontally and vertically.

.1 Stagger joints in adjacent layers at least 150 mm and make joints watertight.

.2 Encase duct bank with 75 mm thick concrete cover.

.7 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.

.8 Use bell ends at duct terminations in manholes or buildings.

.9 Use conduit to duct adapters when connecting to conduits.

.10 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.

.11 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.

.12 Allow concrete to attain 50% of its specified strength before backfilling.

.13 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete.

.1 Tie ducts to spacers with twine or other non-metallic material.

.2 Remove weights or wood braces before concrete has set and fill voids.

.14 Clean ducts before laying:

.1 Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.

.15 Duct cleaning:

.1 Pull 300 mm long x diameter 6 mm less than internal diameter of duct steel wooden mandrel through each duct, immediately after placing of concrete.

.2 Then pull stiff bristle brush through duct; avoid disturbing or damaging ducts where concrete has not set completely.

.3 Pull stiff bristle brush through each duct immediately before pulling-in cables.

.16 Install four 3 m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings.

.1 Wire rods to 15M dowels at manhole or building and support from duct spacers.

.2 Protect existing cables and equipment when breaking into existing manholes.

.3 Place concrete down sides of duct bank filling space under and around ducts.

.4 Rod concrete with flat bar between vertical rows filling voids.

.17 Install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.3 MANHOLES

.1 Install precast manholes.

.2 Provide 115 mm deep window to facilitate cable bends in wall at each duct connection.

.1 Terminate ducts in bell-end fitting flush with window face.

.2 Provide four 10M steel dowels at each duct run connection to anchor duct run.

.3 On runs of 16 ducts and over, support concrete duct encasement on a 700 mm wide by 75 mm thick concrete pier poured against manhole wall between slab and bottom of duct run, provide dowels for anchoring.

.3 Alternately connect large duct runs by leaving square opening in wall, later pouring duct run and wall opening in one pour and install 10M x 3m reinforcing rods in duct run at manhole connection.

.4 Build up concrete manhole neck to bring cover flush with finished grade in paved areas and 40 mm above grade in unpaved areas.

.5 Install manhole frames and covers for each manhole:

.1 Set frames in concrete grout onto manhole neck.

.6 Drain floor towards sump with one to 48 slope minimum and install drainage fittings as indicated.

.7 Install cable racks, anchor bolts and pulling irons as indicated.

.8 Grout frames of manholes:

.1 Cement grout to consist of two parts sand and one part cement and sufficient water to form a plastic slurry.

.9 Ensure filling of voids in joint being sealed.

.1 Plaster with cement grout, walls, ceiling and neck.

.10 Spray paint "X" on ceiling of manhole above floor drain or sump pit.

3.4 MARKERS

.1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run.

.1 Place concrete duct marker at ends of such duct runs.
.2 Construct markers and install flush with grade.

.2 Mark ducts every 150 m along straight runs and changes in direction.

.3 Where markers are removed to permit installation of additional duct, reinstall existing markers.

.4 Lay concrete markers flat and centered over duct with top 25 mm above earth surface.

.5 Provide drawings showing locations of markers.

.6 Install vinyl tape along entire length of duct.

3.5 FIELD QUALITY CONTROL

.1 Site Tests/Inspections:
.1 Inspection of duct will be carried out by Consultant prior to placing.
.2 Placement of concrete and duct cleanout to be done when Consultant present.

3.6 CLEANING

.1 Refer to Division 1.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CSA C22.2 No. 211.1, Rigid types EBI and DB2/ES2 PVC Conduit.
- .2 CSA C22.2 No. 211.3, Rigid Reinforced Thermoset (RE) Conduit and Associated Fittings.

1.2 SUBMITTALS

.1 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for solvent cement. Indicate VOC content.

.2 Submit shop drawings per Section 01330.

1.3 REGULATORY REQUIREMENTS

.1 Underground electrical installations shall be fully compliant with Ontario Electrical Safety Code (OESC) requirements and related bulletins. Installation dimensions shall comply with OESC diagrams D8 through D11, as is applicable. In the event of conflict, the more stringent shall apply to the satisfaction of the local hydro inspector.

PART 2 - PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid PVC duct: to CSA C22.2 No. 211.1, Type DB2/ES2, with moulded fittings, for direct burial expanded flange ends, Trade size as indicated. Nominal length: 6 m plus or minus 12 mm.

.2 Rigid PVC split ducts.

.3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.

.4 Rigid PVC 90° and 45° bends.

.5 Rigid PVC 5° angle couplings.

.6 Expansion joints every metre and as required.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

.1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 MARKERS

.1 Concrete type cable markers: 600 x 600 x 100 mm, with words: "Cable", "Joint", "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

.2 Warning Tape:

.1 Red Vinyl Tape marked “ĐANGER – ELECTRICAL CABLES” for ducts intended to carry voltages above 50 V.

.2 Orange vinyl tape marked “Caution – Buried Telecommunication Cables” for ducts intended to carry voltages below 50 V.

.3 Tape to be complete with tracer wires. Coordinate final tape colours with ESA.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install duct in accordance with manufacturer's instructions.

.2 Clean inside of ducts before laying.

.3 Ensure full, even support every 1.5 m throughout duct length.

.4 Slope ducts with 1 to 400 minimum slope.

.5 During construction, cap ends of ducts to prevent entrance of foreign materials.

.6 Pull through each duct mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.7 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA).
- .1 CAN/CSA C83, Communication and Power Line Hardware.
- .2 CAN/CSA 080 Series, Wood Preservation.
- .3 CAN/CSA-015, Wood Utility Poles and Reinforcing Stubs.
- .4 CSA 0124 - Specification for the Physical Properties of Power and Communication Wood Insulator Pins.
- .5 CSA A14, Concrete Poles.
- .6 CSA/CAN3-A23.3, Design of Concrete Structures.
- .7 CSA C22.1 – Overhead Systems.

.2 American National Standards Institute (ANSI)
- .1 ANSI C29.5, Wet Process Porcelain Insulators, Low- and Medium-Voltage Pin Type.

.3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC).
- .1 EEMAC1B-1, Wet Process Porcelain Insulators (Strain Type).
- .2 EEMAC2B-1, Wet Process Porcelain Insulators (Spool Type).

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 16010 - Electrical General Provisions and Sections 01330 – Submittal Procedures.

.2 The layout of the incoming overhead electrical distribution from the local Hydro Authority will not be finalized by the Utility until after the closing of tender. The Contractor is responsible for providing all necessary coordination with the Utility and submitting designed pole load details as a result of interconnected tensions, sag and span of the overhead wiring. This shall include the imposed structural pole loads on hydro poles and their bases as a result of the final layout from the local Hydro Authority. Submittals shall include all installation considerations such as initial tension/sag and final (worst case) tension/sag. To facilitate this coordination and pre-installation review requirement, the Contractor shall retain a qualified Professional Structural Engineer licensed in the Province of Ontario in order to provide calculations, coordinate and determine the loading to be applied to the poles at the point in time where the local utility has finalized the location of their new hydro service poles. The review shall include loading forces and calculations on all privately owned overhead distribution poles and shall be submitted with a complete set of applicable correspondence details from the local Hydro Authority. All environmental and seasonal stresses induced on the conductors must be considered in determination of the loading for each pole. All applicable standards must be considered, including but not limited to CSA C22.1 - Overhead Systems. The final submittal of loading forces on each pole shall be signed and sealed by the Professional Structural Engineer before submitting. The following parameters shall be considered as a minimum in preparing the required submittal:
- .1 Unfactored Wind Pressure of 400 Pa on conductors, attachments, poles, etc.
- .2 “Heavy” Ice Accretion following the applicable standards.
- .3 Grade 1 Construction as defined by the Overhead Systems Code.

1.3 INSTALLATION COORDINATION

.1 The installation contractor for 4.16 kV overhead service conductors shall coordinate between Hydro One Networks Inc. and the general contractor's Structural Engineer in determining installation specific wire sag and tension details when connecting new hydro poles to the utility point of common coupling. Setting wire sag and tension of installations shall not commence until a contractor's structural review of all pole forces has been properly completed, submitted for review and accepted. Refer to Part 1.3 "Shop Drawings", item 2 for additional details.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Wood preservation: to CAN/CSA 080 Series.

.2 Power line hardware: to CAN/CSA-C83.

.3 All components to be installed as part of an overhead electrical distribution system in conformance with this specification section are to suit Grade 1 Construction as defined under CSA C22.1 – Overhead Systems.

2.2 WOOD POLES

.1 Wood utility poles: to CAN/CSA-015, wood, Class 1 and Class 3, preservative treated.
- .1 Refer to Drawing No. E008 for additional pole details
- .2 13.7 m long poles for primary and secondary circuits. Refer to OESC requirements.
- .3 Wood Preservative: Pentachlorophenol (PCP).

2.3 INSULATORS

.1 Post type insulators: as required, rated for 15 kV complete with all required strain clamps, studs, connectors and terminations to suit.

.2 Suspension dead-end insulators: as required, rated for 15 kV complete with all required strain clamps, studs, connectors and terminations to suit.

.3 Insulator selection and installations shall be fully compliant with Ontario Electrical Safety Code requirements and related bulletins of Rules 75-400 through 75-499. In the event of conflict, the more stringent shall apply to the satisfaction of the local hydro inspector.

2.4 CROSS ARMS

.1 Dead-end cross arms to be either aluminum or fibreglass equivalent, as indicated on Division 16 drawing details."

.2 All other cross arms to be aluminum 6061 T6 alloy.

.3 Cross Arm selection, dimensioning and installations shall be fully compliant with Ontario Electrical Safety Code requirements and related bulletins of Rules 75-200 through 75-299. In the event of conflict, the more stringent shall apply to the satisfaction of the local hydro inspector."

2.5 GUYS AND ANCHORS

.1 Guy wire: to CAN/CSA-G12, 9 mm nominal diameter, stranded, galvanized steel for dead ends and guys.

.2 Guy clamps: three-bolt heavy duty or preform grip type.

.3 Eye bolt: 19 mm thimble, length to suit, four hold guy straps and 16 mm machine bolt with square washer to attach guy wire to pole.

.4 Anchor rod: 19 mm diameter x 2.7 m long, galvanized steel with thimble eye.

.5 Anchor: heavy duty expanding type, four way, 300 mm diameter.

.6 Guy guard: plastic, colored yellow, 2.7 m long.

.7 Guy and Anchor selection and installations shall be fully compliant with Ontario Electrical Safety Code requirements and related bulletins of Rules 75-300 through 75-399. In the event of conflict, the more stringent shall apply to the satisfaction of the local hydro inspector.

2.6 EQUIPMENT IDENTIFICATION

.1 Rustproof number nails with 50 mm high designated number.

PART 3 - EXECUTION

3.1 PREPARATION OF WOOD POLES

.1 Where poles require shortening, cut piece from top only.

.2 Roof top of poles with single slope bevelled top.

.3 Treat roof top, gains, bored holes with preservative before assembly.

3.2 INSTALLATION

.1 Locate and dig pole holes. Make holes large enough to allow space for tamping backfill. Drill holes into bedrock as indicated.

.2 Set poles.

.3 Set poles to maintain even grade. Allow for contour of terrain and do not exceed grading of 1.5 m per pole.

.4 Replace backfill in 150 mm layers. Tamp each layer and apply final layer to drain water away from pole.

.5 For rock mounted poles, install cribs.

.6 For swampy condition install cribs.

.7 For concrete pole, refer to structural drawings and coordinate with other trades for installation.

.8 Locate and install guy wires and anchors at dead-ends, corner poles, and start of branch feeders.

.9 Insert anchor at least 1.8 m into ground. Backfill and tamp in 150 mm layers.

.10 Install insulators.

.11 Install number nails on each pole.

.12 Identify primary circuit on pole showing phasing of each conductor, every 1000 m and including origin of primary pole.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 02315 – Excavation, Trenching and Backfilling.

1.2 SECTION INCLUDES

.1 Provision of rigid conduit - encased underground service ducts.

.2 Direct buried cables.

1.3 REGULATORY REQUIREMENTS

.1 Coordinate and meet requirements of power supply authority. Ensure availability of power when required.

.2 Coordinate the connection of the new service and disconnection of the existing service.

.3 Underground electrical installations shall be fully compliant with Ontario Electrical Safety Code (OESC) requirements and related bulletins. Installation dimensions shall comply with OESC diagrams D8 through D11, as is applicable. In the event of conflict, the more stringent shall apply to the satisfaction of the local hydro inspector.

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01330 - Submittal Procedures.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Conductors: copper, type and size as indicated in Division 16 specifications and drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install cables in trenches in accordance with Division 16.

.2 Allow adequate conductor length for connection to supply by power supply authority.

.3 Install meter socket and conduit.

.4 Allow adequate conductor length for connection to service equipment.

.5 Make grounding connections in accordance with Section 16045 - Grounding.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010 - Electrical General Requirements.

.2 Perform additional tests if required by authority having jurisdiction.

END OF SECTION

PART 1 - GENERAL

1.1 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION

.1 Geotechnical and hydrogeological investigations have been carried out by Cambium Inc and entitled GEOTECHNICAL INVESTIGATION REPORT – Proposed WWTS Upgrades – 100 County Rd 64, Brighton and dated December 18, 2024, (99 pages), GEOTECHNICAL INVESTIGATION REPORT – Proposed Creek Relocation – 100 County Rd 64, Brighton and dated December 18, 2024, (45 pages), and HYDROGEOLOGICAL ASSESSMENT REPORT - 100 County Rd 64, Brighton, ON and dated March 7, 2025, (170 pages). The reports are included in Section 5.

.2 This is hereby offered to the bidder in good faith for general information and guidance. The Owner and the Consultant accept no responsibility for the accuracy of the information within.

.3 The reports provided in this document are for reference only. Responsibility for the review and the statements within remain entirely with its author.

.4 In case of discrepancies between the recommendations contained in this report and requirements of the Contract Documents, the Contract Documents shall govern. Should discrepancies be discovered, advise the Consultant in writing prior to proceeding with Work.

.5 Contractor shall not be entitled to extra payment and / or performance time for conditions that are reasonably inferable from soil investigation report.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM C 478-14. Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
- .2 ASTM D 698-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3)).

.2 Canadian Standards Association (CSA International)
- .1 CAN/CSA-A23.1-09/A23.2-09 (R2014), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consist of A3001, A3002, A3003, A3004 and A3005).
  - .1 CSA-A3001-13, Cementitious Materials for Use in Concrete.
- .4 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

.3 Ontario Provincial Standard Drawings (OPSD)
- .1 OPSD 401.010, Cast Iron, Square Frame with Circular Closed or Open Cover for Maintenance Holes.
- .2 OPSD 404 Series, Aluminum Safety Platform.
- .3 OPSD 701 Series, Precast Concrete Maintenance Holes.
- .4 OPSD 704.010, Precast Concrete Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers.
- .5 OPSD 704.010, Precast Concrete Catch Basins and Ditch Inlets.

.4 Ontario Provincial Standard Specifications (OPSS)
- .1 OPSS.MUNI 1010, Material Specifications for Aggregates – Base, Sub-base, Select Subgrade, and Backfill Material.
- .2 OPSS 1351, Material Specification for Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers.
- .3 OPSS 1850, Material Specification for Frames, Grates, Covers, and Gratings.

1.2 SUBMISSIONS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Provide shop drawings for all structures, identifying all connection information.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store, and handle materials in accordance with manufacture’s written instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Precast Structures as per OPSS.MUNI 1351 and the following:
- .1 Manholes as per OPSD 701 Series (round) as indicated.
- .2 Precast concrete chambers as per OPSD 1101 series.

.2 Joints: made watertight using 20mm butyl mastic in addition to the standard rubber gasket

.3 Ladder rungs: to CAN/CSA-G30.18, No.25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164.
- .1 Rungs to be safety pattern (drop step type).

.4 Precast adjusting rings: to ASTM C478M

.5 Frames, gratings, covers as per OPSS.MUNI 1850 to dimensions as indicated and the following requirements:
- .1 Sanitary manholes to OPSD 401.010 Type 'A'.

.6 Precast concrete adjustment units to OPSD 704.010.

.7 Granular bedding and backfill: to be Granular 'A' to OPSS.MUNI 1010.

.8 Safety Platform as per OPSD 404 Series.

.9 Waterproofing: self-adhering membrane impermeable to moisture vapour and water (i.e. Henry Bakor Blueskin ® SA).

.10 Pipe penetration seal: Link-Seal® modular seal.

.11 Ring clamps: adjustable screw type.

.12 All Precast Chambers not specifically covered by an OPSD shall be designed by manufacturer and a stamped drawing by a Professional Engineer licenced in the Province of Ontario shall be provided.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXCAVATION AND BACKFILL

.1 Excavate and backfill in accordance with Section 02315 – Excavation, Trenching and Backfilling and as indicated.

.2 Obtain approval of Consultant before installing outfall structures, manholes, or catch basins.

3.3 CONCRETE WORK

.1 Do concrete work in accordance with Section 03300, Cast-in-Place Concrete.

.2 Bench manholes as per OPSD 701.021.

3.4 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Complete units as pipe laying progresses

.1 Maximum of three units behind point of pipe laying will be allowed.

.3 Dewater excavation to approval of Consultant and remove soft and foreign material before placing concrete base.

.4 Set precast concrete base on 150mm minimum of granular bedding compacted to 100% SPMDD to ASTM D 698.

.5 Install manhole section as per OPSD 700 series drawings.

.6 All bedding, surround, manhole backfill to be compacted to 100% Standard Proctor maximum dry density.

.7 Bench manholes to OPSD 701.021 as indicated.

.8 Use a resilient connector for all flexible and rigid pipe connections.

.9 Adjust all structures as per OPSS 408.

.10 Infiltration Structure to be installed as per manufacturer's recommendations.

.11 Precast Units:

.1 Make each successive joint watertight with 20mm butyl mastic applied to all joints, in addition to the standard rubber gasket, to the approval of the Consultant.

.2 Clean surplus joint compounds from interior surface of unit as work progresses.

.3 Precast structures must have a self-adhesive waterproofing (i.e. Henry Bakor Blueskin ® SA) a minimum of 300mm above and below every joint.

.4 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

.5 Boot connections must have two ring clamps to tighten the boot to the pipe, to the approval of the Consultant.

.12 For sewers:

.1 Place stub outlets and bulkheads at elevations and in positions indicated.

.2 Bench to provide smooth U-shaped channel as per OPSD 701.021.

.1 Curve channels smoothly.

.2 Slope invert to establish sewer grade.

.13 Compact granular backfill to 100% SPMDD to ASTM D 698.

.14 Place unshrinkable backfill in accordance with Section 02315 – Excavation, Trenching and Backfilling.

.15 Installing units in existing systems:
- .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
- .2 Make joints watertight between new unit and existing pipe.
- .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate breakouts, removals, redirection of flows, blocking unused pipes, or other necessary work.

.16 Existing manhole structures must be cored when new pipes are installed. Sanitary manholes must include a link-seal, adjustable from the inside of the structure.

.17 Set frame and cover to required elevation on no more than three adjustment units.
- .1 Parge and make smooth and watertight.

.18 Clean units of debris and foreign materials.
- .1 Remove fins and sharp projections.
- .2 Prevent debris from entering systems.

.19 Install safety platforms in manholes having a depth of 5m or greater, as indicated.

3.5 ADJUSTING FRAMES AND GRATES

.1 New structures:
- .1 All manholes and catch basins located in the pavement are to have the frame set at base course elevation. These frames are subject to final adjustment immediately prior to surface course installation.

.2 Existing structures:
- .1 Remove existing frames Contractor is responsible for the excavation, handling, hauling, and disposal costs of all soils excavated as part of the Work.

.3 Sectional Units:
- .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
- .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replacing cone section.
  - .1 When amount of raise is less than 600mm, use standard manhole brick, Moduloc, or grade rings.

3.6 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials rubbish, tools, and equipment.

3.7 TESTING

.1 All structures to be water leakage tested as per OPSS 407.

.2 All visible signs of leakage are to be repaired regardless of results of leakage test.

3.8 CLOSEOUT

.1 Contractor to provide pipe size, material, and invert information on as-built drawings.

END OF SECTION

PART 1 - GENERAL

1.1 MATERIAL CERTIFICATION

.1 Submit manufacturer's test data and certification at least two weeks prior to commencing work.

.2 Certification to be marked on pipe.

PART 2 - PRODUCTS

2.1 CORRUGATED STEEL PIPE

.1 Galvanized corrugated steel pipe and end sections of the diameters and thickness shown on the drawing in accordance with OPSS.MUNI 1801.

2.2 HDPE

.1 Corrugated HDPE (e.g. Boss 2000) end sections of the diameters and thickness shown on the drawing in accordance with OPSS.MUNI 1801.

2.3 GRANULAR BEDDING AND BACKFILL

.1 Granular bedding and backfill material to Section 02701 - Aggregates: General.

PART 3 - EXECUTION

3.1 TRENCHING

.1 Do trenching work in accordance with Section 02315 - Excavating Trenching and Backfilling.

.2 Obtain Consultant's approval of trench line and depth prior to placing bedding material or pipe.

3.2 BEDDING

.1 Dewater excavation, as necessary, to allow placement of culvert bedding in the dry.

.2 Place minimum thickness of 150 mm of Granular 'A' material on bottom of excavation and compact to minimum 100% Standard Proctor maximum dry density.

.3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Consultant, free from sags or high points.

.4 Place bedding in unfrozen condition.

3.3 LAYING PIPE CULVERTS

.1 Commence pipe placing at downstream end.

.2 Ensure bottom of pipe is in contact with shaped bed throughout its length.

.3 Do not allow water to flow through pipes during construction except as permitted by Consultant.

.4 Lay pipe with outside circumferential laps facing upstream and longitudinal laps or seams at side of quarter points.

3.4 BACKFILLING

.1 Cover around and over culverts as indicated or as directed by Consultant.

.2 Place granular backfill material backfill material, approved by Consultant, in 300 mm layers to full width.

.3 Compact each layer to 95% Standard Proctor maximum dry density taking special care to obtain required density under haunches.

.4 Protect installed culvert with minimum 600 mm cover of compacted fill before heavy equipment is permitted to cross. During construction, width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1:2.

.5 Place backfill in unfrozen condition.

3.5 JOINTS: CORRUGATED STEEL CULVERTS

.1 Match corrugations or indentations of coupler with pipe sections before tightening.

.2 Tap couplers firmly as they are being tightened, to take up slack and ensure snug fit.

.3 Insert and tighten bolts.

.4 Repair spots where damage has occurred to spelter coating by applying two coats of zinc rich epoxy paint.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 OPSS.MUNI 1010 Material Specialization for Aggregates – Base, Subbase; Select Subgrade and Backfill Material.

.2 OPSS.MUNI 1004 Material Specialization for Aggregates – Miscellaneous.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Sand to be fine aggregates satisfying requirements of applicable section to be one, or blend of following:
- .1 Natural sand.
- .2 Manufactured sand.
- .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.

.2 Granular 'A':
- .1 As per OPSS.MUNI 1010 modified as follows:
  - .1 Crushed, quarried bedrock only.

.3 Granular 'B':
- .1 As per OPSS.MUNI 1010 modified as follows:
  - .1 Granular B Type I within building foundations and footings. Type II in all other areas.
  - .2 Granular B Type II is acceptable for use in lieu of Granular B Type I.

.4 Clear Stone:
- .1 19 mm Clear Stone – Type I As per OPSS.MUNI 1004, modified as follows:
  - .1 Quarried bedrock only.

.5 Engineered Fill:
- .1 To be Granular B as defined above, unless noted otherwise.

2.2 SOURCE QUALITY CONTROL

.1 Inform Consultant of proposed source of aggregates at least two (2) weeks prior to commencing production or hauling to site.

.2 Advise Consultant two (2) weeks in advance of proposed change of material source.

.3 Sampling and testing of aggregates will be carried out by a materials testing agency designated by the Consultant. The materials testing agent shall be allowed to access all sampling locations and reserves the right to request quality assurance samples at any time.

.4 If, in opinion of Consultant, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.5 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

2.3 STOCKPILING AND HANDLING

.1 At all times, aggregates shall be handled and transported in a manner and with equipment that avoids segregation of the material, excess loss of fines, and contamination by any deleterious material.

.2 Stockpile sites shall be level, well drained, free of all foreign materials, and of adequate bearing capacity to support the mass of the materials to be placed thereon. Stockpiles shall be either far enough apart or separated by substantial dividers to prevent intermingling.

.3 For all aggregates, except when stockpiled on Portland cement concrete or asphaltic concrete foundations or on an uncontaminated durable surface, a compacted granular pad of material with a maximum particle size no larger than that of the material being stockpiled and not less than 0.3 m in depth shall be provided to prevent contamination of the piled material. This granular pad shall not be incorporated into the Work.

.1 For sand stockpiles, the foundation shall be as specified above for aggregates or the material may be placed on the ground provided that the bottom 0.3 m of the pile is not incorporated into the Work.

PART 3 - EXECUTION

3.1 NOT APPLICABLE

.1 Not Applicable.

END OF SECTION

PART 1 – GENERAL

1.1 DESCRIPTION

.1 This section specifies requirements for supplying and installing watermains to lines, grades and dimensions indicated on drawings or as directed by the Consultant, for buried watermain 300 mm diameter or smaller.

1.2 REFERENCES

.1 AWWA (***Also note AWWA References contained within OPSS.MUNI 441***).

.1 ANSI/AWWA C105-18, Polyethylene Encasement for Ductile-Iron Pipe Systems

.2 ANSI/AWWA C110-12, Ductile-Iron and Gray-Iron Fittings

.3 ANSI/AWWA C111-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

.4 ANSI/AWWA C200-17, Steel Water Pipe 6” (150mm) and Larger

.5 ANSI/AWWA C203-15, Coal-Tar Protective Coatings and Linings for Steel Water Pipe

.6 ANSI/AWWA C207-18, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)

.7 ANSI/AWWA C301-14, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type For Water and other Liquids

.8 ANSI/AWWA C500-19, Metal-Seated Gate Valves for Water Supply Service

.9 ANSI/AWWA C530-17, Pilot Operated Control Valves

.10 ANSI/AWWA C550-17, Protective Interior Coatings for Valves and Hydrants

.11 ANSI/AWWA C600-17, Installation of Ductile-Iron Water Mains and Their Appurtenances

.12 ANSI/AWWA C602-17, Cement-Mortar Lining of Water Pipelines in Place – 4 In. (100 mm) and Larger

.13 ANSI/AWWA C651-14, Disinfecting Water Mains

.14 ANSI/AWWA C655-18, Field Dechlorination

.15 ANSI/AWWA C900-16, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in-60in (100mm to 1500mm) for Water Transmission and Distribution

.16 ANSI/AWWA C906-15, Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 65 In. (100 mm through 1650mm) for Waterworks

.17 ANSI/AWWA C909-16, Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger

.18 AWWA M11, Steel Pipe: A Guide for Design and Installation (Fifth Edition)

.19 AWWA Manual M9-2008 third edition – Concrete Pressure Pipe

.2 ASME

.1 ANSI/ASME B16.1-2015, Gray Iron Pipe Flanges and Flanged Fittings

.2 ANSI/ASME B16.5-2017, Steel Pipe Flanges and Flanged Fittings

.3 ASTM International (***Also note ASTM References contained within OPSS.MUNI 441***)

.1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 ASTM A351/A351M-18e1, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts

.3 ASTM C117-17, Standard Test Method for Materials Finer than 75 - µm (No. 200) Sieve in Mineral Aggregates by Washing

.4 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN m/m3))
.5 ASTM D2657 (07), Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
.6 ASTM F3125/F3125M-19, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
.7 ASTM F714-13, Standard Specification for Polyethylene (PE) Plastic Pipe (DR PR) Based on Outside Diameter

.4 Plastics Pipe Institute, Second Edition of PE Pipe 2008

.5 Ministry of the Environment, Conservation and Parks (MECP)
.1 Municipal Drinking Water License
.2 Watermain Disinfection Procedure (2020).

.6 Ontario Provincial Standard Specifications (OPSS)
.1 OPSS.MUNI 441 Nov 2016 Watermain Installation in Open Cut
.2 OPSS.MUNI 493 Nov 2019 Temporary Potable Water Supply Services.

1.3 SCHEDULING OF WORK

.1 Schedule work to minimize interruptions to existing services.

.2 Maintain existing water service to plant during construction.

.3 Submit schedule of expected interruptions for approval by the Consultant and Owner and adhere to interruption schedule as approved.

.4 Notify Owner and fire department of any planned or accidental interruption to systems or individual hydrants.

1.4 CONNECTION OF WATERMAIN

.1 All cutting in or connecting to existing watermains shall be done by Contractor under supervision of the Owner.

.2 Contractor shall do all necessary excavation, bedding, backfilling, restoration, etc., for the connection.

1.5 APPROVAL

.1 Installation of watermains to be in accordance with requirements of the OPSS.MUNI 441 as modified herein.

1.6 REPORTING

.1 Results shall be submitted to the Consultant and Owner for review and confirmation prior to final permanent connection and commissioning of the new works. Results must be submitted using a form acceptable by the owner.

.1 The Contractor shall submit a Testing and Disinfection Plan to the Consultant for review and comment by the Owner, prior to any field activities.
.2 The Testing and Disinfection Plan shall include all procedures required to complete the Plan, including but not limited to, proposed water connection locations, backflow prevention, flushing procedures, chlorination procedures, and sampling locations.
.3 Review of the Testing and Disinfection Plan by the Owner or Consultant does not constitute approval of the plan.

PART 2 - PRODUCTS

2.1 GENERAL

.1 The pipe size, type, and class shall be as specified in the Contract Documents.

.2 Fittings shall be suitable for and compatible with the pipe material and class with which they are used.

.3 All material for watermains and associated appurtenances shall be NSF/ANSI/CAN 61 compliant.

.4 The pipe shall be homogeneous throughout, free from voids, cracks, inclusions, discolouration, and other defects.

.5 Ductile Iron Pipe
.1 Ductile iron pipe shall be according to AWWA C151/A21.51.
.2 Pressure Class: 350
.3 Fittings shall be ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53.
.4 Ductile iron pipe shall be cement lined according to AWWA C104/A21.4, and polyethylene encased as per AWWA C105
.5 Ductile iron fittings shall be cement lined with mechanical joints.
.6 All ductile iron pipe and special castings shall be coated outside with coal tar pitch varnish using a hot dip method.
.7 Wedges shall be used at ductile iron joints to ensure electrical continuity.
.8 Rubber gaskets for push-on or mechanical joints shall be according to AWWA C111/A21.11.

.6 Concrete Pressure Pipe
.1 Concrete cylinder pipe including joints and fittings shall be according to AWWA C300, C301, or C303.
.2 Non-cylinder pipe and joints shall be according to AWWA C302 or ASTM C361. Fittings shall be according to AWWA C302.

.7 Polyvinyl Chloride (PVC) Pipe
.1 Polyvinyl chloride pipe shall be blue in colour, supplied complete with gaskets, and according to AWWA C900 and CSA B137.3.
.2 Pressure Class: 200
.3 DR: 14.
.4 Flexible elastomeric seals for bell and spigot joints shall be according to ASTM D3139.
.5 Fittings for polyvinyl chloride (PVC) pipe shall be either:
.1 Ductile iron according to AWWA C110/A21.10 or AWWA C153/A21.53 and shall be cement lined according to AWWA C104/A21.4.

.2 Injection moulded polyvinyl chloride, blue in colour and according to AWWA C907 and CSA B137.2.

.6 Pipe shall be delivered to the site complete with factory installed end caps and a tamper evident seal on the bell end only.

2.2 GATE VALVES

.1 Gate valves for line, branch, isolation, auxiliary, air, drain and for meter installation in sizes 75 mm to 300 mm shall be Resilient-Seated Gate Valves that meet or exceed AWWA C-509. Valves shall open counterclockwise.

.2 Gate valves shall be cast iron or ductile iron body, with non-rising stems and a 51 mm x 51 mm operating nut positioned for vertical operation. The stem seal shall be of standard O-ring type. All valves shall be supplied with either a two-part spray epoxy coating or a fusion bonded epoxy coating, factory applied to both the exterior and interior surfaces of the valve per AWWA C-550.

.3 The pressure rating for gate valves shall be 1380 kPa for valves 75 mm to 300 mm inclusive and 1035 kPa for 400 mm and greater tapping valves.

.4 Nuts and bolts for gate valve bodies/bonnets and gland rings to be type 316 stainless steel.

2.3 VALVE BOXES

.1 The valve boxes shall be 112 mm sliding type, complete with grommeted hole for tracer wire.

.2 The valve boxes shall be of good quality cast iron.

.3 The valve box castings shall have a tensile strength of not less than 138 MPa.

.4 The valve box shall be solid with clean surfaces, free from scales, bumps, flows, blow holes, or other defects.

.5 After cleaning and inspection, the valve boxes shall be thoroughly coasted with an approved casting paint.

.6 The valve box assembly shall consist of five elements. No. 6 base, bottom section, extension, top section, and cap.

.7 The length of the valve box assembly from the top of the connecting pipe to the ground line shall be 2.5 metres.

2.4 PIPE AND JOINT RESTRAINT

.1 All concrete thrust restraints are to comply with OPSD 1103.01 or as required.

.2 Mechanical joint restraint may be used subject to the prior approval of the Consultant.

2.5 HYDRANTS

.1 Each hydrant shall have an isolation valve with a valve box.

.2 Each hydrant shall have a 150 mm barrel with two 63 mm hose connections and one 100 mm Stortz Pumper (Steamer) Port connection and shall be clockwise opening. Hydrants shall be Clow Brigadier D67M, or Canada Valve Century B50-B18.

.3 Fire hydrants shall be dry-barrel type conforming to AWWA C502 with mechanical joint.

.4 Each hydrant shall have a concrete shock collar of 1 m x 1 m x 150 mm thick, the top of which shall be 150 mm below the flange.

.5 The hydrant flanges shall be higher than the crown of the adjacent road or the top of the adjacent curb, whichever is higher. Flanges shall be placed such that connecting bolts can be easily removed.

.6 Hydrants set in ditches or swales shall conform to OPSD 217.05.

.7 All hydrants shall be self-draining. Washed gravel of suitable size and quantity shall be placed around the drain holes to ensure drainage. Such material shall be topped with suitable geotextile to ensure fines do not migrate into the drainage rock.

.8 Fire hydrants, which are not in service, shall have a 300 mm x 300 mm sign affixed on the road-facing side with 35 mm lettering stating “NOTICE: THIS HYDRANT IS NOT IN SERVICE”. The sign colours are black lettering on a reflective yellow background.

.9 Fire hydrants shall be chrome yellow in colour.

2.6 BACKFILL MATERIAL

.1 In accordance with Section 02315 – Excavating, Trenching and Backfilling.

2.7 PIPE DISINFECTION

.1 Liquid chlorine to ANSI/AWWA B301 to disinfect watermains.

2.8 TRACING WIRE

.1 Shall be solid TWM or 12 gauge, copper, 60°C or higher, 600 V plastic coated.

2.9 INSULATION

.1 Insulation is required for watermains and services which are not buried with sufficient cover. 50 mm thick rigid insulation approved by the Consultant shall be installed 300 mm above the top of pipe for every 300 mm of reduced cover. Under pavement, 2.1 m of cover is required, while under landscaped areas, 1.7 m cover is required.

2.10 DUCTILE IRON PIPE RESTRAINT

.1 Mechanical restraint for standardised mechanical joints shall be incorporated in the design of the follower gland and shall impart wedging action against the pipe, increasing its resistance as the pressure increases. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by controlled and limited expansion of each joint during the wedging action. Restraining glands shall be manufactured of ductile-iron conforming to the requirements of ASTM A 536, Grade 65-45-12. Wedging mechanisms shall be manufactured of Ductile iron to hardness of 370 BHN minimum. Dimensions of the gland shall be such that it can be used with the standardised mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest version. Twist off nuts shall be incorporated in the design of the wedge activation screws to insure proper torque during installation.

.2 The mechanical joint restraining device shall have a working pressure of 1750 kPa with a safety factor of 2.1 against separation when tested in the dead-end situation.

.3 The Mechanical joint restraining device shall be Uni-Flange series 1400 or approved equal.

2.11 PVC PIPE RESTRAINT

.1 Mechanical joint restraint devices for PVC Pipe shall incorporate a series of machined serrations (cast serrations are not permitted) on the inside diameter to provide restraint, exact fit, and 360 degree contact and support of pipe wall. Restraint devices shall be manufactured of high strength ductile iron, ASTM A 536, Grade 65-45-12. Bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11.

.2 All joint restraint devices for PVC shall carry a water working pressure rating equivalent to the full rated pressure of the PVC pipe on which they will be installed, with a minimum factor of safety of 2:1 in any nominal pipe size. In addition, they shall meet or exceed the requirements of Uni-B-13-94, Recommended Performance Specification For Joint Restraint Devices For Use with Polyvinyl Chloride (PVC) Pipe.

.3 Restraint Devices shall be Uni-Flange Series 1300, 1350, 1360, 1390 or approved equal.

- .1 Series 1300 - For restraint of PVC pipe with DI mechanical joint or DI Push-on fittings with “ear lugs”.
- .2 Series 1350 - For restraint of PVC pipe bell in spigot joints (new installations).
- .3 Series 1360 - For restraint of PVC pipe in PVC pressure fittings joint (AWWA C907 PVC Fittings or “fabricated PVC pressure fittings).
- .4 Series 1390 - For restraint of PVC pipe bell and spigot joints (new or existing installations).

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Consultant. Remove defective materials from site as directed by Consultant.

3.2 TRENCHING

.1 Do trenching work in accordance with Section 02315 – Excavating, Trenching, Backfilling.

.2 Trench depth to provide cover over pipe of not less than 2.1 m from finished grade or as indicated.

.3 Trench alignment and depth require Consultant's approval prior to placing bedding material and pipe.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete work in accordance with Section 03300 - Cast-in-Place Concrete. Place concrete to details as indicated or as directed by Consultant.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

.1 Place and compact granular bedding materials to OPSD 802 details indicated or specified.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe exterior. Do not use blocks in bedding pipe.

.3 Shape transverse depressions as required to receive bell.

.4 Upon completion of pipe laying, place bedding simultaneously on each side of pipe to prevent displacement. Compact in layers as required.

3.5 PIPE INSTALLATION

.1 Lay pipes to Manufacturer's standard instructions and specifications. Do not use blocks except as specified.

.2 Join pipes in accordance with manufacturer's recommendations.

.3 Bevel or taper ends of PVC pipe to match fittings.

.4 Handle pipe by methods approved by Consultant recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

.5 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

.6 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.

.7 Do not exceed 50% of the permissible deflection at joints recommended by pipe manufacturer.

.8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.9 Position and join pipes with equipment and methods approved by Consultant.

.10 Cut pipes in an approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.11 Align pipes carefully before jointing.

.12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.13 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again.

.14 Complete each joint before laying next length of pipe.

.15 Minimize deflection after joint has been made.

.16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Consultant.

.18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.19 Do not lay pipe on frozen bedding.

.20 Install tracer wire as detailed.

.21 Backfill remainder of trench as per Section 02315 – Excavation, Tracking and Backfilling.

.22 All mains and services shall be marked with a 50 mm wide detectable metallic tape (blue) with the wording “Buried Water Line Below”. The tape shall be Seton Product SP367 or equivalent. The tape shall be laid 300 mm to 450 mm above the main or service.

3.6 VALVE INSTALLATION

.1 Install valves to manufacturer's recommendations at locations as indicated.

.2 Support valves located in valve boxes or valve chambers by means of either concrete or wood blocks, located between valve and solid ground. Bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1m. Valves not to be supported by pipe.

3.7 TRACER WIRE INSTALLATION

.1 Tracer wire shall be looped up the outside of all main valve boxes and extended into the valve box by at least 150 mm through hole 50 mm below the bottom of the cover bell.

.2 All connections must be waterproofed.

.3 Splicing of tracer wire is not allowed unless specified or approved.

.4 Tracer wire continuity of current must be tested and verified.

.5 Tracer wire at hydrant shall be brought to the surface and tied around barrel.

.6 Tracer wire to be secured to pipe at every fitting, valve, and at intervals not exceeding 3 m by the use of fiberglass tape.

3.8 HYDRANTS

.1 Install hydrants at locations as indicated.

.2 Install hydrants in accordance with AWWA Manual of Practice and as detailed.

.3 Install 150 mm gate valve and cast iron valve box on hydrant service leads as indicated.

.4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm to 100 mm above final grade.

.5 Place concrete thrust blocks and restraining rings as indicated and specified ensuring that drain holes are unobstructed.

.6 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.

.7 Install shock collar as detailed.

.8 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.9 THRUST BLOCKS AND RESTRAINED JOINTS

.1 For thrust blocks: complete concrete work in accordance with Section 03300 - Cast-in-Place Concrete.

.2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Consultant.

.3 Keep joints and couplings free of concrete.

.4 Do not backfill over concrete within 24 hours after placing.

.5 Restrain all joints where indicated on the Contract Drawings using approved restraining rings.

3.10 CATHODIC PROTECTION

.1 Tracer wire on mains shall be protected with a 2.3 kg zinc anode, at each end a maximum spacing of which shall be 500 m.

.2 Valves, metallic fittings and hydrants shall be protected with 7.7 kg magnesium anodes.

.3 Other services of 50 mm or smaller shall be protected with a 5.5 kg zinc anode. If the service is copper, this anode shall be connected directly to the service material. If the service is PEX, the anode shall be connected to the tracer wire at the curb stop location.

.4 Anodes shall be set and thermite welded to Consultant's satisfaction.

3.11 HYDROSTATIC AND LEAKAGE TESTING

.1 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.

.2 Notify Consultant at least 24 hours in advance of all proposed tests. Perform tests in presence of Consultant.

.3 Where any section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or two days if high early strength concrete is used.

.4 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Consultant.

.5 Leakage testing is to be scheduled to be completed between 8:00 a.m. and 4:00 p.m. local time.

.6 Leakage testing of pipe and disinfection of pipes shall conform to OPSS.MUNI 441 and as required below:

.1 A test section shall be a section between valves or the completed watermain.

.2 Test pressure shall be 1380 kPa (200 PSI), as measured at the lowest end of the pipeline.

.3 The test section shall be filled slowly with water and all air shall be removed from the pipeline. A 24 hour absorption period may be allowed. The test section shall be subjected to the specified continuous test pressure for two hours.

.4 The leakage is the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage is to be compared with the allowable leakage calculated for the test section. The allowable leakage is 2.22 Litres per millimeter of pipe diameter per kilometer of pipeline per day.

.5 If measured leakage exceeds the allowable leakage, the Contractor shall locate and repair all leaks and the test shall be retested until a satisfactory result is obtained.

3.12 PIPE SURROUND

.1 Upon completion of pipe laying and after Consultant has inspected work in place, surround and cover pipes as indicated.

.2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Do not place material in frozen condition.

.5 Compact each layer from top of bedding to 300 mm above pipe obvert to at least 90% of corrected maximum dry density.

3.13 SURVEYING OF PIPE JOINTS

.1 Contractor shall complete a survey shot, consisting of GPS coordinates and elevation, of all pipe and fitting joints prior to backfilling

- .1 For pipes installed in open cut, survey shot shall be taken from the crown of the pipe joint.
- .2 For pipes installed in tunnels, survey shot shall be taken from the invert of the pipe joint.
- .3 For pipes or fittings installed in the vertical, the vendor shall survey the most northern point of the pipe joint.

.2 Contractor shall maintain records of survey shots in a format acceptable to the Consultant. The shots shall be numbered and correspond with the shop drawings and contract drawings.

.3 The Contractor shall submit survey records monthly for the Consultant's review. This review does not relieve the Contractor of their responsibility for the proper installation of the work. A complete set of survey records shall be re-submitted to the Consultant at the completion of the forcemain installation works.

3.14 BACKFILL

.1 Place backfill material, above pipe surround, in uniform layers in accordance with Section 02315.

.2 Do not place backfill in frozen condition.

3.15 HYDRANT FLOW TESTS

.1 Fire department will conduct flow tests on every hydrant to determine fire flows prior to painting hydrant caps and ports.

3.16 PAINTING OF HYDRANTS

.1 After installation, paint hydrants chrome yellow.

.2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction. Inform Owner personnel to inspect.

3.17 FLUSHING AND DISINFECTING

.1 Flushing, disinfection and microbiological sampling shall be completed per the MECP Watermain Disinfection Procedure, Ministry of Environment and Climate Change Safe Drinking Water Branch, as amended, and AWWA C651-14 Disinfecting Water Mains

.2 Flushing/Swabbing of Watermains

.1 Flushing/Swabbing operations shall be conducted under the supervision of the Contract Administrator. The Contract Administrator shall be notified at least two business days in advance of the proposed date on which flushing/swabbing and disinfecting operations are to commence.

.2 All Watermains shall be wet swabbed as follows:

.1 A minimum of 3 (Three) new foam swabs with a density of approximately 25 kg/m3 and a minimum diameter of 50mm larger than the watermain shall be used.

.2 Swabs shall have a minimum length of 1.5 times the diameter.

.3 Swabs shall be propelled through the watermain using potable water and shall be spaced a minimum of 1.5m meter between swabs.

.4 During the swabbing procedure the contractor is to install spool pieces in place of all butterfly valves. These shall be supplied, installed and removed by the contractor, with the removed spool pieces delivered to the Owner's yard for future use (approximately 2 km from site).

.5 Gate valves must be left in the open position

.6 Swabbing shall continue until the discharge water runs clear within 10 seconds of the last swab exiting the discharge point.

.7 All fitting, taps, valves etc. required for the introduction, propelling and recovery of the swabs, as well as the swabs are to be supplied by the contractor. The removal of all of the above at the completion of the swabbing works is the responsibility of the contractor.

.8 Temporary swab launching as well as retrieval facilities shall be constructed in accordance with drawings

.3 Watermains 500mm and larger, only third party qualified firms, specializing in watermain commissioning, with documented experience and expertise in the swabbing, disinfecting and cleaning of watermains shall be permitted to conduct watermain swabbing. The firm conducting the swabbing must show proof that at least one on-site staff member is a qualified operator under O.Reg. 128/04 (min. Class 1) and be approved by the Contract Administrator in writing before work may begin.

.4 All water discharged by the flushing/swabbing operations shall be at an approved outlet location. The contractor shall be responsible for collecting and/or disposing of all such water, ensuring that all erosion and sediment control and de-chlorination requirements of the MECP, the local conservation authority and various other authorities having jurisdiction are met.

.3 Disinfection and Microbiological Sampling

.1 After flushing/swabbing is completed, water from the existing distribution system shall be allowed to flow at a controlled rate into the new pipeline. Liquid chlorine solution shall be introduced at a controlled rate so that the chlorine dosage is consistent and is distributed throughout the section being disinfected. The chlorine shall be applied so that the free chlorine (CL_2) concentration is 25 mg/L minimum and 200 mg/L maximum throughout the section. The system shall be left charged with the chlorine solution for 24 hours.

.2 The chlorine concentration will be tested in the section after 24 hours, by the Contract Administrator. If tests indicate a chlorine residual in accordance with Table 1 of the MECP Watermain Disinfection Procedure, as amended, the section shall be flushed completely and recharged with water normal to the operation of the system. If the test does not meet the requirements, the disinfection procedure shall be repeated until satisfactory results are obtained.

.3 Immediately after the system has been recharged samples for microbiological testing shall be collected by the Contract Administrator. At each sampling location, a sample shall be taken and tested for free Cl_2 residual prior to collecting the sample for microbiological testing. The free Cl_2 residual must be at least 0.20 mg/L. If it is less than this the chlorination procedure shall be repeated until satisfactory results are obtained before proceeding with sampling for bacteriological testing.

.4 Immediately after confirming the presence of an acceptable Cl_2 residual the contract administrator shall collect a sample for microbiological testing.

.5 Two consecutive acceptable samples taken a minimum of 16 hours apart must be obtained.

.6 If this testing is required by the Contractor to occur outside of the normal working hours (i.e., weekends or holidays) the Contractor will be subject to a flat rate charge of $250.00 plus applicable taxes and will be responsible for any additional laboratory charges incurred. The Corporation may deduct any amount due under this paragraph from any monies that may be due or payable to the Contractor on any account whatsoever.

.7 If there is indication of contamination, the disinfection procedure shall be repeated in its entirety.

.8 The system shall not be put into operation until clearance has been given by the Contract Administrator.

.4 Disposal of Water

.1 Dispose of safely, all chlorinated water from draining operations or used for testing, flushing or disinfecting waterworks.

.2 Dechlorinating agents for the neutralization of disinfecting agent shall be in conformance with AWWA C655.

.3 Do not discharge untreated chlorinated water into any storm sewer, drainage ditch, water course or sanitary sewer.

.4 Provide acceptable equipment and additives to neutralize any chlorinated water which is to be wasted. Residual chlorine in the discharge water must not exceed 0.02 mg/L. The Contractor shall monitor and record the chlorine residual of the discharged water in the presence of the Consultant.

.5 Contractor to ensure no excess de-chlorinating agent is added such that there is any impairment of the environment.

3.18 OPERATION OF VALVES AND HYDRANTS

.1 All water network valves and hydrants on the main distribution system, including watermain accepted by the Owner under this contract, are to be operated by the Owner only. Should the Contractor require operation of these items, the Contractor is to coordinate with the Owner.

3.19 SURFACE RESTORATION

.1 After installing and backfilling over watermains, restore surface to original condition as directed by Consultant.

3.20 BACKFLOW PREVENTION

.1 The Owner shall make available one (1) reduced pressure principal backflow preventer (Hydrant Box) or (1) 100mm double check valve assembly with two 100mm gate valves for use in the supply of water for testing, disinfection and flushing/swabbing. The reduced pressure principal backflow preventer (Hydrant Box) will be enclosed within a locked box that is only to be accessed by Owner personnel. No modifications to the equipment supplied are permitted, and external valves shall not be removed or dismantled. The Contractor will be responsible for the replacement cost of any equipment lost or damaged. Any additional hardware required to complete the temporary installation of this device shall be supplied by the Contractor at his/her expense.

.2 This device will only be made available at the time of testing and for the minimum period required to perform the watermain testing.

.3 The Contractor shall install the backflow prevention device at a location such that the total length of new pipe installed between the existing watermain, and the backflow prevention device shall not exceed 5.0 m. This length of pipe shall be cleaned and disinfected according to ANSI/AWWA 651 section 9.1. Installation shall be in accordance with CSA B64.10.

.4 The backflow prevention device shall be returned to Owner, complete with all fittings supplied, in the condition received. It shall be cleaned completely, and the interior shall be protected from the intrusion of any deleterious material. The Contractor will be charged for any missing or damaged equipment.

.5 There shall be no payment made for installation, relocation, or removal of the backflow prevention device.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section covers supply and installation of non-watermain buried piping that will be subject to internal pressures.

1.2 SUBMITTAL

.1 Provide Shop Drawings for proposed pipe materials and layout.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

.1 Polyvinyl chloride plastic pressure pipe and fittings to CSA B137.3 Flexible elastomeric seals for bell and spigot joints to ASTM D 3139. PVC fittings to CSA B137.2.

.2 Ductile iron pipe to AWWA C151/A21.51. Straight pipe sections to be cement lined to AWWA C111/A21.11. Pressure Class 350.

.3 For small diameter Effluent Water and Service Water lines:

.1 Cross Linked High Density Polyethylene (PEX) meeting NSF 14 & 61, AWWA C904, and CSA B137.5. Sizing must conform to standard copper tube size (CTS) O.D. and be compatible with standard copper tube compression fittings, with a minimum working pressure rating of 1100 kPa (160 psi) at 23oC.

.2 All brass fittings shall be manufactured from Low Lead Alloy C89520 or C89833.

.3 Couplings and adapters shall be compression fittings or compression X Male or Female iron pipe as manufactured by Mueller, Ford Meter, Cambridge Brass.

.4 High density polyethylene to ASTM D3350, maximum allowable hoop stress 5,500 kPa at 23oC. Polyethylene resins shall conform to Type PE 4710. Protection shall be provided against ultraviolet light degradation using carbon black, not less than 2 percent well dispersed in the resin. DR 13.5. Molded fittings, butt fusion joined to ASTM D3261.

2.2 GATE VALVES

.1 Gate valves shall be resilient wedge gate valves that meet or exceed AWWA C-515. The gate valves shall be certified to ANSI/NSF 61. Valves shall open clockwise.

.2 Gate valves shall be ductile iron body, with non-rising stems and a 51 mm x 51 mm operating nut positioned for vertical operation. The stem seal shall be of standard O-ring type. All valves shall be supplied with a two-part fusion bonded epoxy coating, factory applied to both the exterior and interior surfaces of the valve per AWWA C-550.

.3 The maximum working pressure shall be 1725 kPa.

.4 Nuts and bolts for gate valve bodies/bonnets and gland rings to be type 316 stainless steel.

2.3 VALVE BOXES

.1 The valve boxes shall be 130 mm sliding type, complete with grommeted hole for tracer wire.

.2 The valve boxes shall be of good quality cast iron.

.3 The valve box castings shall have a tensile strength of not less than 138 MPa.

.4 The valve box shall be solid with clean surfaces, free from scales, bumps, flows, blow holes, or other defects.

.5 After cleaning and inspection, the valve boxes shall be thoroughly coasted with an approved casting paint.

.6 The valve box assembly shall consist of five elements. No. 6 base, bottom section, extension, top section, and cap.

.7 Contractor to determine the length of the valve box assembly from the top of the connecting pipe to the ground line based on field conditions.

2.4 PIPE RESTRAINTS

.1 Mechanical restraint for standardized mechanical joints shall be incorporated in the design of the follower gland and shall impart wedging action against the pipe, increasing its resistance as the pressure increases. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by controlled and limited expansion of each joint during the wedging action. Restraining glands shall be manufactured of ductile-iron conforming to the requirements of ASTM A 536, Grade 65-45-12. Wedging mechanisms shall be manufactured of Ductile-iron to hardness of 370 BHN minimum. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest version. Twist off nuts shall be incorporated in the design of the wedge activation screws to insure proper torque during installation.

.2 The mechanical joint restraining device shall have a working pressure of 1750 kPa with a safety factor of 2.1 against separation when tested in the dead-end situation.

.3 The Mechanical joint restraining device shall be Uni-Flange series 1400 or approved equal.

2.5 FLEX COUPLERS

.1 Conforms with or exceeds requirements of standards: AWWA C219, NSF-61 and NSF-372.

.2 Carbon steel with fusion bonded epoxy coating conforming with AWWA C-213 standard.

.3 Couplers to be supplied with ANSI 304/305 stainless steel bolts and nuts.

.4 Gasket compound to be approved for contact with sanitary sewage.

.5 Couplers to be properly sized to accommodate different O.D. of pipe when a transition between pipe types occur at the flexible coupler.

.6 Couplers to be Hymax 2000 or approved equivalent.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean pipes of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Consultant. Remove defective materials from site.

3.2 EXCAVATION

.1 Excavate trench as per Section 02315.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete work in accordance with Section 03300 - Cast-in-Place Concrete. Place concrete to details as indicated.

3.4 GRANULAR BEDDING

.1 Do not place material in frozen condition.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe.

.3 Compact bedding to at least 95% Standard Proctor maximum dry density.

3.5 PIPE INSTALLATION

.1 Lay pipes to manufacturers recommendations.

.2 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

.3 Lay pipes true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

.4 Face socket ends of pipe in direction of laying.

.5 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.6 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.

.7 Position and join pipes with equipment and methods approved by Consultant.

.8 Align pipes carefully before jointing.

.9 Install gaskets to manufacturer’s recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.10 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again.

.11 All joints to be fully restrained using mechanical joint accessory supplied by manufacturer.

.12 Minimize deflection after joint has been made.

.13 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.14 Backfill remainder of trench.

3.6 PIPE SURROUND

.1 Upon completion of pipe laying and after Consultant has inspected work in place, surround and cover pipes as indicated.

.2 Place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Do not place material in frozen condition.

.5 Compact each layer from pipe invert to mid height of pipe to 100% Standard Proctor density.

.6 Compact each layer from mid height of pipe to underside of backfill to at least 95% Standard Proctor density.

3.7 BACKFILL

.1 Place marker tape and backfill as per Section 02315.

.2 Under asphalt and concrete walks, compact new Granular 'A' and Granular 'B' layers and top 300 mm of approved backfill to 100% SPMDD. Compact the remainder of approved backfill to 95% SPMDD. In other areas, compact approved backfill to 95% SPMDD."

3.8 CATHODIC PROTECTION

.1 Valves and metallic fittings shall be protected with 7.7 kg magnesium anodes.

3.9 TRACER WIRE

.1 Tracer wire shall be installed securely on the proposed forcemains.

.2 Tracer wire posts shall be Rhino Triview tracer PED with "Sanitary" markings, or approved equivalent. Installation shall be as per manufacturer's requirements.

.3 Trace wire shall be RW90XLPE wire, rated at minus 40˚C, coated 7 strand, 10 gauge.

.4 If required, splices and other wire to wire connections shall be made by using Dryconn waterproof connectors or approved equivalent.

.5 The wire shall be installed in such a manner as to be able to properly trace all pipes without loss or deterioration of signal, or without the transmitted signal migrating off the tracer wire.

.6 Tracer wire conductivity testing is to be conducted by a qualified third-party company and witnessed by the Consultant.

.7 Results of tracer wire conductivity testing are to be noted on a Tracer Wire Field Inspection Report and shall be provided to the Consultant.

.8 A continuity signal shall be applied to the tracer wire and the signal confirmed over the length of all tracer wire installed. The signal shall be detectable for a distance between terminal posts. At no time shall there be a break in the continuity of the tracer wire.

.9 In the event that the conductivity tests fail, the Contractor shall be responsible to repair or reinstall all required tracer wire at their own expense.

3.10 THRUST BLOCK AND RESTRAINED JOINTS

.1 For thrust blocks: complete concrete work in accordance with Section 03300 - Cast-in-Place Concrete.

.2 Place concrete thrust blocks between valves, tees, plugs, caps, horizontal bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Consultant.

.3 Keep joints and couplings free of concrete.

.4 Do not backfill over concrete within 24 h after placing.

.5 Restrain all horizontal and vertical joints as outlined on the Contract Drawings using approved restraining rings.

3.11 TESTING

.1 PVC, HDPE, PEX, and ductile iron forcemains to be hydrostatically and leakage tested as per OPSS.MUNI 411 modified as follows:

.1 Hydrostatic test pressure to be 520kPa (75psi).

3.12 SURFACE RESTORATION

.1 After installing and backfilling over piping, restore surface to original condition or as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02315 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 NFPA 22 – Water Tanks for Private Fire Protection (incl. references contained therein).

.2 City of Ottawa – Drawings and Standard for Rural Water Supply Reservoirs and Water Fill Stations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies WHMIS SDS - Safety Data Sheets in accordance with General and Supplementary Conditions of Contract.

.3 Shop Drawings:
- .1 Submit shop drawings for tanks, manufacturers installation details.

.4 Quality assurance submittals: submit following in accordance with Section 01430 – Quality Control.
- .1 Test reports: submit certified test reports for specified materials from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Consultant to:
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle materials in accordance with Section 01610 – Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 TANK

.1 14,000 USG underground fire water storage tank meeting above referenced specifications.

.2 Example tank: XERXES Single Wall FRP c/w minimum 30” diameter riser with hinged, lockable lid, anti-vortex plate, venting, associated piping for fire connections, suitable deadmen and straps or alternate as approved by contract administrator.

.3 Piping for fire connections (Riser box, draw pipe and/or blue hydrant) preferences to be coordinated with local fire department.

.4 Concrete or steel tanks may be considered at discretion of contract administrator. Tanks must meet above referenced specifications.

.5 Tank contents to be protected from freezing.

.6 Tank to be filled with potable water for ballast during installation and testing and filled to design capacity upon commissioning

.7 Thank to be tested for water tightness in accordance with manufacturer’s instructions

.8 Operation and Maintenance Manuals to be provided.

.9 Signage to be provided behind fire connections, per City of Ottawa Specifications, signifying buried fire water storage and size of tank.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION GENERAL

.1 Install tank per manufacturer’s instructions.

.2 Tank sub-base to be inspected by geotechnical representative. Granular or concrete base to be included per manufacturer’s recommendations and confirmed by geotechnical representative. Dewatering of excavation, as required, shall be included as necessary.

.3 Backfill shall not be undertaken until tank and anchorages are inspected by Consultant. Placement of backfill and compaction per manufacturer’s recommendations.

.4 Surface restoration to match surrounding landscaping.

3.3 FIELD QUALITY CONTROL

.1 Site Tests/Inspections:

.1 Inspection of tank will be carried out by Consultant prior to placing.

.2 Testing of fire connection apparatus to be coordinated with local fire department.

3.4 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies requirements for supplying and installing gravity piping to lines, grades indicated on drawings or as directed by Consultant.

1.2 SOURCE QUALITY CONTROL

.1 Provide certified copies of pipe tests, shop drawings and other pertinent information.

.2 Have all pipes inspected by accredited inspection company before being delivered to job and stamped with their approval mark.

.3 Consultant may reject materials pending result of tests.

.4 Cost of all tests and inspections to be borne by Contractor.

1.3 AS CONSTRUCTED DRAWINGS

.1 Provide data necessary to produce 'as-constructed' drawings, including details of pipe material, invert elevations at maintenance holes and connections, location of tees, bends, clean-outs, maintenance holes, saddles, laterals and caps.

1.4 SCHEDULING OF WORK

.1 Schedule work to minimize interruptions to existing services.

.2 Maintain existing flows during construction.

.3 Submit schedule of expected interruptions for approval by Consultant and adhere to interruption schedule as approved.

PART 2 - PRODUCTS

2.1 SANITARY SEWERS (CONCRETE PIPE)

.1 Non-reinforced concrete pipe and fittings to CSA A257.1-1974 and ASTM C-14, designed for flexible rubber gasket joints to CSA A257.3-1974 and ASTM C-443.

.2 Reinforced concrete pipe and fittings to CSA 257.2-1974 and ASTM C-76, designed for flexible rubber gasket joints to CSA A257.3-1974 and ASTM C-443.

.3 Pipe class, date of manufacture and manufacturer's name to be marked on each pipe length.

.4 Pipe lengths for 375 mm diameter and smaller to be minimum 1.850 m. Lengths for 450 mm diameter and larger at least 2.300 m.

.5 Lifting holes permitted only in pipes over 900 mm diameter, provided lifting tackle incorporates curved steel plate matching lifting tackle.

.6 Elliptical reinforcement permitted only in pipes over 900 mm on condition that lifting holes are provided and used for installation.

.7 Acceptability of concrete pipe to be conditional on meeting requirements of:

.1 Three edge bearing or sand bearing test by method and number as set out ASTM C-76.

.2 Crushing tests on poured concrete cylinders, made by the Supplier, to a maximum of three cylinders per 300 m of pipe supplied.

2.2 SANITARY SEWERS (PVC PIPE)

.1 All pipe and fittings are to carry CSA certification to the appropriate CSA standard sewer grade.

.2 All pipe to be type PSM polyvinyl chloride (PVC) pipe with elastometric gasket as per OPSS 1841 and CSA 182.2 or 182.7.

.3 Profile pipe such as those meeting CSA 182.4 are not to be used for sanitary sewers.

.4 Pipe to be green in colour.

.5 Sanitary mains to be DR 35 pipe, building laterals to be DR 28 pipe.

2.3 STORM SEWERS

.1 All pipe and fittings are to carry CSA certification to the appropriate CSA standard sewer grade.

.2 All pipe to be type PSM polyvinyl chloride (PVC) pipe with elastometric gasket as per OPSS 1841 and CSA 182.2 or 182.7.

.3 Pipe to be green in colour.

.4 Storm mains to be DR 35 pipe, building laterals to be DR 28 pipe coloured white.

.5 PVC pipe with elastomeric gasketed bell and spigot type joints meeting CSA B182.4 with a stiffness of 320 kPa may be used.

.6 Where specified, reinforced concrete pipe with elastomeric gasketed bell and spigot type joints meeting CSA A257.2 is to be used.

.7 Vertical segments of storm piping connected to building downspout to include transition coupling. Vertical segment to use sweep connection to horizontal.

2.4 SUBDRAINS

.1 Perforated 100 mm diameter HDPE pipe and fittings to OPSS 1840, to be installed with geotextile filter sock.

2.5 LATERAL CONNECTIONS TO SEWERS

.1 Use pre-manufactured tees for sewers.

2.6 CEMENT MORTAR

.1 Portland cement to CSA A5-98 normal symbol 10.

.2 Mortar to be one part by volume of cement to two parts clean, sharp sand mixed dry. Add only sufficient amount of water after mixing to give optimum consistency for placement. Do not use additives.

2.7 NON-SHRINK GROUT

.1 Use proprietary products: In-Pakt by Grace Construction Products; V-1 Grout by W.R. Meadows; M-Bed by Sternson; or approved alternative.

2.8 POURED CONCRETE

.1 Comply with requirements of CSA A23.1 and A23.2.
  .1 To requirements of Section 03300 – Cast-in-Place Concrete.

2.9 INSULATION

.1 Note that gravity sewers must have 50mm thick rigid insulation 300mm above top of pipe for every 300mm of reduced cover less than 1.0m.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Clean pipes and fittings of accumulated debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

3.2 TRENCHING

.1 Do trenching and backfill work to Section 02315 – Excavation, Trenching and Backfilling.

.2 Trench line and depth requires Consultant's approval prior to placing bedding material or pipe.

.3 Do not backfill trenches until pipe grade and alignment have been checked and accepted by Consultant.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Where indicated on the Contract Drawings, do concrete work to Section 03300 – Cast-in-Place Concrete. Place concrete to details indicated or directed by Consultant.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

.1 Place and compact granular bedding materials to details indicated or specified.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe exterior. Do not use blocks in bedding pipe.

.3 Shape transverse depressions as required to receive bell.

.4 Upon completion of pipe laying, place bedding simultaneously on each side of pipe to prevent displacement. Compact in layers as required.

3.5 INSTALLATION

.1 Lay and joint pipes in accordance with OPSS.MUNI 410 and manufacturer's recommendations.

.2 Take up and re-lay in correct position any pipe laid with variations from required grade exceeding +20 mm.

.3 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.4 Do not allow any water to flow through pipe during construction, except as may be permitted by Consultant.

.5 Whenever work is suspended, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.6 Pipe Jointing:

- .1 Install gaskets in accordance with manufacturer's recommendations.
- .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .3 Align pipes carefully before joining.
- .4 Maintain pipe joints free from mud, silt, gravel or other foreign material.
- .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
- .6 Complete each joint before laying next length of pipe.
- .7 Apply sufficient pressure in making joints to ensure that the joint is complete as outlined in the manufacturer's recommendations.
- .8 Minimize joint deflection after joint has been made to avoid joint damage.
- .9 At rigid structures, install a pipe joint not more than 500 mm from side of structure.

.7 Block pipes when any stoppage of work occurs to prevent "creep" during down time.

.8 Cut pipes as required for special inserts, fittings or closure pieces, in a neat manner as recommended by pipe manufacturer, without damaging pipe.

.9 Make watertight connections to maintenance holes and with non-shrink grout or as detailed.

.10 Install subdrains as per OPSS 405 with perforations and coupling slots downwards.

.11 Protect subdrains against flotation during installation.

3.6 FLUSHING AND CLEANING

.1 Clean completed sewers to satisfaction of Consultant.

3.7 FIELD TESTING SEWERS

.1 When directed by Consultant, or if deflections are identified in the CCTV inspection, draw a solid plug, in accordance with OPSS.MUNI 410, through all PVC sewers to ensure that pipe is free of obstruction, and not excessively deformed.

.2 Air Test PVC pipe as per OPSS.MUNI 410.

.3 Perform tests in presence of Consultant. Notify Consultant 24 hours in advance of proposed tests.

.4 Repair and retest sewer line as required, until test results are within limits specified.

.5 Repair visible leaks regardless of test results.

.6 Concrete Pressure Pipe tested as gravity sewers shall have no visible evidence of leakage, as per OPSS.MUNI 410.

3.8 CLEANUP

.1 Remove all equipment and excess materials and clean up all work areas continuously as construction progresses.

.2 Before final inspection, clean and flush out all sewers to remove all foreign material.

3.9 CCTV INSPECTION

.1 Sewers shall have a closed-circuit television (CCTV) inspection according to OPSS.MUNI 409 with the following modifications:

- .1 409.06.03 Survey Equipment shall be removed and replaced by:
  - .1 The surveying equipment shall be capable of surveying a length of pipeline up to:
    - .1 350 m where entry to the pipeline may be obtained at each end of the pipeline;
    - .2 30 m where rodding is used; or
    - .3 300 m where a self-propelled unit is used when entry is at only one end of the pipeline.
    - .4 200 m when being towed.

Work shall not commence in a work shift until the Consultant is satisfied that all items of the survey equipment have been provided and are in full working order.

Each survey unit shall contain a means of transporting the CCTV camera in a stable condition through the pipeline.

The CCTV camera must be a self-propelled unit unless otherwise approved in writing by the Consultant.

Each unit shall carry sufficient number of guides and rollers such that, when surveying, all cables are supported away from pipe and maintenance hole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.

.2 409.07.01 Pipeline Cleaning shall be removed and replaced by:

Sewers shall be clean to the satisfaction of the Consultant. If the camera inspection reveals that further cleaning is required, at the sole discretion of the Consultant, the sewer shall be cleaned and re-inspected at no additional cost to the Owner.

.3 409.07.04.01 General shall be removed and replaced by:

Paragraph 4 on page 7 shall be removed and replaced by:

A fixed camera may be used for pipelines less than 175 mm in diameter. For pipelines equal to or greater than 175 mm, a pan and tilt camera shall be used. Each camera must have an accepted sample submissions report prior to being used for inspection work. The camera lens shall be kept clean at all times during the inspection.

Paragraph 8 on page 6 shall have the following item added to the list of minimum required information:

i) First and last name of the NASSCO PACP certified CCTV operator.

Paragraph 1 on page 8 shall have the following information added:

continually displayed in the middle of the bottom portion of the screen and the start maintenance hole ID number will be in the top left corner of the screen and the end maintenance hole ID number will be in the top right corner of the screen.

The standard referenced in Paragraph 3 page 8 shall be NASSCO Canadian Edition of the Pipeline and Assessment Certification Program (PACP).

The following new paragraph shall be inserted after Paragraph 2 on page 8:

Each lateral connection shall be inspected at the point of entry to the main using the swivel head. If the inspection indicates a build-up of material, or the presence of construction debris, the sewer section shall be flushed, the debris captured and removed, and the CCTV inspection repeated at the Contractor’s expense.

.4 409.07.05.01 Paragraph 1 including “a)”, “b)” and “c)” shall be removed and replaced by:

“Reports shall be submitted to the Contract Administrator in the following formats, within 10 working days of the completion of the field work, with the noted number of copies:
One (1) copy of each pipeline report in an electronic format.

One (1) copy of the sewer inspection database (.MDB file), the database shall include NASSCO PACP coding for all completed CCTV inspection work and properly link all file names and file extensions to the video (.mpg) and image (.jpg) files.

One (1) copy of the video survey in an electronic format with each sewer run identified and in its own mpeg format. The name of the video survey file shall be equivalent to the Upstream maintenance hole ID + the Pipe ID + Downstream maintenance hole + date (i.e., “8594-010-5514-_8594-020_20180101.mpg”).

REPORT FORMAT	NO. OF COPIES	REQUIRED
Electronic Format Report	1 per pipeline	Within 10 days of completion of inspection
Digital Data Files (MDB file)	1 per street	Within 10 days of completion of inspection
Electronic copy of the pipeline Videos	1 per pipeline	Within 10 days of completion of inspection. The files will be in a *.mpg format

3.10 MARKING OF MAINS AND SERVICES

.1 Sewer mains shall be marked with 50 mm wide detectable metallic tape green in colour imprinted with “Buried Sewer Line Below”. The tape shall be SETON PRODUCT No. 48300 or equivalent.

.2 The marker tape shall be placed 300mm to 450 mm above the main or service.

3.11 REMOVAL AND/OR ABANDONING EXISTING SEWERS

.1 Removal or abandonment of existing sewer pipes and/or culverts shall be in accordance with OPSS.MUNI 510.

3.12 REMOVAL/ABANDONING OF EXISTING STRUCTURES

.1 In the context of this section the term “structure” shall apply to maintenance holes and inlet structures including their related appurtenances.

.2 Removal or abandonment of existing structures shall be in accordance with OPSS.MUNI 510.

.3 At the direction of the Consultant, the Contractor shall demolish/remove designated maintenance hole structures to a minimum depth of one (1) metre below finished grade. The remaining structure is to be filled with concrete and the resulting excavation backfilled and compacted with Granular “A”. Alternatively, at the discretion of the contractor the structure shall be removed in its entirety. Hose appurtenances that are deemed salvageable in the opinion of the Consultant shall be set aside for removal by others.

END OF SECTION

PART 1 - GENERAL

1.1 NOT APPLICABLE:

.1 Not applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Granular base: Granular 'A' per Section 02701 - Aggregates: General.

PART 3 - EXECUTION

3.1 PLACING

.1 Place granular base after sub-base surface is inspected and approved by Consultant.

.2 Construct granular base to depth and grade in areas indicated.

.3 Ensure no frozen material is placed.

.4 Place material only on clean unfrozen surface, free from snow and ice.

.5 Begin spreading base material on crown line or on high side of one-way slope.

.6 Place material using methods which do not lead to segregation or degradation of aggregate.

.7 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Consultant may authorize thicker lifts (layers) if specified compaction can be achieved.

.8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.9 Remove and replace that portion of layer in which material becomes segregated during spreading.

3.2 COMPACTION

.1 Compaction equipment to be capable of obtaining required material densities.

.2 Compact to density not less than 100% Standard Proctor maximum dry density in accordance with ASTM D 698 and ASTM D 2922.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.4 Apply water as necessary during compacting to obtain specified density.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Consultant.

.6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 SITE TOLERANCES

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.4 PROTECTION

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 NOT APPLICABLE

.1 Not applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Granular sub-base: Granular 'B', Type II as per Section 02701 – Aggregates: General.

PART 3 - EXECUTION

3.1 PLACING

.1 Place granular sub-base after subgrade is inspected and approved by the Consultant.

.2 Construct granular sub-base to depth and grade in areas indicated.

.3 Ensure no frozen material is placed.

.4 Place material only on clean unfrozen surface, free from snow or ice.

.5 Begin spreading sub-base material on crown line or high side of one-way slope.

.6 Place granular sub-base materials using methods which do not lead to segregation or degradation.

.7 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Consultant may authorize thicker lifts (layers) if specified compaction can be achieved.

.8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.9 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 COMPACTION

.1 Compaction equipment to be capable of obtaining required material densities.

.2 Compact to density of not less than 100% Standard Proctor maximum dry density in accordance with ASTM D 698 and ASTM D 2922.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.

.4 Apply water as necessary during compaction to obtain specified density.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Consultant.

.6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 SITE TOLERANCES

.1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.4 PROTECTION

.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by the Consultant.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
- .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.2 American Society for Testing and Materials (ASTM).
- .1 ASTM C 88-13, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
- .2 ASTM C 117-13, Standard Test Method for Material Finer Than 75 mm (No. 200) Sieve in Mineral Aggregates by Washing.
- .3 ASTM C 123-14, Standard Test Method for Lightweight Particles in Aggregate.
- .4 ASTM C 127-15, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.
- .5 ASTM C 128-15, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate.
- .6 ASTM C 131/C 131M-14, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .7 ASTM C 136/C 136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .8 ASTM D 995-95b, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- .9 ASTM D 5581-07A (2013), Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 Inch Diameter Specimen).
- .10 ASTM D 2419-14, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- .11 ASTM D 3203/D 3203M-11, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- .12 ASTM D 4791-10, Standard Test Method for Flat Particles, Elongated Particles or Flat and Elongated Particles in Coarse Aggregate.

.3 Asphalt Institute (AI).
- .1 Asphalt Institute MS-2-2015 Seventh Edition, Asphalt Mix Design Methods.

1.2 PRODUCT DATA

.1 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175°C at least two weeks prior to commencing work.

.2 Submit manufacturer's test data and certification that asphalt cement meets requirements of this section.

.3 Submit manufacturer's test data and certification that hydrated lime meets requirements of this section.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 HL3 and HL8 asphalt is to conform to OPSS Section 1150.

PART 3 - EXECUTION

3.1 PLACING AND COMPACTING

.1 Placing and compacting of hot mixed, hot laid asphaltic concrete is to be in accordance with OPSS Section 313.

3.2 TRENCH CUT REINSTATEMENT

.1 All trench cuts in asphalt are to be repaired with asphalt to match existing asphalt structure.

3.3 ASPHALT PAVING SCHEDULING

.1 After all underground work has been completed and heavy construction vehicle traffic has been reduced to a minimum, all existing asphalt surfaces are to be removed to granular base, including areas patched during construction activities.

.2 Granular base is to be shaped to suit final pavement elevations.

.3 Binder course is to be placed as per OPSS 310.

.4 All catch basins, catch basin manholes, and manholes within the area of asphalt paving are to have their frames and grates set for binder course elevation.

.5 After the acceptance of the results of the CCTV inspection of the storm and sanitary sewer systems, all catch basin and catch basin manholes will have their frame and grates set to surface course elevations just prior to surface course paving.

.6 Manholes may be adjusted as per catch basins or adjusted using one manufactured polyethylene adjustment unit (Turner adjustment ring or approved equivalent) to match the surface course elevation. Metal adjustment rings are not acceptable.

.7 Surface course asphalt is to be placed as per OPSS 310.

.8 Contractor is to maintain and be responsible for the condition of the asphalt paving until final acceptance by the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 OPSS.MUNI 351 – Construction Specification for Concrete Sidewalk.

.2 OPSS.MUNI 353 – Construction Specification for Concrete Curb and Gutter Systems.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete mixes and materials: to Section 03300 - Cast-in-Place Concrete.

.2 Curing Compound: to Section 03300 - Cast-in-Place Concrete.

.3 Granular base: Granular 'A' as per Section 02701 - Aggregates: General.

.4 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

PART 3 - EXECUTION

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with Section 02315 - Excavation, Trenching and Backfilling.

3.2 GRANULAR BASE

.1 Obtain Consultant's approval of subgrade before placing granular base.

.2 Place granular base material to lines, widths, and depths as indicated.

.3 Compact granular base to at least 100% of Standard Proctor maximum dry density.

3.3 CONCRETE

.1 Obtain Consultant's approval of granular base prior to placing concrete.

.2 Do concrete work in accordance with Section 03300 - Cast-in-Place Concrete.

.3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centreline.

.4 Provide edging as indicated with 10 mm radius edging tool.

.5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Consultant can be demonstrated. Hand finish surfaces when directed by Consultant.

3.4 TOLERANCES

.1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.5 EXPANSION AND CONTRACTION JOINTS

.1 Install tooled transverse contraction joints, in concrete walks after floating, when concrete is stiff, but still plastic, at intervals of 2 m.

.2 Install expansion joints as indicated or as directed by Consultant at maximum intervals of 6 m.

.3 When sidewalk is adjacent to curb, make expansion joints of curb, gutters and sidewalk coincide.

3.6 ISOLATION JOINTS

.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.

.2 Install joint filler in isolation joints in accordance with Section 03300 – Cast-in-Place Concrete.

.3 Seal isolation joints with sealant approved by Consultant.

3.7 CURING

.1 Cure concrete by sealing moisture in by applying curing compound approved by Consultant.

.2 Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.

3.8 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with material approved by Consultant. Compact and shape to required contours as indicated or as directed by Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 SOURCE QUALITY CONTROL

.1 Inspection and testing of topsoil will be carried out by an independent testing laboratory. Owner will pay for costs of tests.

.2 Test topsoil from source for clay, sand and silt, N, P, K, Mg, soluble salt content, pH value, growth inhibitors, soil sterilants organic matter and conductivity.

.1 Submit 0.5 kg a sample of topsoil to a testing laboratory and indicate present use, intended use, type of subsoil and quality of drainage. Prepare and ship the sample in accordance with provincial regulations and testing laboratory requirements.

.3 Determine required limestone treatment to bring pH value of soil between a range of 6.0 to 7.5 level.

1.2 SCHEDULING OF FINISH WORK

.1 Schedule the placing of the topsoil and grading to permit sodding and seeding within seven days.

1.3 DEFINITIONS

.1 Compost: should be a mixture of soil and decomposing organic matter, for use as a fertilizer, mulch, or soil conditioner. Compost should be processed organic matter, containing 40% or more organic matter. The product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (a C:N ratio below 25 or 50,) and contain no toxic or growth inhibiting contaminates. Composed bio-solids must meet the requirements of the Guidelines for Compost Quality, Category (A) (B) produced by the Canadian Council of the Ministers of the Environment (CCME), Jan. 2005.

.2 Friable: Soil which is easily crumbled through fingers when held by hand.

PART 2 - MATERIALS

2.1 TOPSOIL

.1 All topsoil supplied by the Contractor will be fertile, friable, natural sandy loam containing not less than 4% of organic matter for sandy loams with an acidity value ranging from pH 6.0 to pH 7.5 and capable of sustaining vigorous plant growth. It will be free of stems or roots, stones and clods more than 50 mm diameter or other extraneous matter. Screening of topsoil will be required if designated by the Consultant. Topsoil shall not be supplied in a frozen state.

.2 Topsoil to be imported:

.1 Friable, neither heavy clay nor very light sandy nature consisting of 45% sand, 35% silt, 20% clay and pH value of 6.0 to 7.5. Free from subsoil, roots, vegetation, debris, toxic materials, stones.

.2 Organic Matter, 4% for clay loams, and 2% for sandy loams to maximum of 20% by volume.

.3 Contain no toxic elements or growth inhibiting materials.

.4 Finished surface free from:
  .1 Debris and stones more than 50 mm diameter.
  .2 Coarse vegetative material, 10 mm diameter and 100-mm length, occupying more than 2% of soil volume.
.5 Consistency: friable when moist.
.6 Topsoil is only to be imported if there is a shortage of suitable topsoil available on site for reuse, at no cost to the Owner.

2.2 GRAVEL PAVING

.1 Granular 'A' as per Section 02701 - Aggregates: General.

2.3 SOIL AMENDMENTS

.1 Fertilizer:
  .1 Complete commercial synthetic fertilizer with minimum 65% insoluble nitrogen.
  .2 Formulation ratio - 10 6 4, 10% nitrogen, 6% phosphoric acid, 4% potash.
  .3 pH range of 6.5 to 8.0.

.2 Peatmoss:
  .1 Derived from partially decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses.
  .2 Elastic and homogeneous, brown in colour.
  .3 Free of wood and deleterious material which could prohibit growth.
  .4 Shredded particle minimum size 5 mm.
  .5 pH range of 3.5 to 6.5.

.3 Sand: washed coarse silica sand, medium to coarse textured.

.4 Limestone:
  .1 Ground agricultural limestone containing minimum calcium carbonate equivalent of 85%.
  .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.

.5 Bonemeal: finely ground with a minimum analysis of 20% phosphoric acid.

2.4 SOURCE QUALITY CONTROL

.1 Advise Consultant topsoil sources to be utilized with sufficient lead time for testing.

.2 Contractor is responsible for amendments to supply topsoil as specified.

.3 Soil testing by recognized testing facility for pH, P and K, and organic matter.

.4 Testing of topsoil will be carried out by a testing laboratory designated by the Consultant. Soil sampling, testing and analysis to be in accordance with Provincial standards.

PART 3 - EXECUTION

3.1 PREPARATION OF EXISTING GRADE

.1 Verify that grades are correct. If discrepancies occur, notify the Consultant and do not commence work until instructions have been received.

.2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage. Remove soil contaminated with toxic materials. Dispose of removed materials as directed by Consultant.

.3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material off site.

.4 Cultivate entire area which is to receive topsoil to depth of minimum 25 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

.5 Planting soil for planting of trees, shrubs, and ground covers: mix 4 parts topsoil with 1 part peatmoss. Incorporate bonemeal into planting soil at rate of 0.5 kg/m^3 of soil mixture.

3.2 PLACEMENT AND SPREADING OF TOPSOIL - PLANTING SOIL

.1 Spread topsoil after subgrade has been approved. Refer to Drawings for direction of surface drainage.

.2 Spread topsoil with adequate moisture in uniform layers not exceeding 150 mm, over approved, unfrozen subgrade, where sodding, seeding and planting is indicated.

.3 For sodded areas keep topsoil 15 mm below finished grade.

.4 Spread topsoil to following minimum depths after settlement unless otherwise specified in the drawings, 80% compaction:

- .1 100 mm for seeded areas
- .2 500 mm for shrub beds
- .3 600 mm for tree beds.

.5 Apply planting soil as indicated on drawings.

.6 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

.7 Avoid spreading or grading in wet, frozen, or saturated state.

3.3 SOIL AMENDMENTS

.1 Apply soil amendments at rate as specified and as determined from soil sample test.

.2 Mix soil amendments into full depth of topsoil prior to application of fertilizer.

.3 Apply planting soil as indicated on drawings and details.

3.4 APPLICATION OF FERTILIZER

.1 Apply fertilizer at least one week after limestone application.

.2 Spread fertilizer uniformly over entire area of topsoil at manufacturer's recommended rate of application or rate determined on basis of soil sample test.

.3 Mix fertilizer thoroughly to the full depth of topsoil.

3.5 FINISH GRADING

.1 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

.2 Consolidate topsoil to required bulk density using equipment approved by the Consultant. Leave surfaces smooth, uniform and firm against deep foot printing.

.3 Place gravel paving in areas shown on drawings to 150 mm depth compacted to 95% Standard Proctor Modified Dry Density and to elevations shown on grading plans. Roll to ensure continuous contours and eliminate high/low areas.

3.6 ACCEPTANCE

.1 Consultant will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.7 SURPLUS MATERIAL

.1 Dispose of materials off site or as directed by the Consultant.

END OF SECTION

PART 1 – GENERAL

1.1 PRODUCT DATA

.1 Provide product data for:
- .1 Seed
- .2 Mulch
- .3 Tackifier
- .4 Fertilizer

.2 Submit in writing to Consultant five days prior to commencing work:
- .1 The volume capacity of a hydraulic seeder in litres.
- .2 Amount of material to be used per tank based on volume.
- .3 Number of tank loads required per hectare to apply specified slurry mixture per hectare.

1.2 SCHEDULING

.1 Schedule hydraulic seeding to coincide with preparation of soil surfaces.

.2 Schedule hydraulic seeding using grass mixtures and mixtures containing Crown vetch or Trefoil between dates recommended by the Ontario Ministry of Agriculture, Food and Rural Affairs.

1.3 DELIVERY AND STORAGE

.1 Deliver grass seed in original containers showing:
- .1 analysis of seed mixture
- .2 percentage of pure seed
- .3 the year of production
- .4 net mass
- .5 date when tagged and location
- .6 percentage germination
- .7 name and address of the distributor

.2 Deliver wood fibre mulch in moisture-proof containers bulk indicating manufacturer, content and net air-dry mass.

.3 Deliver erosion control agent in moisture-proof containers showing manufacturer, content and net mass.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Grass Seed: certified Canada No.1 grade to Government of Canada, Seeds Regulations and having minimum germination of 75% and minimum purity of 97%.

.2 Mulch: specially manufactured for use in hydraulic seeding equipment, free of germination and growth inhibiting factors with following properties:
  .1 Type I mulch:
    .1 Made from wood cellulose fibre.
    .2 Organic matter content: 95% plus or minus 0.5%.
    .3 Value of pH: 6.0.
    .4 Potential water absorption: 900%.
  .2 Type II mulch:
    .1 Made from newsprint, raw cotton fibre and straw, processed to produce fibre lengths of 15 mm minimum and 25 mm maximum. Greater proportions of ingredients to be straw Fiber: wood or wood cellulose fiber free of germinating or growth-inhibiting ingredients and forming blotter like ground cover allowing absorption and percolation of water.

.3 Tackifier: Organic straw mulch tackifiers may include wood and fibre paper mulch or guar and starch based tackifiers. Asphalt based tackifiers are not acceptable.

.4 Water: potable, free of impurities that would inhibit germination.

.5 Inoculants: inoculant containers shall be tagged with an expiry date.

.6 Fertilizer: complete synthetic, slow release fertilizer with maximum 35% water soluble nitrogen. Apply fertilizer at rates based on soil analysis.

2.2 GRASS SEED MIXTURE

.1 Grass Seed Mix
  .1 30% Jasper Creeping Red Fescue
  .2 15% Spartan Hard Fescue
  .3 10% Banff Kentucky Bluegrass
  .4 15% Canada Wild Rye
  .5 15% Little Bluestem
  .6 10% Indian Grass
  .7 5% Big Bluestem

.2 Seed at the rate of 150 kg/ha.

PART 3 - EXECUTION

3.1 WORKMANSHIP

.1 Do not spray onto structures, signs, guide rails, fences, plant material, utilities or any other surfaces not intended to be sprayed.

.2 Keep the site well drained.

.3 Clean up immediately, any materials sprayed on where not intended, soil, mulch, or other debris spilled onto the pavement, dispose of deleterious materials.

.4 Take reasonable care to prevent contamination by seeding slurry of structures, sign, guide rails, fences and utilities.

.5 Where contamination occurs, remove seeding slurry to satisfaction of, and by means approved by Consultant.

.6 Do not perform work under adverse field conditions such as wind speeds more than 10 km/h, frozen ground or ground covered with snow, ice or standing water.

.7 Protect seeded areas from trespass until plants are established.

3.2 PREPARATION OF SURFACES

.1 Verify that grades are correct and prepared in accordance with Section 02911 - Topsoil and Finish Grading. If discrepancies occur, notify Engineer and do not commence work until instructed by Engineer.

.2 Cultivate areas to be seeded to a depth of 25mm and fine grade until free of humps and hollows and deleterious and refuse material.

.3 Ensure areas to be seeded are moist to depth of 150 mm before seeding.

3.3 SEEDING

.1 Seeding and mulching operations shall only be carried within the following periods, where soil humidity allows germination and growth:
- .1 Spring period: May 1st to June 15
- .2 Fall period: August 15 to October 31

.2 Apply when winds less than 10 km/h using equipment suitable for area involved to the approval of the Consultant.

.3 Measure quantities of material by mass or mass-calibrated volume measurement to satisfaction of Consultant.

.4 Charge the seeder with water, mulch, seed, fertilizer and mix thoroughly. Add material into the seeder under agitation. Pulverize and add material slowly into the seeder under agitation.

.5 Add erosion control agents, into seeder and mix thoroughly to complete seeding slurry.

.6 Complete slurry to be applied per hectare:
- .1 seed mixture as specified 150 kg
- .2 mulch 1000 kg
- .3 Tackifier: 230 kg.
- .4 water, minimum 10,000 L
- .5 Fertilizer: 300 kg, ratio 8:32:16.
- .6 Fertilizer 250 kg, ratio 0:46:0

.7 Apply slurry uniformly, at the optimum angle of application for adherence to the surfaces and germination of seed.
- .1 Using the correct nozzle for the application.
- .2 Using hoses for surfaces which are difficult to reach and to control application.

.8 Ensure a uniform dispersal of the mixed material over the entire area designated for seeding and the spray does not dislodge soil or cause erosion.

.9 Blend applications into existing, adjacent grass areas or sodded areas to form uniform surfaces.

.10 Protect all seeded areas from damage by water erosion, pedestrians and vehicles.

3.4 MULCHING

.1 Apply mulch only slurry over low maintenance turf grass areas at a rate of 1000 kg/ha, following seed application by mechanical seeder.

3.5 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform the following operations from time of seed application until acceptance by Consultant.
- .1 Ensure maintenance equipment is suitable, to Consultant's acceptance.
- .2 Keep soil moist during germination period and adequately water grassed areas until as directed by Consultant.
- .3 Apply water to ensure moisture penetration of 75 to 100 mm. Control sprinkling to prevent washouts.
- .4 Cut grass when it reaches height of 70 mm and cut to height of 50 mm. Remove clippings which exceed 10 mm in length which may smother grass.
- .5 Maintain grassed areas free of pests and disease.
- .6 Apply herbicide when it will not cause damage to new grass or other plants.
- .7 Avoid use of dicambal and picloram solutions near trees and shrubs.
- .8 Use only mecoprop on bentgrass turf areas.
- .9 Fertilize seeded areas one month after seeding. Spread evenly and water in well. Postpone fertilizing until next spring if application falls within a four-week period prior to the expected end of growing season.
- .10 Adjust protection barrier as necessary to protect against deterioration due to pedestrian or other traffic as needed.

3.6 ACCEPTANCE

.1 Seeded areas will be accepted by Consultant provided that:
- .1 Seeded areas are uniformly established, and free of rutted, eroded, bare or dead spots and extent of weeds.
- .2 Turf is free of eroded, bare or dead spots and 98% free of weeds.
- .3 No surface soil is visible when grass has been cut to height of 50 mm.
- .4 Seeded areas have been cut at least twice, the last cut being carried out within 24 hours of acceptance.

.5 Areas have been fertilized.

.2 Areas seeded in fall will be accepted in following spring one month after the start of the growing season, provided acceptance conditions are fulfilled.

3.7 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until the end of warranty period:

.1 Repair and reseed dead or bare spots to the satisfaction of the Consultant.

.2 Mow seeded areas and remove clippings, as directed by Consultant.

.3 Fertilize seeded areas in accordance with the fertilizing program. Spread half of the required amount of fertilizer in one direction and remainder at right angles and water in well.

.4 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.

END OF SECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation of polymeric geotextiles used to:
- .1 Separate and prevent mixing of granular materials and subgrade/native backfill.
- .2 Separate and prevent mixing of granular materials of different grading.
- .3 Act as hydraulic filters permitting passage of water while retaining soil strength of granular structure.

1.2 REFERENCES

.1 Ontario Provincial Standard Specifications (OPSS)
- .1 OPSS 1860, Material Specification for Geotextiles.

1.3 SUBMITTALS

.1 Submit mill test data and certificate to Consultant at least one week prior to start of work.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris, and rodents.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, and corrugated cardboard packaging material in appropriate on-site bins for recycling.

.4 Fold up metal banding, flatten, and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 GEOTEXTILE FILTER FABRIC

.1 Geotextile Filter Fabric: Class II, non-woven as per OPSS 1860 with filtration opening size of less than 150 microns. Terrafix 400R, or approved equivalent.

.2 Securing Pins and Washers: Grade 300W, hot-dipped galvanized with minimum zinc coating of 600g/m^2.

2.2 EROSION CONTROL GEOTEXTILE

.1 Erosion Control Geotextile: Single Net Straw Biodegradable Rolled Erosion Control Product.

.2 Securing pins: 200 mm untreated wooden stakes or pegs or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Place geotextile material by unrolling onto graded surface in orientation and manner as per manufacturer's instructions, and in locations indicated on drawings, and retain in position with weights.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles, and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 600 mm minimum over previously laid strip.

.5 Pin successive strips of erosion control geotextile with securing pins, installed 300 mm on centre at top and bottom of slope, and 1000 mm on centre in all other locations.

.6 Pin successive strips of geotextile fibre fabric with securing pins at 400 mm interval at mid-point of lap.

.7 Protect installed geotextile material from displacement, damage, or deterioration before, during, and after placement of material layers.

.8 Upon installation of erosion control geotextile, cover with overlying layer within 4 (four) hours of placement.

.9 Replace damaged or deteriorated geotextile to approval of Consultant.

.10 Place and compact soil layers in accordance with Section 02315 – Excavating, Trenching, and Backfilling.

3.2 CLEANING

.1 Remove construction debris from project site and dispose of debris in an environmentally responsible and legal manner.

3.3 PROTECTION

.1 Vehicular traffic not permitted directly on geotextile.

.2 Do not overload soil or aggregate covering on geotextile.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 American Concrete Institute (ACI):
- .1 ACI 303R, Guide to Cast-in-Place Architectural Concrete Practice.
- .2 ACI 347, Guide to Formwork for Concrete.
- .3 ACI 347.2R, Guide for Shoring/Reshoring of Concrete Multistory Buildings.
- .4 ACI Standard SP004, Formwork for Concrete.

.2 Canadian Standards Association (CSA):
- .1 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA A23.2, Methods of Test for Concrete.
- .3 CAN/CSA O86, Engineering Design in Wood.
- .4 CAN/CSA O121, Douglas Fir Plywood.
- .5 CAN/CSA O141, Softwood Lumber.
- .6 CAN/CSA O151, Canadian Softwood Plywood.
- .7 CAN/CSA S269.1, Falsework and Formwork.

.3 National Lumber Grades Authority (NLGA):
- .1 Standard Grading Rules for Canadian Lumber.

.4 Underwriters' Laboratories of Canada (ULC):
- .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene Boards.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for proprietary materials used in formwork liners, rigid insulation, and coatings and include Product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Submit two (2) copies of WHMIS SDS in accordance with Division 01.

.3 Shop Drawings:
- .1 Submit drawings for formwork and falsework stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .2 Prepare Shop Drawings in accordance with CSA S269.1 for formwork and falsework.
- .3 Indicate formwork design data: Permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork and falsework.
- .5 Indicate method and schedule of construction, shoring, materials, arrangement of joints, , ties, liners, and locations of temporary embedded parts.
- .6 Shoring and bracing required to resist loads due to wet concrete, forms, wind and other forces arising from use of equipment to place concrete.
- .7 Indicate sequence of erection and removal of formwork and falsework.
- .8 Include the following information on falsework Shop Drawings:
  - .1 Longitudinal, lateral, vertical, dead, live and impact loads used in design.

.2 Safe bearing capacity of soil underneath mud sills.
.3 Maximum column, post and support loads.
.4 Deflection diagrams for beams with deflection of 10 mm or more.
.5 Deflection diagrams indicating initial and final elevation of deck surfaces, roofs and soffits.
.6 Grade of structural steel.
.7 Indicate steel posts, girders, beams, connections, bracing and welding, providing sufficient detail for safe performance of falsework.
.8 Fully detailed steel frame shoring.
.9 Species, grades and sizes of wood.
.10 Type and weight of equipment (moving or stationary) supported by falsework.
.11 Sequence, methods and rate of concrete placement.
.12 Proprietary equipment adequately identified for checking purposes.
.13 Full details and locations of splices.

.9 Provide a letter from the Professional Engineer who designed the falsework, that the installation has been constructed in accordance with the design requirements and is suitable for the intended use.

.10 The Owner's Quality Assurance program shall not form part of the Contractor's quality control procedures.

1.3 QUALITY ASSURANCE

.1 Retain a professional engineer registered or licensed in Ontario, Canada, with experience in formwork and falsework design of comparable complexity and scope, to perform following services as part of work of this Section:
.1 Design of formwork and falsework.
.2 Review, stamp, and sign fabrication and erection Shop Drawings, design calculations and amendments.
.3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of work is in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections prior to placing concrete.

.2 Design, construct, and dismantle formwork and falsework in accordance with the requirements of CAN/CSA A23.1, CSA S269.1, and ACI Standard SP004 unless more stringent tolerances are specified.

.3 Prior to placing concrete, ensure Concrete Quality Control Plan steps have been undertaken, including verification of installation and use of formwork and falsework.

.4 Pre-installation Meetings: in accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.
.1 Ensure key personnel, site supervisor, Owner, Consultant, formwork contractor, concrete producer, and materials testing agent attend.
.1 Verify project requirements.

1.4 CONCRETE QUALITY CONTROL PLAN

.1 Incorporate all works within this Section with the Concrete Quality Control Plan located in Section 03300 - Cast-In-Place Concrete.

.2 Include procedures related to formwork and falsework including methods to verify required tolerances have been met.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, handle all materials in accordance with Division 01.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect formwork from damages.

.3 Replace defective or damaged materials with new.

1.6 PROPRIETARY PRODUCTS

.1 Contractor is to have Controlled Permeability Formliner (CPF) Manufacturer’s representative on site for initial installation to provide training and verify the installation. Contractor to provide proof of this training upon request from the Consultant.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 For non-exposed concrete or concrete without special architectural features, use wood and wood Product formwork materials referenced within CSA S269.1. Materials to bear grade marks, or to be accompanied by certificates, test reports, or other proof of conformity.

.2 For exposed concrete or concrete with special architectural features, use formwork materials to stricter requirements of CSA-A23.1/A23.2 and ACI-303.

.3 For liquid retaining structures use Type III Controlled Permeability Formliners (CPF). Acceptable Product: ‘Zemdrain MD’ by Max Frank (Canada) Inc. or approved alternate.

.1 Install, in general, CPF in formwork for all vertical concrete elements in liquid retaining structures prior to placing form ties, reinforcing and concrete.

.2 CPF to be applied to process liquid side only.

.3 Do not use form release agent with CPF.

.4 Pan Forms:

.1 Removable steel, or aluminum free of bends, dents, and residual concrete; having a high potential for reuse as indicated.

.5 Tubular column forms:

.1 Round, spirally wound laminated fiber forms or steel, internally treated with release material.

.2 Spiral pattern not to show in hardened concrete.

.6 Form Ties:

.1 Unexposed Concrete Surfaces: Snap ties, coil ties, or she-bolts to suit application.

.2 Exposed or Architectural Concrete: Plastic cone-type snap ties or coil ties which break off or are removable 38 mm inside concrete surface.

.3 Waterproof or Water Retaining Structures: Plastic cone-type snap ties or coil ties which break off or are removable 50 mm inside concrete surface complete with plastic washer to break surface continuity and prevent water seepage.

.4 Acceptable Manufacturer: National Concrete Accessories or approved alternate.

.7 Form release agent: Proprietary, non-volatile material not to stain concrete or impair subsequent application of finishes or coatings to surface of concrete. Acceptable Manufacturer: W.R. Meadows or approved alternate.

.8 Falsework materials to CSA-S269.1.

.9 Rigid Insulation for structural applications to CAN/ULC-S701.

.1 Moisture resistant, closed-cell extruded rigid foam insulation below foundation elements or slabs on grade as noted on Drawings. Acceptable Product: 'Styrofoam Brand Highload Extruded Polystyrene Foam Insulation' by Dupont, 'Foamular Extruded Polystyrene (XPS) Rigid Foam Insulation' by Owens Corning, or approved alternate. Minimum compressive strength 275kPa / 40 psi.

.2 For additional requirements, refer to Division 07.

.10 Sealant:

.1 Refer to Section 07920 - Joint Sealants.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with Drawings.

.2 Verify the locations of all inserts, anchor bolts, embedded components, etc., with all discipline Drawings and Shop Drawings prior to proceeding with formwork and report any discrepancies to the Consultant.

.3 Fabricate and erect falsework in accordance with CSA S269.1.

.4 Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances specified in CAN/CSA A23.1. Top form ties shall not be located within 150 mm of the top of the concrete placement.

.5 Camber all formwork to compensate for anticipated deflections in formwork prior to hardening of concrete. Positive means of adjustment (wedges or jacks) or shores and struts to be provided and all settlement taken up during concrete placing operation.

.6 Do not place shores and mud sills on frozen ground.

.7 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.8 Align form joints and make watertight. Keep form joints to minimum.

.9 Provide temporary cleanout and inspection openings.

.10 Install 25 mm triangular wood chamfer strips in corners of forms for all corners of columns, walls, beams, and equipment bases which will be exposed in the finished structure.

.11 Install 25 mm triangular drip on all exterior slab soffits set50 mm back from edge of slab.

.12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.13 Ensure that anchors and inserts will not protrude beyond surfaces designate to receive applied finishes, including painting.

.14 Apply non-reactive form release agent prior to placing reinforcing, unless noted otherwise.

.15 Do not close forms before reinforcing and embedded elements have been reviewed.

.16 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Contractor to be responsible for safety of structure, both before and after removal of forms until concrete has reached its specified compressive strength.

.2 Formwork shall be removed in coordination with the curing requirements outlined in CSA A23.1, the Contractor's Concrete Quality Control Plan and Section 03300 - Cast-In-Place Concrete.

.3 Leave formwork in place for following minimum periods of time after placing concrete.
- .1 Two (2) days for walls and sides of beams.
- .2 Two (2) days for columns.
- .3 Two (2) days for footings and abutments.
- .4 Fourteen (14) days for beam soffits, slabs, decks, stairs and other structural members, or three (3) days when replaced immediately with adequate shoring to standard specified for falsework.

.4 Remove formwork when concrete has reached 70% of its 28-day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .1 Demonstration of sufficient compressive strength for formwork removal shall come from test results from field cured cylinders or pull testing to ASTM C900.

.5 The Contractor shall be responsible for any damage that occurs to the concrete as a result of early removal of formwork.

.6 To help avoid colour variations in architectural concrete, ensure length of time between concrete placing and form removal is approximately same for each portion of the work.

.7 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.8 Space reshoring in each principal direction at not more than 3000 mm / 10' apart.

.9 Re-use formwork and falsework subject to the requirements of CSA A23.1/A23.3.

.10 Fill all cone tie holes with an approved non-shrink, non-metallic grout.

3.3 RIGID INSULATION

.1 Prepare ground surface on an even plane with no projections.

.2 Do not place insulation until subgrade has been reviewed by Soils Consultant.

.3 Extent of insulation to be as noted on Drawings.

.4 Lap joints in insulation to be taped per manufacturer's instructions to prevent differential movement. Stagger ship-lapped joints in multi-layered insulation installations.

.5 For additional requirements, refer to Division 7.

END OF SECTION

PART 1 – GENERAL

1.1 DEFINITIONS

.1 Post-Installed Anchor: An anchor installed in hardened concrete or masonry. Reinforcing bar dowels, expansion, undercut, and adhesive-type anchors are examples of Post-Installed Anchors.

.2 Adhesive Anchor: A Post-Installed Anchor or reinforcing bar, inserted into hardened concrete or masonry with an anchor hole diameter not greater than 1.5 times the anchor diameter, that transfers loads to the concrete or masonry by bond between the anchor and the adhesive, and bond between the adhesive and the concrete or masonry system.

.3 Expansion Anchor: A Post-Installed Anchor inserted into hardened concrete or masonry that transfers loads to and from the concrete or masonry by direct bearing, friction, or both. Expansion Anchors may be torque controlled (where the expansion is achieved by a torque acting on the screw or bolt) or displacement controlled (where the expansion is achieved by impact forces acting on a sleeve or plug and the expansion is controlled by the length of travel of the sleeve or plug).

.4 Specialist Inspector: A specially qualified and competent person with both inspection and practical experience in the construction operation requiring special inspection as per ACI 355.4-19. A Specialist Inspector must be employed by a third party approved by the Owner or the Owner's representative and demonstrate competency in testing and inspection of Post-Installed Anchors specific to the contract documents and the Manufacturer's Published Installation Instructions.

.5 Continuous Special Inspection: A special inspection where the Specialist Inspector is present for each anchor installation and is able to observe all steps within the installation procedure.

.6 Periodic Special Inspection: A special inspection where intermittent inspections are performed by a Specialist Inspector with special emphasis on initial installations.

.7 Manufacturer's Published Installation Instructions (MPII): Published instructions for the correct installation of the anchor under all covered installation conditions as supplied in the Product packaging.

1.2 REFERENCES

.1 American Concrete Institute (ACI):
- .1 ACI 355.1R, State-of-the-Art Report on Anchorage to Concrete.
- .2 ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
- .3 ACI 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.
- .4 ACI 318, Building Code Requirements for Structural Concrete and Commentary.

.2 ASTM International:
- .1 ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A143, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- .3 ASTM A153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A307, Carbon Steel Bolts and Studs, 60 ksi Tensile Strength.
- .5 ASTM A325, Structural Bolts, Heat Treated, 120/105 ksi Tensile Strength.

.6 ASTM A449, Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
.7 ASTM A563, Carbon and Alloy Steel Nuts.
.8 ASTM A615, Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
.9 ASTM A775, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
.10 ASTM E488, Standard Test Methods for Strength of Anchors in Concrete Elements.
.11 ASTM E1512, Testing Bond Performance of Bonded Anchors.
.12 ASTM F436, Carbon Steel Washers.
.13 ASTM F593, Stainless Steel Bolts, Hex Cap Screws, and Studs.
.14 ASTM F594, Stainless Steel Nuts.
.15 ASTM F1554, Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

.3 CSA International:
.1 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.
.2 CAN/CSA A23.2, Methods of Test for Concrete.
.3 CAN/CSA-A23.3, Design of Concrete Structures.
.4 CAN/CSA-A23.4, Precast Concrete - Materials and Construction.
.5 CAN/CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.
.6 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.4 ICC-ES:
.1 ICC-ES AC308, Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements.
.2 ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
.1 Safety Data Sheets.

.6 Reinforcing Steel Institute of Canada (RSIC):
.1 RSIC, Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
.1 Submit Product technical data sheets for Post-Installed Anchor systems installed into concrete and/or masonry. Product technical data sheets (do not submit whole catalogs) shall be clearly marked to include:
.1 Tension and shear strength design values including bond strength in cracked & uncracked concrete or masonry as applicable, edge distance, spacing & seismic reduction factors, periodic limitations etc. for each anchor system size and type used on this project.
.2 Submit data on Adhesive Anchors to be used, including material grades and finishes and accessories where required.
.3 Submit catalog cuts on mechanical, Expansion, Screw, or Undercut Anchor bolts and drop-ins, including material grades and finishes, and any torque requirements.
.4 Manufacturer’s printed installation instructions (MPII).
.5 WHMIS Safety Data Sheets (SDS).

.3 Should the Contractor wish to use an alternate system not listed herein, submit the Evaluation Service Report (ESR) for proposed Post-Installed Anchor system from a qualified independent testing and evaluation agency as per ACI 355.2R/ACI 355.4R such as ICC-ES. Submit calculations for review and approval stamped by a Professional Engineer licensed in Ontario Canada showing that, for all applicable details, the proposed alternative will provide equal or greater performance. Calculations must include all applicable modification factors.

.4 Shop Drawings:

.1 Submit Shop Drawings to the Consultant a minimum of 14 Working Days prior to any proof load testing. Shop Drawings to show testing equipment and arrangement including all key dimensions demonstrating compliance with ASTM E488.

.5 Reports/Certificates:

.1 Submit documentation of equipment calibration to the Consultant a minimum of 14 Working Days prior to any proof load testing.

.2 Submit third-party proof-load test reports. Reports shall include the following as a minimum:

.1 Project name, report number, date of testing, ambient air temperature, field personnel completing the testing.

.2 Location of the tested anchors/reinforcing bars (drawing reference and photographs)

.3 Type, size, embedment depth and associated drawing/detail.

.3 Submit installation report from Hilti's Adaptive Torque module for all torque-controlled expansion anchors as described in PART 3 to Satisfy SafeSet requirements.

.4 Submit manufacturer's certification of Contractor training in Post-Installed Anchors prior to initiating work of this Section.

.5 Submit installers' ACI/CRSI Adhesive Anchor Installer Certification, or approved equivalent.

.6 The Consultant will provide the review reports from the on-site Special Inspections to the Contractor and the Owner. The Special Inspector shall furnish a report to the Consultant, Owner and the Contractor stating that the work has been performed and that the materials used and the installation procedures used conform to the approved Contract Documents and the MPII.

1.4 QUALITY ASSURANCE

.1 Installer Qualifications:

.1 A representative from the Post-Installed Anchor manufacturer shall be present at start of project to provide Product-specific training to all Contractor personnel involved in the installation of Post-Installed Anchors.

.2 For projects involving installation of horizontal or upwardly inclined Adhesive Anchors to support sustained tension loads, installers must have completed the ACI/CRSI Adhesive Anchor Installer Certification program, or approved equivalent.

.2 Quality Plan:

.1 Develop and implement a Quality Plan that verifies that the Post-Installed Anchor installation and inspection is in conformance with this Section. Include quality plan steps in submission under Specification Section 03300, Cast-in-Place Concrete.

.2 The Concrete Quality Control Plan shall describe, as a minimum, the following quality control procedural steps related to:

.1 Installation of post-installed mechanical anchors;

.2 Installation of post-installed Adhesive Anchors;

.3 Anchor installer Training by Manufacturer;

.4 Periodic inspection of Post-Installed Anchors;
.5 Continuous inspection of Adhesive Anchors installed in horizontal or upwardly inclined applications to support sustained tension loads;
.6 Proof load testing including frequency and number of anchors;
.7 Defective work, including: identification, documentation, submission of proposed repair details, and follow-up inspection;
.8 Risk Management: List and describe any anticipated project specific risks associated with this Section or related Sections and outline proposed means of mitigation.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, handle all materials in accordance with Division 01.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect anchors and anchor systems from damages.
.3 Replace defective or damaged materials with new.

1.6 SPECIALIST INSPECTION

.1 All Post-Installed Anchors shall be subject to Periodic Special Inspections by a Specialist Inspector. These inspections will take place at the onset of anchor installations within the work area to confirm understanding and observe practices. The Contractor shall be responsible for advising a minimum of two (2) Working Days in advance of any adhesive anchor installations and facilitate all necessary cooperation to phase and schedule work to ensure that the Special Inspector is accommodated in their reviews.

.2 A program for Periodic Special Inspection shall conform to the following requirements:
.1 The Special Inspector shall verify the initial installations of each type and size of anchor by construction personnel on site.
.2 Subsequent installations of the same anchor type and size by the same construction personnel shall be permitted to be performed in the absence of the Special Inspector.
.3 Any change in the anchor Product being installed or the personnel performing the installation shall require an initial inspection.
.4 For ongoing inspection over an extended period, the Special Inspector shall make regular inspections to confirm correct handling and installation of the Product.

.3 All post-installed Adhesive Anchors installed in horizontal and upwardly inclined orientations to resist sustained tension loads shall be subject to Continuous Special Inspections during installation by a Specialist Inspector.

.4 The inspection program for Continuous Special Inspections shall verify, as a minimum, the following items:
.1 Hole drilling method in accordance with the MPII.
.2 Anchor edge distance and spacing.
.3 Hole diameter and depth.

.4 Hole cleaning in accordance with the MPII.
.5 Anchor element type, material, diameter, and length.
.6 Adhesive identification and expiration date.
.7 Adhesive installation in accordance with the MPII.

.5 The Owner will appoint a third-party Specialist Inspector to complete the Special Inspections.

.6 Special Inspection services will be paid directly by the Owner.

.7 Additional inspections due to failed tests, poor workmanship or failed inspections will come at no additional cost to the Owner and will be paid by the Contractor through a Change Order to the Contract.

.8 Supply all necessary cooperation to facilitate site inspections. Provide safe access and working areas for inspectors on site.

.9 The Contractor will be responsible for all corrective actions to address any concerns identified. Where installed anchors are deemed to be non-conforming, in the sole discretion of the inspector, they shall be replaced at no additional cost to the Owner.

1.7 PROOF-LOADING OF ADHESIVE ANCHOR SYSTEMS

.1 A sample of five (5) percent (minimum of five (5)) of each type of post-installed Adhesive Anchors shall be proof-loaded by an independent testing agency. A minimum of one batch of tests shall be completed for each lot of 100 anchors installed.

.2 For all post-installed Adhesive Anchors installed in horizontal and upwardly inclined applications to resist sustained tension loads, a sample of ten (10) percent (minimum of five (5)) shall be proof-loaded by an independent testing agency. A minimum of one batch of tests shall be completed for each lot of 100 anchors installed.

.3 The anchors tested shall be selected by the Consultant Selected anchors shall be a representative sample of all anchors within the lot.
.1 Where anchored components cannot be proof loaded using the required equipment due to reinforcing bar hooks, tight spacing, or adjacent interferences, Contractor shall provide additional sacrificial straight anchors to be tested in their place.
.2 Following testing, sacrificial anchors exposed to view in the finished structure and/or exposed to exterior or process conditions shall be removed and patched following concrete repair procedures.

.4 Unless noted otherwise, proof load tests shall be applied as confined static tension tests on standard density concrete aged 28 days or more in accordance with ASTM E488.

.5 Proof load tests for all Adhesive Anchors shall be performed with a maximum test load set at the lesser of 67% of the nominal bond strength of the anchor system or 80% of the yield capacity of the anchor or reinforcing bar. Test loads will be provided by the Consultant.

.6 Loads shall be maintained for 10 seconds with no visible movement or deformities.

.1 Should an anchor fail the proof loading program, the testing scope shall be increased to 100% of all anchors until corrections to the procedure demonstrate satisfactory conformity and proof-load tests pass the minimum requirements as determined by the Consultant. All failed anchors shall be removed, replaced and re-tested with all affected concrete repaired in accordance with the Contractor's Quality Plan. The costs of all additional testing resulting from non-conforming anchors shall be borne by the Contractor.

.2 All test reports shall be provided to the Consultant within seven (7) Working Days and any failures in the testing shall be reported immediately to the Consultant.

.7 Testing services will be paid for from a cash allowance carried in Division 01. Testing services will be paid directly by the Owner.

.8 Supply all necessary cooperation to facilitate site inspections. Provide safe access and working areas for testing on site.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Adhesive Anchor systems shall have a current ICC-ES Evaluation Service Report that states recommended design capacities. Reports shall be in accordance with ICC-ES AC308 and ASTM E1512.

.2 Anchors shall be manufactured under an approved quality assurance program with follow-up inspections by an inspection agency under ISO/IEC 17020 by a recognized accreditation body conforming to the requirements of the ISO/IEC 17011.

.3 Post-Installed Anchors shall be qualified for earthquake loading in accordance with ACI 355.2 or ACI 355.4.

.4 Adhesive Anchor system shall be a high-strength, premeasured, two-part, self-mixing, cartridge-type epoxy adhesive.

.1 Acceptable Product: 'HIT HY 200 V3 with Safeset' or 'HIT-RE 500 V3 with Safeset' by Hilti, Inc. Where depth of embedment exceeds the maximum depth for use with the Safeset system, 'Hilti HIT HY 200' and 'HIT-RE 500 V3' Adhesives shall be the standard of acceptance.

.2 Where anchors or dowels are to be drilled and embedded into hollow (ungrouted or grouted) masonry, provide adhesive and sleeve (screen tube) system for this specific application. Acceptable Product: 'HIT-HY 270' by Hilti, Inc.

.3 Unless noted otherwise on Drawings anchors shall be stainless steel.

.1 Stainless Steel threaded rods (HAS-R rods) grade 316 conforming to ASTM F593 CW1, CW2 or ASTM A193 Grade 8(M), Class 1, depending on size. Or Hilti's stainless steel HIT-Z-R rods grade 316. Fully threaded for adhesive applications

.2 Carbon steel threaded rods (HAS rods) conforming to ASTM F1554 Grade 36 (Hilti HAS-V-36), or ASTM F1554 Grade 55 (Hilti HAS-E-55), or ASTM F1554 Grade 105 (Hilti HAS-B-105) with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1). Or Hilti's carbon steel HIT-Z rods conforming to ASTM A510 with chemical composition of AISI 1038. Fully threaded for adhesive applications.

.5 Mechanical Anchors:

.1 Anchors to be Hot-dip galvanized or stainless steel as shown on Drawings.

.2 Acceptable Product: 'Kwik Bolt TZ2' (Carbon Steel and Stainless Steel), 'Kwik Bolt 3 (HDG)', or 'HDI' by HILTI, Inc. with SafeSet.

.3 Screw Anchors: Screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings, where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide Hilti Kwik-HUS-EZ or Hilti Kwik-HUS EZ-I.

.4 Anchors to be installed and pretensioned using Adaptive Torque Technology by Hilti, Inc.

.5 Anchors shall be rated for a minimum of twice the required load capacity.

.6 Reinforcing Steel Dowels: To CSA G30.18, Grade 400W deformed billet steel.

.7 All threaded rods and anchor bolt accessories, including nuts, washers, etc. shall be of the same material as the rods/bolts.

PART 3 – EXECUTION

3.1 INSTALLATION OF ADHESIVE ANCHOR SYSTEMS

.1 All Adhesive Anchors shall be installed by qualified personnel in accordance with the Contract Documents and the MPII. Conduct a thorough training with the manufacturer's representative for all anchors on the project.

.2 Installation of horizontal or upwardly inclined Adhesive Anchors to support sustained tension loads shall be performed by personnel certified by ACI/CRSI Adhesive Anchor Installer Certification Program or similar program with equivalent requirements.

.3 Adhesive Anchors to be subject to periodic or continuous inspection and proof loading in accordance with work of this Section.

.4 Provide templates or other means to accurately locate anchors.

.5 Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

.6 Masonry wall (cores) shall be filled with grout where anchors are to be installed. In existing construction where masonry cores are not (and cannot be) grout filled, manufacturer's masonry screen tube shall be used with anchor installation.

.7 Anchor capacity is dependent upon spacing between adjacent anchors and proximity of anchors to edges of substrate. Install anchors in accordance with spacing and edge clearances noted on the Drawings. Unless noted otherwise, anchor bolts installed into concrete and/or masonry shall not be closer than 150 mm o.c.

.8 Anchor bolts and dowels shall be clean and free of coatings or other contaminants that would impair bonding to the chemical adhesive.

.9 Threaded rods shall be long enough to project through the entire depth of nut and extend 13 mm beyond the top of nut, unless noted otherwise. Do not cut hot dip galvanized rods.

.10 Anchor bolts and dowels shall not be installed in concrete less than twenty-one (21) days old, or older if recommended by the manufacturer.

.11 Drill holes with rotary impact hammer drills using carbide-tipped bits or hollow drill bit system. Use of diamond core bit with or without roughening tool for anchor holes requires approval from engineer of record prior to drilling. Unless otherwise shown in the Drawings, all holes shall be drilled perpendicular to the concrete surface.

.12 Scan all areas to be drilled for installation of adhesive anchors and ensure that no reinforcing steel, conduits, pipes, etc. are disturbed/damaged by drilling operations.

.13 Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors.

.14 Adhesive Anchors shall be fully cured prior to applying load on anchor.

3.2 INSTALLATION OF MECHANICAL ANCHOR SYSTEMS

.1 All mechanical anchors shall be installed by qualified personnel in accordance with the Contract Documents and the MPII. Conduct a thorough training with the manufacturer's representative for all anchors on the project.

.2 Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

.3 Drilled holes shall be cleaned out and free of dust and trapped water in accordance with the MPII.

.4 Anchors shall be fully seated prior to pretension. Pretension in accordance with manufacturer's instructions. Pretension using Adaptive Torque technology by Hilti.

.5 Engineer may request any/all these mechanical anchors to be proof-loaded.

.6 Anchor capacity is dependent upon spacing between adjacent anchors and proximity of anchors to edges of substrate. Install anchors in accordance with spacing and edge clearances noted on the Drawings. Unless noted otherwise, Anchor bolts installed into concrete and/or masonry shall not be closer than 150 mm o.c.

.7 Anchors to be subjected to Periodic Special Inspection by a Specialist Inspector.

.8 Provide templates or other means to accurately locate anchors.

.9 Drill holes with rotary impact hammer drills using carbide-tipped bits or Hilti's hollow drill bit system. Use of diamond core bit with or without roughening tool for anchor holes requires approval from engineer of record prior to drilling. Unless otherwise shown in the Drawings, all holes shall be drilled perpendicular to the concrete surface.

.10 Scan all areas to be drilled for installation of mechanical anchors and ensure that no reinforcing steel, conduits, pipes, etc. are disturbed/damaged by drilling operations.

3.3 REPAIR OF DEFECTIVE WORK

.1 Remove and replace misplaced or defective anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, non-metallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as defective.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM A123/A123M, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Produce for Detecting Embrittlement.
- .3 ASTM A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- .4 ASTM A722/A722M, Standard Specification for Uncoated High-Strength Steel Bars for Prestressing Concrete.
- .5 ASTM A767, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

.2 Canadian Standards Association (CSA):
- .1 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA A23.2, Test Methods and Standard Practices for Concrete.
- .3 CAN/CSA A23.3, Design of Concrete Structures.
- .4 CAN/CSA A23.4, Design of Precast Concrete Structures.
- .5 CAN/CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
- .6 CAN/CSA S413, Parking Structures.
- .7 CAN/CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC):
- .1 RSIC, Reinforcing Steel Manual of Standard Practice.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Concrete Quality Control Plan under Section 03300 Cast-in-Place Concrete.

.3 Product Data:
- .1 Submit manufacturer's data sheets for mechanical connections (couplers), where applicable.
- .2 Submit field touch-up material for galvanized reinforcing.
- .3 Submit manufacturer's data sheets for high-strength threaded reinforcing bars.

.4 Shop Drawings:
- .1 Prepare reinforcing steel Shop Drawings in accordance with RSIC Manual of Standard Practice that conform to the Drawings with respect to placement, quantity, and size of reinforcing steel bars.
- .2 Shop Drawings shall contain the following information:
  - .1 Element location.
  - .2 Materials, grade and finishes of reinforcing.
  - .3 Sizes, spacings, lengths and locations of reinforcement, with identifying labels.
  - .4 Bar bending details.
  - .5 Length and location of all lap splices. Refer to Section 03600 – Concrete Joints and Accessories for joint requirements.
  - .6 Types and locations of mechanical couplers where approved by Consultant.

.7 Concrete cover.
.8 Placement of reinforcement at all openings, depressions, spandrels, joints, interfaces and sleeves.
.9 Show bar supports, hangers, inserts, waterstops, anchor bolts, etc.

.3 Detail to requirements of CAN/CSA-A23.1 and RSIC, Reinforcing Steel Manual of Standard Practice. Ensure adjustments are made in detailing of reinforcing steel for splices and development lengths. Splice lengths are to be based on bar position within section (e.g., top bars) and reinforcement coatings (e.g., epoxy).

.4 Provide elevation drawings of all walls (including masonry walls), beams, columns and piers, cross referenced to plan drawings and indicate bar size, spacing, laps, bends, etc. Provide drawings for each differing section of steel arrangement. Do not indicate various areas on one detail.

.5 Reinforcing steel Shop Drawings shall be reviewed and accepted in accordance with the Concrete Quality Control Plan prior to submitting to the Consultant.

.6 Shop Drawings shall be in a single, complete set in order that all details may be read in conjunction with plans, elevations, and all other dependent details. Quantity and format of Shop Drawings are to be in accordance with Division 01. Reproduction of Contract Documents will not be acceptable as Shop Drawings.

.7 Shop Drawings shall correspond to each detail on drawing. Each wall, slab, etc. to be separately listed. Bar lists, where provided, shall be reviewed only for general conformity, quantities are not checked in detail.

.8 All details and sections to be to a scale of not less than 1:25.

.9 The construction Drawings show reinforcing steel placement for the project that shows the intent of reinforcing of concrete elements. These Drawings can accomplish this description through the use of nomenclature such as similar and typical, indicating similar arrangements of reinforcing steel within concrete elements but potential variation of formed dimensions and lengths to accommodate the intended final construction.

.10 The reinforcing steel Shop Drawings shall be of sufficient detail to allow for a clear understanding of the fabrication limits, quantity, and placement of all reinforcing steel on the project.

.5 Submit reinforcing steel mill certificates certifying that the reinforcing steel bars conform to the project Specifications and showing the chemical composition of the reinforcing steel and mechanical properties.

1.3 CONCRETE QUALITY CONTROL PLAN

.1 Coordinate all works within this Section with the Concrete Quality Control Plan and Section 03300 Cast-in-Place Concrete.

.2 Include procedures related to reinforcing steel including methods to verify required tolerances have been met.

1.4 QUALITY ASSURANCE

.1 Pre-installation Meetings: In accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.

.1 Ensure key personnel, site supervisor, Owner, Consultant, Reinforcing Steel Supervisor, concrete producer, and materials testing agent attend.

.1 Verify project requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, and handle all materials in accordance with CAN/CSA A23.1 and the RSIC Manual of Standard Practice.

1.6 SUBSTITUTES

.1 Substitution of different size bars permitted only upon written approval of Consultant.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and the RSIC, Reinforcing Steel Manual of Standard Practice.

.2 Reinforcing bars: To CSA G30.18, Grade 400W deformed billet steel sourced from North American mills.

.3 Fibre reinforced polymer (FRP) reinforcing bars: To CSA S807, Glass fibre reinforced polymer (GFRP), Grade G600-EI-D2. Plain round bars: To CSA G40-20/G40.21.

.4 Cold-drawn annealed steel wire ties: 1.5 mm diameter to ASTM A1064/A1064M.

.5 Slab Bolsters and High Chairs: To suit application. For exposed concrete, chairs and bolsters to be plastic tipped or stainless steel. For sandblasted or bush-hammered concrete surfaces, chairs and bolsters to be stainless steel.

.6 Mechanical connections (couplers): To suit application and subject to approval of Consultant.

.1 Where permitted, shall develop in tension or compression as required, at least 120% of the specified yield strength, fy, of the bar, but not less than 110% of the actual yield strength of the bar used in the test of the welded splice.

.2 Acceptable manufacturers: Dayton Superior, nVent LENTON, Barsplice.

.7 Form Saver Inserts: Integral threaded cast-in inserts to suit application and subject to approval of Consultant.

.1 Where permitted, shall develop in tension or compression as required, at least 120% of the specified yield strength, fy, of the bar, but not less than 110% of the actual yield strength of the bar used in the test of the welded splice.

.2 Acceptable manufacturers: Dayton Superior, nVent LENTON, Barsplice.

.8 Smooth Dowel Caps: Plastic (non-ferrous) dowel caps to permit movement of plain round bar in construction joint. Acceptable Product: Dowel Caps by Deslaurier Inc.

PART 3 - EXECUTION

3.1 PLACING REINFORCEMENT

.1 Place and protect reinforcing steel in accordance with CAN/CSA-A23.1 and the Concrete Quality Control Plan of Section 03300 Cast-in-Place Concrete.

.2 Before placing, clean all reinforcement of any loose scale, dirt, or any other coatings that would impair the bond.

.3 Place reinforcement accurately and secure in place by use of chairs, spacers, and hangers to prevent displacement of reinforcement from intended bar position. Do not wet-set reinforcement.

.4 Maintain cover to reinforcement during concrete placement and ensure welded wire fabric is lifted during concrete placement.

.5 Specified cover to reinforcing steel as noted on Drawings.

.1 Where architectural reveals reduce the concrete cover, clear concrete cover should be measured from the reveal location.

.6 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.

.7 Bar and wire fabric development lengths to be in accordance with CSA A23.3.

.8 Bar and wire fabric lap splices lengths to be in accordance with CSA A23.3.

.1 All lap splices to be Class ‘B’ for tension and 1.3 x compression development length for compression.

.2 Bars shall be securely fastened together unless noted otherwise. Where permitted by the Consultant, non-contact lap splices in flexural members shall have a transverse spacing not exceeding the lesser of one-fifth of the required lap splice length of 150 mm.

.3 Welded splices, where permitted by the Consultant, shall develop in tension, at least 120% of the specified yield strength, fy, of the bar, but not less than 110% of the actual yield strength of the bar used in the test of the welded splice.

.1 Welding of reinforcing shall not be performed without prior approval of methods by Consultant. All welding shall conform to CSA Standard W186 and shall only be performed by welders certified by the Canadian Welding Bureau.

.4 Lap splicing of reinforcing bars 35M or larger marked continuous in beams or other areas of high congestion will not be permitted. Provide continuous reinforcing or mechanically coupled connections, if approved by Consultant.

.9 Detail and fabricate all hooks and bends in reinforcing steel to be standard in accordance with CSA A23.1

.10 Provide corner bars to match longitudinal reinforcing at all intersections (including footings) unless otherwise indicated.

.11 Adequately support slab and stair bars on continuous high chairs to resist against weight of workmen and equipment.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.

.2 Straightening or re-bending of reinforcing bars is not permitted. Discard bars with bends or kinks not shown on bar lists.

.3 When field bending is authorized, bend without heat, applying slow and steady pressure.

.4 Replace bars which develop cracks or splits.

3.3 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of galvanized reinforcing steel with compatible finish to provide continuous coating.

.2 Follow all manufacturer's recommendations.

3.4 INSERTS AND OPENINGS

.1 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from Consultant before placing of concrete.

.2 Unless otherwise noted, provide hooked ends at all reinforcing terminated at openings in walls and slabs. Refer to Drawings for additional reinforcing around openings.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 American Concrete Institute (ACI):
- .1 ACI 207.1R, Guide to Mass Concrete.
- .2 ACI 211.2, Standard Practice for Selecting Portions for Structural Lightweight Concrete.
- .3 ACI 212.3R, Report on Chemical Admixtures for Concrete.
- .4 ACI 213R, Guide for Structural Lightweight Aggregate Concrete.
- .5 ACI 301, Specifications for Structural Concrete.
- .6 ACI 302.1R, Guide for Concrete Floor and Slab Construction.
- .7 ACI 303R, Guide to Cast-in-Place Architectural Concrete Practice.
- .8 ACI 305R, Guide to Hot Weather Concreting.
- .9 ACI 306R, Guide to Cold Weather Concreting.
- .10 ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
- .11 ACI 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.
- .12 ACI 350.2, Concrete Structures for Containment of Hazardous Materials.
- .13 ACI 350.5, Specifications for Environmental Engineering Concrete Structures.
- .14 ACI 360R, Guide to Design of Slabs-on-Ground.

.2 ASTM International (ASTM):
- .1 ASTM C33M, Standard Specification for Concrete Aggregates.
- .2 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
- .3 ASTM C330M, Standard Specification for Lightweight Aggregates for Structural Concrete.
- .4 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
- .5 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .6 ASTM C1074, Standard Practise for Estimating Concrete Strength by the Maturity Method.
- .7 ASTM 567M, Standard Test Method for Determining Density of Structural Lightweight Concrete.

.3 CSA Group (CSA)
- .1 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA A23.2, Methods of Test for Concrete.
- .3 CAN/CSA-A23.3, Design of Concrete Structures.
- .4 CAN/CSA A283, Qualification Code for Concrete Testing Laboratories.
- .5 CAN/CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .6 CAN/CSA S900.2, Structural Design of Wastewater Treatment Plants.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets.

.5 International Concrete Repair Institute (ICRI):
- .1 ICRI Technical Guideline No. 310.1R, Guideline for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.
- .2 ICRI Technical Guideline No. 310.2R, Guideline for Selecting and Specifying Surface Preparation for Sealers, Coatings, Polymer Overlays and Concrete Repair.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Concrete Quality Control Plan:

.1 Submit a Concrete Quality Control Plan to Consultant within fourteen (14) Working Days after commence work date and in advance of the Pre-Installation meeting.

.2 Concrete Quality Control Plan to include:

.1 Thermal Control Plan for mass concreting in accordance with CSA A23.1. Thermal Control Plan shall be stamped by a Professional Engineer licensed in Ontario, Canada.

.3 Consultant will provide review comments and request necessary changes, if any, within ten (10) Working Days after receipt.

.4 If changes are required, resubmit Concrete Quality Control Plan within five (5) Working Days after return of reviewed copy. No formwork activities are to commence on site until the Concrete Quality Control Plan is returned as “Reviewed” or “Reviewed as Noted (Resubmission Not Required)”.

.5 The reviewed Concrete Quality Control Plan shall be implemented and followed by the Contractor for all concrete work on the project.

.3 Concrete Producer:

.1 Provide Consultant within fourteen (14) Working Days of commence work date with a valid and recognized certificate from the plant delivering concrete.

.2 Concrete Producer to have a minimum of ten (10) years construction experience in industrial facilities, liquid containing structures and be experienced in performance-based Specifications.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture meet specified requirements.

.3 Consultant may reject proposed Concrete Producer who does not meet the requirements or have proven ability to perform the work.

.4 Submit concrete mix designs including as a minimum:

.1 Intended use.

.2 Exposure Class based on CSA A23.1.

.3 Minimum Compressive strength at age.

.4 Maximum water to cementing materials ratio.

.5 Nominal maximum aggregate size.

.6 Slump range.

.7 Plastic air content (%).

.8 List of all supplemental cementing materials, including percentage (if used).

.1 Where High Volume Supplementary Cementitious Materials Type 1 or 2 are proposed by the Concrete Producer indicate additional curing requirements.

.9 List of all admixtures (if used).

.10 Crystalline Concrete Waterproofing Admixture Product including dosage rate.

.1 Provide written project specific recommended dosage rate from the Crystalline Concrete Waterproofing Admixture Manufacturer on their corporate letterhead.

.11 Acceptable placement methods (i.e., chute, pump, etc.).

.12 Identify any limitations that would limit the use of concrete mix for intended use (i.e., cold weather work).

.13 Where the planned placement method or environmental conditions in the field differ from the acceptable parameters listed in the previously accepted concrete mix design(s), submit new/revised concrete mix designs for review and acceptance by the Consultant.

.5 Product Data:

.1 Submit manufacturer's instructions, printed Product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include Product characteristics, performance criteria, physical size, finish, and limitations.

.2 Submit two (2) copies of WHMIS SDS.

.6 Site Quality Control Submittals:

.1 Provide testing and inspection results and reports for review by Consultant and do not proceed without written approval when deviations from mix design or parameters found.

.2 Submit written certification from the Crystalline Concrete Waterproofing Admixture Manufacturer verifying the presence of the Product in the finished structure.

.3 Concrete pours: Provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described the Concrete Quality Control Plan.

.4 Concrete hauling time: Provide for review by Consultant deviations exceeding maximum allowable time of 120 minutes for concrete delivered to site of work and discharged after batching.

1.3 QUALITY ASSURANCE

.1 Pre-installation Meetings: In accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.

.1 Ensure key personnel, site supervisor, Owner, Consultant, formwork contractor, concrete producer, and materials testing agent attend.

.1 Verify project requirements.

.2 Discuss the Contractor’s Concrete Quality Control Plan submission.

1.4 PERFORMANCE BASED SPECIFICATION

.1 Concrete producer to meet the concrete performance criteria established within this Specification.

1.5 CONCRETE QUALITY CONTROL PLAN

.1 Prior to commencing formwork or concrete activities, submit a project specific Concrete Quality Control Plan for review by Consultant. Failure to address the project specific requirements will be returned ‘Revise and Resubmit’.

.2 Ensure Concrete Quality Control Plan identifies the procedural steps that will be undertaken by the Contractor during the course of construction to verify and document that all Division 03 work meets the project Specifications.

.3 The Concrete Quality Control Plan shall include the proposed quality control procedures on the following items:

.1 Roles and Responsibilities: Identify and describe the roles and responsibilities of the personnel in charge of the implementation, execution and supervision of the Concrete Quality Control Plan, including:

.1 Project Manager.

.2 Site Superintendent.

.3 Quality Coordinator.

.4 Formwork Supervisor.
.5 Reinforcing Steel Supervisor.
.6 Concrete Producer.
.7 Concrete Placer.
.8 Concrete Finisher.
.9 Geotechnical Consultant.
.10 Materials Testing Agent.
.11 Post-Installed Anchor Specialist Inspector.
.12 Proof Load Testing Agent.

.2 Describe the Contractor's procedural steps to verify that the following items, where applicable, have been completed in accordance with the Contract Specifications:
.1 Formwork and Falsework.
.2 Reinforcing Steel.
.3 Coordination with other trades for required inserts, openings, joints and accessories.
.4 Concrete Placement, Testing, Finishing, and Curing.
.5 Finished Concrete Surface Mock-ups.
.6 Hot and Cold Weather Work, including preparation, protection, placement, curing, heating/cooling, insulation, and temperature monitoring.
.7 Thermal Control plan: mass concreting, including placement plan, curing, protection, and temperature monitoring.
.8 Material Testing coordination and requirements,
.9 Include description of in-situ maturity testing methods where applicable.
.10 Coordination of Post-Installed Anchor Specialist Inspection and Testing.
.11 Inspection and testing procedures including minimum timelines for Consultant and Materials Testing Agent notification.
.12 Review of installation of proprietary systems by manufacturer's representative.
.13 Deficiencies and non-conforming Products and materials including identification, documentation, submission of proposed repair procedures, Consultant review, and follow-up site-review.
.14 Risk management plan identifying known or anticipated project specific risks, probability and impact, and risk strategy.

.3 Provide sample of Contractor's quality control and data logging form(s) to be used on the project. It is expected that each form will contain a review checklist to be signed by the Contactor's personnel implementing and overseeing the Concrete Quality Control Plan to confirm that the procedural steps outlined above have been completed. An example form is included at the end of this Specification. Do not include Consultant and/or Owner sign-off on this form.

.4 Provide sample of Contractor's quality control data logging forms to be used on the project. An Example Concrete Curing Log and Concrete Cylinder Log are included at the end of this Specification.

.4 Acceptance of the Concrete Quality Control Plan by the Consultant shall be considered a requirement for payment for work under Division 03.

.5 Prior to placement of concrete ensure all pre-placement inspection processes and assembled documentation has been carried out to conform to the Concrete Quality Control Plan.

.6 Notify the Consultant and all pertinent Third-Party Materials/Testing Authorities at least Three (3) Working Days in advance of the proposed placement of concrete. Upon notification the Consultant may elect to review the contents of the Concrete Quality Control Plan to assess if the work is proceeding in general conformance with the Contract Documents. The Consultant may elect to review the work on site and prepare appropriate record of observations for the Owner. The Third-Party Materials Testing Consultant and Other Testing Authorities will complete testing in accordance with the Contract.

1.6 CONCRETE QUALITY CONTROL MEETINGS

.1 Schedule monthly concrete quality control meeting for the first six (6) months of concrete activities to review the overall quality of work and the implementation of the Contractor's Concrete Quality Control Plan.

.2 Schedule quarterly concrete quality control meetings thereafter until the concrete work is substantially completed.

.3 Ensure key personnel, site supervisor, Consultant, formwork contractor, concrete producer, and materials testing agent attend.

.4 Contractor shall schedule and chair the meeting.

.5 Contractor shall record and distribute the meeting minutes within five (5) Working Days to all parties in attendance.

.6 Meeting minutes to include significant decisions and identify action items and action dates by attendees or the parties they represent.

1.7 CONCRETE QUALITY CONTROL PLAN SUMMARY REPORT

.1 Submit summary report to Consultant monthly for audit. Report shall include the following as a minimum:

- .1 A summary of the concrete work undertaken each month.
- .2 Completed Quality Control and Data Logging Forms.
- .3 Material Testing Results from Laboratory.
- .4 Minutes from Concrete Quality Control Review Meetings
- .5 List of deviations from the Concrete Quality Control Plan and the corrective action taken by the Contractor.
- .6 Other information as may be reasonably requested by the Owner or Consultant.

1.8 SUBGRADE INSPECTION

.1 The Owner will appoint a Geotechnical Consultant to test compaction of backfill material under slab on grade and to verify bearing capacity of foundation subgrade.

.2 Notify Geotechnical Consultant a minimum of two (2) Working Days prior to placement of compacted backfill, working mat, insulation, void form, or concrete. Do not place the same until underlying subgrade material has been inspected and accepted by the appointed Geotechnical Consultant.

.3 Geotechnical Consultant will be paid from cash allowance carried in Division 01. Supply all necessary cooperation.

1.9 MATERIAL TESTING DURING CONSTRUCTION

.1 The Owner will appoint a Material Testing Agent to verify the cast-in-place concrete meets the mix design requirements outlined in this Specification.

.2 Notify Materials Testing Agent a minimum of two (2) Working Days prior to placement of concrete.

.3 Testing requirements and frequency are to be as per CAN/CSA A23.1/A23.2. The Contractor shall cast a minimum of three cylinders per compressive strength test.

.4 Submit laboratory testing results within five (5) Working Days of completing test.

.5 The Materials Testing Agent will be paid from cash allowance carried in Division 1. Supply all necessary cooperation.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, and handle all materials in accordance with the Concrete Quality Control Plan. Ensure all concrete materials are handled in accordance with CSA A23.1.

.2 Concrete to be delivered to site and discharged within 120 minutes maximum after batching.

.3 Continuous concrete delivery from plan shall meet CSA A23.1/A23.2.

PART 2 - PRODUCTS

2.1 CONCRETE

.1 Use ready-mix concrete. All constituent materials shall conform to the requirements of CAN/CSA-A23.1.

.2 Concrete mix design shall comply with requirements of CAN/CSA-A23.1 based on Alternative No. 1 in Table 5. Ready-mix concrete to be proportioned mixed and delivered in accordance with CAN/CSA-A23.1.

.3 Pump mix designs shall not be modified from normal concrete mix designs by the changing cement content or quantities of coarse and fine aggregate.

.4 Use 20 mm maximum coarse aggregate unless noted.

.5 Refer to the Contract Drawings for concrete mix design requirements and class of exposure.

.6 Slump shall be determined by the Concrete Producer to meet workability requirements for concrete placement for the project.

2.2 ADMIXTURES

.1 Admixtures other than air entraining and water reducing agents are not permitted unless approved by Consultant. Calcium chloride shall not be used.

.2 Air Entraining Admixture: To ASTM C260.

.3 Chemical Admixtures: To ASTM C494. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.

.4 Water Reducing Agent: To ASTM C494, non-chloride.

.5 Retardation Agent: To ASTM C494, non-chloride.

.6 Superplasticizer: To ASTM C494, use only when approved by Consultant.

2.3 CRYSTALLINE CONCRETE WATERPROOFING

.1 Crystalline concrete waterproofing applied as per manufacturer's recommendations at the locations indicated on the Contract Drawings.

.2 Acceptable Products: 'Admix C-series' by Xypex or 'Krystol Internal Membrane (KIM)' waterproofing system by Kryton International Inc.

.1 Concrete producer to coordinate with proprietary crystalline concrete waterproofing manufacturer's representative for the design of concrete mixes.

.3 Contractor shall coordinate surface applied crystalline waterproofing membrane with Specification 03500 – Concrete Finishing and Curing.

2.4 GROUT

.1 Shrinkage compensating grout for general applications:

.1 Non-shrink, non-metallic cementitious grout capable of developing compressive strength of 40MPa at 7 days.

.2 Acceptable Products: 'SikaGrout 212' by Sika Canada, 'High Strength Precision Grout' by Five Star Products Inc., '1428 HP' Mineral Based Precision Grout by W.R. Meadows Inc., or approved alternate.

.2 Refer to Division 05 for grouting under baseplates and equipment supports.

PART 3 - EXECUTION

3.1 PLACING

.1 Place concrete in accordance with CAN/CSA-A23.1.

.2 Prior to placing concrete for elements bearing on grade, verify that subgrade has been compacted and accepted by Geotechnical Consultant.

.3 Prior to placement of concrete ensure all pre-placement inspection processes and assembled documentation has been carried out to conform to the Concrete Quality Control Plan.

3.2 COLD WEATHER REQUIREMENTS

.1 Carry out cold weather concreting in accordance with the requirements of CAN/CSA A23.1 and the Concrete Quality Control Plan. Protection shall be provided by means of heated enclosures, coverings, insulation, or a suitable combination of these methods.

.2 Placing concrete against subgrade surface with temperature below 5°C is prohibited. Employ suitable means to maintain surface temperatures at minimum 5°C. Verify through credible forms of temperature measurement.

.3 Placing concrete upon or against other surfaces such as formwork with surface temperature below 5°C is prohibited. Employ suitable means to maintain surface temperatures at a minimum of 5°C. Verify through credible forms of temperature measurement.

.1 Alternatively, the use of non-chloride, non-corrosive accelerators are to be used when reviewed and accepted by the Consultant to meet the minimum ambient temperatures required for the concrete placement.

.4 When the air temperature is at or below 5°C or there is a likelihood of it falling to that limit within the curing period, employ suitable means to maintain temperature of all concrete surfaces at a minimum of 10°C for the duration of the required curing period. Provide sufficient thermometers, in accordance with CAN/CSA A23.1.

.5 Remove and replace any portion of concrete allowed to freeze prior to reaching a compressive strength of at least 10 MPa.

.6 At the time of placing and during the curing period, all concrete surfaces shall be protected from direct exposure to combustion gases by formwork or an impermeable membrane. Provision shall be made for venting of all combustion products from gas-fired heaters. Repair any concrete damaged by carbonation.

.7 The Contractor shall employ a protection methodology near the end of the curing period to ensure the temperature differential between the concrete surface and ambient is less than that described in Table 20 of CSA A23.1.

3.3 HOT WEATHER REQUIREMENTS

.1 Carry out hot weather concreting in accordance with requirements of CAN/CSA A23.1 and the Concrete Quality Control Plan when ambient air temperatures are above 27°C. Hot weather concreting measures shall include cooling of the formwork, reinforcement, and concreting equipment by fogging and evaporation; cooling of concrete materials; provision of windbreak structures; shading; placement timing; or a suitable combination of these methods.

.2 Site conditions (air temperature, humidity, and wind speed) shall be monitored as per ACI 305 to assess the need for evaporation control measures no later than one (1) hour before the start of concrete placing operations and continuing at intervals not exceeding 30 minutes until specified curing procedures have been applied.

.3 Curing measures should be implemented immediately following completion of finishing operations and efforts shall be made to protect the concrete from low humidity, drying winds and extreme ambient temperature differential.

3.4 MASS CONCRETE REQUIREMENTS

.1 Carry out mass concreting in accordance with the requirements of CAN/CSA A23.1, ACI207 and the Contractor’s Concrete Quality Control Plan and Thermal Plan for any concrete placement with minimum dimension equal or greater than 1.0 m / 3’.

.2 Concrete and ambient temperatures shall be monitored during the thermal control period to determine compliance with CSA A23.1.

.1 Internal core and surface temperature shall be measured via embedded thermocouples.

.2 Surface temperature to be measure within 25 mm to 75 mm of the concrete surface.

.3 Maximum concrete temperature difference in mass placement shall not exceed 20°C.

3.5 INSERTS AND OPENINGS

.1 Set sleeves, ties, hangers, waterstops, anchor bolts and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 200 mm not indicated on structural Drawings must be approved by Consultant.

.2 No sleeves, ducts, pipes or other openings shall pass through beams, column capitals or columns, except where specifically detailed on structural Drawings or reviewed by Consultant.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from Consultant before placing of concrete.

.4 Coordinate locations and sizes of sleeves and openings shown on structural Drawings with architectural, mechanical and electrical Drawings.

.5 Set all anchor bolts using templates provided by appropriate trade requiring same. Securely fasten anchor bolts in place to maintain correct position and alignment during concreting. Misplaced anchor bolts shall be considered defective concrete and shall be removed and replaced or otherwise corrected to Consultant's satisfaction.

3.6 FINISHING AND CURING

.1 Refer to Section 03500 – Concrete Finishing and Curing.

3.7 REPAIR OF NON-CONFORMING CONCRETE

.1 When directed by the Consultant, concrete repair procedures are to be completed in accordance with:

.1 Section 03380 - Concrete Patches and Repairs.

.2 Section 03390 – Concrete Crack Injection.

.3 Contractor’s Concrete Quality Control Plan.

.2 When directed by the Consultant, repair procedures are to be designed by a Professional Engineer registered in Ontario, Canada.

3.8 PROTECTION

.1 Do not commence erection of building superstructure until concrete substructure has achieved at least 70% of specified concrete strength in field curing, but not less than seven (7) days. Staged construction has not been considered in the design of the finished structure.

END OF SECTION

Concrete Placement Report (Sample)

Project Name:	Contractor Name:	
Description/Location of Placement:		
Date of Placement:		
Concrete Mix Design:		
Mix Design # _____	Exposure Class: _____	
Compressive Strength @ 28/56 Days: _____Mpa	Air Content (%): _____	
Quantity (m^3):	Slump: _____	
Site Testing Results: Slump:	Air %:	
Time of Concrete Arrival:	Placement Start:	Placement Finish:
Concrete Placement Methodology:		
Confirmation of Any Heating/Cooling Requirements:		
Confirmation of Curing Type:	Curing Duration:	

	Personnel Responsible for Verification (printed)	Initials and date
Pre-Placement Checklist:		
Verification of subgrade preparation.		
Verification of layout .		
Verification of formwork and falsework.		
Verification of placement of reinforcing steel .		
Verification of Concrete Accessories, Inserts, anchor bolts and openings.		
Verification of mechanical/electrical embeds.		
Overall Release (Civil Foreman) Signature:	Date:	

	Personnel Responsible for Verification (printed)	Initials and date
Placement Checklist:		
Monitoring of protection of surroundings during placement.		
Monitoring of concrete placement and finishing.		
Monitoring of movement of falsework and formwork during placement.		
Monitoring of embedments during placement.		

	Personnel Responsible for Verification (printed)	Initials and date
Post-Placement Checklist:		
Date and time of formwork removal.		
Curing practices used.		
Final concrete inspection.		

*NOTE: Modify this form as requied to suit the project specific requirements.

Concrete Pour Log					Curing Type		Temperature Reading						
Pour #	Description / Location of Pour	Date	Mix #	Quantity (m^3)	Curing Duration	Curing Method	24 Hrs	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													
31													
32													
33													
33													
	do not use this line												

END OF SECTION

Concrete Pour Log					Testing Result Summary					
Pour #	Description / Location of Pour	Date	Mix #	Quantity (m^3)	# of Cylinders Taken	Measured Air Content %	Compressive Strength (MPa)			Meets Specs (Y/N)
							7 Day	28 Day (Cylinder 1)	28 Day (Cylinder 2)	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
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27										
28										
29										
30										
31										
32										
33										
33										
	do not use this line									

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Concrete Institute (ACI)

.1 ACI 350.1, Tightness Testing of Environmental Engineering Concrete Structures - Specification.

1.2 CONCRETE QUALITY CONTROL PLAN

.1 Coordinate all works within this Section with the Concrete Quality Control Plan and Section 03300 Cast-in-Place Concrete.

.2 Quality Plan submission under Section 03300 shall include procedural steps related to Liquid tightness testing.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Submit proposed liquid tightness test procedures and schedules for each liquid retaining concrete structure identified herein a minimum of fourteen (14) Working Days prior to commencing first leak test.

.3 Submit sample liquid tightness test form/report prior to completing first liquid tightness test. An example template is appended to this Section.

.4 Submit proposed repair methods, materials and modifications to address any non-conforming tightness results, as required.

.5 Submit completed liquid tightness test forms/report within one (1) week following completion of each liquid tightness test.

1.4 APPROVALS

.1 Obtain approval from the Consultant for the test procedures, the source of the water to be used, and the discharge locations and methods for liquid tightness tests.

.2 Supply and disposal arrangements and costs by Contractor, unless otherwise noted.

1.5 QUALITY ASSURANCE

.1 Notify the Consultant a minimum of two (2) Working Days in advance of testing so that Consultant may allow for scheduling of quality assurance reviews.

.2 Supply all necessary cooperation to allow Consultant to witness observations included in the test results.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Water:
- .1 Use only potable water unless approved otherwise.
- .2 Refer to Division 01 for water supply.

.2 Repair Products in accordance with Section 03380 - Concrete Patches and Repairs and03390 - Concrete Crack Injection.

PART 3 - EXECUTION

3.1 GENERAL

.1 Liquid tightness testing to be completed for all new liquid retaining or conveying structures of cast-in-place concrete, unless noted otherwise.

.2 A leak is defined as visibly flowing water or seepage of water (moisture) that can be smeared on the concrete surface or picked up on a dry hand. This shall be verified when the concrete surface is outside of direct sunlight.

.3 A visual review shall be a preliminary test for all structures undergoing leakage testing.

.4 Do not commence testing until all structural concrete work has been completed, all concrete has reached its specified strength, and is a minimum 28 days old.

.5 Where tightness testing occurs for below grade liquid retaining concrete structures, no backfill shall be placed against the walls and the in-situ groundwater level shall be below the top of the base slab.

.6 Do not perform liquid tightness tests in any way which is likely to endanger the structural integrity of any structure.

.7 Liquid tightness testing shall be completed prior to installation of any specified coatings, liners, etc., unless noted otherwise.

.8 Where a permanent liquid retaining concrete coating system is specified over an existing concrete substrate, leakage testing shall occur when authorized by the Consultant following sign-off of the coating system installation by the Manufacturer and/or Third-Party Inspector.
- .1 When the coated assembly fails to pass the leakage test, deficiencies in the coating shall be remedied prior to retesting.

.9 All electrical conduits and fittings to be sealed to prevent wetting during leakage testing.

.10 All penetrations and inlets/outlets shall be securely sealed to prevent loss of water during the test. These locations shall be repaired before test measurements. No allowance shall be made in test measurements for uncorrected known points of seepage.

.11 The initial filling of a new structure shall not exceed a rate of 1200 mm per hour. Filling shall continue until the water surface is at the design maximum liquid level, or either 25 mm below any fixed overflow level in covered structures or 100 mm in open structures, whichever is lower.

3.2 PREPARATION

.1 Clean structure to permit examination of concrete surfaces for areas of potential leakage.

.2 Remove standing water in or outside of the structure that would interfere with the examination of the exposed concrete surfaces of the structure.

.3 Lower groundwater around structure below the top of the base slab.

.1 Leakage Test

.1 Fill structure to maximum level for a minimum 3-day period.

.2 All visible leaks to be repaired by polyurethane resin injection grouting or other approved methods.

.3 Perform liquid tightness test after any visible leaks have been repaired.

3.3 TESTING

.1 Perform all liquid tightness testing under the supervision of the Consultant and subject to their prior approval.

.2 Furnish all labour, water and equipment, including temporary pumps, measuring instruments, etc. necessary for testing.

.3 Each cell in a multi-cell structure is to be tested individually, unless noted otherwise

.4 Carry out liquid tightness tests for cast-in-place concrete structures in accordance with ACI 350.1 by filling the structures with water to the specified level and measuring drop in water level over the prescribed testing duration.

.1 The prescribed testing duration shall be:

.1 The theoretical time required to lower the water surface 9.5mm when calculated assuming a loss of water at the net leakage rate as defined in the Criteria for Acceptance below.

.2 The testing duration need not exceed 5 days, where a day is defined as a 24-hour period.

.2 The vertical distance to the water surface shall be measured to within 2 mm from a fixed point on the structure above the water surface. Measurements shall be recorded at 24-hour intervals.

.3 The water temperature shall be recorded at a depth of 450 mm, unless otherwise specified, below the water surface at the start and end of the test.

.4 Evaporation and precipitation shall be measured and recorded via a floating container. Theoretical calculations will not be accepted.

.5 The change in water volume in the structure shall be calculated and corrected for evaporation, precipitation, and temperature based on the measurements in the floating container. Theoretical calculations will not be accepted.

.5 If any structure does not meet the quantitative acceptance criteria it is permitted to immediately retest a structure when there is no observable leakage.

.6 If a tested structure shows visible leakage or leakage in excess of the permissible rate:

.1 Empty the structure as required to remedy defects.

.2 Re-test the structure after the remedial work has been completed.

.3 Repeat this procedure until leakage testing meets acceptance criteria.

.4 All costs associated with additional testing shall be borne by the Contractor.

3.4 CRITERIA FOR ACCEPTANCE

.1 Criteria for acceptance of cast-in-place concrete structures to be:

.1 No visible leakage of water at external walls or floor of structures.

.2 The net leakage rate over the prescribed testing period shall not exceed 0.050% of volume of the structure per day.

.1 The volume of the tank shall be calculated based on the vertical depth of water in the structure.

Type of containment structure	Default hydrostatic test quantitative criterion
Fully lined prior to hydrostatic test	No measurable loss
Required to have secondary containment	No measurable loss
With monolithically placed floors designed to be shrinkage crack free	0.0125% of volume per day
Other types	0.050% of volume per day
Concrete-paved reservoirs and channels	0.100% of volume per day

END OF SECTION

LIQUID TIGHTNESS TEST

Structure:_____
Portion/Component of Structure Tested: _____
Liquid Tightness Test Designations: HST-VIO and,
Allowable Leakage (%) per 24 hours: _____
Required Days of Testing: ____ Days

Test Start: Date:_____ Time: _____

Projected Test Finish: Date: _____ Time:_____

Leak Testing Measurements and Calculations

DATE	TIME	TEMPERATURE		WEATHER CONDITION[2]	VISIBLE LEAKAGE?		WATER LEVEL IN TANK (mm)	WATER LEVEL IN FLOATING CONTAINER (mm)	LOSS OF WATER (mm) [3]		TOTAL LOSS[3] (A) – (B) (mm)	TOTAL LOSS[3] (%)
		AIR	WATER[1]		DETECTED (Y/N)	RESOLVED (Y/N)			TANK	CONTAINER		
Initial									-	-	-	-
24 hrs												
48 hrs												
72 hrs												
96 hrs												
120 hrs												
*												

(1) Measured 450mm below surface.
(2) Weather shall note dry, windy, sunny, rainy or other weather conditions.
(3) Loss of water shall be negative values. Addition of water shall be positive values.
(4) All measurements to be measured to within 2mm from a fixed point on the tank above the water surface.
(*) Add additional days in 24 hour increments as required to meet requirements as per Section 03350 3.3.5.

Average Leakage Rate = $\frac{\Sigma\text{Total Loss (\%)}}{\text{\# of 24-hour periods}}$ = _____ = _____

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes: this section specifies material and performance criteria required to supply and install thermoplastic liner of high-density polyethylene (HDPE) cast into the walls and ceilings as specified on the Drawings. Provide thermoplastic lining suitable for sulfate exposures and liquid-tight applications at maximum pressure of 7.5 kPa and maximum temperature of 30°C.

1.2 REFERENCES

.1 This Section incorporates by reference the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of a listed document, the requirements of this Section prevail.

.2 ASTM D412 - Test Methods for Rubber Properties in Tension.

.3 CAN/CGA-B105 - Installation Code for Digester Gas Systems.

.4 ASTM D2240 - Test Method for Rubber Property – Durometer Hardness.

.5 ASTM D2657 - Butt Fusion of Polyolefin Pipe and Fittings.

.6 ASTM D638 - Test Method for Tensile Properties of Plastics.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Procedures: Section 01330.

.2 Action Submittals:

- .1 Shop drawings showing complete thermoplastic liner layout information, including joint locations, details of liner at openings, terminations at all openings and embedments, and methods of repair.
- .2 Liner installation and testing requirements, material specifications and welding instructions.
- .3 Certified test results on physical property, chemical resistance, and quality control test data, as specified in Subsection 2.2.
- .4 500 mm x 500 mm individual samples of liner sheet, joint strips, sealing tape, weld strips, and adhesive.
- .5 Design details showing continuous termination at all edges to prevent migration of raw sewage, or gas between liner surface and concrete.
- .6 Proof of installer’s/welder’s qualifications and results of factory testing prior to commencement of work.
- .7 Evidence of installer’s experience for similar installations; refer to Quality Assurance requirements of this Section.

.3 Informational Submittals:

- .1 Applicable maintenance information.

.4 Closeout Submittals:

- .1 Certified warranty as per manufacturer’s standard warranty period.
- .2 Records of installation as described below.

1.4 CONCRETE QUALITY CONTROL PLAN

.1 Coordinate all works within this Section with the Concrete Quality Control Plan and Section 03300 Cast-In-Place Concrete.

.2 Include procedures related to the thermoplastic liner including formwork layout, reinforcing placement, pipe layout/placement are verified in coordination with the installation methods for the thermoplastic liner.

1.5 QUALITY ASSURANCE

.1 All material, adhesives and incidentals necessary for proper application of thermoplastic lining are to be furnished by the same Manufacturer and be compatible with each other and with the adhesives employed.

.2 Factory check electronically all lining material to ensure freedom from pinholes, porosity and imperfections.

.3 Installer to be trained and approved by Manufacturer and have at least five years proven experience with the installation of thermoplastic liners.

.4 Manufacturer's Representative to inspect completed installation prior to placement of concrete, to witness any joint or holiday tests and give written assurance that installation meets Manufacturer's requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Ship, protect and store materials in accordance with Division 01.

.2 Prevent degradation from exposure to ultra-violet during storage and installation and upon completion prior to handover.

1.7 SERVICE CONDITIONS

.1 Furnish materials suitable for exposure to municipal raw sewage containing some industrial wastes and exposure to sludge gases.

.2 Raw sewage may contain gross waste solids, vegetable parts, sand, silt, petroleum products, industrial solvents, and animal fats and oils and methane, hydrogen sulphide and carbon dioxide.

.3 The expected raw sewage temperature range is 10ºC to 30ºC and pH may range from 4.5 to 8.5. Provide lining material impermeable to raw sewage, and sludge gases and non-conducive to bacterial or fungus growth.

.4 Liner to not only protect concrete surfaces but to provide both long term liquid and gas tightness. Installation to prevent migration of raw sewage, water or sludge gas through liner or between the liner and concrete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

.1 Manufacturers: Candidate manufacturers and models are listed below. The manufacturer's standard product may require modification to conform to specified requirements.

.1 T Grip: KST Holland

.2 AGRU Sure-Grip: AGRU America

2.2 MATERIALS

.1 Lining sheets and accessory strips: Polyethylene.

.2 Copolymer resins are not permitted.

.3 The following physical properties, when tested in accordance with Subsection 2.3 – Testing are required for all thermoplastic liner sheets, and accessory strips.

	Property	Initial	After 112 Days
(1)	Tensile strength, MPa	15 (min)	14.5 (min)
(2)	Elongation at break, percent	200 (min)	200 (min)
(3)	Shore durometer, Type D	50-60 at 1 s	50-60±5 at 1 s
(4)		35-50 at 10 s	35-60±5 at 10 s
(5)	Weight change, percent	-	±1.5
(6)	Working temperature, degrees C	30	30

.4 Thermoplastic liner to have good impact resistance and have an elongation sufficient to bridge up to 5 mm settling cracks which may occur in the joint after installation, without damage to the installed thermoplastic liner.

.5 Minimum sheet thickness: 3 mm.

.6 Locking "T" extensions or stubs are to be manufactured from same material as liner sheet and integrally bonded/extruded; spaced maximum 65 mm apart and minimum 19 mm protrusion.

.7 Provide manufactured weld or joint strips, profile strips, inside and outside corner profiles for all joints are required.

.8 Minimum width of accessory strips or profiles 100 mm; minimum thickness 3 mm nominal.

.9 Colour white or yellow.

2.3 PRE-INSTALLATION TESTING

.1 Procedures: Section 01330.

.2 Subject tensile specimens and weight change specimens to the following solutions for a period of

120 days at 30°C±1°C.

Chemical Solution	Concentration, Percent
Sulphuric acid	20
Sodium Hydroxide	5
Ammonium Hydroxide	5
Nitric Acid	1
Ferric Chloride	1
Soap	0.1
Detergent (LAS)	0.1
Bacteriological	BOD not less than 700 mg/L

.3 Remove and test specimens from each of the chemical solutions at 30-day intervals

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Perform all work in strict conformance with the specifications, instructions and recommendations of the thermoplastic liner Manufacturer.

.2 Flash all pipes, conduits and sleeves passing through the thermoplastic liner as specified on the Drawings or as recommended and demonstrated by the Manufacturer.

.3 Closely fit and properly secure thermoplastic liner sheets to the concrete inner forms prior to any concreting operation.

.4 For thermoplastic liners with locking extensions place so that thermoplastic liner sheet locking ribs run vertically on vertical surfaces.

.5 Minimize the number of welding joints.

.6 Protect all joints and make mortar tight.

.7 During placement and consolidation of concrete, exercise caution not to damage the thermoplastic liner and the joints.

.8 After all forms have been removed, nails, form ties and protruding wire or metal objects are to be cut back from the surface and holes filled with grout and pointed flush, then sealed with weld patches or strips.

.9 Repair all defective joints, wrinkles and areas which do not bond to concrete as directed by the Engineer.

.10 Repair damaged area of thermoplastic liner due to modification of existing concrete as indicated or as recommended by the thermoplastic liner Manufacturer.

.11 Warm sheets and jointing strips to allow easy placement of liner against forms; stretch sheets over formed surfaces and secure to forms using nails or staples.

.12 Pour concrete and compact to ensure a dense homogenous concrete securely anchoring the locking extensions or stubs into the concrete.

.13 Do not use sharp instruments to pry forms from lined surfaces; mark form tie holes before ties are broken off.

.14 Extrusion weld strips and repair patches using qualified welders conversant with approved methods and techniques; continuously weld joint until joint is completed.

.15 Provide adequate ventilation during welding operations.

.16 Ensure welding gun is compatible with thermoplastic liner system.

.17 Prevent prolonged exposure to ultraviolet during installation.

3.2 PRE-OPERATIONAL CHECK-OUT AND TESTING

.1 Procedures: Section 01330.

.2 After installation is complete and forms are removed, test all surfaces including welds with an approved electrical holiday or flow detector with the instruments set at 20,000 volts or higher if necessary; test all welds by non-destructive proving methods; maintain a record of results.

.3 Provide portable scaffolding for testing and inspection access.

.4 Test each transverse welding strip which extends to a lower edge of the thermoplastic liner within two days of completion. Extend welding strips to provide tabs 50 mm below the thermoplastic liner and test each tab with a 5 kg pull normal to the face of the structure; hold thermoplastic liner adjoining welding strips against the concrete during testing.

.5 Maintain pull if a weld failure develops until no further separation occurs.

.6 Retest defective welds after repairs have been made; trim tabs away neatly after the welding strip has passed test and inspection.

.7 Apply a test load of 1800 kg/m for 60 seconds to test thermoplastic liner locking extensions or stubs embedded in concrete; test at a temperature between 25°C and 30°C.

.8 All tests to be witnessed by Manufacturer’s Representative.

END OF SECTION

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Concrete Patch: Where concrete deterioration extends to a depth less than 38 mm and removal operations do not expose any reinforcing steel to view. Filling formwork tie holes is not considered a concrete patch.

.2 Concrete Repair: Where concrete deterioration extends to a depth exceeding 38 mm or removal operations exposed any reinforcing steel to view. Removals must extend a minimum of 25 mm below the reinforcing steel.

1.2 REFERENCES

.1 American Concrete Institute (ACI):
- .1 ACI 201.1, Guide for Conducting a Visual Inspection of Concrete in Service.
- .2 ACI 546R, Guide to Concrete Repair.
- .3 ACI 546.3R, Guide to Material Selection for Concrete Repair.
- .4 ACI 562, Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary.

.2 Canadian Standards Association (CSA) International:
- .1 CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CSA A23.2, Methods of Test for Concrete.
- .3 CSA-A23.3, Design of Concrete Structures.
- .4 CSA-S448.1, Repair of Reinforced Concrete in Buildings and Parking Structures.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

.4 International Concrete Repair Institute (ICRI):
- .1 ICRI Technical Guideline No. 120-1, Guidelines and Recommendations for Safety in the Concrete Repair Industry.
- .2 ICRI Technical Guideline No. 310.1R, Guideline for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.
- .3 ICRI Technical Guideline No. 310.1R, Guide for the Preparation of Concrete Surfaces for Repair Using Hydro-demolition Methods.
- .4 ICRI Technical Guideline No. 320.1R, Guide for Selecting Application Methods for the Repair of Concrete Surfaces.
- .5 ICRI Technical Guideline No. 320.2R, Guide for Selecting and Specifying Materials for Repair of Concrete Structures.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.Submit Quality Assurance documentation for firm and individual personnel assigned to complete the work of this Section.

.2 Submit single page Product catalogue cuts for all materials specified within this Section including written installation instructions that describe surface preparation, Product mixing, Product application and Product curing.

.3 Submit written confirmation confirming the compatibility of each Product with all of the materials with which it will come into contact.

1.4 CONCRETE QUALITY CONTROL PLAN

.1 Coordinate all works within this Section with the Concrete Quality Control Plan and Section 03300 Cast-In-Place Concrete.

.2 Quality Plan submission under Section 03300 shall include procedural steps related to:
- .1 Identification of required concrete patches/repairs.
- .2 Hold points for Consultant review.
- .3 Concrete removal methodology.
- .4 Surface preparation.
- .5 Application of patch/repair Products.
- .6 Curing.

1.5 QUALITY ASSURANCE

.1 Concrete Patch and Repair work shall be carried out by work crews with a minimum of ten (10) years of experience in this type of work.

.2 Employ only personnel with at least three (3) years' experience in this type of work.

.3 Supply a minimum of five (5) concrete repair projects completed successfully using the type of materials specified.

.4 Pre-installation Meetings: In accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.
- .1 Ensure key personnel, site supervisor, Owner, Consultant, formwork contractor, concrete producer, and materials testing agent attend.
  - .1 Verify project requirements.

1.6 MEASUREMENT FOR PAYMENT

.1 The Contractor will not be compensated for concrete repairs or patches required to repair defective concrete under Section 03300 or to meet the liquid tightness requirements of Section 03350, where applicable.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, and handle all materials in accordance with Division 01 and manufacturer's instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 CONCRETE REMOVAL EQUIPMENT

.1 "Chipping Hammers" not heavier than nominal 15-pound (7 Kg) class to be used for all concrete removal.

2.2 FORMWORK AND FALSEWORK

.1 Refer to Section 03100 – Concrete Formwork for requirements for formwork and falsework to be used in the repairs.

2.3 REINFORCEMENT

.1 Refer to Section 03200 – Concrete Reinforcement for requirements for reinforcing.

2.4 BONDING AGENT AND INTEGRAL MIGRATING CORROSION INHIBITOR

.1 Water-based epoxy-cementitious bonding agent and steel coating with integral migrating corrosion inhibitor. Acceptable Product: 'SikaTop Armatec-110 EpoCem' by Sika Canada or approved alternate.

2.5 CONCRETE PATCHES

.1 Acceptable Concrete Patch Repair Products for horizontal/vertical surfaces: 'SikaTop-122' by Sika Canada, 'EucoRepair V100' by Euclid Chemical, or 'Structural Concrete V/O' by Five Star Products Inc.

2.6 CONCRETE REPAIRS

.1 Acceptable Concrete Repair Products for horizontal/vertical surfaces:
- .1 Specified patching mortars if they are extended within the limits shown in the Product data sheets.
- .2 Ready mix concrete with 14 mm maximum aggregate size.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND DEMARCATION OF CONCRETE REPAIRS

.1 Erect scaffolding or other temporary means of safe access, as required, to permit an arm's reach review of the existing concrete.

.2 Complete visual review and hammer-sound or chain drag survey to identify areas of concrete delamination, spalling, scaling or other degradation.

.3 Demarcate areas of noted degradation. Areas of repairs to be straight line and square/rectangular only. Mark lines to extend at least 150 mm beyond affected areas.

.4 Submit sketches along with general elevation photographs showing locations and sizes of noted degradation.

.5 Consultant will review above-noted submittal and visit the site to review the Contractor-denoted repair areas prior to Contractor completing removals. Provide two (2) Working Days notice for site review and allow for three (3) Working Days to provide written approval of repair areas.

3.2 CONCRETE REMOVAL

.1 Do not commence concrete removal until Consultant has reviewed and accepted mark lines.

.2 Cover or wet down any dry materials to prevent blowing dust and debris.

.3 Concrete shall be removed in such a manner as to prevent damage to adjacent concrete, reinforcing steel, structural steel, and other components and utilities to remain in place. Hammers shall not come into contract with reinforcing bars in a manner which will cause debonding of bars in adjacent concrete areas not being repaired.

.4 Concrete removal will not be permitted within 900 mm of newly placed concrete for a minimum of 72 hours.

.5 All effluent from saw cutting to be collected to prevent contamination of the area.

.6 Saw-cut the perimeter of the affected area perpendicular to the concrete surface to a minimum depth of 20 mm.

.1 Prior to saw-cutting, scan and locate reinforcing and other embedded items using appropriate scanning technology. Do not cut reinforcing or other embedded items without approval of the Consultant.

.7 Remove existing concrete at concrete patch locations as designated via saw cutting and/or chipping to achieve a sound substrate. All removal areas to be square/rectangular in three dimensions. Where reinforcing steel is exposed by the removal process, this shall be considered a concrete repair rather than a concrete patch.

.8 Remove existing concrete at concrete repair locations as designated via saw cutting and/or chipping to achieve a sound substrate, and to a point where reinforcing steel is free of rust. All removal areas to be square/rectangular in three dimensions. Undercut reinforcing steel by a minimum of 25 mm.

.1 Where existing reinforcing is to be incorporated into new construction, removal shall be via chipping only. Do not damage reinforcing steel to remain.

3.3 PREPARATION, MIXING, APPLICATION AND CURING OF CONCRETE REPAIRS

.1 Surface profile shall be mechanically roughened to a minimum concrete surface profile of CSP 6 as per ICRI Technical Guidance No.310.1.

.2 Consultant will review the prepared concrete substrate prior to placement of concrete repair or patching materials. Provide two (2) Working Days notice for review and allow for three (3) Working Days to provide written approval of surface preparation.

.3 Steel reinforcement to remain shall be thoroughly prepared by mechanical methods to remove all traces of rust or other bond inhibiting material. If reinforcing steel is corroded, notify Consultant to review the conditions and determine whether additional reinforcing bars are required to be installed.

.4 Not more than 24 hours before placing new concrete surface, thoroughly clean patch areas using power vacuum and/or compressed air. Sandblast concrete as required to remove embedded dirt, grease or other stains.

.5 Apply approved anti-corrosion bonding agent at interfaces between new and existing concrete and to all exposed reinforcing steel.

.6 Check and tighten all shoring and bracing.

.7 Mix, apply and place specified concrete repair Product into patch or repair areas, as per manufacturer's published installation instructions or in accordance with CSA A23.1, as applicable.

.8 Refer to manufacturer's recommendations for hot and cold weather work. Provide sufficient thermometers in accordance with CAN/CSA A23.1 for the duration of the required curing period.

.9 Cure for a minimum of seven (7) days and in accordance with manufacturer's recommendations, whichever is greater.

.10 Provide compatible finish, as defined by the coating manufacturer for application of concrete coating Product. Where exposed concrete without coating will be applied, a smooth form finish is acceptable.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Crack injection shall include pressure injection, routing, and sealing of cracks in concrete for the purpose of structural rehabilitation and water seepage control.

1.2 REFERENCES

.1 American Concrete Institute:
- .1 ACI 201.1, Guide for Conducting a Visual Inspection of Concrete in Service.

.2 ASTM International:
- .1 ASTM D4285, Standard Test Method for Indicating Oil or Water in Compressed Air.

.3 CSA International:
- .1 CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CSA A23.2, Methods of Test for Concrete.
- .3 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
- .4 CSA S269.1, Falsework and Formwork.
- .5 CSA-S448.1, Repair of Reinforced Concrete in Buildings and Parking Structures.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

.5 International Concrete Repair Institute:
- .1 ICRI Technical Guideline No. 03738, Guide for the Selection of Grouts to Control Leakage in Concrete Structures.
- .2 ICRI Technical Guideline No. 120-1, Guidelines and Recommendations for Safety in the Concrete Repair Industry.
- .3 ICRI Technical Guideline No. 210.1R, Guide for Verifying Field Performance of Epoxy Injection of Concrete Cracks.
- .4 ICRI Technical Guideline No. 310.1R, Guideline for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 The following shall be submitted a minimum of two (2) weeks prior to commencing the work:
- .1 Crack repair work plan including at least the following information.
  - .1 A description of the method of repair, including the following minimum information:
    - .1 Basis of selection.
    - .2 Proposed effective pressure.
    - .3 Surface finishing.
    - .4 Location and size of injection ports.
    - .5 Surface treatment of the concrete prior to surface sealing.
    - .6 Method of storing and handling grouts, cleaning solvents, and waste materials.
  - .2 A list of the materials to be used for crack preparation and repair, including the following minimum information:

.1 Material specifications.
.2 Product data sheets with test data.
.3 Safety data sheets.
.4 Pot life of the components to be used based on a sample size of 200 ml at 5°C and 20°C.

.3 A certificate from the material supplier shall be submitted stating the material is suitable for the intended use in this Contract and is compatible with all the materials with which it will come into contact.

.4 A list of the equipment and accessories to be used including the following minimum information:
.1 The operating pressure of each component.
.2 The type of injection port and means of closure.

.3 Certificates:
.1 Provide written certification from the Product manufacturer attesting to the approved Contractor status of the applicator for all Products in this Specification.

.4 If the Contractor elects to propose a substitute repair Product manufacturer for approval, all of the above items shall be submitted for approval along with at least two references from completed projects with similar repairs. References shall include project and name with phone numbers of the Consultant able to attest to quality of the repairs performed on that project.
.1 The specific repair Products must be compatible with any proposed finishes or applied coatings.
.2 The Contractor shall be responsible for any additional time required to complete the work due to substitution of Products.

1.4 CONCRETE QUALITY CONTROL PLAN

.1 Coordinate all works within this Section with the Concrete Quality Control Plan and Section03300 Cast-In-Place Concrete.

.2 Quality Plan submission under Section 03300 shall include procedural steps related to:
.1 Identification of required concrete injection.
.2 Hold points for Consultant review.
.3 Concrete removal methodology.
.4 Surface preparation.
.5 Application of repair Products.
.6 Curing.

1.5 QUALITY ASSURANCE

.1 Qualifications:
.1 Crack Injection work shall be carried out by work crews with a minimum three (3) years of experience, in this type of work.
.2 Employ only applicators with at least three (3) years of experience in this type of work.
.3 Applicator has received training in the use of the spray equipment and is approved by the Product manufacturer/supplier.
.4 Supply a minimum of five (5) crack injection projects completed successfully using the type of materials specified.
.5 Provide a letter from the Supplier of coating materials to certify that the applicators have been approved for application of proposed materials.

.2 Pre-installation Meetings: In accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.
- .1 Ensure key personnel, site supervisor, Owner, Consultant, Crack Injection Contractor attend.
  - .1 Verify project requirements.

.3 General:
- .1 When the repair operation is complete, the Consultant shall review the work to determine if the completed work contains defects.

.4 Crack Injection:
- .1 The 75 mm diameter test cores shall be examined for the percentage of the crack depth filled.

.5 Ratio Test:
- .1 The proportioning ratio of the injection material shall not deviate more than 5% from the manufacturer's specified proportioning ratio stated in the work plan.

.6 Pot Life:
- .1 The proportion of material and pot life shall not deviate from that specified by the manufacturer in the work plan.

.7 Acceptance or Rejection:
- .1 The Consultant shall accept or reject material on the basis of the ratio testing and pot life determination results.
- .2 Crack injection shall be accepted or rejected on the basis of the percentage of crack depth filled as determined by evaluating the test core taken in each ten-metre increment of length.
- .3 Rejection of the ten-metre increment of crack shall be applied during the entire grouting operation.
- .4 Where 90% or more of the crack depth is filled in the test core, the ten-metre increment of crack length represented by the core shall be accepted.
- .5 Where 80 to 89% of the crack depth is filled in the test core, the work shall be accepted, and a payment adjustment shall be applied to the ten-metre increment length of crack represented by that core.
- .6 Where less than 80% of the crack depth is filled in the test core, the ten-metre increment of crack length represented by the core shall be rejected.

1.6 EXAMINATION

.1 Prior to executing any concrete repairs, the following steps shall be taken:
- .1 A submission of Proposed Concrete Repair Products by Contractor, including review by Consultant.
- .2 A review of the existing concrete surfaces by the Contractor and Consultant.
- .3 Demarcation of repair areas by Contractor.
- .4 Review of demarcated repair areas by the Consultant.
- .5 Direction to proceed with demarcated areas by the Consultant.

1.7 INSPECTION

.1 In scheduling work, allow for a minimum of three (3) Working Days following demarcation of removal areas for Consultant on-site review to occur and five (5) Working Days for Consultant direction on the repair area.

.2 No repair material to be placed without written authorization from Consultant following their review of the work including surface preparation.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, and handle all materials in accordance with the manufacturer's specifications.

PART 2 - PRODUCTS

2.1 CRACK INJECTION RESIN

.1 In water retaining structures: Foam-producing polyurethane resin as per manufacturer's recommendations. Acceptable Products: 'MME Flexible Resin' Water-Reactive Polyurethane Resin by MME Multiurethanes Ltd. or approved alternate.

2.2 GAUGES

.1 In addition to the calibrated gauges required for use with the pumps and with the injection hose, additional gauges shall be available on site to replace those that malfunction.

.2 Certificates of calibration, from an organization accredited by the Standards Council of Canada shall be supplied for each gauge certifying that the gauges are capable of measuring the pressure within a tolerance of ± 5 kPa.

2.3 PUMPS

.1 Equipment used for pressure injection shall be suitable for the intended use and compatible with the grout.

.2 Pumps shall be positive displacement type and shall be capable of delivering a minimum of two litres of grout per minute.

.3 Pumps shall be capable of developing a maximum regulated operating pressure at least equal to twice the effective pressure.

.4 Pumps shall be equipped with a calibrated gauge and shall be capable of accurately maintaining an effective operating pressure of 50 kPa or less.

.5 Plural component pumps shall be used when multicomponent solution grouts are used.

.6 Hand cartridge pumps shall not be used unless the volume of crack repair is less than one litre of resin for 100 m^2 of gross repair area.

2.4 MIXERS

.1 Static In-Line Mixers:

.1 Static in-line mixers shall produce a homogeneous grout and shall be sized to accommodate the minimum and maximum anticipated flow rates.

.2 Static mixers shall have the manufacturer's plate attached showing the following mixer information:
  .1 Size.
  .2 Type.
  .3 Maximum operating pressure.

.2 Agitating Mixer
  .1 Agitating mixers shall have a power-driven paddle mixing head and produce a homogeneous component.
  .2 The speed of the mixers shall be variable to a maximum of 500 rpm.

2.5 INJECTION HOSES

.1 Injection hoses shall have a rated working pressure equal to or greater than the maximum pump operating pressure and shall be equipped with a calibrated gauge at the injection port end.

2.6 INJECTION PORTS

.1 Injection ports shall be removable or non-metallic insert type units. The pressure capacity of the injection ports shall be at least equal to the maximum operating pressure of the pump. All injection ports shall be equipped with a shut-off valve or other mechanical means of closure under pressure.

.2 Surface mounted injection ports shall not be used.

2.7 AIR COMPRESSOR

.1 Compressed air shall be free from oil and water when tested according to ASTM D4285.

2.8 DRILLS

.1 Drilling of the injection holes shall be performed using a rotary percussion or rotary diamond type drill.

.2 Percussion drilling equipment shall not be used for drilling holes greater than 26 mm diameter and holes within 150 mm of any edge of concrete.

.3 Only holes 26 mm or less in diameter shall be drilled within 50 mm of any free edge of concrete.

2.9 ROUTING EQUIPMENT

.1 Routing equipment shall be any of the following:
  .1 Concrete router.
  .2 Hand-held grinding wheel or a multi-bladed cut-off saw equipped with abrasive or diamond blades.
  .3 Multi-bladed floor saw cutting equipment equipped with diamond blades.

PART 3 - EXECUTION

3.1 GENERAL

.1 Installation of all accessories and material shall be according to the manufacturer's recommendations and as specified in the submitted work plan.

.2 Work shall only proceed when the temperature of the concrete is 5 °C or greater.

3.2 ACCESS

.1 Adequate access shall be provided to facilitate:
- .1 Performance of work.
- .2 Review and measurement of the work by the Consultant.

3.3 CRACK IDENTIFICATION

.1 Prior to commencement of the work, the cracks requiring repair, as identified by the Consultant shall physically marked as to their extent in the presence of the Consultant.

.2 This information shall be recorded and a copy submitted to the Consultant.

3.4 DRILLING FOR INJECTION PORTS

.1 Injection holes shall be drilled, on each side of the crack, at a 45° angle to the surface of the concrete. The holes shall be located such that they intersect the crack section at approximately the midpoint, and they shall extend through the crack section. The holes shall be sized to accommodate the injection ports. The spacing of the holes shall not exceed the depth of the crack or 200 mm, and the holes shall be alternated from one side of the crack to the other.

.2 Prior to installation of the injection ports each hole shall be individually cleaned of all deleterious material by an air-water blast to completely remove all drill cuttings from the hole.

.3 Injection ports shall be inserted into the holes and sealed. The inserted end of the injection port shall not extend beyond the point at which the drilled hole intersects the crack.

3.5 CLEANING AND FLUSHING

.1 After the injection ports have been inserted, cracks shall be flushed in accordance with the manufacturer's recommendations to remove all deleterious material prior to the injection of grout. The flushing material shall be injected through the injection port and continued until it exudes from the adjacent injection port and the crack is thoroughly cleaned. This flushing shall proceed from one end of the crack to the other.

3.6 SURFACE PREPARATION AND SEALING

.1 Surface opening of the cracks shall be sealed prior to injection.

.2 The surface of the concrete shall be mechanically cleaned for a distance of 25 mm each side of the crack sections to prepare a clean substrate for bonding of the surface sealing compound. The surface preparation and sealing shall be as recommended by the manufacturer of the surface sealing material.

.3 The surface sealing material shall completely confine the injection grout to the crack section with only the injection ports providing access. The surface sealing material shall withstand the maximum injection pressure without developing leakage along the crack section.

.4 Surface sealing of passive cracks shall not commence until at least one hour after the final air flush.

3.7 INJECTION OF GROUT

.1 General:

.1 Injection of grout shall proceed from the injection port at the lowest elevation of the crack and continue upwards along the crack on an injection port to injection port basis without interruption to the other end of the crack. The injection nozzle shall not be moved to the adjacent injection port until grout is showing at the next higher adjacent injection port or refusal criteria is developed.

.2 While under pressure, each injection port shall be sealed immediately after completion of injection at that injection port.

.3 When a maximum operating pressure greater than 3 Mpa is required to inject the grout, the injection operation shall cease until the Contractor determines why this operating pressure is required.

.2 Monitoring:

.1 The volume of grout used within each five metres of crack length shall be recorded. The pump gauge pressure shall be recorded every 10 minutes. The volume of grout and pump pressure shall be related to the crack location.

.2 The records shall indicate crack location and number, injection port spacing and confirmation of grout showing or refusal. A copy of the recorded information shall be submitted to the Consultant at the end of each Day.

.3 Effective Pressure:

.1 When calculating the effective pressure, the head losses shall be determined prior to commencement of injection.

.2 Head losses shall be determined in the presence of the Consultant by performing a pressure flow test, through the equipment, for each equipment configuration used.

.4 Ratio Test:

.1 Plural component injection equipment proportioning shall be verified in the presence of the Consultant by measuring the volume output of material in the pressure lines at least once for each two hours of operation.

.2 When deviation from the manufacturer’s specified proportioning ratio exceeds 5%, immediate adjustment or replacement of the equipment is required.

.5 Pot Life Determination:

.1 Prior to commencing the grouting operation, a sample shall be taken from the material containers on site and manually proportioned to the specified component ratio in the presence of the Consultant. The total sample size shall be 200 ml, and the same size container shall be used for each sample taken.

.2 The temperature of the material at the time of mixing and the pot life of the mixed material shall be recorded.

.3 The proportions of materials and pot life shall conform to those specified in the original submissions.

.4 An additional sample shall be taken from the end of the injection hose and a further pot life determination performed.

.5 During grouting material samples shall be taken on a frequency of at least one per hour of operation and the pot life recorded.

.6 Deviation from the proportions and pot life specified shall result in immediate discontinuance of use of the material.

.7 All records shall be submitted to the Consultant at the end of each Working Day.

3.8 SURFACE FINISHING

.1 Surface finishing shall not proceed until the curing period, as specified by the material supplier, has elapsed. Surface finishing shall consist of removal of the injection ports and the surface sealant flush with the original concrete surface. Core holes and holes left after the removal of injection ports shall be filled with a cement-based non-shrink grout after the surface sealant has been removed.

.2 Where the crack is not completely filled to the injection surface, the crack shall be filled with a compatible material acceptable to the Consultant. The material shall be applied according to the manufacturer’s recommendations.

3.9 CORING

.1 Upon request by the Consultant, the Contractor shall take a 75 mm diameter test core for each completed ten-metre increment of injected crack for the full depth of the crack at no additional cost to the Owner.

.2 Coring shall be completed within 1½ to 2 hours after injection, at locations specified by the Consultant. The ten-metre increment is the length of a continuous crack or a cumulative measurement of cracks of lesser length. The cores shall be submitted to the Consultant. Similar coring shall be done to check remedial work.

.3 Filling of Core Holes:

.1 Following the extraction of cores all slurry and other debris shall be removed from the core holes. The holes shall be blasted with compressed air and filled with non-shrink grout flush with the surface of the concrete.

.2 Surface preparation, mixing, installation, and curing shall be according to the manufacturer’s recommendations.

3.10 REMEDIAL ACTION

.1 The failure of the test cores to meet the Quality Assurance requirements specified in PART 1 shall be sufficient cause for immediate review and adjustment of the method of injection. The ten-metre increments represented by the failed test cores shall be repaired such that at least 80% of the crack depth is filled. The method of repair shall be submitted to the Consultant prior to the commencement of the work.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Concrete Institute (ACI):
- .1 ACI 301, Specifications for Structural Concrete.
- .2 ACI 308, Guide to Curing Concrete.

.2 ASTM International (ASTM):
- .1 ASTM A82, Steel Wire, Plain, for Concrete Reinforcement.
- .2 ASTM A123, Standard Specification for Zinz (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A185, Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- .4 ASTM A416, Steel Strand, Uncoated Seven Wire for Prestressed Concrete.
- .5 ASTM A421, Stress-Relieved Steel Wire for Prestressed Concrete.
- .6 ASTM A497, Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- .7 ASTM A615, Deformed and Plain Carbon-Steel Bars for Carbon Reinforcement.
- .8 ASTM A666, Annealed or Cold-Work Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .9 ASTM F3125/F3125M - High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.3 Canadian Precast/Prestressed Concrete Institute (CPCI):
- .1 CPCI Design Manual – 5th Edition.
- .2 Fire Resistance Ratings for Prestressed and Precast Concrete.

.4 Canadian Standards Association (CSA):
- .1 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA A23.2, Methods of Test for Concrete.
- .3 CAN/CSA A23.3, Design of Concrete Structures.
- .4 CAN/CSA A23.4, Precast Concrete – Materials and Construction.
- .5 CAN/CSA A283, Qualification Code for Concrete Testing Laboratories.
- .6 CAN/CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .7 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .8 CAN/CSA S269.3, Concrete Formwork.
- .9 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .10 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .11 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

.6 International Concrete Repair Institute (ICRI):
- .1 ICRI 310.2R – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

.7 National Research Council (NRC):
- .1 National Building Code of Canada (NBC).

.8 Precast Concrete Institute (PCI):
- .1 PCI Manual for Design of Hollowcore Slabs.
- .2 PCI MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- .3 PCI MNL-124, Design for Fire Resistance of Precast/Prestressed Concrete.
- .4 PCI MNL-127, Standards and Guidelines for the Erection of Precast Concrete Products.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit precast concrete manufacturer's instructions, printed Product literature and data sheets for proprietary materials used in precast concrete hollowcore planks and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .1 Indicate standard component configuration, design loads, deflections, and cambers.
- .2 Submit two (2) copies of WHMIS SDS in accordance with Division 01.

.3 Mix Designs:
- .1 Submit concrete mix designs including as a minimum:
  - .1 Concrete.
  - .2 Grout.

.4 Shop Drawings:
- .1 Submit drawings for precast concrete hollowcore planks stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .2 Shop Drawings are to indicate, at a minimum:
  - .1 Design loads including uniformly distributed loads and concentrated loads and loads transferred to hollowcore panels through embedded elements.
  - .2 Design capacities of hollowcore planks calculated in accordance with the relevant standards.
  - .3 Layout of precast hollowcore planks, including sections to be filled solid.
  - .4 Details of joints and connections between planks.
  - .5 Connection details of planks to other construction (supporting structure) such as walls, beams, etc.
  - .6 Edge and support conditions.
  - .7 Dimensions.
  - .8 Openings to be completed in the shop including size and location.
  - .9 Openings intended to be field cut including size and location.
  - .10 Relationship to adjacent materials.

.5 Prestressing Strands: Certified mill test reports to be submitted to Consultant upon request.

.6 Installation Data:
- .1 Handling control and storage of hollowcore planks.
- .2 Fabricator’s installation requirements including any temporary support requirements, and procedures and perimeter conditions requiring special attention.
- .3 Procedures for field installed openings.
- .4 Protection of hollowcore planks following installation before enclosed within building envelope.

.7 Closeout Review Report: The precast concrete manufacturer shall supply a final sign-off report stating that the installation is in general conformance with their installation drawings and their requirements. Report shall be sealed by the Professional Engineer responsible for the Shop Drawings.

1.3 QUALITY ASSURANCE

.1 Retain a professional engineer registered or licensed in Ontario, Canada, with experience in precast concrete hollowcore plank design of comparable complexity and scope, to perform following services as part of work of this Section:

- .1 Design of precast concrete hollowcore planks.
- .2 Review, stamp, and sign fabrication and erection Shop Drawings and amendments.
- .3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of work is in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections prior to placing grout.

.2 Pre-installation Meetings: In accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.

- .1 Ensure key personnel, site supervisor, Owner, Consultant, formwork contractor, concrete precast supplier representative, and materials testing agent attend.
  - .1 Verify project requirements.
  - .2 Contractor to discuss anchoring, reinforcing placement and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.
  - .3 Placement of topping for hollowcore planks.

.3 Fabricator:

- .1 Precast concrete manufacturers to be certified to Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program in Commercial Precast and Prestressed Concrete Products (Structural) Category C2 prior to the time of bid.
- .2 Precast fabrication to meet the requirements of CSA-A23.4, including Annexes A and B, together with PCI MNL-116 and 117 and CPCQA certification requirements.
- .3 Only precast elements fabricated under the CPCQA plant certification program to be acceptable, and plant certification is to be maintained for the duration of fabrication, erection, and until warranty expires.

.4 Erector: Company specializing in performing the work of this Section with minimum five (5) years documented experience.

.5 Welding:

- .1 Perform welding to CSA W59 and CSA W186.
- .2 Welders to be qualified within previous twelve (12) months to CSA-W47.1.

.6 Maintain plant records and quality control program during production of precast planks in accordance with CSA A23.4. Make records available upon request.

1.4 PERFORMANCE BASED SPECIFICATION

.1 Precast concrete producer to meet the concrete performance criteria established within this specification.

- .1 Design in accordance with CSA A23.3 and CSA A23.4.

.2 Size components to withstand design loads as noted on the Contract Documents as well as all handling and erection stresses.

.3 Design connections/attachments of precast elements for the factored seismic diaphragm loads/forces specified. Provide additional reinforcement to suit diaphragm loads including for shear collectors, struts and ties as indicated on drawings.

.1 The concrete topping over the hollowcore is intended to be used as the primary diaphragm for the roof structure. A surface roughness to meet a minimum amplitude of 5 mm (CSP 6 in accordance with ICRI 310.2R) will be required on the top surface of the hollowcore.

.2 Include for diaphragm shear transfer using cast in dowels using 400W steel reinforcement. Detail number and spacing to allow for loads to be transferred into collectors.

.4 Locations and sizes of openings. Specify and coordinate any field opening requirements, limitations and tolerances. All openings larger than 150 mm diameter shall be completed in the shop.

.5 Maximum allowable deflection of planks as per CSA-A23.3 and the contract documents.

.6 Design components to accommodate construction tolerances, as per relevant CSA codes.

.7 Precast components to be designed with concrete mix that will achieve a minimum specified compressive strength of 40 MPa at 28 days, with properties according to CSA-A23.1 for Class F-2 exposure. Slump and air tests not applicable according to CSA-A23.1 Clause 8.9.6.

.8 Components at the interface between of the precast and in-situ works (masonry) including solid filled sections have assumed a minimum specified compressive strength for the grout for the precast hollowcore to be 20 MPa at 28 days.

.9 The precast concrete manufacturer shall be responsible for determining the camber on the hollowcore planks to produce a structure that can have the topping installed and the top surface sloped in accordance with the Contract Drawings.

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

.1 Coordinate the requirements within this section with Division 01.

.2 Deliver, store, and handle all materials in accordance with CSA A23.1. Store all precast concrete including hardware off the ground, covered in a dry place. Separate stacked members with battens across the full width of each bearing point.

.3 For grout placements for the hollowcore plank works, ensure that this work including delivery, handling, protection is completed in accordance with CAN/CSA A23.1/A23.2.

1.6 COORDINATION

.1 Precast concrete manufacturer to provide information and drawings to Contractor to coordinate with other work having a direct bearing on work of this Section.

.2 Contractor to coordinate field cut openings with affected Section.

PART 2 - PRODUCTS

2.1 ACCEPTABLE FABRICATORS

.1 Coreslab Structures (ONT) Incorporated.

.2 Pre-con Precast Limited.

.3 Stubbe’s Precast Incorporated.

2.2 MATERIALS

.1 Concrete Materials: To CSA-A3000 and CSA-A23.1/A23.2. Minimum compressive strength of 40 MPa at 28 days.

.2 Prestressing Steel Strands:

.1 Seven Wire Stressed Relieved: To ASTM A416/A416M with supplement for low relaxation wire.

.2 Single Wire Stressed Relieved: To ASTM A421/A421M with supplement for low relaxation wire.

.3 Grade of sufficient strength commensurate with member design.

.3 Reinforcing Steel: To CSA G30.18, deformed steel bars.

.4 Cement Grout: Minimum compressive strength of 40 MPa at 28 days.

.5 Concrete Topping: Refer to Section 03300 – Cast-in-Place Concrete.

.6 Connecting and Supporting Devices: CSA-G40.20/G40.21 carbon steel; plates, angles, items cast into concrete, and inserts; fasteners to ASTM F3125.

.7 Core Hole End Plugs: To dam the concrete or grout.

.8 Bearing Pads: As required by precast concrete manufacturer.

.9 Shims: Plastic.

2.3 FABRICATION

.1 To commence upon receipt of reviewed Shop Drawings and schedules.

.2 Conform to CSA-A23.1 and CSA A23.4.

.3 Embed anchors, inserts, plates, angles, and other items at locations indicated on reviewed Shop Drawings.

.4 Provide for openings between planks and at ends to suit connections to supporting structure for diaphragm requirements.

.5 Provide openings required by other Sections, at locations indicated on reviewed Shop Drawings.

.6 Precast hollowcore planks containing hairline cracks which are visible but less than 0.5 mm in width and/or excessive in quantity require approval by Consultant prior to installation.

.7 Precast hollowcore planks which contain honeycombs or other surface defects deep enough to expose prestressing strands shall be rejected.

.8 Precast hollowcore planks that are damaged or have cracks greater than 0.5 mm / 0.02” in width shall be rejected.

.9 All rejected precast hollowcore planks shall be removed from the site and replaced at no additional cost to the Owner.

2.4 COMPONENTS

.1 Nominal Thickness: 356 mm as indicated on Structural Drawings.

.2 Nominal Plank Width: 1220 mm nominal with special panels as required to suit building dimensions.

.3 Allow for infill panels as required to suit indicated area. Infill panels using solid cast or cast-in place panels sections.

2.5 FINISHES

.1 Concrete Finish to CSA A23.4:
- .1 Top Surface: To accommodate specified topping design requirements.
- .2 Bottom Surface: Finish Grade B.

.2 Connecting and Supporting Steel Devices: Hot-dip galvanized.

.3 Finish of formed surfaces shall be as detailed on the Shop Drawings.

.4 Submit a reference sample in accordance with CSA A23.4 clause 26.2.1.

2.6 SOURCE QUALITY CONTROL AND TESTS

.1 Provide testing and analysis of all site-placed concrete and grout associated with the hollowcore planks.

.2 Provide shop inspection and testing for stressing strands.

.3 Test samples in accordance with specified standards.

PART 3 - EXECUTION

3.1 EXAMINATION AND COORDINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for precast concrete hollowcore plank installation in accordance with precast concrete manufacturer's written instructions.
- .1 Visually inspect substrate prior to commencing with Work of this section in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

.2 Bearing surfaces shall be flat and free of irregularities. Before erection, verify that bearing surfaces are sized to provide the required clearances. Correct bearing surface irregularities with non-shrink grout and/or grinding as required. Provide bearing pads only as required by precast concrete manufacturer’s design.

.3 Ensure that surface profile is verified at time of receipt in accordance with the performance requirements.

3.2 ERECTION

.1 Do not place precast concrete hollowcore slabs on masonry bearing surfaces until the structure has reached a minimum of 75% of it's design strength in field curing, but not less than 7 days. Staged construction has not been considered in the design of the finished structure.

.2 Prior to erection and again after installation, check precast concrete for damage such as cracking, spalling, and honeycombs. Precast concrete that does not meet the surface finish requirements specified in Part 2 shall be repaired or removed and replaced at the Contractor's expense.

.3 Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members to the satisfaction of the Consultant.

.4 Align and maintain uniform horizontal and end joints, as erection progresses.

.5 Maintain any temporary bracing if required for the supporting structure components or to avoid any rotation or excessive deflections of the supporting components.

.6 Install bearing pads at bearing ends of planks as required.

.7 Erect members level and plumb to the tolerances specified in CSA A23.3 and A23.4.

.8 Adjust differential camber between precast members to tolerance before final attachment and grouting.

.9 Adjust differential elevation between precast members to tolerance before final attachment and grouting.

.10 Grout all plank joints, trowel smooth. Ensure to solidly pack entire depth of keyway flush to the top of precast. Prevent leakage or droppings of grout through the assembled deck. Any grout that seeps through the deck shall be removed before it hardens. Grouting shall not start until all units are in place.

.11 Transition differential elevation of adjoining planks with grout to a maximum slope as required to suit materials to be placed above. Differential camber in excess of 6 mm shall be dressed with non-shrink grout as per Section 03300 – Cast-in-Place Concrete.

.12 Secure units in place according to erection drawings. Perform welding in accordance with CSA W59. Coordinate connection to load bearing and lateral force resisting system as shown on Contract Drawings.

.13 Ensure that openings for diaphragm connections are in accordance with Contract Drawings and Final Hollowcore Shop Drawings.

.14 Field cut holes and openings up to 150 mm in diameter to be cored or drilled by the trade requiring them, subject to the approval of the precast concrete manufacturer and in accordance with reviewed Shop Drawings.

.15 All openings shall be shown on the Shop Drawings:

- .1 Openings up to 150 mm in diameter may be cored or drilled on site by the trade requiring them, subject to the approval of the precast concrete manufacturer and in accordance with reviewed Shop Drawings.
- .2 Openings larger than 150 mm shall be provided in the shop.

.16 Do not cut any reinforcing without prior approval of the precast concrete manufacturer and Consultant.

3.3 CONSTRUCTION LOADS

.1 Loads shall not be placed on precast hollowcore planks until all keyways are fully grouted with grout having achieved the minimum specified design strength, and/or as instructed in writing by the precast concrete manufacturer.

.2 In no case shall concentrated loads or construction loads exceeding the design loads be placed on the hollowcore planks.

3.4 FIELD QUALITY CONTROL

.1 Structural Engineer responsible for the design of precast concrete hollowcore planks, or his/her authorized representative, shall inspect the work following erection and again at completion and shall issue a report to the Consultant.

.2 Materials or work not meeting the requirements of this Specification or the reviewed Shop Drawings shall be rejected.

.3 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

3.5 CLEANING

.1 Refer to Division 01 for requirements for progress and overall cleaning.

.2 Clean weld marks, dirt, or blemishes from surface of exposed members, caused by the work of this Section.

.3 Clean field welds with wire brush and touch up with galvanized paint.

.4 Upon completion of the work of this Section, remove all surplus materials and debris from this site.

3.6 PROTECTION OF FINISHED WORK

.1 Refer to Division 01 for general requirements on protection of work at completion.

.2 Protect members from physical damage and from water infiltration and freezing immediately following installation.

.3 Protect members from damage caused by field welding or erection operations performed by the work of this Section.

.4 Provide non-combustible shields during welding operations, as required.

.5 Protect hollowcore planks in accordance with precast concrete manufacturer’s instructions.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Concrete Institute (ACI)
- .1 ACI 301, Specifications for Structural Concrete.
- .2 ACI 308, Guide to Curing Concrete.

.2 ASTM International (ASTM)
- .1 ASTM A82, Steel Wire, Plain, for Concrete Reinforcement.
- .2 ASTM A123, Standard Specification for Zinz (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A185, Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- .4 ASTM A416, Steel Strand, Uncoated Seven Wire for Prestressed Concrete.
- .5 ASTM A421, Stress-Relieved Steel Wire for Prestressed Concrete.
- .6 ASTM A497, Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- .7 ASTM A615, Deformed and Plain Carbon-Steel Bars for Carbon Reinforcement.
- .8 ASTM A666, Annealed or Cold-Work Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .9 ASTM F3125/F3125M - High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.3 Canadian Precast/Prestressed Concrete Institute (CPCI):
- .1 CPCI Design Manual – 5th Edition.

.4 Canadian Standards Association (CSA):
- .1 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA A23.2, Methods of Test for Concrete.
- .3 CAN/CSA A23.3, Design of Concrete Structures.
- .4 CAN/CSA A23.4, Precast Concrete – Materials and Construction.
- .5 CAN/CSA A283, Qualification Code for Concrete Testing Laboratories.
- .6 CAN/CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .7 CAN/CSA S269.3, Concrete Formwork.
- .8 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

.6 International Concrete Repair Institute (ICRI)
- .1 ICRI 310.2R – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

.7 National Research Council (NRC):
- .1 National Building Code of Canada (NBC).

.8 Precast Concrete Institute (PCI)
- .1 PCI Manual for Design of Hollowcore Slabs.
- .2 PCI MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

.3 PCI MNL-124, Design for Fire Resistance of Precast/Prestressed Concrete.
.4 PCI MNL-127, Standards and Guidelines for the Erection of Precast Concrete Products.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Division 01.

.2 Quality Control Plan
  .1 Incorporate the receiving, storage and installation of the precast concrete launders into the Concrete Quality Control Plan identified in Section 03300 – Cast-in-Place Concrete including:
    .1 Review of delivered components at site.
    .2 Handling control and storage of precast sections.
    .3 Existing conditions for placement of precast sections.
    .4 Installation quality control for grout, reinforcing, installation, etc.
    .5 Protection of precast sections following installation for duration of construction works.
    .6 Final quality control of the precast sections prior to leaving precast facility including supporting reporting by precast design engineer (in employ of precast manufacturer).
  .2 Submit Concrete Quality Control Plan to Consultant to the timelines identified in Section 03300 – Cast-in-Place Concrete.
  .3 The reviewed Quality Control Plan shall be implemented and followed by the Contractor for all precast concrete work on the project.

.3 Submit concrete mix designs in accordance with the requirements stipulated in Section 03300 – cast-in-place concrete.

.4 Product Data:
  .1 Indicate standard component configuration, reinforcing layouts, design loads, deflections and cambers (if applicable), and any product limitations including handling of the precast sections on site.

.5 Shop Drawings:
  .1 Shop drawings shall be stamped and signed by a Professional Engineer licensed in the Province of Ontario and shall include as a minimum:
    .1 Design loads as identified under 1.4 – Performance Requirements including uniformly distributed loads and concentrated loads.
    .2 Design capacities of precast launder sections calculated in accordance with the relevant standards.
    .3 Layout of precast launders including reinforcing bar layouts and clear concrete cover.
    .4 Concrete properties in accordance with the mix design.
    .5 Details of joints and connections between precast sections.
    .6 Connection details of precast sections to other construction (supporting structure) such as walls, corbels, slabs, etc.
    .7 Edge and support conditions.
    .8 Dimensions.
    .9 Relationship to adjacent materials.
    .10 Handling and shipping requirements at site.

.6 Prestressing Strands: Certified mill test reports to be submitted to Consultant upon request.

.7 Manufacturer’s Instructions: submit manufacturer’s installation instructions and special handling criteria, installation sequence and cleaning procedures.

.8 Closeout Review Report: Prior to release and shipping of the precast launders, the precast manufacturer shall supply a final sign-off report stating that the fabrication of the launders is in general conformance with the fabrication drawings and their requirements. The sign-off report shall confirm the condition of the launders as they were released for shipping. Sign-off report shall be sealed by a Professional Engineer licensed in the Province of Ontario, in the employ of the precast manufacturer.

1.3 QUALITY ASSURANCE

.1 Fabricator:
- .1 Precast concrete manufacturers to be certified to Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program in Commercial Precast and Prestressed Concrete Products (Structural) Category C2 prior to the time of bid.
- .2 Precast fabrication to meet the requirements of CSA A23.4:16 (R2021), including Annexes A and B, together with PCI MNL-116 and CPCQA certification requirements.
- .3 Only precast elements fabricated under the CPCQA plant certification program to be acceptable, and plant certification is to be maintained for the duration of fabrication, erection, and until warranty expires.

.2 Perform welding to CSA W59-13 and CSA W186-M1990 (R2016).

.3 Welder: Qualified within previous twelve (12) months to CSA W47.1:19.

.4 Maintain plant records and quality control program during production of precast sections. Make records available upon request.

.5 Erector: Company specializing in performing the work of this section with minimum ten (10) years documented experience.

.6 Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the Province of Ontario.

1.4 PERFORMANCE REQUIREMENTS

.1 The Precast Concrete producer to meet the concrete performance criteria established within this specification.

.2 Design components to withstand the following specified design loads with accompanying load combinations in accordance with OBC 2012 and CSA S900.2:
- .1 Full water and dead loads.
- .2 Lateral loads due to weir attachment (coordinate with drawings).
- .3 Uplift loads.
- .4 Environmental loads.
- .5 Temperature variation in accordance with the local temperatures and guidance in NBCC 2015 Structural Commentaries.
- .6 All handling and erection stresses.

.3 Maximum Allowable Deflection of precast launder sections should not exceed L/360 or 10mm, whichever is less.

.4 Design components to accommodate construction tolerances, as per relevant CSA codes.

.5 Precast components to be designed with concrete mix that will achieve a minimum specified compressive strength of 40 MPa at 28 days, with additional properties according to CSA A23.1:19 Table 2 for Class C-1 exposure.

.6 Components at the interface between the precast and in-situ works (cast-in-place concrete) have assumed a minimum specified compressive strength for grout of 40 MPa at 28 days.

1.5 REGULATORY REQUIREMENTS

.1 Conform to applicable code for design load and on-site handling requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Coordinate the requirements of this section with Division 1.

.2 Deliver, store and handle materials in accordance with the Concrete Quality Control Plan and the manufacturer's written instructions. Store all precast concrete off the ground, covered and in a dry place. Ensure all concrete materials are handled in accordance with CAN/CSA A23.1.

.3 Protect materials during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Materials: to CAN/CSA-A3000, CSA A23.1/A23.2.

.2 Prestressing Steel Strands:
- .1 Seven Wire Stress Relieved – ASTM A416/A416M with supplement for low relaxation wire.
- .2 Single Wire Stress Relieved – ASTM A421/A421M with supplement for low relaxation wire.
- .3 Grade of sufficient strength commensurate with member design.

.3 Reinforcing Bars: to CSA G30.18, Grade 400W, deformed steel bars.

.4 Cement Grout: In accordance with Section 03300 – Cast-in-Place Concrete

.5 Joints: Coordinate with Drawings and Specification 03600 – Joints and Accessories.

.6 Gaskets: Coordinate with Specification 03600 – Joints and Accessories.

2.2 ACCESSORIES

.1 Connecting and Supporting Devices: Refer to Drawings. Coordinate weir plates with Mechanical Drawings.

.2 Bearing Pads: As required by precast manufacturer.

.3 Shims: Plastic.

2.3 FABRICATION

.1 To commence upon receipt of approved shop drawings and schedules.

.2 Conform to CSA A23.4:16 (R2021).

.3 Embed anchors, inserts, plates, angles, and other items at locations indicated on approved shop drawings.

2.4 COMPONENTS

.1 Nominal dimensions to be as indicated in the contract documents.

2.5 FINISHES

.1 Precast launders which consist of honeycombs or other surface defects deep enough to expose prestressing strands or reinforcing steel shall be rejected.

.2 Precast launders containing hairline cracks which are visible but less than 0.5mm in width and/or excessive in quantity require approval by Consultant prior to installation.

.3 Precast launders that are damaged or have cracks greater than 0.5mm in width shall be rejected and replaced at no additional cost to the Owner.

.4 All rejected precast launders shall be removed from site and replaced at no additional cost to the Owner.

.5 Connecting and Supporting Steel Devices: Prime painted.

2.6 FABRICATION TOLERANCES

.1 Conform to CSA A23.4:16 (R2021).

2.7 SOURCE QUALITY CONTROL AND TESTS

.1 Provide testing and analysis of all site-placed concrete and grout associated with the precast concrete launders.

.2 Provide shop inspection and testing for prestressing strands.

.3 Test samples in accordance with the specified standards.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.2 FABRICATION

.1 Do concrete work in accordance with Section 03300, Cast-in-Place Concrete.

.2 Fabricate launders in accordance with details provided in the contract documents. Provide reinforcing steel as required to achieve the indicated clear spans.

.3 Set pulling irons and other built-in items in place prior to placing concrete.

3.3 EXAMINATION

.1 General Contractor to verify that site conditions are ready to receive work and field measurements are as indicated on approved drawings.

.2 Verify supporting structure is ready to receive work.

3.4 SURFACE REPAIR

.1 Prior to erection and again after installation, Contractor shall check precast concrete for damage such as cracking, spalling, and honeycombs. Precast concrete that does not meet the surface finish requirements specified in Part 2 shall be repaired or removed and replaced at the Contractor's expense.

3.5 BEARING SURFACES

.1 Bearing surfaces shall be flat and free of irregularities. Before erection, the Contractor shall verify that bearing surfaces are sized to provide the required clearances. Correct bearing surface irregularities with non-shrink grout and/or grinding as required. Provide bearing pads only as required by launder manufacturer's design.

3.6 ERECTION

.1 Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members to the satisfaction of the Consultant.

.2 General Contractor to maintain any temporary bracing if required for the supporting structure components to avoid any rotation or excessive deflections of the supporting components.

.3 Adjust differential elevation between precast members to tolerance before final attachment and grouting.

.4 Secure units in place according to erection drawings. Perform welding in accordance with CSA W59-13.

.5 Do not field cut or modify precast sections in any way without prior approval of the precast manufacturer and Consultant.

3.7 ERECTION TOLERANCES

.1 Erect members as indicated in the approved shop drawings, within allowable tolerances.

.2 Erect to the tolerances as specified in CSA A23.4:16 (R2021).

3.8 CLEANING

.1 Refer to Division 1 for requirements for progress and overall cleaning.

.2 Clean weld marks, dirt and blemishes from surface of exposed members caused by the work of this Section.

.3 Upon completion and verification of performance of installation, remove all excess materials, rubbish, tools and equipment from the site.

3.9 PROTECTION OF FINISHED WORK

.1 Refer to Division 1 for general requirements on protection of Work at completion.

.2 Protect members from physical damage and damage caused by field welding or erection operations performed by the work of the Section.

.3 Provide non-combustible shields during welding operations, as required.

.4 Contractor shall protect precast launders in accordance with the Quality Plan.

END OF SECTION

PART 1- GENERAL

1.1 REFERENCES

.1 American Concrete Institute:
- .1 ACI 301, Specifications for Structural Concrete.
- .2 ACI 303R, Guide to Cast-in-Place Architectural Concrete Practice.
- .3 ACI 308R, Guide to External Curing of Concrete.

.2 ASTM International:
- .1 ASTM C171, Standard Specification for Sheet Materials for Curing Concrete.
- .2 ASTM C309, Liquid Membrane-Forming Compounds for Curing Concrete.
- .3 ASTM C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- .4 ASTM E1155M, Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric).

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-25.20, Surface Sealer for Floors.

.4 CSA International:
- .1 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA A23.2, Methods of Test for Concrete.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Provide manufacturer’s printed Product literature and data sheets for concrete finishes and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS Safety Data Sheets for all Products.
- .3 Include application instructions for concrete floor treatment(s).

.3 Submit written declaration that the components used are compatible and will not adversely affect finished flooring Products and their installation adhesives.

1.3 CONCRETE QUALITY CONTROL PLAN

.1 Coordinate all works within this Section with the Concrete Quality Control Plan and Section 03300 Cast-in-Place Concrete.

.2 Include procedures related to floor finish tolerances including methods to measure and verify floor flatness requirements have been met.

1.4 QUALITY ASSURANCE

.1 Pre-installation Meetings: in accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.
  .1 Ensure key personnel, site supervisor, Owner, Consultant, Concrete Finisher, concrete producer, and materials testing agent attend.
    .1 Verify project requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, and handle all materials in accordance with CSA A23.1 and manufacturers instructions.

1.6 VERIFICATION OF FLOOR FLATNESS AND LEVELNESS

.1 Surfaces shall be considered to comply with the F-Number tolerances if the overall combined values of the entire floor installation are greater than or equal to the overall F-Number specified in Table 21 of CAN/CSA A23.1 for the specified floor finish category, with no placement less than 60% of the specified overall value.

PART 2 - PRODUCTS

2.1 CURING MATERIALS

.1 Materials used for curing shall be in accordance with CSA A23.1.

.2 Water shall be clean and shall not contain any deleterious substances. Water to meet the requirements of ASTM C94/C94M.

.3 Plastic film used as a moisture barrier for curing concrete shall comply with ASTM C171.

2.2 CURING AND SEALING COMPOUNDS

.1 For interior or exterior applications subject to paint, resilient tile or resilient flooring:
  .1 Curing Compounds shall be a dissipating, VOC-compliant, water-based, liquid membrane forming, including a fugitive dye, conforming to CAN/CSA-A23.1 and ASTM C309, Type 1-D. Products shall be suitable for intended application.
  .2 Acceptable Products:
    .1 ‘1100’ by W.R. Meadows.
    .2 ‘Kurez DR VOX’ by Euclid Chemical.
    .3 ‘Resin Cure with Dye J11WD’ by Dayton Superior.
  .3 Provide white pigment to ASTM C309, Type II, Class A for hot weather work, where approved. Moisture loss not to exceed 4.0 kg/m^3 in a 72-hour period when tested per ASTM C156.

.2 For interior or exterior exposed applications:
  .1 Curing and Sealing Compounds, shall be a water based, VOC-compliant, clear, glossy, non-yellowing acrylic emulsion, conforming to CAN/CSA-A23.1 and ASTM C309 Type 1, and ASTM C1315 Type 1, Class A.

.2 Acceptable Products:
  .1 ‘Florseal WB-25’ by Sika Canada.
  .2 ‘VOCOMP 30’ by W.R. Meadows.
  .3 ‘Super Diamond Clear VOX’ by Euclid Chemical.

.3 Provide white pigments to ASTM C309 Type II, Class A for hot weather concrete, where approved. Moisture loss not to exceed 4.0 kg/m^3 in a 72-hour period when tested per ASTM C156.

2.3 AGGREGATE HARDENERS

.1 Dry shake applied non-metallic aggregate.
  .1 Acceptable Products:
    .1 ‘Diamag 7’ by Sika Canada.
    .2 ‘MasterTop 100’ by Sika Canada.
    .3 ‘785 Genflor’ non-metallic floor hardener by W.R. Meadows.
    .4 ‘Surflex-TR’ by Euclid Chemical.

PART 3 - EXECUTION

3.1 FINISH FOR FORMED SURFACES

.1 Non-exposed Concrete Finish:
  .1 A "rough form finish" as defined by CAN/CSA-A23.1 will be acceptable for surfaces not exposed to view in finished structure.

.2 Exposed Concrete Finish:
  .1 A "smooth-form finish" as defined by CAN/CSA-A23.1 will be required for all surfaces exposed to view in finished structure and all liquid retaining structures, troughs, etc.
  .2 Utilize only new sheets of plywood coated with release agent and cone-type ties, unless noted otherwise.
  .3 Horizontal joints shall occur at same elevation on all visually related surfaces.
  .4 Patch all cone tie holes with an approved non-shrink, non-metallic grout.

.3 Architectural Concrete Finish - where indicated on architectural Drawings:
  .1 Finish to CAN/CSA-A23.1 and ACI 303.
  .2 Form all recesses using dressed lumber.
  .3 Form chamfers at all outside corners formed by intersection of a vertical and horizontal surface, using dressed lumber.
  .4 Edges of plywood panels shall be milled to ensure tight contact with adjacent edges and surfaces. All edge joints shall be arranged symmetrically in any panel or surface.
  .5 Horizontal joints shall occur at same elevation on all visually related surfaces.
  .6 All joints and form tie patterns shall be arranged and approved by the Consultant before formwork is built.
  .7 Unless noted otherwise, install grey plastic set back plugs in cone tie holes.

3.2 FLOOR FINISHING

.1 Finish floors in accordance with CSA-A23.1.

.2 Slab and floor tolerance measurements shall be made in accordance with the F-Number system as specified in CSA-A23.1.

.1 Use a steel trowelled finish for interior slabs. Finished surface to be free of any trowel marks, uniform in texture and appearance. Two passes with trowels are required on exposed concrete floors.

.2 Concrete substrates that are to have finished flooring materials installed are to be clear of defects that will impact the installation and/or warranty of the flooring Product.

.3 When the Contractor fails to meet the floor flatness requirements, submit proposed procedures for correction of floor flatness deficiencies for Consultant review.

3.3 CURING

.1 Cure all concrete in accordance with the requirements of CAN/CSA-A23.1.

.2 Curing compounds shall not be used in the following scenarios:

.1 Where curing compounds are not compatible with specified finishes.

.2 Wet curing methods shall be used for liquid retaining structures for a minimum of seven (7) days.

.3 Wet curing methods shall be used during hot weather concreting, unless otherwise approved by the Consultant.

3.4 SURFACE PREPARATION

.1 All newly cast concrete to receive any proprietary waterproofing/sealing agent to be water blasted and/or prepared to manufacturer’s requirements. Consult manufacturer’s literature for requirements prior to applying any Products to newly cast concrete.

.2 Where moisture-sensitive finishes are to be applied to a concrete surface, the moisture conditions of the concrete shall be verified prior to its application in accordance with CSA A23.1 and manufacturer’s instructions.

3.5 FLOOR SEALING

.1 Unless noted otherwise, seal all exposed concrete floor areas, interior/exterior stairs and landings, exterior equipment pads, as well as concrete toppings with two coats of an approved sealing compound.

.2 Preparation of surfaces, quantities used, and application procedures and installation precautions to be in strict compliance with manufacturer’s instructions and directions.

3.6 FLOOR HARDENING

.1 Refer to the Drawings for extent and coverage rate of floor hardeners.

.2 Incorporate hardener into freshly floated concrete as a "dry shake". Adhere strictly to manufacturer's recommendations and directions.

.3 Incorporate integral hardener into the concrete mix at the time of batching for air-entrained concrete or for vertical or inclined applications. Adhere strictly to manufacturer's recommendations and directions.

3.7 FINISH FOR EXTERIOR SLABS, EQUIPMENT PADS, STAIRS AND LANDINGS

.1 Provide non-slip broom finish.

.2 Seal with two coats of an approved sealer.

.3 Harden where indicated on Drawings.

.4 Provide a minimum thirty (30) calendar day drying period after moist curing for all concrete exposed to freeze-thaw or de-icing exposure when saturated.

3.8 HIGH PERFORMANCE COATINGS

.1 Refer to Division 07 for architectural coatings.

.2 Refer to Division 09 for high performance coatings.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- .2 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
- .3 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).
- .4 ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

.2 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Damp proofing and Waterproofing and for Roof Coatings.
- .2 CAN/ CGSB 41-GP, Polyvinyl Chloride Water Stop.
- .3 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Canadian Standards Association (CSA) International:
- .1 CAN/CSA-A23.3, Design of Concrete Structures.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer’s data sheets for joint sealants, fillers and accessories.
- .2 Submit manufacturer’s data sheets for waterstops. Clearly indicate which item(s) are to be used.

.3 Shop Drawings:
- .1 Provide plan and/or elevation drawings showing proposed construction joint layout.

.4 Prior to putting liquid retaining elements into service obtain field review of waterproof expansion joints by the manufacturer. Provide a letter from the manufacturer confirming that the expansion joint has been installed and cured in accordance with the manufacturer’s written instructions and is suitable for intended use.

1.3 CONCRETE QUALITY CONTROL PLAN

.1 Coordinate all works within this Section with the Concrete Quality Control Plan and Section 03300 Cast-in-Place Concrete.

1.4 QUALITY ASSURANCE

.1 Pre-installation Meetings: In accordance with Division 01, convene pre-installation meeting one (1) week prior to beginning concrete works.
  .1 Ensure key personnel, site supervisor, Owner, Consultant, formwork contractor, concrete producer, and materials testing agent attend.
    .1 Verify project requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying Product name and manufacturer.

.2 Store materials in a clean dry area and in accordance with manufacturer's instructions.

.3 Protect materials during handling and application to prevent damage.

1.6 PROPRIETARY PRODUCTS

.1 Contractor is to have waterstop and expansion joint Manufacturer's representative on site for initial installation to provide training and verify the installation. Contractor to provide proof of this training upon request from the Consultant

PART 2 - PRODUCTS

2.1 JOINTS

.1 Isolation Joints:
  .1 Unless noted otherwise on Drawings, isolation joint filler material shall be impregnated fiberboard suitable for interior and exterior applications. Acceptable Product: 'Fibre Expansion Joint' by W.R. Meadows.

.2 Contraction Joints:
  .1 Interior Applications: Self-levelling two component epoxy urethane filler. Acceptable Products: 'Loadflex' by Sika Canada, 'Masterseal CR 190' by Sika Canada, or 'Rezi-Weld Flex' by W.R. Meadows.
  .2 Exterior Applications: Non-sag elastic sealant complete with foam backer road. Acceptable Product: 'Sikaflex Concrete Fix' by Sika Canada.
  .3 Colour of joint filler to be selected by Consultant from Manufacturer's standard colour line.

.3 Construction Joints:
  .1 Vertical and horizontal applications within liquid retaining structures: Two component potable water approved, non-sag, polyurethane elastomeric sealant and breaker tape. Acceptable Product: 'Sikaflex-2C NS EZ mix' by Sika Canada.

.4 Expansion joints:
  .1 All expansion joints and accessories shall be NSF 61 approved.
  .2 Provide factory made fabrications for all changes of direction, intersections and transitions.

.3 Expansion Joint Filler: Potable water approved pre-coated, pre-formed, pre-compressed self-expanding joint system specifically designed for use with compressed expanding foam joint filler (waterproof).
  .1 Acceptable Product for interior of tunnel and below grade elements: 'DSM System' by Sika Emseal.
  .2 Acceptable Product for liquid retaining structures: 'Submerseal' by Sika Emseal.
  .3 Manufacturer to select sealant system appropriate to the movement, head pressure and design requirements at each joint location that meet the project Specifications.
.4 Depth of seal as recommended by manufacturer.

2.2 WATERSTOPS

.1 All waterstops and accessories shall be NSF 61 approved.

.2 Provide factory made fabrications for all changes of direction, intersections and transitions.

.3 Provide grommets, pre-punched holes, or hog rings spaced at 300 mm on center along length of waterstop.
  .1 PVC waterstops:
    .1 Construction Joints:
      .1 Urethane PVC Waterstops to CGSB 41-GP-35M (Withdrawn), 152 mm x 9.5 mm flat ribbed profile, unless otherwise noted on Drawings.
      .2 Acceptable Product: 'Item #679' by Sika Greenstreak.
    .2 Expansion Joints:
      .1 Urethane PVC Waterstops to CGSB 41-GP-35M (Withdrawn), 230 mm x 9.5 mm ribbed with 25 mm center bulb, unless otherwise noted on Drawings.
      .2 Acceptable Product: 'Item #735' by Sika Greenstreak.

.4 Hydrophilic Waterstops:
  .1 Sealing Material – construction joints for water retaining and below grade joints. Acceptable Products: 'Hydrotite' by Sika, 'Hydrotite CJ-0725' by MME Multiurethanes Ltd.
  .2 Urethane waterstop hydrophilic sealing material adhesive. Adhesive used for construction joint waterstop and sealant in accordance with manufacturer's published recommendations. Acceptable Product: 'Leakmaster' by MME Multiurethanes Ltd.

2.3 UNDERSLAB SLIP SHEET

.1 (1)-15 mil thick polyethylene sheet(s) designed to perform as a slip sheet to minimize friction and restraint exerted by the subgrade. Acceptable Product: 'Perminator' by W.R. Meadows, 'Stego Wrap' by Stego Industries, or approved alternate.

2.4 VAPOUR RETARDERS, AIR BARRIERS AND AIR-VAPOUR BARRIERS

.1 Refer to Division 07 for vapour retarders, air barriers and air-vapour barriers.

2.5 NON-SLIP STAIR AND LANDING INSERTS

.1 Cast-in place:
- .1 Base of heat-treated extruded aluminum alloy, abrasive filler to be a mixture of aluminum oxide and silicon carbide granular in epoxy matrix, abrasive shall project a minimum of 1.5 mm above finished surface.
- .2 Colour to be selected by Consultant from manufacturer's full product line.
- .3 Acceptable Products: 'Type R-315P' by Balco Inc., 'Type 231BF Supergrit Safety Treads' by Wooster Products Inc., or approved alternate.

.2 Retro Fit/Surface applied.
- .1 Single component stair nosings with ribbed abrasive and concrete screws. Mill finish aluminum extrusions, AA-M10. All surfaces in contact with masonry or concrete shall be protected by a factory-applied coating.
- .2 Colour to be selected by Consultant from manufacturer's full product line.
- .3 Acceptable Products: 'Type RS-405L' by Balco Inc., 'Type 333-FT' by Wooster Products Inc., or approved alternate.

PART 3 - EXECUTION

3.1 JOINTS IN SLAB ON GRADE CONSTRUCTION

.1 Isolation joints:
- .1 Isolation joints shall be located as shown on the Drawings.
- .2 Isolation joint filler shall be cut to fully penetrate the depth of the joint and accommodate the thickness of sealant, where applicable. Isolation joint material shall not extend above the top of the slab.

.2 Contraction Joints:
- .1 Contraction joints shall be located as shown on the structural Drawings.
- .2 Unless otherwise indicated on Drawings, divide interior slabs-on-grade into panels not exceeding 16 m² in area of 4 m in length by means of construction joints or contraction joints as detailed on Drawings. Aspect ratio of panels shall not exceed 1:1.5 maximum.
  - .1 Early entry saw cutting of joints shall be performed within the first one (1) or two (2) hours of finishing, and before final set to minimize the risk of random cracking.

.3 Fill all contraction joints with an approved control joint filler and sealant.

.4 Construction Joints:
- .1 Construction joints shall be located and detailed as shown on the structural Drawings.
- .2 Provide 16 mm diameter by 900 mm long smooth steel rods at [400 mm centres across joint at mid-height. Grease or wrap rod to prevent bond on one side of joint or install into smooth dowel cap as specified in Section 03200 – Concrete Reinforcement.
- .3 Contractor shall wait a minimum of 72 hours prior to pouring adjacent sections.
- .4 Fill construction joints with an approved joint sealant.

3.2 CONSTRUCTION JOINTS IN OTHER NON-LIQUID RETAINING ELEMENTS

.1 Construction joints shall be located so as not to impair the structural integrity of the finished structure and shall be reviewed and accepted by the Consultant.

.2 Horizontal joints shall occur at the same elevation on all visually related surfaces.

.3 Prepare all existing concrete surfaces in accordance with CAN/CSA-A23.1. All laitance and foreign matter shall be removed and the surface roughened to an amplitude of 5 mm, unless noted otherwise. A Concrete Surface Profile (CSP) 6 is considered acceptable.

.4 Unless noted otherwise, reinforcement shall be continuous through construction joints.

.5 Construction joints in foundation raft and suspended slabs restrained by connecting walls:

.1 Place slabs in alternate strips with the larger dimension of any single placement no greater than 15,000mm.

.2 Locate construction joints in suspended slabs near the quarter-point of the spans of slabs and beams, unless indicated otherwise on the Drawings. If a beam intersects a girder at this location, offset the construction joint in the slab and girder by a distance equal to two (2) times the width of the beam.

.6 Construction joints in girders and beams:

.1 Construct concrete beams and suspended slabs monolithically, unless indicated otherwise on the Drawings.

.2 Locate construction joints near the quarter-point of the spans of beams and girders, unless otherwise noted on the Drawings.

.3 Horizontal construction joints subject to approval of Consultant. Shear key and additional inclined shear reinforcing steel will be required at no cost to the Owner.

.7 Construction joint in walls:

.1 Locate construction joints in walls no less than 2 m minimum away from junction of two or more walls, a column or beam supported on wall, nearest edge of an opening wider than 600 mm, and a construction joint in abutting slab construction.

.2 Place wall in alternate portions with a distance between vertical construction joints not exceeding 12 m. Horizontal construction joints shall not exceed 6 m.

.8 Construction joints in columns:

.1 Column capitals, haunches, drop panels, and brackets should be placed monolithically with the slab.

.9 The Contractor is to make their own assessment and provide construction joints as required to suit their own sequence of work.

.10 Contractor shall wait a minimum of 72 hours prior to pouring adjacent sections.

.11 All construction joints in elements that intercept wet and dry areas to include PVC waterstops and elastomeric joint sealant.

3.3 CONSTRUCTION JOINTS IN LIQUID RETAINING ELEMENTS

.1 In addition to the Construction Joint requirements listed above for other non-liquid retaining elements, the following more stringent limits shall apply for construction joints in elements forming part of a liquid retaining structure.

.2 Construction joints in foundation raft and suspended slabs restrained by connecting walls:

.1 Place slabs in alternate strips with the larger dimension of any single placement no greater than 10 m.

.3 Construction joint in Walls:

.1 Place wall in alternate portions with a distance between vertical construction joints not exceeding 10 m.

.4 Construction joints between walls and slab:

.1 Place starter wall as indicated.

.5 All construction joints in liquid retaining structures to include PVC waterstops and elastomeric joint sealant.

3.4 EXPANSION JOINTS

.1 Contractor to provide properly formed and prepared expansion joint openings constructed to the exact dimensions and elevations shown on manufacturer's standard system drawings or as shown on the Contract Drawings. Deviations from these dimensions will not be allowed without the written consent of the Consultant.

.2 Prepared joint shall be cleaned of all contaminants immediately prior to installation of the expansion joint system. Repair spalled, irregular or unsound joint surface prior to installation. Ensure joint sides are smooth. Ensure sufficient joint depth to receive the full depth of the size of the expansion joint being installed.

.3 Refer to manufacturer's guidelines for installation.

.4 No drilling, screwing or fasteners of any type are permitted to anchor the sealant system into the substrate.

.5 System to be installed by qualified sub-contractors according to published installation procedures and/or in accordance with job-specific installation instructions of manufacturer's representatives.

.6 Protect the expansion joint system and its components during construction. Damage to be repaired at Contractor's expense. Clean exposed surfaces with a suitable cleaner that will not harm or attach the finish.

3.5 WATERPROOFING OF EXPANSION JOINTS

.1 Contractor to have representative of expansion joint manufacturer on site for initial installation of expansion joint waterproofing systems to verify application.

.2 Contractor to have representative of expansion joint manufacturer on site to verify installation and curing of expansion joint waterproofing system and confirm suitability for intended use.

3.6 WATERSTOPS

.1 Use cast-in-place PVC waterstops for new concrete applications unless noted otherwise.

.2 Use of hydrophilic waterstops not shown on Drawings is subject to Consultant approval.

.3 Center waterstops on wall and/or slab unless noted otherwise.

.4 Install in strict accordance with manufacturer's published installation instructions.

.5 Waterstops to be securely tied in place to avoid movement during concrete placement. Wet setting of waterstops is not permitted.

.6 All transitions, intersections and splices shall be heat welded to maintain continuity. Lap splices are not permitted.

3.7 UNDERSLAB SLIP SHEET

.1 Install underslab slip sheet below all interior slabs on grade that do not have a vapour retarders, air barrier or air-vapour barrier.

.2 Puncture sheets to allow water to drain.

.3 Install in strict accordance with manufacturer's published installation instructions.

3.8 NON-SLIP STAIR AND LANDING INSERTS

.1 Unless otherwise noted, install non-slip inserts, one per tread and landing.

.2 Install in accordance with manufacturer product installation instructions (MPII).

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International):
- .1 CAN/CSA A82, Fired Masonry Brick Made From Clay or Shale.
- .2 CAN/CSA-A165 SERIES, Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
- .3 CAN/CSA-A179, Mortar and Grout for Unit Masonry.
- .4 CAN/CSA A370, Connectors for Masonry
- .5 CAN/CSA A371, Masonry Construction for Buildings.
- .6 CSA S304, Design of Masonry Structures.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets as required by other Sections within Division 04 and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit a copy of Workplace Hazardous Materials Information System (WHMIS) - Safety Data Sheets (SDS) in accordance with Division 01.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada detailing temporary bracing required to resist wind pressures and lateral forces during installation. Design and installation of temporary bracing shall be in accordance with CSA A371 including Annex B.
- .2 Submit Shop Drawings as required by other Sections within Division 04.

.4 Samples: Provide samples as required by other Sections within Division 04.

.5 Workplan: Provide plan drawings showing intended sequence of masonry construction along with an approximate timeline.
- .1 Workplan will be used as the basis for preliminary planning of Consultant third party reviews but will not replace notification by Contractor.

.6 Certificates: Submit manufacturer's Product certificates certifying materials comply with specified performance characteristics and criteria and physical requirements.

.7 Test and Evaluation Reports:
- .1 Submit certified test reports in accordance with Division 01.
- .2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
- .3 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.

.8 Installer Instructions: Submit manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Provide manufacturer's instructions in accordance with Division 01 covering care, cleaning and maintenance requirements along with parts catalogue, with cuts and identifying numbers.

1.4 QUALITY ASSURANCE

.1 Contractor Qualifications:
- .1 Manufacturer: Company specializing in work of this Section with minimum of ten (10) years of experience supplying materials conforming to the reference standards within Division 04.
  - .1 Manufacturers to be capable of providing field service representation during construction and approving application method.
- .2 Installer: Company and personnel specializing in work of this Section with minimum of five (5) years of experience with work similar to this project.
  - .1 Installers employed on this project must demonstrate ability to reproduce mock-up standards.
- .3 Masons: Company and personnel specializing in masonry installations with minimum of ten (10) years experience with load bearing industrial masonry work similar to this project (wastewater treatment plants and/or post disaster structures).
  - .1 Masons employed on this project must demonstrate ability to reproduce mock-up standards.

.2 Mock-ups:
- .1 Construct mock-ups in accordance with Division 01.
- .2 Construct mock-up panels of exterior walls, as applicable, to demonstrate complete masonry wall assembly. The mock-up panel shall be 1200 mm long x 1800 mm tall showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, pointing, coursing, grouting, mortar and workmanship. Work with other trades to provide a mock-up of critical wall details.
- .3 Mock-up used:
  - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .4 Construct mock-up in location designated by Consultant.
- .5 Allow ten (10) Working Days for review of mock-up by Consultant before proceeding with work under this Section.
- .6 When accepted by Consultant, mock-up will demonstrate minimum standard for this work and shall be left on-site until all masonry work is complete. Mock-up may not remain as part of finished work to the approval of the Consultant.

.3 Pre-installation meetings: Comply with Division 01. Conduct pre-installation meeting one (1) week prior to commencing masonry works.
- .1 Ensure key personnel, site supervisor, Owner, Consultant, Masonry foreman/superintendent, and materials testing agent attend.
- .2 Purpose of the meeting is to:
  - .1 Verify project requirements, including:
    - .1 Types of construction (i.e. loadbearing, non-loadbearing, interior, exterior, fire ratings, etc.).
    - .2 Mock-ups.
    - .3 Hot and Cold weather protection procedures.
    - .4 Grouting procedures (low lift and/or high lift).
    - .5 Consultant review.
    - .6 Materials Testing.
  - .2 Discuss substrate conditions.
  - .3 Coordinate Products, installation methods and techniques.

.4 Sequence work of related Sections.
.5 Coordinate with other building subtrades.
.6 Review manufacturer's installation instructions.
.7 Review masonry cutting operations, methods and tools including dust mitigation.
.8 Review warranty requirements.

.4 Sequencing: Sequence with other work in accordance with Division 01. Comply with manufacturer's written recommendations for sequencing construction operations.

.5 Site Reviews by Consultant:
.1 The Consultant will review the work on site and prepare appropriate record of observations for the Owner.
.2 Notify the Consultant a minimum of seven (7) Working Days in advance of commencing masonry work on each building.
.3 Supply all necessary cooperation to facilitate Consultant site reviews.

1.5 TESTING

.1 Inspection and testing will be carried out by Independent Testing & Inspection Agency designated by Owner.
.1 Refer to Division 01 for payment.
.2 Notify inspection agency minimum of 48 hours in advance of requirement for tests.

.2 Refer to Section 04051 - Masonry Mortar and Grout for prequalification, pre-construction and construction testing requirements for mortar and grout.

.3 Refer to Section 04220 - Concrete Unit Masonry for testing requirements for masonry units.

.4 Submit laboratory testing results within five (5) Working Days of completing test.

1.6 EXTRA MATERIALS

.1 Provide an additional ten (10) of each type and size of brick unit for use by the Owner.

.2 Deliver and store where directed by Owner.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01.

.2 Keep materials dry until use except where wetting of clay bricks is specified by the manufacturer.

1.8 COLD WEATHER CONSTRUCTION

.1 When the ambient temperature is less than 5°C, all masonry construction shall be completed in accordance with the cold weather construction requirements of CSA A371 and as follows.
.1 Maintain records of ambient temperatures and document preventative measures taken to satisfy the project requirements.

.2 Materials to arrive at job site dry and be stored in a manner that prevents wetting. Do not wet masonry units in cold weather construction.

.3 Masonry units:

.1 The minimum temperature of the unit when laid shall not be less than 4°C.

.4 Mortar:

.1 Heat constituent materials used in mortar to achieve mortar that exhibits similar properties to mortar mixed in normal temperatures.

.2 Do not overheat and place at less than 50°C to avoid flash setting.

.5 Grout:

.1 Minimum grout temperature at time of placement to be 20°C.

.2 Reduce batch size as required to suit the above-noted temperature requirements and workability of the material.

.6 During construction, protection requirements are determined as indicated in Table 1, below, based on the air temperature.

.7 When work is stopped even for a short period, the top surface of the wall should be covered, and the cover should extend a minimum of 1 m down each side.

Table 1: General Heating and Protection Requirements During Construction

Air Temperature, °C	General Requirements During Construction
-4 to 4	Mortar shall have a minimum temperature of 4°C and a maximum temperature of 50°C
-7 to -4	1) Mortar shall have a minimum temperature of 4°C and a maximum temperature of 50°C 2) Source heat shall be provided on **BOTH** sides of walls under construction 3) Windbreaks shall be employed when wind is in excess of 25 km/h
-7 and below	1 Mortar shall have a minimum temperature of 4°C and a maximum temperature of 50°C 2) Enclosures and supplementary heat shall be provided to maintain an air temperature above 0°C

.8 Upon completion of the construction (i.e., at the end of the day, or when the wall is finished) the protection requirements are outlined in Table 2, below, where the mean temperature for a day is measured by adding the maximum and minimum temperature for that day (24 period, midnight to midnight) and dividing by two.

Table 2: Protection Required Upon Completion of Construction

Mean Daily Air Temperature, °C	Protection Required Upon Completion and Construction
0 to 4	Masonry shall be protected from rain or snow for 48 hours
-4 to 0	Masonry shall be completely covered for 48 hours
-7 to -4	Masonry shall be completed covered with insulating blankets for 48 hours
-7 and below	The masonry temperature shall be maintained above 0°C for 48 hours by enclosure and supplementary heat

1.9 HOT WEATHER CONSTRUCTION

.1 When the ambient temperature is greater than 32°C all masonry construction shall be completed in accordance with the hot weather construction requirements of CSA A371 and as follows.

.2 Take precautions to prevent excessive moisture loss and loss of workability in materials during hot weather including limiting the mortar spreading rate.

.3 Protect freshly laid masonry from drying too rapidly by means of waterproof, non-staining coverings.

.4 Refer to 04051 – Mortar and Grout for additional restrictions on batch time prior to placement.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Refer to other Division 04 Sections for Masonry materials.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Prior to commencing work of this Section, examine existing conditions in accordance with Division 01.

.2 Verification of Existing Conditions:

.1 Verify that:

.1 Substrate conditions which have been previously installed under other Sections or Contracts, are acceptable for Product installation in accordance with manufacturer's instructions prior to installation of masonry.

.2 Field conditions are acceptable and are ready to receive work.

.3 Built-in items are in proper location, and ready for roughing into masonry work.

3.3 PREPARATION

.1 Prepare surface in accordance with manufacturer's written recommendations and coordinate with Division 01.

.2 Establish and protect lines, levels, and coursing.

.3 Protect adjacent materials from damage and disfiguration.

.4 Do not commence erection of building superstructure until concrete substructure has achieved at least 70% of specified concrete strength in field curing, but not less than 7 days. Staged construction has not been considered in the design of the finished structure.

3.4 CONSTRUCTION

.1 All masonry construction accordance with CSA-A371.

.2 Build masonry plumb, level, and true to line, respecting construction tolerances permitted by CSA-A371.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimal cutting.

.4 The approved mock-up shall establish the standard of acceptance for workmanship.

.5 Do not use masonry units, with chips, cracks, broken corners, excessive colour and texture variation as specified in CAN/CSA A165 and CAN/CSA A82 and as per approved range of colour samples. Units shall be representative of those used in the mock-up.

.6 Coursing Height:
- .1 Masonry veneer Refer to Architectural drawings.
- .2 Concrete unit masonry: 200 mm for one block and one joint.

.7 Special Shapes:
- .1 Install bullnose block to the following locations unless otherwise indicated:
  - .1 All exposed interior wall corners, including interior face of exposed exterior wall corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
  - .2 All exposed partial height wall caps.
  - .3 Window sills.
  - .4 Exposed concrete block at window and door jambs exceeding 100 mm / 4” in depth.
- .2 Provide purpose-made shapes for lintels, beams, and bond beams with reduced webs, sawcut stretcher units with reduced webs, or U-lintel units with sawcut or otherwise notched bottom faces to permit continuity of vertical reinforcement and grout.

.8 Bonding:
- .1 Install masonry in running bond unless noted otherwise.
- .2 Hollow or Semi-Solid Units: Spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness.
  - .1 Cut and cradle excess mortar and keep the cavity clear in brick veneer.
  - .2 Keep cells clear of mortar in hollow block.
- .3 Solid Units: Apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .4 Ensure compacted head joints. Use full or face-shell joint as indicated. Full joints to be buttered on all four sides and laid so that head joints and bed joints are formed at the same time.
- .5 Lay unit to ensure full bond with the mortar.
- .6 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean, and reset units in new mortar.
- .7 Tool joints when the mortar is ‘thumbprint’ hard.
- .8 Do not interrupt bond below or above openings.

.9 Where it becomes necessary for construction purposes to stop-off a horizontal run of masonry, this shall be done only be racking back each course, and, if grout is used, by stopping the grout no less than 100 mm back of the rack. Toothing shall not be permitted without approval from the Consultant.

.9 Jointing:

.1 Concave Joints:

.1 Allow joints to set just enough to remove excess water (thumbprint hard), then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints, where concave joints are indicated.

.10 Cutting:

.1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

.3 Do not cut reinforced and grouted cells.

.4 Do not overcut.

.11 Building-In:

.1 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors inserts, sleeves and conduits.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar and embed anchors.

.4 Fit masonry closely against electrical and plumbing outlets so collars, plates, and covers overlap and conceal cuts.

.12 Wetting of Bricks:

.1 Concrete and calcium silicate (sand-lime) units shall never be wetted before or during laying unless recommended by the manufacturer.

.2 When the initial rate of absorption of a fired clay brick js greater than 30g/min/194cm^2, the recommendations of the manufacturer or the specified procedure for wetting of units shall be followed.

.3 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

.13 Provision for Movement:

.1 Leave 10 mm space below shelf angles.

.2 Leave 25 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.3 Built masonry to tie in with lateral support details, with provision for vertical movement.

.14 Control Joints:

.1 Construct continuous vertical control joints in brick veneer as indicated and at the following locations, unless noted otherwise:

.1 At maximum 7.6 m centre to centre spacing in panels without openings.

.2 At maximum 6.1 m centre to centre spacing in panels with window and/or door openings.

.3 Position control joints 1 m from corners, at changes in wall height, and above window/door jambs.

.2 Install continuous joint fillers in control joints at locations indicated.

.3 Apply joint sealant in control joint, in accordance with Section 07920 - Joint Sealants.

.1 Joint sealant colour to match mortar colour.

.2 Tool joint sealant to a smooth finish to match mortar joint.

.15 Movement Joints:

.1 Construct continuous vertical movement joints in concrete block masonry walls as indicated and at the following locations, unless noted otherwise:

.1 In loadbearing walls as indicated.

.2 In interior non-loadbearing concrete block masonry walls at a maximum of 7.2 m centre to centre spacing and not closer than 600 mm from openings and corners, unless otherwise noted.

.3 At locations between walls on foundations and walls on thickened slabs on grade.

.2 Install continuous joint fillers in movement joints at locations indicated.

.3 Apply joint sealant in movement joint, in accordance with Section 07920 - Joint Sealants.

.1 Joint sealant colour to match mortar colour.

.2 Tool joint sealant to a smooth finish to match mortar joint.

.16 Lintels:

.1 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

.1 Install special shaped units as necessary.

.2 Refer to Drawings for lintel size and details.

.2 Loose Steel Lintels:

.1 Install loose steel lintels centered over opening width, unless otherwise noted.

.2 Minimum bearing shall be 200 mm at each end on solid/grouted masonry, unless otherwise noted.

.3 Refer to Drawings for lintel size and details.

3.5 SITE TOLERANCES

.1 Tolerances in notes to CSA-A371 apply.

3.6 PATCHING AND REPAIRS

.1 In general, repair or replace all masonry construction that fails to meet the project requirements including the minimum standards for workmanship and materials determined by the mock-up. The following will be required as a minimum:

.1 Patch damaged masonry walls that have been rejected.

.2 Point all holes in mortar joints except weep holes.

.3 Point all voids in concrete unit masonry faces.

.4 Repoint defective mortar joints per CSA A371 and as follows:

.1 Rake mortar joints square at the back of the joint to a depth of 2 to 2.5 times the joint thickness.

.2 Remove mortar from both surfaces of the adjacent masonry and all loose material.

.3 Saturate the joints with clean water and, after the free surface water has been absorbed, fill and compact with a mortar compatible with the unit and existing mortar.

.2 Notwithstanding the above, the Consultant may elect for the Contractor to prepare a written repair procedure depending on the nature and extent of the non-conforming work.

3.7 CLEANING

.1 Clean in accordance with Division 01.

.2 Progress Cleaning: In accordance with related masonry Sections.

.3 Final Cleaning:

.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.1 Use only detergents, or proprietary masonry cleaners as recommended by the manufacturer.

.2 Use non-metallic tools in cleaning operations.

.3 Remove excess mortar and mortar smears without degrading mortar bond integrity.

.2 Upon completion of installation and verification of performance of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.8 TEMPORARY BRACING

.1 Temporary Bracing:

.1 Provide temporary bracing of masonry work during and after erection for anticipated loading in accordance with CSA A371 until permanent lateral support is in place.

.2 Provide temporary support for masonry beams and lintels until they have adequately cured to resist dead and construction loads.

.3 Install bracing in accordance with approved Shop Drawings.

3.9 PROTECTION

.1 Moisture Protection:

.1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.

.2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

.3 Air Temperature Protection: Protect completed masonry as required by Cold Weather Construction and Hot Weather Construction requirements identified in PART 1 of this Section.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International):
- .1 CSA A23.1 / A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CAN/CSA A179, Mortar and Grout for Unit Masonry.
- .3 CAN/CSA A371, Masonry Construction for Buildings.
- .4 CAN/CSA S304, Design of Masonry Structures.
- .5 CSA-A3000, Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014), Update No. 3 (2014).

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Refer to Section 04050 – Common Work Results for Masonry.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Division 1.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for masonry mortar and grout and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Confirmation of material sources for all constituent materials.
- .3 Submit Workplace Hazardous Materials Information System (WHMIS) - Safety Data Sheets (SDS) in accordance with Division 01.

.3 Samples:
- .1 Provide two (2) samples of cured mortar in size as requested by Consultant.

.4 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions.

.5 Test Reports:
- .1 Submit certified test reports in accordance with Division 01 and 04050 – Common Work Results for Masonry.
- .2 Test reports to include sand gradation tests in accordance with CAN/CSA A179 showing compliance with specified performance characteristics and physical properties.
- .3 Test reports to include prequalification, pre-construction and construction test results as specified in this Section.

.6 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 QUALITY ASSURANCE

.1 Quality Assurance in accordance with 04050 – Common Work Results for Masonry.

1.5 TESTING

.1 Testing in accordance with CSA A179 and Division 01.

.2 Construction Testing:
- .1 Compressive Strength testing (mortar cube):
  - .1 For concrete block and hollow brick masonry:
    - .1 For a project having 500 m^2 or more of block or hollow clay brick masonry complete a test for each 500 m^2 or portion thereof.
    - .2 For a project having less than 500 m^2 of block or hollow clay brick masonry complete a test for each 250 m^2 or portion thereof.
  - .2 For brick masonry:
    - .1 For a project having 250 m^2 or more of brick masonry complete a test for each 250 m^2 or portion thereof.
    - .2 For a project having less than 250 m^2 of brick masonry complete a test for each 125 m^2 or portion thereof.
- .2 Compressive strength testing (grout cylinder):
  - .1 For a project having 20 m^3 or more of grout complete a test for each 20 m^3 or portion thereof.
  - .2 For a project having less than 20 m^3 of grout complete a test for each 10 m^3 or portion thereof.
  - .3 Perform a slump test at the same time as each grout compressive strength test.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01, CSA A179, Section 04050 - Common Work Results for Masonry, and with manufacturer's written instructions.

1.7 SITE CONDITIONS

.1 Refer to 04050 - Common Work Results for Masonry for ambient conditions under which the work must be performed.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Use same brands of materials and source of aggregate for entire project.

.2 Cement:
- .1 Portland Cement: To CAN/CSA-A3000, Type GU – General use hydraulic cement (Type 10)
  - .1 Gray colour.
  - .2 Use low VOC Products.

.2 Masonry Cement: To CAN/CSA-A3002 and CAN/CSA-A179.
  .1 Use low VOC Products.
.3 Mortar Cement: To CAN/CSA-A3002 and CAN/CSA-A179.
  .1 Use low VOC Products.
.4 Packaged Dry Combined Materials for mortar: To CAN/CSA-A179 using gray colour cement.

.3 Aggregate: Supplied by one supplier:
  .1 Fine aggregate to CAN/CSA A179.
  .2 Coarse aggregate to CAN/CSA A179 crushed stone or gravel.

.4 Water: Clean to CSA A179.

.5 Lime:
  .1 Quick Lime: To CAN/CSA A179.
  .2 Hydrated Lime: To CAN/CSA A179.

.6 Bonding Agent: Latex or Epoxy type.

.7 Polymer Latex: Organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2 ADMIXTURES

.1 Admixtures may only be used in mortar and grout where approved by the Consultant and will require pre-qualification and pre-construction testing in accordance with Annex B of CSA A179.

2.3 MORTAR MIXES

.1 Mortar to CAN/CSA A179.

.2 Mortar for interior/exterior masonry above grade:
  .1 Loadbearing: Type S.
  .2 Non-Loadbearing: Type S.
  .3 Acceptable Product: ‘Masonry Cement (Type S)’ by St. Mary’s Cement (CBM Aggregates), ‘Mortar Mix (Type S)’ by Sakrete, ‘King Block (Type S)’ by Sika Canada.

.3 Coloured mortar: Use coloured mortar for brick veneer masonry only. Use colouring admixture not exceeding 10% of cement content by mass or integrally coloured masonry cement, to produce coloured mortar to match approved sample.
  .1 Acceptable manufacturer: Solomon Colours or approved alternate.
  .2 Mortar pigments: SGS Concentrated A, H, and X Series Mortar Colours.
    .1 Colour: As later selected by Consultant from manufacturer’s complete colour range.
    .2 Incorporate colour and admixtures into mixes in accordance with manufacturer’s instructions.
    .3 Material: Natural and synthetic, milled, blended iron oxides.
    .4 Carbon added for darker colours shall not exceed 4 percent.
    .5 Produce uniform and consistent colour.
    .6 Inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, lime proof, and nonbleeding.
    .7 Free of deleterious fillers and extenders.

.8 Particle Size: 95 to 99 percent minus 325 mesh.
.9 pH: 6.5 to 9.0.
.10 Compliance: ASTM C979.
.11 Tests: ASTM C91 and ASTM C270. Exceed 1,800 psi / 12.4 kPa at 28 days strength requirement.

.4 Stain Resistant Pointing Mortar: One part Portland cement, 1/8-part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate to 2 percent of Portland cement by weight.

2.4 MORTAR MIXING

.1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to within 1% accuracy.

.2 Mix mortar ingredients in accordance with CAN/CSA A179 in quantities needed for immediate use.

.3 Maintain sand uniformly damp immediately before mixing process.

.4 Add mortar colour in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.

.5 Using anti-freeze compounds including calcium chloride or chloride-based compounds is prohibited.

.6 Adding air entraining admixture to mortar mix is prohibited.

.7 Use a batch type mixer in accordance with CAN/CSA A179.

.8 Pointing mortar: Prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

.9 Re-temper mortar only within its useful life in accordance with CSA A179, when water is lost by evaporation.

2.5 GROUT MIXES

.1 To CSA A179: Slump 200-275 mm.
  .1 Acceptable Product: 'Masonry Cement' by St Mary's Cement (CBM Aggregates), 'King CELLFILLER C-20' by Sika Canada, or approved alternate.

.2 Fine grout shall be used in all grout spaces where the least dimension is less than 50 mm / 2".
  .1 Acceptable Product: 'Masonry Cement' by St Mary's Cement (CBM Aggregates), 'King CELLFILLER E-20' by Sika Canada, or approved alternate.

2.6 GROUT MIXING

.1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 transit mixed.

.2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA A179.

.3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.

.4 Using calcium chloride or chloride-based admixtures is prohibited.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine as per Section 04050- Common Work Results for Masonry.

3.2 PREPARATION

.1 Prepare as per Section 04050- Common Work Results for Masonry.

.2 Apply bonding agent to existing concrete surfaces.

.3 Clean debris from cores and plug clean-out holes with block masonry units.

.4 Brace masonry for wet grout pressure.

3.3 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.4 CONSTRUCTION

.1 Do masonry mortar and grout work in accordance with CAN/CSA A179, CSA A371 and manufacturer’s instructions.

.2 Take precautions for Hot Weather Construction and Cold Weather Construction as per CSA A371 and Section 04050 - Common Work Results for Masonry.

3.5 MIXING

.1 Mortar and grout shall be mixed using a mechanical batch mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes.

.2 Clean all mixing boards and mechanical mixing machine between batches.

.3 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.6 MORTAR PLACEMENT

.1 Install mortar to CAN/CSA A371, manufacturer's instructions and Section 04050 - Common Work Results for Masonry.

.2 Remove excess mortar from grout spaces.

.3 Bed and Head joints:

.1 The constructed thickness of the first mortar bed joint at the base of the unit masonry built on a non-masonry element shall be from 6 mm to 20 mm / 1/4” to 3/8”, except that for masonry veneer built on shelf angles or lintels, the constructed thickness shall be from 0 mm to 13 mm / 0” to 1/2".

.2 Mortar bed and head joints other than the first mortar bed joint shall have a thickness of 10 mm / 13/32” +/- 3 mm / 1/8”.

.4 Mortar manufactured at the job site shall be used and placed in final position within 2.5 hrs after mixing.

.1 When the air temperature is 25°C this limit shall be reduced to 1.5 hrs.

.5 Mortar manufactured off-site shall be used and placed in final position within a period not exceeding the useful life specified by the manufacturer.

3.7 GROUT PLACEMENT

.1 Install grout to CAN/CSA A371, manufacturer's instructions and Section 04050 - Common Work Results for Masonry.

.2 Install grout screen below voids to be filled with grout; keep screens 25 mm / 1” back from faces of units.

.3 Work grout into masonry cores and cavities to eliminate voids.

.4 Do not install grout in lifts greater than 400 mm / 16”, without consolidating grout by rodding.

.5 Place grout in lifts of not more than 1.5 m / 5’ following the low-lift procedure.

.6 Where approved by Consultant grout placement may follow the high-lift procedure as per CAN/CSA A371 and as follows:

.1 For each grout pour, cleanout openings shall be provided in the bottom course of masonry for all cells containing reinforcement.

.2 All cells containing reinforcement and all other cells and voids that need to be grouted shall be completely filled with grout in lifts not exceeding 3 m / 10’, except that where the total grout pour is higher than 3 m / 10’, the grout shall be placed in lifts not exceeding 2 m / 6’-6”.

.7 Do not displace reinforcement while placing grout.

.8 Grout manufactured at the job site shall be used and placed in final position within 1.5 hrs after mixing.

.9 Grout manufactured off-site shall be used and placed in final position within a period not exceeding the useful life specified by the manufacturer.

3.8 FIELD QUALITY CONTROL

.1 Consultant review in accordance with Section 04050 - Common Work Results for Masonry.

.2 Test and evaluate mortar prior to construction and during construction in accordance with CAN/CSA A179.

.3 Test and evaluate grout prior to construction and during construction in accordance with CAN/CSA A179.

3.9 CLEANING

.1 Clean in accordance with Division 01 and Section 04050 – Common Work Results for Masonry supplemented as follows:

.2 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Remove droppings and splashings using clean sponge and water.

.3 Clean masonry with low pressure clean water and soft natural bristle brush.

.3 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01.

3.10 PROTECTION

.1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International Inc.:
- .1 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
- .2 ASTM A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .3 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .4 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .5 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .6 ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .7 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .8 ASTM A580/A580M, Standard Specification for Stainless Steel Wire.
- .9 ASTM A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- .10 ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .11 ASTM A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- .12 ASTM A1008/A1008M, Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

.2 Canadian Standards Association (CSA International):
- .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .2 CSA A23.3, Design of Concrete Structures.
- .3 CSA A82, Fired masonry brick made from clay of shale.
- .4 CSA A165 Series, CSA Standards on concrete masonry units.
- .5 CAN/CSA A179, Mortar and Grout for Unit Masonry.
- .6 CSA-A370, Connectors for Masonry.
- .7 CAN/CSA A371, Masonry Construction for Buildings.
- .8 CSA G30.1.8, Carbon Steel Bars for Concrete Reinforcement.
- .9 CSA G40.21, Structural Requirements for Rolled or Welded Structural Quality Steel.
- .10 CSA S304, Design of Masonry Structures.
- .11 CSA W186-M, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC):
- .1 Reinforcing Steel Manual of Standard Practice.

1.2 SECTION INCLUDES

.1 This Specification is intended to cover the design of masonry connectors which includes the following:
- .1 Ties used to interconnect the wythes of a masonry wall or attach masonry veneer to its structural backing.

.2 Anchors used to connect masonry walls to intersecting walls or to other structural members.

.3 Fasteners used to secure a masonry tie or anchor to a structural member, or to interconnect components of a multi-component tie or anchor.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Refer to Section 04050 - Common Work Results for Masonry.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed Product literature, and data sheets for connectors and reinforcing materials and include Product characteristics, performance criteria, physical size, finish, and limitations.

.2 Submit copy of Workplace Hazardous Materials Information System (WHMIS) - Safety Data Sheets (SDS).

.3 Source Quality Control:

.1 Provide Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis.

.2 Upon request inform Consultant of proposed source of material to be supplied.

.4 Shop Drawings:

.1 Connectors:

.1 Submit Shop Drawings showing horizontal and vertical spacing of connectors as listed herein.

.1 Indicate horizontal and vertical spacing of cavity wall reinforcement and ties to suit application and to Ontario building code requirements for wind and seismic hazard requirements.

.2 On placement drawings, indicate sizes, spacing, location, and quantities of each type of connector. Placement drawings shall be provided for each elevation.

.2 Reinforcing bars:

.1 Prepare reinforcing steel Shop Drawings in accordance with RSIC Manual of Standard Practice that conform to the drawings with respect to placement, quantity, and size of reinforcing steel bars.

.2 Shop Drawings shall contain the following information:

.1 Element location.

.2 Materials, grade and finishes of reinforcing.

.3 Sizes, spacings, lengths and locations of reinforcement, with identifying labels.

.4 Bar bending details.

.5 Length and location of all lap splices.

.6 Types and locations of mechanical couplers where approved by Consultant.

.7 Location of reinforcing steel within cell or course.

.8 Placement of reinforcement at all openings and joints.

.3 Detail to requirements of CAN/CSA-A23.1, CAN/CSA S304, CAN/CSA A371 and RSIC, Reinforcing Steel Manual of Standard Practice. Ensure adjustments are made in detailing of reinforcing steel for splices and development lengths. Splice lengths are to be modified to account for any reinforcement coatings (e.g., epoxy).

.4 Provide elevation drawings of all walls, piers, cross referenced to plan drawings and indicate bar size, spacing, laps, bends, etc. Provide drawings for each differing section of steel arrangement. Do not indicate various areas on one detail.

.5 Shop Drawings shall be in a single, complete set in order that all details may be read in conjunction with plans, elevations, and all other dependent details. Quantity and format of Shop Drawings are to be in accordance with Division 01. Reproduction of Contract Documents will not be acceptable as Shop Drawings.

.6 Shop Drawings shall correspond to each detail on drawing. Each wall to be separately listed. Bar lists, where provided, shall be reviewed only for general conformity, quantities are not checked in detail.

.7 All details and sections to be to a scale of not less than 1:25.

.8 The construction drawings show reinforcing steel placement for the project that shows the intent of reinforcing of masonry elements. These drawings can accomplish this description through the use of nomenclature such as similar and typical, indicating similar arrangements of reinforcing steel within masonry elements.

.9 The reinforcing steel Shop Drawings shall be of sufficient detail to allow for a clear understanding of the fabrication limits, quantity, and placement of all reinforcing steel on the project.

1.5 DESIGN RESPONSIBILITY

.1 Connectors within this section have been designed to satisfy the performance requirements of CSA A370.

1.6 QUALITY ASSURANCE

.1 Quality Assurance in accordance with Section 04050 – Common Work Results for Masonry.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle masonry anchorage and reinforcing materials in accordance with Division 01 and Section 04050 – Common Work Results for Masonry.

.2 Protect connectors and connector material from damage from bending, scratching, or contamination by oil or other foreign matter.

.3 Where the corrosion protection of a tie cannot be labelled or colour coded on its carton, cube or package, the tie or connector shall be colour coded to indicate its level of corrosion protection.

1.8 SUBSTITUTES

.1 Substitution of different size bars permitted only upon written approval of Consultant.

.2 Substitution of post-installed reinforcing steel dowels for specified cast-in dowels is permitted only upon written approval of Consultant and subject to the following conditions:

.1 The change, including all periodic and/or continuous inspection of drilling and adhesive installation, and all proof load testing shall be completed at no additional cost to the Owner.

.2 Dowels to be embedded to the depth shown on the Contract Documents or to a depth specified by the Consultant if these dowels terminate in standard hooks.

.3 The Contractor shall satisfy all requirements of Section 03150.

PART 2 - GENERAL

2.1 REINFORCING

.1 Reinforcing bars: To CSA G30.18, Grade 400W, deformed billet steel sourced from North American mills.

.2 Mechanical reinforcing connections (couplers) to suit application and subject to approval of Consultant.
- .1 Where permitted, shall develop in tension or compression as required, at least 120% of the specified yield strength, fy, of the bar, but not less than 110% of the actual yield strength of the bar used in the test of the welded splice.
- .2 Acceptable manufacturer: Dayton Superior, Erico, Barsplice.

.3 Horizontal Joint Reinforcement for Masonry Walls: To CSA A370.
- .1 Prefabricated ladder style joint reinforcement to suit block size.
- .2 Cold-drawn high tensile strength steel wire conforming to ASTM A82/A82M. Wire to be knurled.
- .3 Standard gauge: 3.7 mm / 9 ga. side rods x 3.7 mm / 9 ga. cross rods), unless otherwise noted on Drawings.
- .4 Provide prefabricated corners and tees at intersecting walls as specified on Drawings.
- .5 Corrosion Protection: Hot Dip Galvanizing to ASTM A123/A123M – 460 g/m^2.
- .6 Acceptable Product: '220 Ladder Mesh' by Hohmann & Barnard or approved alternate.

2.2 CONNECTORS FOR MASONRY VENEER

.1 Connectors: to CAN/CSA A370 and CSA-S304.

.2 Veneer Ties to New Masonry Back-up:
- .1 1.6 mm / 16 gauge thermal block corrugated plate connector complete with 4.76 mm / 3/16" diameter V-Tie and insulation support.
- .2 Acceptable Product: 'Fero Thermal Tie - Slotted Block Tie (Type 1)' by Fero Corp.
- .3 Size:
  - .1 To suit wall section. Refer to Drawings for wall assemblies.
  - .2 Length of Embedment in Block is 6 mm / 1/4" less than block width.
- .4 Finish: Stainless Steel
  - .1 Block Plate to ASTM A240, Type 304L.
  - .2 V-Tie to ASTM A580, Type 304.

.3 Veneer Ties to Structural Steel Back-Up:
- .1 16 gauge Corrugated Gripstay Anchor - complete with 14 gauge Gripstay Channel.
- .2 Acceptable Product: 'BL-364 Corrugated GripStay Anchor with BL-362-C Gripstay Channel' by Blok-Lok.
- .3 Size:
  - .1 To suit column section. Refer to Drawings for wall assemblies.
- .4 Finish: Stainless Steel.
  - .1 Channels to ASTM A580, Type 304.
  - .2 Anchor to ASTM E 437, Type 304.
  - .3 Fasteners: As noted above.

.4 Veneer Ties to Structural Metal Stud Back-Up:

.1 1.6 mm / 16 gauge thermal slotted L-Plate connector - holed complete with 4.76 mm / 3/16" dia. V-Tie and Insulation Support.

.2 Acceptable Product: 'Fero Thermal Tie – Slotted Rap-Tie Masonry Connector' by Fero Corp.

.3 Size:

.1 To suit wall section. Refer to Drawings for wall assemblies.

.4 Finish: Stainless Steel.

.1 Block Plate to ASTM A240, Type 240L.

.2 V-Tie to ASTM A580, Type 304.

.3 Fasteners: As noted above.

2.3 FABRICATION

.1 Fabricate reinforcing in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Fabricate connectors in accordance with CAN/CSA A370 and CAN/CSA A371.

.3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.

.4 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.

.5 Ship reinforcement and connectors, clearly identified in accordance with Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.2 INSTALLATION

.1 Comply with manufacturer's written recommendations, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

.2 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371, CSA A23.1/A23.2 and CSA S304 unless indicated otherwise.

.3 Coordinate installation with quality control and assurance processes and as agreed upon following approved mock-up.

3.3 BONDING AND TYING

.1 Bond walls of two or more wythes using metal connectors in accordance with Ontario Building Code, CSA-S304, CAN/CSA-A371 and as indicated.

.2 Provide connectors to masonry veneer at the following spacing:
- .1 400 mm / 16” vertical spacing and 800 mm / 32” horizontal spacing.
- .2 200 mm / 8” from openings.
- .3 200 mm / 8” from top of wall and 200 mm / 8” from bottom of wall.
- .4 For wood parapets, provide a minimum of 2 rows of connectors at 800 mm / 32” horizontal spacing.

3.4 VERTICAL/HORIZONTAL REINFORCING

.1 Refer to Drawings for size and placement of horizontal and vertical reinforcing steel.

.2 Vertical reinforcing to be one piece from top of floor to underside of floor above. Reinforcing to be visible prior to grouting wall.

.3 Where vertical reinforcement must be spliced, follow a construction procedure that ensures specified lap lengths. Lap splices to be Class B tension lap splice based on a grout strength of 20MPa per CSA S304.

.4 Where high-lift grouting is necessary and approved by the Consultant, comply with the height limitations of CSA A370, while ensuring specified lap lengths.

.5 Unless noted otherwise, install standard ladder-type horizontal joint reinforcement in all non-load bearing walls at 400 mm / 16” centres.

.6 Unless noted otherwise, install full height vertical 15M bar in grouted cores on both sides of all openings. Notch bond beam blocks and lintel units each side of openings if vertical reinforcement passes through lintel bearing.

.7 Where approved, install reinforcing with couplers in accordance with manufacturer’s instructions to provide noted capacity. Ensure proper cover to face of masonry core is provided to meet the requirements of CSA S304 and A370.

3.5 REINFORCED LINTELS AND BOND BEAMS

.1 Reinforce masonry beams, masonry lintels and bond beams as indicated.

.2 Place reinforcement and grout in accordance with CSA-S304, CAN/CSA A371, and CAN/CSA A179.

.3 Support and position reinforcing bars in accordance with CAN/CSA A371.

.4 A “bond beam” course is to be formed from standard stretcher and pier blocks, with webs notched to receive the horizontal reinforcing or from purpose-made blocks with web knockouts. Reinforcing to have 20 mm clear cover to top of masonry unit.

.5 Where the course below the bond beam is not required to be grouted, install grout screens to retain the grout. Discontinue grout screens at vertically grouted cores.

.6 Standard bond beam reinforcing, unless noted otherwise: 1-15M.

.7 Beam reinforcing to be continuous unless noted otherwise, lapped with Class B tension splices.

.8 At intersecting walls, provide 1-15 M corner bar at all bond beams, unless noted otherwise. Corner bar legs to provide Class B splices with horizontal reinforcement. Knock out face shells of blocks at intersection of bond beams to allow free flow of grout between walls.

.9 Unless otherwise detailed, the first course above an opening greater than 400 mm in a concrete block wall is to be formed from lintel units with a solid bottom. Horizontal reinforcement is to be placed in the bottom of the block with spacers to maintain 20 mm below the bar.

.1 Reinforcing to be continuous over the opening and to extend 200 mm each side, unless noted otherwise.

.10 Provide horizontal bond beams as noted and in the following locations:

.1 Base and top of all walls.

.2 Openings at all stair landings.

.3 At the bottoms of masonry openings greater than 400 mm.

3.6 GROUTING

.1 Grouting in accordance with Section 04051 – Masonry Mortar and Grout.

3.7 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA-S304 and as indicated.

.2 Refer to Drawings for standard details for lateral support of permanent masonry walls.

.3 Materials shall meet the requirements of Division 03 and 05.

3.8 MOVEMENT JOINTS

.1 Reinforcement shall not be continuous across movement joints unless otherwise indicated.

3.9 FIELD BENDING

.1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars and connectors which develop cracks or splits.

3.10 FIELD QUALITY CONTROL

.1 Site inspections in accordance with Section 04050 - Common Work Results for Masonry.

3.11 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.12 CLEANING

.1 Clean in accordance with Division 01 and Section 04050 – Common Work Results for Masonry.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International Inc.:
- .1 ASTM D2240, Standard Test Method for Rubber Property - Durometer Hardness.
- .2 ASTM D1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

.2 Canadian Standards Association (CSA International):
- .1 CAN/CSA A370, Connectors for Masonry.
- .2 CAN/CSA A371, Masonry Construction for Buildings.
- .3 CAN/CSA-ISO 14021, Environmental Labels and Declarations - Self-Declared Environmental Claims Type II Environmental Labelling.
- .4 CSA S304, Design of Masonry Structures.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Refer to Section 04050 - Common Work Results for Masonry.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for masonry accessories and include Product characteristics, performance criteria, physical size, finish, and limitations.

.3 Shop Drawings:
- .1 Submit Shop Drawings showing flashing and installation details. Indicate sizes, spacing, location, and quantities of fasteners.

.4 Samples:
- .1 Submit two (2) masonry accessory samples in accordance with Division 01, supplemented as follows:
  - .1 Materials: two (2) coloured samples, illustrating colour and colour range. Include:
    - .1 Movement joint filler.
    - .2 Lap adhesive.
    - .3 Mechanical fasteners.
    - .4 Reglets.
    - .5 Brick vents.
  - .2 Two (2) moisture control material samples, illustrating colour and colour range, size, and shape. Include:
    - .1 Weep hole vents.
    - .2 Weep hole protector.
    - .3 Grout screens
  - .3 Two (2) flashing material samples, illustrating colour and colour range, size, shape, and profile. Include as specified:
    - .1 Sheet metal flashings.

.2 Composite flashings.
.3 Plastic and rubber flashings.

.5 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.7 Manufacturer's Instructions: submit manufacturer's instructions as follows:
.1 Submit installation instructions for fillers, adhesives, brick vents, weeps, diverters, screens, and flashings.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect masonry accessories from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Control joint filler: Closed cell neoprene sponge with tear strip, purpose-made for horizontal and vertical applications conforming to ASTM D1056, size and shape to suit application.
.1 Acceptable Product: ‘NS Neoprene Sponge’, by Blok-Lok or approved alternate.

.2 Lap adhesive: As recommended by masonry flashing manufacturer.

.3 Weep hole vents: Polyester compressible mesh sized to suit masonry unit and mortar joint, colour to match mortar or as approved by Consultant.
.1 Acceptable Product: ‘Weep Vent’, by Mortar Net Solutions, or approved alternate.

.4 Mechanical fasteners: Refer to Section 04052 – Masonry Connectors and Reinforcing.

2.2 MOISTURE CONTROL

.1 Weep Hole Protector:
.1 Pre-manufactured high-density nylon or polyethylene open mesh, 250 mm / 10" high, thickness to suit cavity.
.1 Acceptable Product: ‘Mortar Net’ by Mortar Net Ltd. or approved alternate.

.2 Grout Screens: 6 mm / 1/4" square monofilament screen fabricated from high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.
.1 Size: To suit application.
.2 Acceptable Product: '#MGS – Mortar/Grout Screen' by Hohmann & Barnard, Inc., or approved alternate.

2.3 FLASHINGS

.1 Flashings: Refer to Section 07280 - Air/Vapour Barriers.

.2 Prefinished Metal Flashings: Refer to Section 07620 – Sheet Metal Flashing and Trim.

.3 Aluminum Flashings: Refer to Section 07620 – Sheet Metal Flashing and Trim.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION: MATERIALS

.1 Install continuous movement joint fillers in movement joints at locations indicated on Drawings.

.2 Lap adhesive: Apply adhesive to flashing lap joints.

.3 Mechanical fasteners: Install fasteners to suit application and in accordance with manufacturer's written installation instructions.

.4 Reglets: Install reglets at locations indicated on Drawings.

3.3 INSTALLATION: MOISTURE CONTROL

.1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm / 24" on centre.

.2 Weep hole protector: Install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

.3 Grout Screens: Install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

3.4 INSTALLATION: FLASHINGS

.1 Build in flashings in masonry in accordance with CAN/CSA A371.
- .1 Install drip plates and flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity is interrupted by horizontal members or supports and as shown on Drawings. Install flashings under weep hole courses and as indicated.
- .2 In cavity walls and veneered walls, carry flashings over horizontal face of drip plates of exterior masonry, under outer wythe, then up backing not less than 150 mm / 6”, and as follows:
  - .1 For masonry backing embed or bond flashing 25 mm / 1” in joint.
  - .2 For concrete backing, insert or bond flashing into reglets.
  - .3 Lap joints 150 mm / 6” and seal with adhesive.

.2 Form flashing (end dams) at lintels, sills, and wall ends to prevent water from travelling horizontally past flashing ends.

.3 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.5 CLEANING

.1 Clean in accordance with Division 01.
- .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM C73, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).
- .2 ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- .3 ASTM C216, Standard Specification for Facing Brick (Solid Masonry Units Made of Clay or Shale).

.2 Brick Industry Association (BIA):
- .1 Technical Note No. 20, Cleaning Brick Work.

.3 Canadian Standards Association (CSA International):
- .1 CAN/CSA A82, Fired Masonry Brick Made From Clay or Shale.
- .2 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
- .3 CAN/CSA A371, Masonry Construction for Buildings.
- .4 CSA S304, Design of Masonry Structures.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Refer to Section 04050 - Common Work Results for Masonry.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for brick masonry units and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions in accordance with Section 04050 - Common Work Results for Masonry.

.4 Samples:
- .1 Provide samples as follows:
  - .1 One (1) of each type of masonry units specified, including special shapes.
  - .2 Samples: Used for testing and when accepted become standard for material used.

.5 Test Reports:
- .1 Submit certified test reports in accordance with Division 01 and 04050 – Common Work Results for Masonry.

1.4 QUALITY ASSURANCE

.1 Quality Assurance in accordance with Section 04050 – Common Work Results for Masonry.

1.5 TESTING

.1 Inspection and testing will be carried out by Independent Testing & Inspection Agency designated by Consultant.

.2 Refer to Division 01 for payment.

.3 Notify inspection agency minimum of 48 hours in advance of requirement for tests.

.4 A minimum of five masonry units shall be selected and tested in accordance with CSA S304, CSA A82, CSA A165 Series and ASTM C73.

.1 For each 500 m^2 of wall or portion thereof for each unit type.

.5 In lieu of the above-noted construction testing, the manufacturer can provide evidence of compliance and assured uniformity for the Products under submission for Consultant review.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.1 Offload brick masonry packages using equipment that will not damage the surfaces.

.2 Do not use brick tongs to move or handle masonry.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Do not double stack cubes of brick masonry.

.3 Cover masonry units with non-staining waterproof membrane covering.

.4 Allow air circulation around units.

.5 Installation of wet or stained masonry units is prohibited.

.6 Keep brick masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.

.7 Store and protect brick masonry from nicks, scratches, and blemishes.

.8 Replace defective or damaged materials with new.

.9 Keep materials dry until use except where wetting of bricks is specified.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

.1 Veneer Brick:

.1 Brick: To CAN/CSA A82, ASTM C261.

.2 Type: X.

.3 Grade: EG.
.4 Size: 290 x 90 x 57 and 290 x 90 x 90 mm
.5 Colour and texture: Maximum of three (3) colours as later selected by Consultant from manufacturer's complete colour range.
.6 Face brick not to exceed maximum water absorption of 8% in 24-hour cold-water submersion test, with maximum water absorption of 0.88% in C/B ratio (saturation coefficient).
.7 Include installation of all brickwork, and all associated work in Contract.
.8 Acceptable Product: 'Nueva Collection' by Brampton Brick, or approved alternate.

2.2 CLEANING COMPOUNDS

.1 Cleaning Compounds:
.1 Use low VOC Products.
.2 Compatible with substrate and acceptable to masonry manufacturer for use on Products.
.3 Cleaning compounds compatible with brick masonry units and in accordance with manufacturer's written recommendations and instructions.

2.3 TOLERANCES

.1 Tolerances for clay brick masonry units in accordance with CAN/CSA A82.

.2 Tolerances for concrete brick masonry units in accordance with CAN/CSA A165.2.

.3 Tolerances for prefaced concrete masonry units in accordance with CAN/CSA A165.3.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Prepare as per Section 04050 - Common Work Results for Masonry.

3.2 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 CONSTRUCTION

.1 Construction to conform to CAN/CSA A371 and Section 04050 - Common Work Results for Masonry.

3.4 INSTALLATION TOLERANCES:

.1 To CAN/CSA A371.

3.5 PATCHING AND REPAIRS REPAIR/RESTORATION:

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar, and repair defective work in accordance with Section 04050– Common Work Results for Masonry.

3.6 FIELD QUALITY CONTROL

.1 Consultant review in accordance with Section 04050 - Common Work Results for Masonry.

.2 Test and evaluate concrete block units during construction in accordance with CSA S304.

3.7 CLEANING

.1 Clean in accordance with Division 01 and Section 04050 – Common Work Results for Masonry, supplemented as follows.

.2 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

.3 Clean unglazed clay masonry: Mock up panel specified in Section 04050 - Common Work Results for Masonry as directed below and leave for one week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work, and clean brick masonry as follows.

- .1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
- .2 Scrub with solution of 25 mL trisodium phosphate and 25 mL household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions.
- .3 Repeat cleaning process as often as necessary to remove mortar and other stains.
- .4 Use acid solution treatment for difficult to clean masonry as described in Technical Note No.20 by the Brick Industry Association.

.4 Clean concrete brick masonry as work progresses.

- .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of brick and finally by brushing.

.5 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

3.8 PROTECTION

.1 Brace and protect brick masonry in accordance with Section 04050 - Common Work Results for Masonry.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International Inc.:
- .1 ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- .2 ASTM E336, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.

.2 Canadian Standards Association (CSA International):
- .1 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (covers: A165.1, A165.2, A165.3).
- .2 CAN/CSA A371, Masonry Construction for Buildings.
- .3 CSA S304, Design of Masonry Structures.

.3 National Research Council Canada (NRC)
- .1 National Building Code of Canada (NBC).
- .2 National Fire Code of Canada (NFC).

.4 South Coast Air Quality Management District (SCAQMD)
- .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

.5 Underwriters' Laboratories of Canada (ULC):
- .1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Refer to Section 04050 - Common Work Results for Masonry.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for each type of concrete masonry unit and include Product characteristics (i.e. four facets), performance criteria, physical size, finish and limitations.

.3 Samples:
- .1 Provide samples as follows:
  - .1 One (1) of each type of masonry units specified, including special shapes.
  - .2 Samples used for testing and when accepted become standard for material used.

.4 Test Reports:
- .1 Submit certified test reports in accordance with Division 01 and 04050 – Common Work Results for Masonry.

1.4 QUALITY ASSURANCE

.1 Quality Assurance in accordance with Section 04050 – Common Work Results for Masonry.

1.5 TESTING

.1 Inspection and testing will be carried out by Independent Testing & Inspection Agency designated by Consultant.

.2 Refer to Division 01 for payment.

.3 Notify inspection agency minimum of 48 hours in advance of requirement for tests.

.4 The manufacturer shall provide evidence of compliance and assured uniformity for the Products under submission for Consultant review.

- .1 Alternatively, a minimum of five masonry units shall be selected and tested in accordance with CSA S304, A165 Series and ASTM C140.
  - .1 For each 500 m^2 of wall or portion thereof for each unit type.
  - .2 For each 250 m^2 of wall or portion therefore for concrete masonry units with specified strength higher than 15MPa.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.
- .2 Do not use brick tongs to move or handle masonry.

.3 Storage and Handling Requirements:

- .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Do not double stack cubes of concrete unit masonry.
- .3 Cover masonry units with non-staining waterproof membrane covering.
- .4 Allow air circulation around units.
- .5 Installation of wet or stained masonry units is prohibited.
- .6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.
- .7 Store and protect concrete unit masonry from nicks, scratches, and blemishes.
- .8 Replace defective or damaged materials with new.
- .9 Keep materials dry until use except where wetting of bricks is specified.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Standard concrete block units: To CAN/CSA-A165 Series (CAN/CSA-A165.1).
- .1 Headworks Building Exterior Load Bearing Masonry Walls:
  - .1 Type: H/15/A/O.
  - .2 Size: 190mm H x 240mm W x 390mm L.
- .2 UV Building Exterior Load Bearing Masonry Walls:
  - .1 Type: H/15/A/O.
  - .2 Size: 190mm H x 240mm W x 390mm L.
- .3 Process Building Exterior Load Bearing Masonry Walls:
  - .1 Type: H/30/A/O.
  - .2 Size: 190mm H x 240mm W x 390mm L.
- .4 Interior Non-Load Bearing Masonry Walls (all buildings):
  - .1 Type: H/15/A/O.
  - .2 Size: 190mm H x 190mm W x 390mm L.

.2 Special shapes:
- .1 Provide bull-nosed units at all exposed corners, sills. and tops of partial height walls.
- .2 Provide purpose-made shapes for lintels, beams, and bond beams with reduced webs, sawcut stretch units with reduced webs, or U-lintel units with sawcut or otherwise notched bottom faces to permit continuity of vertical reinforcement and grout.
- .3 Provide additional special shapes as indicated.

2.2 CLEANING COMPOUNDS

.1 Cleaning Compounds:
- .1 Use low VOC Products.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on Products.
- .3 Cleaning compounds compatible with concrete block masonry units and in accordance with manufacturer's written recommendations and instructions.

2.3 TOLERANCES

.1 Tolerances for standard concrete masonry units in accordance with CAN/CSA A165.1, supplemented as follows:
- .1 Maximum variation between units within specific job lot not to exceed +/- 2 mm / 0.087”.
- .2 No parallel edge length, width or height dimension for individual unit to differ by more than +/- 2 mm / 0.087”.
- .3 Out of square tolerance not to exceed +/- 2 mm / 0.087”.

.2 Tolerances for architectural concrete masonry units in accordance with CAN/CSA A165.1, supplemented as follows:
- .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed +/- 2 mm / 0.087”.
- .2 No parallel edge length, width or height dimension for individual unit to differ by more than +/- 2 mm / 0.087”.
- .3 Out of square tolerance not to exceed +/- 2 mm- / 0.087”.

.4 Maximum variation in width between units within specific job lot for specified dimension not to exceed +/-2 mm / 0.087”.

2.4 EXPOSED FACES

.1 Exposed Faces: Uniform texture, free of imperfections, indentations, and surface cracks impairing finish or appearance in accordance with CAN/CSA A165.1.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Prepare as per Section 04050 - Common Work Results for Masonry.

3.2 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 CONSTRUCTION

.1 Construction to conform to CAN/CSA A371 and Section 04050 - Common Work Results for Masonry:

3.4 INSTALLATION TOLERANCES:

.1 To CAN/CSA A371.

3.5 PATCHING AND REPAIRS

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar, and repair defective work in accordance with Section 04050 – Common Work Results for Masonry.

3.6 FIELD QUALITY CONTROL

.1 Consultant review in accordance with Section 04050 - Common Work Results for Masonry.

.2 Test and evaluate concrete block units during construction in accordance with CSA S304.

3.7 CLEANING

.1 Clean in accordance with Division 01 and Section 04050 – Common Work Results for Masonry, supplemented as follows.

.1 Progress Cleaning:

.1 Standard Concrete Unit Masonry:

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.

3.8 PROTECTION

.1 Brace and protect concrete unit masonry in accordance with Section 04050 - Common Work Results for Masonry.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International (ASTM):
- .1 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
- .2 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Services and Other Special Purpose Applications.
- .4 ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
- .5 ASTM F3125M, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.2 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-85.10, Protective Coatings for Metals.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
- .1 Handbook of the Canadian Institute of Steel Construction.
- .2 CISC Code of Standard Practice for Structural Steel.
- .3 CISC Guide for Specifying Architecturally Exposed Structural Steel (AESS).
- .4 CISC Guide for the Design of Crane Supporting Structures, 4th Edition.
- .5 CISC Design module 7 – Moment Connection for Seismic Application 3rd edition.
- .6 CISC/CPMA Standard 2, Quick Drying Primer for use on Structural Steel.
- .7 CISC/CPMA Standard 1, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .8 CISC Steel Fabrication Quality Systems Guideline and Commentary.

.4 CSA Group (CSA):
- .1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .2 CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA-S16, Limit States Design of Steel Structures.
- .4 CSA-S136, North American Specifications for the Design of Cold Formed Steel Structural Members.
- .5 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .6 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.
- .7 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .8 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .9 CSA W59, Welded Steel Construction (Metal Arc Welding).

.5 Master Painters Institute (MPI):
- .1 MPI-INT 5.1, Structural Steel and Metal Fabrications.
- .2 MPI-EXT 5.1, Structural Steel and Metal Fabrications.

.6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
- .1 NACE No. 3/SSPC-6, Commercial Blast Cleaning.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Division 01.

.2 Submit proof of approval by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

.3 Submit proof of CISC Steel Structures Certification.

.4 Shop Drawings:

.1 Submit connection design details, erection diagrams, and shop details for each member, hereafter referred to as Shop Drawings. Structural steel and joist Shop Drawings shall be reviewed and accepted in by the Contractor prior to forwarding on to the Consultant.

.2 Shop Drawings to be submitted electronically. Quantity and format of Shop Drawings are to be in accordance with Division 01. Reproduction of Contract Documents will not be acceptable as Shop Drawings.

.3 Submit Shop Drawings in a single, complete set in order that all details may be read in conjunction with plans, elevations and all other dependent details.

.4 All materials, finishes, and loadings shall be clearly illustrated. All submittals shall be made in English with any abbreviations clearly defined.

.5 Where Shop Drawings are re-submitted, clearly illustrate all revisions from previous submissions using revision marks and "bubbles".

.6 Structural steel Shop Drawings to be stamped and signed by a qualified Professional Engineer registered in the Province of Ontario in the employ of the steel fabricator to signify that fabricator's responsibilities with respect to detailing and connection design have been completed and reviewed for compliance with Contract Documents.

.7 Clearly show, in plan, all members, bridging, bracing, connections, steel lintels, hangers, etc.

.8 For assemblies, components, and connections designated as AESS, clearly identify all of the following:

.1 Distinguish between shop and field welds and show size, length, and type of each weld.

.2 Grinding, finish, and profile of welds.

.3 Type and finish of bolts. Indicate which side of the connection bolt heads should be placed.

.4 Orientation of exposed seams in HSS members.

.5 Special tolerances.

.6 Erection requirements.

.9 Provide details to illustrate spandrel beams, bracing and bridging systems, column and beam splices, bearing and base plates, framing at openings, connections and any other non-standard items or details required by the Consultant.

.10 Provide details to illustrate spandrel beams, bracing and bridging systems, column and beam splices, bearing and base plates, framing at openings, connections and any other non-standard items or details required by the Consultant.

.11 Drawings to be prepared by fabricator in accordance with A.I.S.C. Structural Steel Detailing Manual.

.12 Do not commence fabrication until complete set of Shop Drawings has been reviewed by the Consultant. Where fabrication is initiated prior to such review, all subsequently required revisions shall be at no cost to the Owner.

.13 Submit mill test reports prior to fabrication of structural steel. Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project. Mill test reports to be certified by metallurgists qualified to practice in the Province of Ontario.

.14 Provide structural steel fabricator’s affidavit stating that materials and Products used in fabrication conform to applicable material and Products standards specified and indicated.

.15 Upon request by the Consultant submit BIM model of fabrication and connections. Format and submission information to be agreed upon as part of Shop Drawings.

.5 Samples:

.1 Provide samples of AESS components as noted below:

.1 Surface preparation of bare steel.

.2 Finished and painted steel.

.3 Welds, including final profiling of welds.

.4 Reduced scale representation of completed welded and bolted connections.

.2 Provide samples demonstrating each AESS Category finish requirements.

.3 Samples are to be submitted to Consultant for review 30 days in advance of commencing full scale fabrication of AESS components.

.4 Additional samples of elements indicated above may be required by the Consultant if the samples are not accepted. Additional samples to be completed to the satisfaction of the Consultant. All costs for samples to be by the Contractor. Where full scale fabrication is initiated prior to acceptance of samples, all subsequently required revisions shall be at no cost to the Owner.

1.3 QUALITY ASSURANCE

.1 Meetings:

.1 Convene pre-fabrication meeting in accordance with Division 01 one (1) week prior to beginning steel fabrication.

.1 Ensure key personnel, site supervisor, Owner, Consultant, steel fabricator, steel erector, and steel inspector attend.

.2 Convene pre-installation meeting in accordance with Division 01 one (1) week prior to beginning steel erection.

.1 Ensure key personnel, site supervisor, Owner, Consultant, steel fabricator, steel erector, and steel inspector attend.

.2 Qualifications:

.1 Fabrication of structural steel to be performed only by firm holding current and valid CISC Steel structures Certification.

.2 Fabrication and erection of structural steel to be performed only by firm fully approved by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

1.4 INSPECTIONS

.1 Shop and Site inspections to ensure conformance with this Section will be conducted by the inspection company appointed by Owner. Shop and site inspections to be performed only by a firm certified by the Canadian Welding Bureau for the requirements of CSA Standard W178 (Qualification of Welding Inspection Organizations) for buildings by visual methods.

.2 Testing company services will be paid for by the Contractor from a cash allowance carried in Division 01.

.3 All inspection procedures to be as outlined in CAN/CSA S16:19 Annex P and be performed to inspection class IC3. Supply all necessary cooperation to facilitate shop and site inspections. Provide safe access and working areas for testing on site.

.4 Ensure timely reviews by steel inspectors during construction and coordinate with erection sequencing. Address deficiencies as noted by the steel inspector, prior to proceeding to next sequence.

.5 Submit reports from each inspection and final report certifying that installation of all structural steel has been performed in accordance with Contract Documents.

1.5 EXAMINATION

.1 Prior to fabrication, review all dimensions in conjunction with all Contract Documents. Report any conflicts or uncertainties for clarification.

.2 Prior to erection, examine all site conditions and dimensions which may affect this work. Report any inconsistencies to the Consultant for direction.

1.6 COORDINATION

.1 Review all Contract Documents and Shop Drawings related to all other trades which may affect this work. Report any discrepancies to the Consultant for direction.

.2 Cooperate with all other trades to fully coordinate all dimensions, openings, details, etc., which may be required during fabrication or erection.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Store and handle steel members to prevent damage which will impair adequacy or appearance of material in finished structure.

.2 All members damaged during shipping, handling or erection shall be repaired to the satisfaction of the Consultant at no cost to the Owner.

.3 Store joists in vertical position, blocked off ground in such a manner as to avoid overstraining and to keep them reasonably clean. Remove dirt and debris after member has been erected and apply touch-up paint as required.

.4 Take special precautions when erecting long slender joists or members. Do not release hoisting cables until the member is laterally supported by at least one line of bridging and/or bracing.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Structural Steel:

.1 Hot rolled structural sections and bars (W,S,C,L): Grade 350W to CAN/CSA G40.21 unless indicated otherwise.

.2 Hollow structural sections: Grade 350W to CAN/CSA G40.21 manufactured to CAN/CSA G40.20, Class 'C' only, unless indicated otherwise. Substitution to ASTM A500 will not be accepted as equivalent. Substitution to ASTM A1085 will be subject to review and approval.

.3 Plates: Grade 300W to CAN/CSA G40.2 unless indicated otherwise.

.2 Bolts: High strength to ASTM A325M with suitable nuts and hardened steel washers.

.3 Anchor Bolts: Mild steel to ASTM F1554 with suitable nuts and hardened steel washers, 19 mm diameter unless indicated otherwise. Provide template for trade responsible for installation. Grades of anchor bolts to be field identifiable by colour coating and match grades shown on Drawings. All field modification to anchor bolts are to be submitted to the Consultant for review.

.4 Welding Materials: Conforming to W48.3 and suitable for use intended.

.5 Grout below baseplates to be flowable non-shrink, non-metallic grout with a minimum compressive strength of 40 MPa at seven (7) days.
.1 Acceptable Product: 'SikaGrout 212' by Sika Canada, 'V-3 10K' by W.R. Meadows, or approved alternate.

.6 Paint:
.1 Shop and touch-up paint to CISC/CPMA 2-75.
.2 Colour of shop applied primer: Grey.
.3 Coordinate primer with Division 09 Specifications. Consider primer compatibility with intumescent paint.

.7 Galvanizing:
.1 Galvanizing to stricter requirements of ASTM A123/A123M or CAN/CSA-G164, minimum zinc coating 600 g/m^2.
.2 Zinc-rich touch-up coating, ready mixed to CAN/CGSB-1.181-99. Acceptable Product: 'Galvafroid' by Fosroc or approved alternate.

2.2 DESIGN AND FABRICATION

.1 All fabrication to comply with requirements of CAN/CSA S16. All welding to conform to requirements of CSA W59. Use only welders approved by Canadian Welding Bureau for class of work being performed.

.2 Fabrication
.1 Fabricate structural steel not designated as AESS, in accordance with CAN/CSA-S16 and in accordance with reviewed Shop Drawings.
.2 Structure is considered to be Static. Fabrication of plates and holes are to be drilled or punched in accordance with CSA-S16.

.3 Substitutions of member sizes will be permitted only if equivalent stiffness and load carrying capacity are provided and no interference with other details will result. Substitutions, including all necessary modifications to the work of this Section and all other trades, to be at no cost to the Owner.

.4 The camber of steel members shall be verified in the shop and in the field. When no camber is indicated, turn the member natural camber up.

.5 Where design reactions are not indicated, design and detail all connections to resist a total shear based on tributary floor, roof and wall loads noted and considering any concentrated loading which occurs on members. As a minimum, connections shall be capable of supporting one-half the allowable uniformly distributed load or 50% of the connected member shear capacity for the member and span considered. Provide a minimum of two (2) 19 mm / 3/4" diameter A325 bolts per connection, unless noted otherwise.

.6 Where moment connections are indicated on Drawings without design loads, connection shall be designed to develop the full moment and shear capacities of the weakest member being connected.

.7 Connect all columns to the base plates for the larger of the following forces in addition to the other forces shown:

.1 For the factored horizontal component of the bracing and bracing locations; or,

.2 For 3% of the factored vertical column load applied horizontally.

.8 In general, framed connections with double angles, end connection plates or seated connections with top or side clip angles are acceptable. The Consultant may require the use of a specific connection type at their discretion, if considered necessary to ensure structural action assumed in design.

.9 Structural steel fabricator shall perform the necessary review to determine the full impact of connection clearance requirements, as well as the potential introduction of doubler plates, continuity plates, and/or web flange or other stiffeners.

.10 Provide torsional restraint of eccentrically loaded spandrel beams at connections to other beams or columns. Seated connections with top clip angles or framed connections with top and bottom clip angles are acceptable.

.11 No splices shall be made unless shown on the Drawings or reviewed and approved by the Engineer of Record. Design all splices to develop full capacity of member unless noted otherwise.

.12 Design and detail all connections for vertical and horizontal diagonal bracing members to resist the specified loads in accordance with CAN/CSA S16. Where bracing loads are not specified, design connections to develop full tension capacity of member.

.13 Detail and reinforce all slots, holes and openings in members so as to avoid overstressing. Construct re-entrant corners free from notches and with largest practical radii, with a minimum radius of 13 mm.

.14 Where ASTM A325 galvanized bolts are used, tensioning of bolts procedures and inspections are to be strictly followed. Incorrect tensioning with improper quality reviews will result in replacement of affected bolts at the cost of the Contractor. High strengths galvanized bolts cannot be tensioned more than once.

.15 Grind smooth or detail all butt welds, connections and splices in members, which will be exposed when construction is complete, so as to be as unobtrusive as possible. Appearance, location and details of exposed splices and connections to be to the Consultant's approval.

.16 Detail sloping beams to permit level bearing at each support unless specifically indicated otherwise.

.17 Stitch weld double angle members back-to-back to limit the slenderness ratio of each angle to less than that of the whole member.

.18 Unless indicated otherwise, where steel deck changes direction of span, provide a 76 x 76 x 7.9 mm continuous steel angle welded to ends of joists or top of beam to support deck. Install similar angle at all areas where continuity of support steel is interrupted or additional support for deck or metal forms is required due to framing details which cause span of deck or metal forms to exceed those intended on Drawings.

.19 For attachment of wood framing or blocking, provide 18 mm diameter drilled holes for 16 mm bolts unless noted. Space at 400 mm centres and stagger each side of flange or chord.

.20 “J” bolt type anchor bolts will not be permitted. Wet setting of anchor bolts is not acceptable practice.

.21 Drift pins shall not be used to enlarge misaligned or unfair bolt holes. Holes that require enlarging shall be reamed.

.22 For base plates resisting lateral or tensile loads (e.g., braced bays or wind columns), appropriately designed plate washers shall be installed where oversized base plate holes are employed to accommodate anchor rod installation tolerances.

.23 Provide miscellaneous materials and accessories associated with good practice that are not shown on Drawings.

.24 Prequalified connection shall be detailed in strict accordance to design loads showed on Drawings. Probable and nominal connections design shall be provided upon request to ensure compatibility with lateral force resisting system design intent and capacity protected element.

2.3 PREPARATION AND CORROSION PROTECTION

.1 Clean structural steel to the requirements of SSPC - SP3 as a minimum.

.2 Apply one shop coat of primer paint except as follows:
- .1 Do not paint surfaces and edges to be field welded. If painted, remove paint for field welding for a distance of at least 50 mm on all sides of joint.
- .2 Do not paint contact surfaces of high strength bolted friction type connections where specified.
- .3 Do not paint members of portions thereof which will be encased in, or in direct contact with, cast-in-place concrete.
- .4 Where member is to be protected using intumescent paint. All surface preparation and primers are to be coordinated with intumescent paint supplier.

.3 Blast clean all steel members (including angle lintels, shelf angles, anchor plates and bolts, mechanical rooftop framing, etc.,) which will be exposed to weather or a corrosive environment in finished structure, to requirements of SSPC - SP6. Galvanize to stricter requirements of ASTM A123/A123M or CAN/CSA-G164 (withdrawn).

.4 Where members will be exposed to view in completed structure, carefully clean and paint so as to be free of imperfections which will mar finished painted surface.

.5 After erection, touch-up all field bolts, field welds and all damaged or missing shop paint with one touch-up coat of paint.

PART 3 - EXECUTION

3.1 PROTECTION

.1 Do not commence erection of building superstructure until concrete substructure has achieved at least 70% of specified concrete strength in field curing, but not less than seven (7) days. Staged construction has not been considered in the design of the finished structure.

3.2 ERECTION

.1 Erection of all structural steel members to conform to requirements of CSA S16.

.2 Make adequate provision for erection stresses and install adequate temporary bracing to withstand all loads to which structure may be subject during erection and subsequent construction, including loads due to wind, equipment and operation of same. Leave temporary bracing in place as long as necessary for safety or until walls and/or permanent bracing upon which frame depends for lateral stability and all connections thereto, are completed.

.3 Supply beam and column anchor bolts for installation by trade constructing bearing surface. Prior to erection, check location and elevation of all anchor bolts and advise the Consultant of any discrepancies. Any corrective measures necessary to be approved by the Consultant.

.4 Support column bases at minimum four (4) points by leveling nuts or steel shims so as to provide a minimum 40 mm grout space below base plates.

.5 Fabricate connections to comply with requirements of CAN/CSAS16. Field connections may be accomplished by welding or with high strength bolts. Bolted connections shall be pretensioned as per the requirements of CAN/CSA S16. Perform field welding carefully so as not to cause any damage to joists, structural steel, bridging or deck.

.6 Do not weld across beam flanges or joist chord members.

.7 Do not weld anchor bolts without written approval from Consultant.

.8 The design incorporates rigid roof diaphragms consisting of the roof deck and continuous framing members. To ensure the required diaphragm action, design connections and splices in perimeter framing to develop full member capacity and weld perimeter framing member to each supporting member with minimum 40 mm of 6 mm fillet weld.

END OF SECTION

PART 1- GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB 1.181 (Withdrawn), Ready-Mixed Organic Zinc-Rich Coating.

.3 CSA Group (CSA):
- .1 CSA C22.2 No.79, Cellular Metal and Cellular Concrete Floor Raceways and Fittings.
- .2 CSA S16, Design of Steel Structures.
- .3 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.
- .4 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .5 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .6 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .7 CSA W59, Welded Steel Construction (Metal Arc Welding).

.4 Canadian Institute of Steel Construction (CISC):
- .1 CISC Steel Fabrication Quality Systems Guideline and Commentary.

.5 Canadian Sheet Steel Building Institute (CSSBI):
- .1 CSSBI 10M, Standard for Steel Roof Deck.
- .2 CSSBI 12M, Standard for Composite Steel Deck.
- .3 CSSBI B13, Design of Steel Deck Diaphragms.
- .4 CSSBI B61, Manufacturer Certification for Cold Formed Steel Framing Members.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Division 01.

.2 Submit proof of CISC Steel Structures Certification.

.3 Submit manufacturer’s instructions, printed Product literature and data sheets for steel decking and connectors including Product characteristics, performance criteria, physical size, finish, and limitations.

.4 Submit diaphragm connection pattern and confirm the capacity of each diaphragm in both uplift (kPa) and diaphragm action (kN/m).

.5 Shop Drawings:
- .1 Shop Drawings to be submitted electronically. Quantity and format of Shop Drawings are to be in accordance with Division 01. Reproduction of Contract Documents will not be acceptable as Shop Drawings.

.2 Submit Shop Drawings in a single, complete set in order that all details may be read in conjunction with plans, elevations and all other dependent details.

.3 All materials, finishes, openings and loadings shall be clearly illustrated. All submittals shall be made in English with any abbreviations clearly defined.

.4 Where Shop Drawings are re-submitted, clearly illustrate all revisions from previous submissions using revision marks and "bubbles".

.5 Shop Drawings to be stamped and signed by a qualified Professional Engineer registered in the Province of Ontario in the employ of the steel deck fabricator to signify that fabricator's responsibilities with respect to detailing and connection design have been completed and reviewed for compliance with Contract Documents, including temporary erection conditions.

.6 Submit confirmation that steel deck fastener installers have been trained and certified by manufacturer or submit welders' certification.

1.3 QUALITY ASSURANCE

.1 Meetings:

.1 Convene pre-installation meeting in accordance with Division 01 one (1) week prior to beginning steel erection.

.1 Ensure key personnel, site supervisor, Owner, Consultant, steel fabricator, steel erector, and steel inspector attend.

.2 Qualifications

.1 Material manufacture and fabrication to be performed by a member company of Canadian Sheet Steel Building Institute (CSSBI).

1.4 INSPECTIONS

.1 Site inspections to ensure conformance with this Section will be conducted by the inspection company appointed by Owner. Site inspections to be performed only by a firm certified by the Canadian Welding Bureau for the requirements of CSA Standard W178 (Qualification of Welding Inspection Organizations) for buildings by visual methods.

.2 Testing company services will be paid for by the Contractor from a cash allowance carried in Division 01.

.1 All inspection procedures to be as outlined in CAN/CSA S16:19 Annex P and be performed to inspection class IC3. The following items noted as optional in CAN/CSA S16:19 shall be included in the inspections.

.2 Supply all necessary cooperation to facilitate site inspections. Provide safe access and working areas for testing on site.

.3 Ensure timely reviews by steel inspectors during construction and coordinate with erection sequencing. Address deficiencies as noted by the steel inspector, prior to proceeding to next sequence.

.4 Submit reports from each inspection and final report certifying that installation of all steel deck has been performed in accordance with Contract Documents.

1.5 COORDINATION

.1 Review all Contract Documents and all Shop Drawings produced by all other trades which may affect this work. Report any discrepancies to the Consultant for direction.

.2 Consult all trades to ascertain location and size of openings required in deck. Ensure that all steel framing required has been installed prior to erection.

.3 Supply and install framing around all deck openings per details shown on Drawings. Final number, size and location of opening are to be coordinated with mechanical and electrical Drawings and subtrades.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Exercise care in storing, handling, and placing steel deck units to prevent damage which will impair adequacy or appearance of material in finished structure.

.2 Damaged material to be replaced at no cost to the Owner.

.3 If site storage is necessary, store materials in neat bundles stacked on wood blocking clear of ground and tilted slightly to ensure that no water lies on material and in accordance with manufacturer's recommendations.

.4 Handle materials in accordance with safety provisions outlined in CSSBI Standards for Steel Roof Deck to avoid injury or damage.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Structural steel for bearing plates, openings framing, miscellaneous angles - hot rolled structural steel, Grade 350 W to CSA G40.21.

.2 Hollow structural sections for deck support: Grade 350 W to CAN/CSA G40.21.

.3 Roof Deck: Base steel thickness and depth of profile as indicated on Drawings. Minimum yield strength: 275 MPa.

.1 Acceptable Product: Canam 'P-3615 & P-3606' by Canam, or approved alternate.

.4 Composite Floor Deck: Non-cellular composite deck with (20 gauge) 0.91 mm core thickness. Deck to be roll-formed with integral locking lugs to provide positive mechanical interlock and shear transfer between concrete fill and deck. Minimum yield strength: 275 MPa.

.1 Acceptable Product: '1.5BLI' by Canam or approved alternate.

.5 Touch-up paint: Zinc rich anti-corrosion, 'Galvafroid' by Fosroc.

.6 Finishes:

.1 Zinc coated: To ASTM A653, Z275 designation.

.2 Unless otherwise specified, provide galvanized finish except for surfaces designated as site-painted (supply Wipe Coat) or as prefinished on Room Finish Schedule.

.7 Closures to be supplied as indicated and in accordance with manufacturer's recommendations. For concrete topping, ensure that all closures are supplied around column and openings.

.8 Mechanical fasteners as indicated on Drawings and in accordance with manufacturer's written instructions. Alternate fastening methods are subject to approvals by the Consultant.

.9 Welding Materials: Conforming to W48.3 and suitable for use intended.

.10 Cover plates, cell closures, and flashings: Steel sheet with minimum base steel thickness of 0.91 mm / 20 ga. minimum. Metallic coating same as deck material.

.1 Primer: Zinc rich, ready mix to CAN/CGSB-1.181.

.2 Caulking in accordance with Section 07920 – Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Prior to installation, examine all site conditions carefully and report any defects found to Consultant. Do not commence erection until corrective measures are completed to Consultant's satisfaction.

.2 Prior to erection, visually inspect metal decking and inform Consultant of unacceptable conditions immediately upon discovery. Do not commence erection until corrective measures are completed to Consultant's satisfaction.

.3 Make field measurements necessary to ensure proper fit of decking.

.4 Review all Contract Documents and all Shop Drawings produced by all other trades which may affect this work. Report any discrepancies to Consultant for direction.

3.2 ERECTION

.1 Erection as indicated and in accordance with CSA S136 and CSSBI and in accordance with approved erection drawings.

.2 Structural steel work: In accordance with CSA S16.

.3 Ensure that all steel framing required has been installed prior to erection of metal deck.

.4 Welding: In accordance with CSA W59.

.5 Weld and test stud shear connectors through steel deck to steel joists/beams below in accordance with CSA W59.

.6 Welding to be performed by firms certified by the Canadian Welding Bureau for Division 1 or 2 under CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding or trained and certified by manufacturer.

.7 Where double joists occur, weld deck to both joists at 300 mm centres staggered, or as indicated on Drawings.

.8 Span deck units over three or more supports whenever possible. Supply in sheets of sufficient length to extend from high points of framing to low points. Bend as required to conform to slope of supporting steel.

.9 Place and align units in their final position prior to making permanent connections, taking care to provide adequate temporary connections to resist construction forces, wind, etc.

.10 Lap ends: To 50 mm minimum. Locate laps above framing members. Secure lapped units to each other and to supporting member with HILTI sidelap connectors at 300 mm centres, or as indicated on Drawings.

.11 Support connections and side lap connections to be in accordance with diagrams shown on structural Drawings.

.12 Steel deck to have a minimum end bearing length of 50 mm on steel framing.

.13 Blowholes will not be accepted. Where blowholes occur, replace deck unit, conceal with cover plate, or otherwise propose remedial measures to Consultant's satisfaction.

.14 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

.15 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28-day compression strength.

3.3 CONNECTIONS

.1 Install connections in accordance with CSSBI recommendations as indicated. Install proprietary fasteners in strict accordance with manufacturer’s recommendations.

.2 Contractor to have proprietary anchoring system manufacturer’s representative on site for initial application of all proprietary anchoring systems to verify installation.

3.4 CLOSURES AND PERIMETERS

.1 Install closures in accordance with manufacturer’s recommendations.

.2 Perimeter angles in accordance with structural Drawings with splice connection design for forces shown on Drawings.

3.5 OPENINGS AND AREAS OF CONCENTRATED LOADS

.1 Cut openings in deck as required by other trades. Coordinate with other trades as required to confirm size and location of all openings. Supply and install sub-framing as shown on structural Drawings.

.2 Openings up to 150 mm square require no reinforcing.

.3 Openings with any one dimension between 150 mm and 300 mm be reinforced with 75 x 75 x 6 mm angle sections. Supply and install angles under ribs and extend minimum three (3) ribs on each side of opening. Secure angles to deck ribs with 19 mm long welds at each rib on each side.

.4 Openings with any one dimension greater than 300 mm and areas of concentrated load to be reinforced in accordance with structural framing details, except as otherwise indicated. Weld deck to framing at 150 mm centres around openings.

3.6 PAINTING

.1 Touch-up all welds and all defects and damage in galvanized surfaces with zinc rich paint.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This Specification specifies wind bearing steel stud systems which include the following:
- .1 Wall studs subjected to lateral loads (no axial loads other than self-weight and the weight of applied finishes).
- .2 Steel bridging.
- .3 Top and bottom track.
- .4 Head, sill and jamb members for wall openings.
- .5 Stud, bridging and track connections.
- .6 Top and bottom connections to the main structure including detailing to accommodate roof deflections.

.2 The full responsibility of design of wind bearing steel stud systems is delegated under this Specification. The responsibility includes the design of the metal stud framing to Ontario Building Code and the referenced material standards as well as the performance requirements stipulated herein. The design will require the Contractor to retain a qualified professional engineer licensed in the Province of Ontario to prepare signed and sealed design and fabrication drawings.

.3 Refer to Division 09 for non-loadbearing interior partition studs.

1.2 REFERENCES

.1 ASTM International:
- .1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 CSA International:
- .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .2 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .3 CSA W59, Welded Steel Construction (Metal Arc Welding) [Metric].
- .4 CAN/CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members and S136.1- Commentary on North American specification for the design of cold-formed steel structural members.

.3 Canadian General Standards Board:
- .1 CAN/CGSB-1.181 Ready-Mixed Organic Zinc-Rich Coating.

.4 Canadian Institute of Steel Construction (CISC):
- .1 CISC Steel Fabrication Quality Systems Guideline and Commentary.

.5 Canadian Sheet Steel Building Institute (CSSBI):
- .1 CSSBI 51, Lightweight Steel Framing Manual.
- .2 CSSBI B61, Manufacturer Certification for Cold Formed Steel Framing Members.
- .3 CSSBI Fact Sheet #3, Care and Maintenance of Prefinished Sheet Steel Building Products.

.4 CSSBI Technical Bulletin Vol. 7, No. 2, Changing Standard Thicknesses for Canadian Lightweight Steel Framing Applications.
.5 CSSBI S5, Guide Specification for Wind Bearing Steel Studs.

1.3 DESIGN REQUIREMENTS

.1 Design shall be completed in accordance with the Ontario Building Code and CSA-S136.

.2 Stud depths are shown on the Drawings. Adjust stud material thicknesses and spacings, as required by the design criteria. Use greater or lesser stud and joist depths only when approved by the Consultant.

.3 Space wall studs at 406 mm maximum. Use lesser stud spacings if required by the design criteria.

.4 For wind load calculations, the reference velocity pressure, q, shall be based on a one in 50-year probability of being exceeded in any one year.

.5 Maximum flexural deflections under specified wind loads shall be limited to L/360.

.6 Design connections to accommodate vertical deflection movement of the structure, frame shortening and vertical tolerances without imposed axial loads onto the framing. Leave a minimum gap of 12 mm.

.7 Design to conform to the requirements of fire-rated assemblies specified.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Division 01.

.2 Submit manufacturer’s proof of CSSBI Certification.

.3 Product Data:
.1 Submit manufacturer's instructions, printed Product literature and data sheets for structural metal studs and include Product characteristics, performance criteria, physical size, finish, and limitations.

.4 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
.2 Indicate design loads, member sizes and spacing, materials, design thickness exclusive of coatings, coating specifications, connection and bracing details, screw sizes and spacing, and anchors.
.3 Indicate locations, dimensions, openings, and requirements of related work.
.4 Indicate welds by welding symbols as defined in CSA W59.
.5 Indicate temporary bracing required for erection purposes.

.5 Certificates:
.1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
.2 Submit two (2) certified copies of mill reports covering material properties.

.6 Manufacturer's Engineer Reports:

.1 Submit written report from manufacturer's design Engineer responsible for Shop Drawings, within three (3) Working Days of review, verifying compliance of work, as described in PART 3 - FIELD QUALITY CONTROL. Include on the report stamp and seal of Engineer.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer registered in the Province of Ontario, Canada to provide the following services:

.1 Design the wind bearing steel stud wall system.

.2 Prepare, seal and sign all Shop Drawings.

.3 Perform field review as described in PART 3 – FIELD QUALITY CONTROL.

.2 Manufacturer's must be certified to CSSBI-61 by the CISC.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect structural metal studs from nicks, scratches, and blemishes.

.3 Protect steel studs during transportation, site storage, and installation in accordance with CSSBI Sheet Steel Facts #3.

.4 Handle and protect galvanized materials from damage to zinc coating.

.5 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel to CAN/CSA S136, fabricated from ASTM A653/A653M, Grade 230 steel.

.2 Zinc coated steel sheet (Galvanized): Quality to ASTM A653/A653M, with Z275 designation coating.

.3 Fasteners and Welds:

.1 Bolts and nuts shall conform to the requirements of ASTM A307 or ASTM F3125. Hot dip galvanized bolts, nuts and washers to ASTM A123/A123M,600 g/m² zinc coating.

.2 Sheet metal screws, concrete anchors and other fasteners shall have a minimum coating thickness of 0.008 mm of zinc.

.3 Welding materials shall conform to the requirements of CSA W59 and certified by Canadian Welding Bureau.

.4 Welding electrodes shall be of the 490MPA minimum tensile strength series (e.g., E49xx).

.5 Zinc rich paint for touching up welds and damaged metallic coatings shall conform to CAN/CGSB-1.181.

.4 Screws:
- .1 Self-drilling, self-tapping sheet metal screws, corrosion protected with minimum zinc coating thickness of 0.008 mm.
- .2 Sheet metal screws shall be of the minimum diameter indicated on the Shop Drawings but not less than #8.
- .3 Screws shall be 5 mm longer than twice the thickness of steel.
- .4 Sheet metal screws covered by sheathing materials shall have low profile heads.

.5 Anchors: Concrete expansion anchors or other suitable drilled type fasteners.

.6 Touch up primer: Zinc rich, to CAN/CGSB-1.181.

2.2 STEEL STUD DESIGNATIONS

.1 Colour Code: To CSSBI Technical Bulletin Vol.7, No. 2.

2.3 METAL FRAMING

.1 Steel Studs: To CAN/CSA S136, fabricated from metallic coated steel, depth as indicated.
- .1 Thickness as indicated on reviewed Shop Drawings.

.2 Stud Tracks: Fabricated from same material and finish as steel studs, depth to suit.
- .1 Bottom track: Single piece.
- .2 Top track: Single piece.

.3 Deflection Ceiling Track: Purpose made with 64 mm leg x width to suit stud depth; pre-punched 38 mm long slots spaced at 25 mm o/c.
- .1 Acceptable Product: ‘Multi-slot MST 250’ by Bailey Metal Products Limited, or approved alternate.

.4 Bridging: Fabricated from same material and finish as studs, 38 x 12 x thickness as indicated on reviewed Shop Drawings.

.5 Angle Clips: Fabricated from same material and finish as studs, 38 x 38 mm x depth of steel stud, thickness as indicated on reviewed Shop Drawings.

.6 Tension Straps and Accessories: As recommended by manufacturer.

.7 Acoustical Sealant: To Section 07920 – Joint Sealants.

.8 Insulating strip: Rubberized, moisture resistant 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for structural metal stud framing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate prior to commencing with work of this Section.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 GENERAL

.1 Weld in accordance with CSA W59.

.2 Certification of companies: To CSA W47.1 for fusion welding and CSA W55.3 for resistance welding.

.3 Do structural metal stud framing work to CSSBI S5.

3.3 ERECTION

.1 Erect components to requirements of reviewed Shop Drawings.

.2 Anchor top and bottom track securely to structure at 800 mm on centre maximum, unless otherwise indicated on Shop Drawings.

.3 Erect studs plumb, aligned and securely attach with 2 screws minimum, unless otherwise indicated in the Contract Documents or reviewed Shop Drawings. Should discrepancies exist, use most stringent method to attach studs unless otherwise approved in writing by Consultant.

.4 Seat studs into bottom tracks and single piece top track where applicable.

.5 Brace steel studs with horizontal internal bridging at 1500 mm maximum.

.1 Fasten bridging to steel clips fastened to steel studs with screws or by welding.

.6 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on Shop Drawings.

.7 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 64 mm leg purpose made deflection ceiling tracks as specified.

.8 Limit free play in connections perpendicular to the plane of the framing to +/-0.5 mm relative to the building structure.

.9 Touch up welds with coat of zinc rich primer.

.10 Install continuous insulating strips below bottom tracks and above top tracks to isolate studs from uninsulated surfaces.

.11 Install continuous insulating strip under studs and tracks around perimeter of sound control partitions.

.12 Temporary bracing shall be provided wherever necessary to withstand all loads to which the steel stud wall system may be subject during erection and subsequent construction. Leave in place as long as required for the safety and integrity of the wall system.

3.4 ERECTION TOLERANCES

.1 Plumb: Not to exceed 1/500th of member length.

.2 Out of Straightness (Camber and Sweep): Not to exceed 1/1000th of member length. For track, camber shall not exceed 1/400th of member length.

.3 Spacing: Not more than +/- 3 mm / 1/8” from design spacing.

.4 Gap between end of stud and track web: Not more than 4 mm / 5/32”.

3.5 CUTOUTS

.1 Maximum size of cutouts for services as follows:

Member Depth	Across Member Depth (mm)	Along Member Length	Centre-to-Centre Spacing
92	38 max.	105 max.	600 min.
102	38 max.	105 max.	600 min.
152	64 max.	115 max.	600 min.

.2 Limit distance from centerline of last unreinforced cutout to end of member to less than 305 mm / 12”. Otherwise provide reinforce cut-outs.

.3 Align web cut-outs in studs as required for the installation of through-the-knockout style bridging and services.

3.6 FIELD QUALITY CONTROL

.1 Shop Drawing Design Engineer’s Field Services:
- .1 Obtain written report from design engineer responsible for Shop Drawings verifying compliance of work, in handling, installing, applying, protecting, and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS. Include on the report stamp and seal of Engineer.
- .2 Provide Shop Drawing design engineer’s field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits to review work as follows.
  - .1 After delivery and storage of Products, and when preparatory work is complete but before installation begins.
  - .2 During progress of work as necessary.
  - .3 Upon completion of work, after cleaning is carried out.

3.7 CLEANING

.1 Progress Cleaning: Clean in accordance with Division 01.
  .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01.

3.8 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by structural metal stud installation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Provide the following components as required and / or where indicated:
- .1 Gratings and support framing.
- .2 Checkered plate covers and support framing.
- .3 Trench covers and frames.
- .4 Masonry lateral support brackets.
- .5 Corner guards.
- .6 Miscellaneous angle/channel frames.
- .7 Under counter support brackets.
- .8 Bollards.
- .9 Equipment support frames;
- .10 Ladders.
- .11 Sutro weirs.
- .12 Other metal fabrications shown and not specifically covered in other Sections.

.2 The above list is intended as a guide only and not to be considered as a complete list of all items to be provided. Examine Drawing and other Specification Sections thoroughly to determine items and quantities required.

.3 The Contractor is to coordinate the correct installation of any fabricated items including obtaining suitable templates and guides required for a top-quality installation. Items to be fabricated and supplied to the site for installation in a timely manner which does not impact schedules or quality of workmanship of the associated trades.

1.2 REFERENCES

.1 Aluminum Association (AA)
- .1 AA DAF 45, Designation System for Aluminum Finishes.

.2 ASTM International (ASTM):
- .1 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
- .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .3 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .4 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Services and Other Special Purpose Applications.
- .5 ASTM A269/A269M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- .6 ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
- .7 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .8 ASTM F3125M, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 Mpa) Minimum Tensile Strength, Inch and Metric Dimensions.

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-85.10, Protective Coatings for Metals.

.4 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
- .1 Handbook of the Canadian Institute of Steel Construction.
- .2 CISC Code of Standard Practice for Structural Steel.
- .3 CISC Guide for Specifying Architecturally Exposed Structural Steel (AESS).
- .4 CISC/CPMA Standard 2, Quick Drying Primer for use on Structural Steel.
- .5 CISC/CPMA Standard 1, Quick-Drying, One-Coat Paint for Use on Structural Steel.

.5 CSA Group (CSA):
- .1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .2 CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA-S16, Limit States Design of Steel Structures.
- .4 CSA-S136, North American Specifications for the Design of Cold Formed Steel Structural Members.
- .5 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .6 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.
- .7 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .8 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .9 CSA W59, Welded Steel Construction (Metal Arc Welding).

.6 National Association of Architectural Metal Manufactures (NAAMM):
- .1 AMP 531, Metal Bar Grating Manual.
- .2 AMP 532, Heavy Duty Metal Bar Grating Manual.

.7 The Master Painters Institute (MPI):
- .1 Architectural Painting Specification Manual.

.8 Underwriters Laboratories (UL)
- .1 UL 2768, Architectural Surface Coatings

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for sections, plates pipe, tubing, bolts and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit a digital copy in PDF format of WHMIS SDS in accordance with Division 01.
  - .1 For finishes, coatings, primers, and paints applied on site: Indicate VOC concentration in g/L.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by Professional Engineer registered or licensed in Ontario, Canada in the employ of the steel fabricator to signify the fabricator's responsibilities with respect to member design, detailing and connection design have been completed and reviewed for compliance with the Contract Documents.

.2 Shop Drawings shall indicate the following as a minimum:
  .1 Materials, strengths, cuts, copes, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  .2 Provide details to illustrate bracing and bridging systems, column and beam splices, bearing and base plates, connections and any other standard items or details required.
  .3 For all aluminum fabrications, clearly indicate base metal yield strength (Fy) and reduced yield strength (Fwy) at welded heat affected zone.
.3 Metal fabrication Shop Drawings shall be reviewed and accepted by the Contractor prior to forwarding on to the Consultant.
.4 Do not commence fabrication until complete set of Shop Drawings has been reviewed by the Consultant. Where fabrication is initiated prior to such review, all subsequently required revisions shall be at no cost to the Owner.

.4 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.5 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 QUALITY ASSURANCE

.1 Metal fabrication to be performed only by firm fully approved by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

.2 Retain a professional engineer registered or licensed in Ontario, Canada, with experience in metal fabrication design of comparable complexity and scope, to perform following services as part of work of this Section:
  .1 Design of members and their connections and development of detailed fabrication drawings.
  .2 Review, stamp, and sign fabrication and erection Shop Drawings.

.3 Steel design to CSA-S16, Limit States Design of Steel Structures.

.4 Aluminum design to CSA-S157, Strength Design in Aluminum.

1.5 COORDINATION

.1 Review Contract Documents and Shop Drawings related to all other trades which may affect this work. Report any discrepancies to the Consultant for review.

.2 Cooperate with all other trades to fully coordinate all dimensions, openings, details, etc. which may be required during fabrication or installation.

.3 Supply all built-in items such as anchor bolts, bearing plates, steel lintels, etc. unless noted otherwise. Turn over such built-in items to the trade responsible for installation.

.4 Supply all necessary cooperation to facilitate Consultant’s review of work on site. Provide safe access and working areas for review and inspection on site.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect metal fabrication items from damage.
- .3 Replace defective or damaged materials with new.
- .4 Prevent the formation of wet storage stain on galvanized articles by complying with the following measures:
  - .1 Stack articles or bundle to allow air between the galvanized surfaces during transport from supplier. Load materials in such a manner that continuous drainage can occur.
  - .2 Raise articles from the ground and separate with strip spacers to provide free access to air or most parts of the surface. Incline in a manner which will allow continuous drainage. Do not lay galvanized steel on cinders, clinkers, wet soil or decaying vegetation.
  - .3 Handle galvanized articles in such a manner as to avoid any mechanical damage and to prevent distortion.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 All metal fabrications to be constructed of hot rolled steel unless noted otherwise.

.2 All metals to be new materials free from corrosion or other defects impairing strength, durability or finished appearance, in all respects to uses required and subject to review of Consultant. All materials to be of best commercial quality for purposes specified.

.3 Hot rolled structural sections and bars: CAN/CSA-G40.21, Grade 350W.

.4 Hollow structural sections (HSS): CAN/CSA-G40.21, Grade 350W, Class 'C' only, unless indicated otherwise.

.5 Steel Angles and plates: CAN/CSA-G40.21, Grade 350W.

.6 Steel pipe: Seamless to ASTM A53/A53M, Grade B, Fy = 240MPa.

.7 Welding materials: To CSA W59.

.8 Welding electrodes: To CSA W48 Series.

.9 Stainless Steel Bolts: 300 series to ASTM F593 with compatible nuts.

.10 High-Strength Bolts: To ASTM F3125, Grade 325, Hot Dip Galvanized Finish with compatible nuts.

.11 Anchor bolts: To ASTM F1554, Grade 55, Hot Dip Galvanized Finish with compatible nuts.

.12 Aluminum sections and plates: Aluminum alloy 6061-T6 to ASTM B209 and ASTM B308 (CSA Alloy GS11N-T6). Structural sections including support angle framing and stiffeners to be 6061-T6 alloy.

.13 Stainless steel tubing: To ASTM A269, Type 302 commercial grade.

.14 Post Installed Fasteners:
- .1 Unless otherwise noted, use Type 316 stainless steel Hilti anchors secured with Hilti Hit HY 200 V3 (safe set) adhesive anchoring system.
- .2 Refer to Division 03.

.15 Grout Beneath Base Plates or Equipment levelling: Non-shrink, non-metallic, flowable, 40 MPa at seven (7) days.
- .1 Acceptable Product: 'SikaGrout 212' by Sika Canada, 'V-3 10K' by W.R. Meadows, or approved alternate.

.16 Grout beneath Equipment for levelling: Suitable for vibrating equipment, non-shrink, non-metallic, flowable, 40 MPa at 24 hrs.
- .1 'V-1' by W.R. Meadows or approved alternate.

.17 Sheet steel: Cold rolled, with stretcher level degree of flatness to ASTM A653/A653M.

.18 Provide miscellaneous materials and accessories associated with good practice that are not shown on Drawings.

2.2 FINISHES

.1 Thoroughly clean steel of loose scale, rust, oil, dirt and other foreign matter. Suitably prepare steel surfaces to receive specified finishes.

.2 Grind smooth sharp projections.

.3 Remove oil and grease by solvent cleaning.

.4 Apply coatings in the shop and before assembly. Where size permits, galvanize components after assembly.

.5 Shop primer:
- .1 For interior components:
  - .1 CAN/CGSB-1.40: Red and to Section 09900.
- .2 For exterior components to be painted: Refer to Section 09900
  - .1 Touch-up: CAN/CGSB-1.181.
  - .2 Acceptable Product: 'Inorganic Coating 'No.2000.302', by Glidden, or approved alternate.

.6 Where painted finish is specified:
- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.
- .2 Apply one (1) coat of shop primer except surfaces to be in contact with concrete.
- .3 Apply two (2) coats of primer to parts inaccessible after final assembly.
- .4 Use primer as prepared by manufacturer without thinning or adding admixtures.
- .5 Do not paint surfaces to be field welded.

.7 Hot dip galvanized all exterior components not scheduled to be painted or aluminum, components located within exterior building elements, and where indicated, interior components after fabrication in accordance with the stricter requirements of ASTM A123/ A123 M and CAN/CSA-G164, minimum coating weight 600 g/m^2.

.1 High strength bolts and anchors shall be supplied with compatible nuts.

.2 Touch up galvanized coating with zinc rich paint to CAN/CGSB-1.181.

.3 Acceptable Product: 'Galvafroid' by Fosroc, as distributed by W.R. Meadows.

.8 Where paint finish is indicated for exterior components: Blast clean metal to "Near White Grade" (SSPC-SP-10) and spray apply a coat of zinc rich paint, maximum 3 mm / 1/8" thick.

.9 Stainless steel: AISI No. 4 finish.

.10 Aluminum:

.1 Finish exposed surfaces of aluminum components to Aluminum Association (AA), Designation System for Aluminum Finishes.

.1 Structural beams or channels: Mill Finish.

.2 All exposed surfaces of interior and exterior aluminum sections with anodic oxide treatment in accordance with Aluminum Association specification #14 clear, designation AA M12C22A41.

2.3 ISOLATION COATING

.1 Isolate aluminum from following components by means of teflon gasket or alkali resistant asphaltic coating of bituminous paint to CAN/CGSB 1.108, Type 1, without thinner as recommended by manufacturer.

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area such as fasteners.

.2 Concrete, mortar and masonry.

.3 Wood.

2.4 ALUMINUM GRATINGS

.1 Fabricators must be members of National Association of Architectural Metal Manufacturers for Metal Bar Grating.

.1 Approved Suppliers:

.1 Borden Gratings.

.2 Accurate Screen & Grating.

.2 Gratings to be swaged or pressure locked hot rolled bar grating with bearing bars at 30 mm centres and cross bars at 100 mm centres.

.3 Depth of grating: As noted on Contract Drawings. All grating to be serated.

.4 All panels to be banded. Clearance at sides not to exceed 6 mm.

.5 Continuous gratings to be arranged in panels of approximately 2000 mm widths, except over slide gates, where 300 mm sections are to be used.

.6 Where grating is located over channels with equipment or gate operation required or as noted on plan, ensure that all sections of grating are less than 22kg in weight.

.7 When panels are laid side by side, ensure that carrier or spacer bars line up to preserve a continuous appearance.

.8 Grating fasteners are required to prevent movement when subject to moving loads.
- .1 Acceptable Product:
  - .1 'X-FCM-R (Stainless Steel) Fastener Disc' with compatible stud by Hilti.
  - .2 'Grate-Fast 11 Series' by Lindapter.
  - .3 Or compatible stainless steel saddle clip by Grainger, Accurate Screen & Grating, or approved alternate.

.9 Gratings to be supported on framing angles and supporting members set into or bolted to concrete as indicated.

.10 Finish:
- .1 Grating, framing angles and supporting members: Aluminum.

2.5 STEEL CHECKER PLATE COVERS

.1 Checker plate to be raised four-way pattern 6.4 mm thick steel with steel angle support frames and stiffeners as required.

.2 Hinges to be steel butt hinges.

.3 Plates may be fabricated by joining smaller plate sections together provided these sections are not narrower than 300 mm and raised patterns of all portions match directionally.

.4 Angle stiffeners shall be provided at spacing noted on Drawings in short direction of plate when span exceeds limit noted on Drawings.

.5 Provide continuous neoprene gasket at all covers noted to be gas-tight or gasketed.
- .1 Provide gasket between bolt-on angles and concrete.

.6 Provide perimeter cast-in or bolted perimeter angle on all four sides of checkered plate cover with a minimum of three (3) 6.4 mm / 1/4" diameter set screws per side.

.7 Secure checker plate covers down to supporting metal framing with flat head countersunk bolts or self-tapping screws.

.8 Secure checker plate covers down to supporting metal grating with counter-sunk flat socket cap screw bolt.
- .1 Acceptable Product: 'Plate-Grate-Fast' by Lindapter or approved alternate.

.9 Refer to Standard Details on Contract Drawings.

.10 Finish:
- .1 Checker plate cover, framing angles and angle stiffeners: Galvanized.
- .2 Fasteners: Galvanized

2.6 ALUMINUM CHECKER PLATE COVERS

.1 Checker plate to be raised four-way pattern 6.4 mm thick (minimum) aluminum with steel angle support frames and stiffeners as required.

.2 Hinges to be aluminum butt hinges.

.3 Plates may be fabricated by joining smaller plate sections together provided these sections are not narrower than 300 mm and raised patterns of all portions match directionally.

.4 Angle stiffeners shall be provided as required per the design engineer's details.

.5 Provide continuous neoprene gasket at all covers noted to be gas-tight or gasketed.
- .1 Provide gasket between bolt-on angles / aluminum framing and concrete.

.6 Provide perimeter cast-in or bolted perimeter angle on all four sides of checkered plate cover (unless noted otherwise) with a minimum of three (3) 6.4 mm / 1/4" diameter set screws per side.

.7 Secure checker plate covers down to supporting metal framing with flat head countersunk bolts or self-tapping screws.

.8 Provide hinges and collapsible lifting handles on checkered plate above all ladders.

.9 Provide hinged lifting hooks on removable checkered plate above pumps in influent pumping station.

.10 Secure checker plate covers down to supporting metal grating with counter-sunk flat socket cap screw bolt.
- .1 Acceptable Product: 'Plate-Grate-Fast' by Lindapter or approved alternate.

.11 Refer to Standard Details on Contract Drawings.

.12 Finish:
- .1 Checker plate cover, framing angles and angle stiffeners: Aluminum.
- .2 Fasteners: Stainless Steel.

2.7 MASONRY LATERAL SUPPORT BRACKETS

.1 Provide channel or angle brackets to support tops of non-loadbearing masonry partitions. Refer to Standard Details on Contract Drawings.

.2 Provide support brackets complete with all anchors and fasteners.

.3 Finish: Galvanized finish.

2.8 CORNER GUARDS

.1 Stainless Steel angle: 50 x 50 x 1.5 mm thick x 1220 mm high.

.2 Attach with adhesive.

2.9 OVERHEAD DOOR FRAMES

.1 Fabricate frames from steel, sizes of steel plate and opening as indicated.

.2 Weld steel together to form continuous frame for jambs and head of openings, sizes as indicated.

.3 Anchor to jamb frame at spacing as indicated on engineered Shop Drawings.

.4 Finish: Refer to Section 09960 – High Performance Coatings.

2.10 UNDER COUNTER SUPPORT BRACKETS

.1 Fabricate under counter brackets from 50 mm x 10 mm thick steel flat bar.

.2 Weld flat bar together to form continuous support bracket for counter tops as indicated. Space brackets for 914 mm maximum spacing for counter support.

.3 Pre-drill holes for fastening of countertop as required by Section 06400 – Architectural Woodwork.

.4 Shop prime steel under counter support brackets in accordance with Section 09900 – Painting.

2.11 BOLLARDS

.1 Fabricate bollards from standard thickness (schedule 40) pipe to details as shown on Drawings.

.2 Finish: Hot-dip galvanized.

.3 Provide smooth bollard sleeve:
- .1 Material: High density polyethylene bollard sleeve.
- .2 Size: To suit steel pipe.
- .3 Colour: Yellow. Provide 2 layers of 50 mm wide reflective tape spaced 100 mm c/c within top 300 mm of bollard.

2.12 ACCESS LADDERS

.1 Construct aluminum access ladders as indicated on Drawings.
- .1 Design of aluminum ladders by miscellaneous metals supplier.
- .2 Attach side rails to walls with bent steel brackets at maximum 1200 mm o.c vertically. Size stringer and brackets as detailed but in aluminum thickness as sized and detailed by fabricator for intended use. Pre-drill holes for bolt fastening to stringers and anchorage to wall.
- .3 Fall Prevention System: Acceptable Product: “Safetyup Posts” by Bilco or approved alternate.

2.13 SUTRO WEIRS

.1 Construct stainless steel sutro weirs in grit channels as indicated on Drawings.
- .1 Design of weir plate and reinforcement by miscellaneous metals supplier.
- .2 Dimensions and details of weir plates described in Process drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate prior to commencing with work of this Section.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FABRICATION

.1 Fabricate components in the shop in largest size practicable to minimize field jointing.

.2 Fabricate components square, straight, true, fee from warpage and other defects. Accurately cut, machine file and fit joints, corners, copes and mitres.

.3 Reinforce fabricated components to safely withstand expected loads.

.4 Make joints in built-up sections with hairline joints in least conspicuous locations and manner.

.5 Make allowance for thermal expansion and contraction when fabricating exterior work.

.6 Joints shall be welded unless otherwise indicated and unless details of construction do not permit welding. Exposed welds shall be continuous and ground smooth.

.7 Grind smooth sharp projections.

.8 Use self-tapping shake-proof round headed screws on items requiring assembly by screws or as indicated.

.9 Close exposed open ends of tubular members with welded on steel plugs.

.10 Where work of other Sections is to be attached to work of this Section, prepare work by drilling and tapping holes, as required to facilitate installation of such other work.

.11 Work of this Section, supplied for installation under other Sections, shall be prepared as required ready for installation by drilling, countersinking and tapping holes, forming shapes and cutting to required sizes.

.12 Grind off mill stampings and fill recessed markings on steel components left exposed to view.

.13 Follow recommendations of AISI Committee of Stainless Steel Producers when fabricating, joining, welding, and finishing stainless steel components. Remove heat discolouration with mechanical, chemical or electrochemical means. Provide temporary protective coverings for all stainless steel components.

.14 All aluminum fabrication to be by shop welding in an inert gas atmosphere in accordance with CSA Standards S157 and W47.2. Field joining by brazing not permitted.

.15 Where possible, fit and shop assemble work, ready for erection.

3.3 ERECTION

.1 Perform welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles as follows, unless otherwise indicated:

- .1 To concrete and solid masonry with adhesive type anchor bolts.
- .2 To hollow construction with toggle bolts.
- .3 To sheet metal with screws or bolts.
- .4 To structural steel or plates with bolts or by welding.
- .5 To wood with bolts or lag screws.
- .6 Fill space between railing members and sleeves with non-shrink grout.

.4 Provide all components required for anchoring. Make anchoring in concealed manner wherever possible. Make exposed fastenings, where approved by Consultant, neatly and of the same material, colour, texture, and finish as base metal on which they occur. Keep exposed fastenings evenly spaced.

.5 Supply components for work by other trades in accordance with Shop Drawings and schedule.

.6 Make field connections with bolts to CSA S16, unless noted on Drawings.

.7 Thread dimensions of galvanized or other plated materials to be such that nuts will thread over bolts, without rethreading or chasing.

.8 All fastenings to be selected to avoid galvanic action between dissimilar metals.

.9 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.10 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer.

.11 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

3.4 CLEANING

.1 Progress Cleaning:

- .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment

3.5 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

PART 1 - GENERAL

1.1 DEFINITIONS

.1 The term “railing” shall be taken to mean balustrades, guards, rails, and railings of all types.

1.2 REFERENCES

.1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM):
- .1 ANSI/NAAMM MBG 531, Metal Bar Grating Manual.
- .2 ANSI/NAAMM AMP, Metal Stair Manual.

.2 ASTM International:
- .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .2 ASTM A123/A123M, Standard Specification for Zinc (Hot Dipped Galvanized) Coating on Iron and Steel Products.
- .3 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
- .4 ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .5 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
- .6 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .7 ASTM A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
- .8 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .9 ASTM B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- .10 ASTM F3125/F3125M, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-1.40 (Withdrawn), Anti-corrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-85.10 (Withdrawn), Protective Coatings for Metals.
- .3 CAN/CGSB-1.181 (Withdrawn), Ready-Mixed Organic Zinc-Rich Coating.

.4 Canadian Institute of Steel Construction (CISC):
- .1 Handbook of the Canadian Institute of Steel Construction.
- .2 CISC Code of Standard Practice for Structural Steel.
- .3 CISC Steel Fabrication Quality Systems Guideline and Commentary.

.5 CSA International:
- .1 CSA G40.20-13/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CAN/CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA-S16, Limit States Design of Steel Structures.
- .4 CSA-S157/S157.1, Strength Design in Aluminum.

.5 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
.6 CSA W47.2. Certification of Companies for Fusion Welding of Aluminum.
.7 CSA W48, Filler Metals for Allied Materials for Metal Arc Welding.
.8 CSA W55.3, Certification of Companies for Resistance Welding of Aluminum.
.9 CSA W59, Welded Steel Construction (Metal Arc Welding).

.6 Green Seal Environmental Standards (GS)
.1 GS-11, Paints and Coatings.

.7 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
.1 Safety Data Sheets (SDS).

.8 National Association of Architectural Metal Manufactures (NAAMM):
.1 AMP 510, Metal Stair Manual.
.2 AMP 521, Pipe Railing Systems Manual

.9 The Master Painters Institute (MPI)
.1 Architectural Painting Specification Manual.

.10 The Society for Protective Coatings (SSPC):
.1 Systems and Specifications Manual, Volume 2.

.11 Environmental Choice Program
.1 CCD-048, Surface Coatings - Recycled Water-borne

.12 Underwriters Laboratories (UL)
.1 UL 2768, Architectural Surface Coatings

.13 NACE International
.1 ANSI/NACE No. 13/SSPC-ACS-1- 2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittals.

.2 Submit proof of approval by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

.3 Product Data:
.1 Submit manufacturer's instructions, printed Product literature and data sheets for stairs and railings and include Product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit a digital copy in PDF format of WHMIS SDS in accordance with Division 01.
.1 For finishes, coatings, primers, and paints applied on site: Indicate VOC concentration in g/L.

.4 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada for design of metal stairs and landings, handrails, guardrails and all connection details including anchorage. Shop Drawings shall indicate the following as a minimum:
.1 Design code(s).

.2 Design loads.
.3 Material design standard(s).
.4 Member sizes including orientation, layout, elevation, and location.
.5 Indicate materials, strengths, cuts, copes, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
.6 For all aluminum fabrications, clearly indicate base metal yield strength (Fy) and reduced yield strength (Fwy) at welded heat affected zones.
.7 Indicate construction details, sizes of steel sections and thickness of steel sheet.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada for design of metal to metal connections for steel and aluminum industrial-type guardrails with details shown on Contract Drawings.

.5 Submit certified test reports showing compliance with specified material performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

.1 Fabrication of metal stairs and railings to be performed only by firm fully approved by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

.2 Retain a professional engineer registered or licensed in Ontario, Canada, with experience in metal fabrication design of comparable complexity and scope, to perform following services as part of work of this Section:
.1 Design of metal stairs and landings, handrails and guardrails, complete with connections and anchorage to the performance requirements stipulated herein, the Ontario Building Code and the material standards referenced therein.
.2 Design of metal-to-metal connections for steel and aluminum industrial-type guardrails with details shown on the Contract Drawings.
.3 Review, stamp, and sign design, fabrication and erection Shop Drawings.

.3 Design Requirements:
.1 Minimum vertical live load of 4.8 kPa shall be considered.
.2 Limit live load deflection at landings and platforms to 6 mm.
.3 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

1.5 INSPECTIONS

.1 Site inspections to ensure conformance with this Section will be conducted by the inspection company appointed by Owner. Site inspections to be performed only by a firm certified by the Canadian Welding Bureau for the requirements of CSA Standard W178 (Qualification of Welding Inspection Organizations) for buildings by visual methods.

.2 Testing company services will be paid for by the Contractor from a cash allowance carried in Division 01.

.3 All site inspection procedures to be as outlined in CAN/CSA S16:19 Annex P and be performed to inspection class IC1. The following items noted as optional in CAN/CSA S16:19 shall be included in the including the inspections.

.4 All inspection procedures for aluminum components be as noted above however reviews to be in accordance with CAN/CSA S157.

.5 Supply all necessary cooperation to facilitate site inspections. Provide safe access and working areas for testing on site.

.6 Submit reports from each inspection and final report certifying that installation of all structural steel has been performed in accordance with Contract Documents.

1.6 COORDINATION

.1 Review Contract Documents and Shop Drawings related to all other trades which may affect this work. Report any discrepancies to the Consultant for review.

.2 Cooperate with all other trades to fully coordinate all dimensions, openings, details, etc. which may be required during fabrication or installation.

.3 Supply all built-in items such as anchor bolts, bearing plates, etc. unless noted otherwise. Turn over such built-in items to the trade responsible for installation.

.4 Supply all necessary cooperation to facilitate Consultant’s review of work on site. Provide safe access and working areas for review and inspection on site.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect metal fabrication items from damage.
- .3 Replace defective or damaged materials with new.
- .4 Prevent the formation of wet storage stain on galvanized articles by complying with the following measures:
  - .1 Stack articles or bundle to allow air between the galvanized surfaces during transport from supplier. Load materials in such a manner that continuous drainage can occur.
  - .2 Raise articles from the ground and separate with strip spacers to provide free access to air or most parts of the surface. Incline in a manner which will allow continuous drainage. Do not lay galvanized steel on cinders, clinkers, wet soil or decaying vegetation.
  - .3 Handle galvanized articles in such a manner as to avoid any mechanical damage and to prevent distortion.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 All metal fabrications to be constructed per the following:
- .1 Exterior guardrails and handrails: Aluminum
- .2 Exterior stair and landings: Aluminum
- .3 Interior guardrails and handrails (located in Process areas): Aluminum
- .4 Interior guardrails and handrails (located in stairwells): Galvanized Steel
- .5 Interior stairs and landings (located in Process areas): Aluminum
- .6 Interior stairs and landings (located in stairwells): Galvanized Steel

.2 All metals to be new materials free from corrosion or other defects impairing strength, durability or finished appearance, in all respects to uses required and subject to review of Consultant. All materials to be of best commercial quality for purposes specified.

.3 Hot rolled structural steel sections: To CSA G40.20/G40.21 Grade 350 W.

.4 Hollow structural sections (HSS): CAN/CSA-G40.21, Grade 350W, Class ‘C’ only, unless indicated otherwise.

.5 Steel angles and plate: To CSA G40.20/G40.21, Grade 350W.

.6 Floor plate: To CSA G40.20/G40.21, Grade 300 W, shapes and sizes as indicated on Contract Documents.

.7 Steel pipe: To ASTM A53/A53M, seamless black.

.8 Metal grating stair treads: To ANSI/NAAMM MBG 531, aluminum, with abrasive nosings. Sizes and dimensions as indicated.

.9 Aluminum sections and plates: Aluminum alloy 6061-T6 to B209-65 and B308-65 (CSA Alloy GS11N-T6). Structural sections including support angle framing and stiffeners to be 6061-T6 / 6351-T6 alloy. Fy = 240 MPa.

.10 Welding materials: To CSA W59.

.11 High strength bolts: To ASTM A F3125/F3125M, Grade A325, with compatible nuts.

.12 Anchor bolts: To ASTM F1554, Grade 55, with compatible nuts.

.13 Post Installed Fasteners:
- .1 Unless otherwise noted, use 316 stainless steel Hilti anchors secured with Hilti Hit HY 200 (safe set) adhesive anchoring system.
- .2 Refer to Division 03.

.14 Grout Beneath Base Plates or Equipment levelling: Non-shrink, non-metallic, flowable, 40 MPa at seven (7) days.
- .1 Acceptable Product: ‘SikaGrout 212’ by Sika Canada, ‘V-3 10K’ by W.R. Meadows, or approved alternate.

2.2 FINISHES

.1 Thoroughly clean steel of loose scale, rust, oil, dirt and other foreign matter. Suitably prepare steel surfaces to receive specified finishes.

.2 Grind smooth sharp projections.

.3 Remove oil and grease by solvent cleaning.

.4 Apply coatings in the shop and before assembly. Where size permits, galvanize components after assembly.

.5 Shop primer:
- .1 For interior components:
  - .1 CAN/CGSB-1.40: Grey and to Division 09.
- .2 For exterior components to be painted: EXT 5.2 C - Inorganic zinc rich paint.
  - .1 Touch-up: CAN/CGSB-1.181.
  - .2 Acceptable Product: 'Inorganic Coating 'No.2000.302' by Glidden, or approved alternate.

.6 Where painted finish is specified:
- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.
- .2 Apply one (1) coat of shop primer except surfaces to be in contact with concrete.
- .3 Apply two (2) coats of primer to parts inaccessible after final assembly.
- .4 Use primer as prepared by manufacturer without thinning or adding admixtures.
- .5 Do not paint surfaces to be field welded.

.7 Hot dip galvanize all exterior components not scheduled to be painted, components located within exterior building elements, and where indicated, interior components after fabrication in accordance with the stricter requirements of ASTM A123/ A123 M and CAN/CSA-G164, minimum coating weight 600 g/m^2.
- .1 High strength bolts and anchors shall be supplied with compatible nuts.
- .2 Touch up galvanized coating with zinc rich paint to CAN/CGSB-1.181.
- .3 Acceptable Product: 'Galvafroid' by Fosroc, as distributed by W.R. Meadows.

.8 Where paint finish is indicated for exterior components: Blast clean metal to "Near White Grade" (SSPC-SP-10) and spray apply a coat of zinc rich paint, maximum 3 mm / 1/8" thick.

.9 Stainless steel: AISI No. 4 finish.

.10 Aluminum:
- .1 Finish exposed surfaces of aluminum components to Aluminum Association (AA), Designation System for Aluminum Finishes.
  - .1 Structural beams or channels: Mill Finish
  - .2 All exposed surfaces of interior and exterior aluminum sections with anodic oxide treatment in accordance with Aluminum Association specification #14 clear, designation AA M12C22A41.

2.3 ISOLATION COATING

.1 Isolate aluminum from following components by means of teflon gasket or alkali resistant asphaltic coating of bituminous paint to CAN/CGSB 1.108, Type 1, without thinner as recommended by manufacturer.

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area such as fasteners.

.2 Concrete, mortar and masonry.

.3 Wood.

2.4 FABRICATION

.1 Fabricate in accordance with NAAMM Metal Stair Manual.

.2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.

.3 Exposed welds to be continuous for length of each joint. File or grind exposed welds smooth and flush to match finish of adjacent work.

.4 Accurately form connections with exposed faces flush:

.1 Make mitres and joints tight.

.2 Make risers of equal height.

.5 Shop fabricate stairs in sections as large and complete as practicable.

.6 All aluminum fabrication to be by shop welding in an inert gas atmosphere in accordance with CSA Standards S157 and W47.2. Field joining by brazing shall not be permitted.

.7 Items to be galvanized to be fabricated first and cleaned of welding slag, scale, etc.

.8 Thread dimensions of galvanized or other plated materials to be such that nuts will thread over bolts, without rethreading or chasing.

.9 All fasteners to be selected to avoid galvanic action between dissimilar metals.

.10 Where aluminum is permanently attached to concrete or masonry, apply bituminous enamal isolation coating on attached surface.

2.5 METAL STAIRS – GENERAL

.1 Metal Stairs:

.1 Build stairs to profiles shown. Sizes of stringers and other structural members indicated are minimum sizes.

.2 Construct stairs to safely support minimum live load of 4.8 kPa evenly distributed over treads and landings.

.3 Cope and crank stringers as necessary to lie with floor members at framed openings for stairs. Apply continuous welds to cranked stringer joints.

.4 Fabricate tread pans and support brackets for metal pan stairs from minimum 3 mm sheet steel and as indicated and continuously weld to support members. Grind exposed welds smooth.

.5 Where indicated, provide metal grating stair treads bolted or welded to stringers. Provide abrasive non-slip nosings.

2.6 METAL RAILINGS

.1 Definition: the term “railing” shall be taken to mean balustrades, guards, rails and railings of all types.

.2 Fabricate railings to sizes and general details as indicated on the Structural Architectural (SA) Drawings.

.3 Guardrails and handrails are to be constructed of Aluminum, unless noted otherwise.

.4 Fabricate railings to conform to all applicable OBC requirements.

.5 At stairs, design connections to stair to meet the requirements of OBC.

.6 Construction: unless otherwise indicated:
- .1 Galvanizing holes shall be plugged with plastic caps for exterior railings.
- .2 Close open ends of tubular members with welded metal plugs.
- .3 Turn handrails down at exposed open ends.
- .4 Turn exposed ends of wall rails into wall and terminate with end flange.
- .5 Post spacing and material thickness as per design requirements.
- .6 Cope or mitre corners, angles and intersections, weld and grind smooth.

.7 Wall Mounted Handrail:
- .1 Wall handrails: 38 mm diameter steel pipe.
- .2 Pre–manufactured Wall handrail Bracket c/w Cover: Satin stainless finish, complete with one 11 mm clear centre hole, anchoring system to meet OBC requirements, matching snap–on cover plate to conceal mounting hardware, 75 mm clearance from wall to centre of handrail.
  - .1 Acceptable Product: ‘Model No. 1962’ by R & B Wagner Inc or approved alternate.

2.7 STEEL PAN STAIRS

.1 Fabricate stairs with closed riser steel pan construction, as indicated.

.2 Form treads and risers from minimum 3 mm steel plate. Secure treads and risers to steel angles horizontal and vertical welded to stringers.

.3 Wall stringers to be formed from minimum 300 mm deep channels.

.4 Outer stringers to be formed from minimum 300 mm deep channels with 5 mm thick plate fascia welded on.

.5 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.

.6 Close ends of stringers where exposed.

.7 Finish: Galvanized steel.

2.8 GRATING TREADS AND GRATING STAIRS

.1 Where indicated on drawings, form treads and landings from open grating.

.2 Form steel grating treads and landings from metal bar grating to profile indicated and secure to stringers and supports as indicated. Form landings of grating and reinforce as required.

.3 Provide abrasive non-slip nosings as indicated.

.4 Fabricators must be members of National Association of Architectural Metal Manufacturers for Metal Bar Grating.

.1 Approved Suppliers:

.1 Borden Gratings

.2 Accurate Screen & Grating

.5 Gratings to be swaged or pressure locked aluminum grating with bearing bars at 30 mm centres and cross bars at 100 mm centres.

.6 Depth of grating: 51mm deep grating. Final size at landings by Designer.

.7 All panels to be banded. Clearance at sides not to exceed 3 mm.

.8 When panels are laid side by side, ensure that carrier or spacer bars line up to preserve a continuous appearance. Clips are required to prevent movement when subject to moving loads.

.9 Gratings to be supported on framing angles and supporting members.

.10 Framing angles and supports to be Aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal stairs and railing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate prior to commencing with work of this Section.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION OF STAIRS

.1 Install in accordance with NAAMM, Metal Stair Manual and OBC requirements.

.2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.

.3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.4 Perform welding work in accordance with CSA W59 unless specified otherwise.

.5 Exposed welds to be continuous.

.6 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

.7 Install pipe rails for handrails and guardrails to meet OBC anchoring requirements.

.8 Coordinate supply and installation of steel brackets and steel stair stringer closure panel.

3.3 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International (ASTM):
- .1 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
- .2 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Services and Other Special Purpose Applications.
- .4 ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
- .5 ASTM F3125M, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.2 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-85.10, Protective Coatings for Metals.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
- .1 Handbook of the Canadian Institute of Steel Construction.
- .2 CISC Code of Standard Practice for Structural Steel.
- .3 CISC Guide for Specifying Architecturally Exposed Structural Steel (AESS).
- .4 CISC Design module 7 – Moment Connection for Seismic Application 3rd edition.
- .5 CISC/CPMA Standard 2, Quick Drying Primer for use on Structural Steel.
- .6 CISC/CPMA Standard 1, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .7 CISC Steel Fabrication Quality Systems Guideline and Commentary.

.4 CSA Group (CSA):
- .1 CSA G40.20-13/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .2 CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA-S16, Limit States Design of Steel Structures.
- .4 CSA-S136, North American Specifications for the Design of Cold Formed Steel Structural Members.
- .5 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .6 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.
- .7 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .8 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .9 CSA W59, Welded Steel Construction (Metal Arc Welding).

.5 Master Painters Institute (MPI):
- .1 MPI-INT 5.1, Structural Steel and Metal Fabrications.
- .2 MPI-EXT 5.1, Structural Steel and Metal Fabrications.

.6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
- .1 NACE No. 3/SSPC-6, Commercial Blast Cleaning.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Submit proof of approval by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

.3 Submit proof of CISC Steel Structures Certification.

.4 Shop Drawings:

.1 Submit connection design details, erection diagrams, and shop details for each member, hereafter referred to as Shop Drawings. Structural joist Shop Drawings shall be reviewed and accepted by the Contractor prior to forwarding on to the Consultant.

.2 Shop Drawings to be submitted electronically. Quantity and format of Shop Drawings are to be in accordance with Division 01. Reproduction of Contract Documents will not be acceptable as Shop Drawings.

.3 Submit Shop Drawings in a single, complete set in order that all details may be read in conjunction with plans, elevations and all other dependent details.

.4 All materials, finishes, and loadings shall be clearly illustrated. All submittals shall be made in English with any abbreviations clearly defined.

.5 Where Shop Drawings are re-submitted, clearly illustrate all revisions from previous submissions using revision marks and "bubbles".

.6 Steel joist Shop Drawings to be stamped and signed by a qualified Professional Engineer registered in the Province of Ontario in the employ of the steel fabricator to signify that fabricator's responsibilities with respect to detailing and connection design have been completed and reviewed for compliance with Contract Documents.

.7 Clearly show, in plan, all members, bridging, bracing, connections, steel, etc.

.8 Provide details to illustrate bridging systems, splices, bearing and base plates, special joist panels, framing at openings, connections and any other non-standard items or details required by Consultant.

.9 Submit complete design calculations for all open web steel joists. Include section properties of all member components. Indicate size, type and spacing and connection details of bridging members. Provide details for member-to-member welding, bearing shoes, bearing plates, tie connections, etc. Indicate design loadings and live load deflections (expressed as a ratio of joist span). Joist calculations to be stamped and signed by Professional Engineer, registered in the Province of Ontario, who is responsible for their design.

.10 Drawings to be prepared by fabricator in accordance with A.I.S.C. Structural Steel Detailing Manual.

.11 Do not commence fabrication until complete set of Shop Drawings has been reviewed and accepted by the Consultant. Where fabrication is initiated prior to such review, all subsequently required revisions shall be at no cost to the Owner.

.5 Submit mill test reports prior to fabrication of structural steel. Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project. Mill test reports to be certified by metallurgists qualified to practice in the Province of Ontario.

.6 Provide structural steel fabricator’s affidavit stating that materials and Products used in fabrication conform to applicable material and Product standards specified and indicated.

1.3 QUALITY ASSURANCE

.1 Meetings:
- .1 Convene pre-installation meeting in accordance with Division 01 one (1) week prior to beginning steel erection.
  - .1 Ensure key personnel, site supervisor, Owner, Consultant, steel fabricator, steel erector, and steel inspector attend.

.2 Qualifications:
- .1 Fabrication of structural steel to be performed only by firm holding current and valid CISC Steel Structures Certification.
- .2 Fabrication and erection of steel joists to be performed only by firm fully approved by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

1.4 INSPECTIONS

.1 Site inspections to ensure conformance with this Section will be conducted by the inspection company appointed by Owner Site inspections to be performed only by a firm certified by the Canadian Welding Bureau for the requirements of CSA Standard W178 (Qualification of Welding Inspection Organizations) for buildings by visual methods.

.2 Testing company services will be paid for by the Contractor from a cash allowance carried in Division 01.

.3 All inspection procedures to be as outlined in CAN/CSA S16:19 Annex P and be performed to inspection class IC3. The following items noted as optional in CAN/CSA S16:19 shall be included in the inspections.

.4 Supply all necessary cooperation to facilitate site inspections. Provide safe access and working areas for testing on site.

.5 Ensure timely reviews by steel inspectors during construction and coordinate with erection sequencing. Address deficiencies as noted by the steel inspector, prior to proceeding to next sequence.

.6 Submit reports from each inspection and final report certifying that installation of all steel joist framing has been performed in accordance with Contract Documents.

1.5 COORDINATION

.1 Review all Contract Documents and Shop Drawings related to all other trades which may affect this work. Report any discrepancies to Consultant for direction.

.2 Cooperate with all other trades to fully coordinate all dimensions, openings, details, etc., which may be required during fabrication or erection.

1.6 STORAGE AND HANDLING

.1 Store and handle steel to prevent damage which will impair adequacy or appearance of material in finished structure.

.2 All members damaged during shipping, handling or erection shall be repaired to the satisfaction of the Consultant at no cost to the Owner.

.3 Store joists in vertical position, blocked off ground in such a manner as to avoid overstraining and to keep them reasonably clean.

.4 Maximum duration of site storage to be limited to one (1) month prior to installation unless provisions are made to properly protect coatings. Plans for storage of material beyond this period are to be submitted for review prior to implementation and maybe subject to recoating at the cost of the Contractor.

.5 Take special precautions when erecting long slender joists. Do not release hoisting cables until the member is laterally supported by at least one line of bridging and/or bracing.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Structural Steel:
- .1 Hot rolled structural sections and bars: Grade 350W to CAN/CSA G40.21 unless indicated otherwise.
- .2 Hollow structural sections: Grade 350W to CAN/CSA G40.21 manufactured to CAN/CSA G40.20, Class 'C' only, unless indicated otherwise. Substitution for ASTM A500 will not be accepted as equivalent. Substitution to ASTM A1085 will be subject to review and approval.
- .3 Joist material: Cold roll formed steel having a minimum yield stress of 375 MPa or hot rolled steel as above. Substitution from hot to cold rolled material are subject to approval by the Consultant
- .4 Angles and plates: Grade 300W to CAN/CSA G40.2 unless indicated otherwise.

.2 Bolts: High strength to ASTM A325M with suitable nuts and hardened steel washers.

.3 Welding Materials: Conforming to W48.3 and suitable for use intended.

.4 Paint:
- .1 Shop and touch-up paint to CISC/CPMA 2-75.
- .2 Colour of shop applied primer: Grey.
- .3 Coordinate primer with Division 09. Consider primer compatibility with intumescent paint.
- .4 Site applied final coat once structure is enclosed or properly protected: In accordance with Division 09.

2.2 DESIGN AND FABRICATION

.1 Design, fabricate, and erect open web steel joists in accordance with CAN/CSA S16 to support design loads indicated on Drawings. All concentrated point loads indicated on Drawings are in addition to uniformly distributed roof or floor design loads unless otherwise noted.

.2 Maximum demand capacity ratio for all components of OWSJ including deflection to be limited to 0.98.

.3 Prior to fabrication, review all dimensions in conjunction with all Contract Documents. Report any conflicts or uncertainties for clarification.

.4 Fabricate joists to depths indicated. Deflection under live and snow load for roofs to be as shown on Contract Drawings.

.1 Camber OWSJs as required to account for deflection due to self-weight of OWSJ and composite floor slabs. The camber of steel members shall be verified in the shop and in the field. When no camber is indicated, turn the member natural camber up.

.2 Refer to Drawings for other deflection limitations.

.5 Shop mark ends of joists designed for non-uniform loads to define orientation.

.6 Minimum length of horizontal leg of top chord angles shall be 40 mm. Minimum member thickness shall be 6 mm. Do not use single angles or other unsymmetrical shapes as web members.

.7 Provide shoe depths required to suit elevation of joist bearing surfaces and which will result in top of steel elevations noted.

.8 Where joists frame onto supporting members from one side only, ensure that reaction point of joist is centred over centroid of support member.

.9 Provide ceiling extensions where ceilings are indicated supported from joists on architectural Drawings or in finish schedule.

.10 Centre equipment supports, framing for openings, etc., over joist panel points or otherwise provide chord reinforcing or additional web members to transfer loads to panel points. Equipment sizes and weights shown on Drawings are preliminary. Coordinate between trades as required based on final equipment selection and trade contractor methods.

.11 Align web members to allow mechanical and electrical services to be run through joists without interference.

.12 Provide open panels in joists where necessary to accommodate ductwork or piping runs. Refer to mechanical and electrical Drawings and trade contractor for final duct and conduit designs.

.13 Do not cut, drill, or weld joists in the field unless authorized by Consultant and OWSJ designer. Members so modified shall be reinforced or replaced to the satisfaction of the Consultant and OWSJ designer. Attach mechanical and electrical services by means of clamping devices or U-bolt type connectors.

.14 Design and space bridging to meet requirements of CAN/CSA S16 according to chord properties of joists supplied.

.15 Install additional lines of bridging at first interior bottom chord panel point of cantilevered joists or joists subject to wind uplift.

.16 Where duct runs or equipment between joists necessitate removal of bridging, install a combination of horizontal and diagonal cross bridging between first two joists each side of section removed at each line affected. If two or more adjacent joist spaces are affected, install additional line of horizontal and diagonal cross bridging at each side of equipment, located as directed by Consultant. Final bridging configuration is the responsibility of the OWSJ designer.

2.3 PREPARATION AND CORROSION PROTECTION

.1 Clean steel joists to the requirements of SSPC - SP3 as a minimum.

.2 Apply one shop coat of primer paint except as follows:
- .1 Do not paint surfaces and edges to be field welded. If painted, remove paint for field welding for a distance of at least 50 mm on all sides of joint.
- .2 Do not paint members of portions thereof which will be encased in, or in direct contact with, cast-in-place concrete.

.3 Blast clean all steel joists which will be exposed to weather or a corrosive environment in finished structure, to requirements of SSPC - SP6. Galvanize to stricter requirements of ASTM A123/A123M or CAN/CSA-G164.

.4 Where members will be exposed to view in completed structure, carefully clean and paint so as to be free of imperfections which will mar finished painted surface.

.5 After erection, touch-up all field bolts, field welds, and all damaged or missing shop paint with one (1) touch-up coat of paint.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 ERECTION

.1 Erection of all steel joists to conform to requirements of CAN/CSA S16.

.2 Make adequate provision for erection stresses and install adequate temporary bracing to withstand all loads to which structure may be subject during erection and subsequent construction, including loads due to wind, equipment, and operation of same. Leave temporary bracing in place as long as necessary for safety or until walls and/or permanent bracing upon which frame depends for lateral stability and all connections thereto, are completed.

.3 Weld joists bearing on steel members to the supporting member with two 6 mm fillet welds, each 40 mm long, unless indicated otherwise or to suit joist connection design.

.4 Fabricate connections to comply with requirements of CAN/CSAS16. Field connections may be accomplished by welding or with high strength bolts. Perform field welding carefully so as not to cause any damage to joists, structural steel, bridging or deck.

.5 Do not weld across beam flanges or joist chord members.

.6 Install all bridging, including end connections before any construction loads are placed on joists, except weight of workers necessary to install bridging.

.7 Where bridging lines end at masonry or concrete walls, bolt bridging members to slotted holes in a vertical steel angle anchored securely to the wall. Bolts to be 13 mm diameter with vertical slots to permit a joist deflection of L/240 without binding.

.8 Where bridging lines end at structural steel members or other types of construction, install a combination of diagonal and horizontal bridging between last two joists.

END OF SECTION

PART 1- GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM D2898, Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.

.2 American Wood-Preservers' Association (AWPA):
- .1 AWPA M2, Standard for the Inspection of Preservative Treated Products for Industrial Use.
- .2 AWPA M4, Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products.

.3 Underwriter's Laboratories of Canada (ULC):
- .1 CAN-ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.4 Canadian Standards Association (CSA International):
- .1 CSA O80 Series, O80S2, Wood Preservation.
- .2 CSA O80.27-1.1, This Standard covers the fire-retardant treatment of Douglas Fir, hardwood, softwood, and Poplar plywood by pressure processes.
- .3 CSA O322, Procedure for Certification of Pressure-Treated Wood Materials for Use in Permanent Wood Foundations.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Shop Drawings:
- .1 Submit Shop Drawings to indicate type and locations for each type of Use Category (UC) for preservative lumber and plywood that will be used.

.3 For Products treated with preservative by pressure impregnation submit following information certified by authorized signing officer of treatment plant:
- .1 Information listed in AWPA M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWPA M2 applicable to specified treatment.
- .2 Moisture content after drying following treatment with water-borne preservative.
- .3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal.
- .1 Separate waste materials for reuse and recycling.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Products delivered to site must show certification mark of a Canadian Lumber Standards Accreditation Board (CLSAB), verifying that lumber has been treated in compliance to the applicable CSA treatment standard and that all quality assurance inspection procedures have been followed.

.2 Where pressure treated material is required, provide certified pressured treated material to the following minimum CLSAB Use Categories (UC) in accordance with CSA O80:

- .1 UC1: Interior use, above ground, dry, protected from weather such as but not limited to interior framing.
- .2 UC2: Interior use, above ground, damp protected conditions, but can be exposed to dampness such as, but not limited to sill plates.
- .3 UC3.1: Exterior use, above ground, protected by coating, free draining such as, but not limited to coated millwork, siding, trim.
- .4 UC3.2: Exterior use, above ground, uncoated, exposed to all weather cycles such as, but not limited to foot and deck bridgeboards, joists, bridge and deck rails.

.3 Wood elements treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

.4 Primers, Paints, and Coatings: In accordance with manufacturer's recommendations for surface conditions.

PART 3 - EXECUTION

3.1 APPLICATION: PRESERVATIVE

.1 Provide pressure treated material where indicated.

.2 Following water-borne preservative treatment, dry material to maximum moisture content of:

- .1 Lumber: 19%.
- .2 Plywood: 18%.

3.2 APPLICATION: FIELD TREATMENT

.1 Cut and site apply field treatment to preservative and fire-retardant material in accordance with manufacturer’s written recommendations for intended use.

.2 Comply with AWPA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWPA M2.

.3 Remove chemical deposits on treated wood to receive applied finish.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute/National Particleboard Association (ANSI/NPA)
- .1 ANSI/NPA A208.1, Particleboard.

.2 ASTM International
- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.
- .2 ASTM C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .3 ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- .4 ASTM C1396/C1396M, Standard Specification for Gypsum Board.
- .5 ASTM F1482, Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring.
- .6 ASTM D1761, Standard Test Methods for Mechanical Fasteners in Wood.
- .7 ASTM D5055, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
- .8 ASTM D5456, Standard Specification for Evaluation of Structural Composite Lumber Products.

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-11.3, Hardboard.
- .2 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type.
- .3 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.
- .4 CAN/CGSB-71.26, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.

.4 CSA International
- .1 CAN/CSA-A123.2, Asphalt Coated Roofing Sheets.
- .2 CAN/CSA-A247, Insulating Fiberboard.
- .3 CSA B111, Wire Nails, Spikes and Staples.
- .4 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .5 CSA O112.9, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
- .6 CSA O121, Douglas Fir Plywood.
- .7 CAN/CSA O122, Structural Glued-Laminated Timber.
- .8 CSA O141, Softwood Lumber.
- .9 CSA O151, Canadian Softwood Plywood.
- .10 CSA O153 Poplar Plywood.
- .11 CSA O325, Construction Sheathing.
- .12 CSA O437 Series, Standards on OSB and Waferboard.
- .13 CSA-Z809, Sustainable Forest Management.

.5 Forest Stewardship Council (FSC)
- .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.

.6 National Lumber Grades Authority (NLGA)
- .1 Standard Grading Rules for Canadian Lumber.

.7 Sustainable Forestry Initiative (SFI)
.1 SFI Standard.

.8 The Truss Plate Institute of Canada
.1 Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses.

.9 Underwriters' Laboratories of Canada (ULC)
.1 CAN/ULC-S706, Standard for Wood Fibre Insulating Boards for Buildings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed Product literature and data sheets for wood Products and accessories and include Product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit manufacturer's instructions, printed Product literature and data sheets for pressure treated preservative in accordance with Section 06070 – Wood Treatment.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.3 QUALITY ASSURANCE

.1 Lumber identification: By grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 All lumber shall be sound, straight, dressed all sides and kiln dried, and moisture content at any time during shipment and storage shall not exceed 19%.

.3 Grading: 120, National Grading Rule for Dimension Lumber.

.4 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect wood from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01355 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Lumber: Unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:
- .1 CAN/CSA-O141.
- .2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
- .1 S2S in accordance with the following standards:
  - .1 CSA O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber, 1987 edition.
- .2 Board sizes: "Standard" or better grade.
- .3 Dimension sizes: "Standard" light framing or better grade.
- .4 Post and timbers sizes: "Standard" or better grade.
- .5 Forest Stewardship Council (FSC) certified.
- .6 When installed over concrete block or poured concrete: Use Pressure Treated Wood.

.3 Panel Materials:
- .1 Douglas fir plywood (DFP): to CSA O121, standard construction, urea-formaldehyde free.
  - .1 Exterior locations: Canadian softwood plywood (CSP) to CSA O151, standard construction, exterior grade at all exterior locations.
- .2 Canadian softwood plywood (CSP) not exposed: to CSA O151, standard construction, urea-formaldehyde free.
  - .1 Interior locations exposed: Canadian Softwood Plywood to CSA O151, Good One (1) Side (G1S) at all interior exposed locations.
- .3 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.

.4 Wood Preservative:
- .1 Refer to Section 06070 - Wood Treatment for preservative-treated wood.

2.2 ACCESSORIES

.1 Fasteners: To CAN/CSA-G164, for exterior work, interior highly humid areas, and pressure-preservative.

.2 Nails, spikes and staples: To CSA B111.

.3 Bolts: 12.5 mm / 1/2" diameter unless indicated otherwise, complete with nuts and washers.

.4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

.5 Suitable screw fasteners for anchorage of wood blocking to steel studs or structural steel.

.6 Suitable screw fasteners for anchorage of wood blocking in the roofing system as specified in the roofing Section.

.7 Suitable screw fasteners for anchorage of wood to concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for Product installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate prior to commencing with work of this section.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

.1 Treat surfaces of material with wood preservative where indicated in accordance with Section 06070 - Wood Treatment.

.2 Confirm compatibility of treated surfaces with adjacent materials. Notify Consultant of unacceptable conditions immediately upon discovery. Proceed with treatment only after approval of adjacent materials are deemed acceptable. Treat material as indicated as follows:
- .1 Curbs, nailers, and sleepers on roof deck.
- .2 Wood furring for wood products on outside surface of exterior masonry and concrete walls.

3.3 PRESSURE TREATED COMPONENTS

.1 Use preservative pressure treated lumber and plywood within exterior wall and roof systems and at other locations indicated in accordance with Section 06070 - Wood Treatment.

.2 Where it is necessary to cut, bore or otherwise alter pressure treated components in the field, treat cut surfaces with heavy coat of wood preservative in accordance manufacturer’s written recommendations.

.3 Use fire retardant pressure treated plywood at backboards and where plywood is installed on steel stud framed wall, behind gypsum board and parapets extend beyond 610 mm / 2’-0”.

3.4 INSTALLATION

.1 Comply with requirements of OBC, supplemented by the following paragraphs.

.2 Construct and install work as indicated on Drawings.

.3 Machine dressed work shall be slow fed using sharp cutters and finished members shall be free from drag, feathers, slivers or roughness of any kind.

.4 Align and plumb faces of furring and blocking to tolerance of 1:600.

.5 Install members true to line, levels and elevations, square and plumb.

.6 Construct continuous members from pieces of longest practical length.

.7 Install spanning members with "crown edge" up.

.8 Frame materials with tight joints rigidly held in place.

.9 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by work of other trades.

.10 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.

.11 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.12 Install nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

.13 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

.14 Use caution when working with particle board. Use dust collectors and high-quality respirator masks.

.15 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.16 Countersink bolts where necessary to provide clearance for other work.

3.5 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.
- .1 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 - Construction/Demolition Waste Management and Disposal.
- .2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI):
- .1 ANSI A208.1, Particleboard.
- .2 ANSI A208.2, Medium Density Fiberboard (MDF) for Interior Applications.
- .3 ANSI/HPVA HP-1, Standard for Hardwood and Decorative Plywood.

.2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Woodwork Institute (WI):
- .1 North American Architectural Woodwork Standards (NAAWS 4.0).

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-71.20, Adhesive, Contact, Brushable.
- .2 CAN/CGSB 11.3, Hardboard

.4 CSA International:
- .1 CSA B111, Wire Nails, Spikes and Staples.
- .2 CSA O112.10, Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).
- .3 CSA O121, Douglas Fir Plywood.
- .4 CSA O141, Softwood Lumber.
- .5 CSA O151, Canadian Softwood Plywood.
- .6 CSA O153, Poplar Plywood.
- .7 CAN/CSA-Z809, Sustainable Forest Management.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.6 National Electrical Manufacturers Association (NEMA):
- .1 ANSI/NEMA LD-3, High-Pressure Decorative Laminates (HPDL).

.7 National Hardwood Lumber Association (NHLA):
- .1 Rules for the Measurement and Inspection of Hardwood and Cypress.

.8 National Lumber Grades Authority (NLGA):
- .1 Standard Grading Rules for Canadian Lumber 2010.

.9 Sustainable Forestry Initiative (SFI):
- .1 SFI-2015 Standard.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for architectural woodwork and include Product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit one (1) digital PDF copy of WHMIS SDS.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Indicate details of construction, profiles, jointing, fastening and other related details.
  - .1 Scales: Profiles and details as required, to Consultant approval, to clearly define the work.
- .3 Indicate materials, thicknesses, finishes and hardware.
- .4 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.

.4 Samples:
- .1 Submit for review and acceptance of each unit.
- .2 Samples may be returned for inclusion into work.
- .3 Submit duplicate samples of hardwood, softwood, and plywood: Sample size 305 x 305 mm / 12” x 12” or 305 mm / 12” long unless otherwise specified or requested by Consultant.
- .4 Submit duplicate samples of laminated plastic for colour selection.
- .5 Submit duplicate samples of laminated plastic joints, edging, cutouts and countertop profiles.

1.3 QUALITY ASSURANCE

.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .1 Protect millwork against dampness and damage during and after delivery.
- .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect architectural woodwork from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to work of this Section.
- .5 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Softwood lumber: Unless specified otherwise, S4S, moisture content 15% or less in accordance with following standards:

.1 CSA O141.
.2 CAN/CSA-Z809 or FSC or SFI certified.
.3 NLGA Standard Grading Rules for Canadian Lumber.
.4 AWMAC Custom grade, moisture content as specified.

.2 Machine stress-rated lumber is acceptable for all purposes.

.3 Hardwood lumber: Moisture content 5-9% or less in accordance with following standards:
.1 National Hardwood Lumber Association (NHLA).
.2 CAN/CSA-Z809 or FSC or SFI certified.
.3 AWMAC Custom grade, moisture content as specified.

.4 Douglas fir plywood (DFP): To CSA O121, standard construction, CAN/CSA-Z809 or FSC or SFI certified.

.5 Canadian softwood plywood (CSP): To CSA O151, standard construction, CAN/CSA-Z809 or FSC or SFI certified.

.6 Hardwood plywood: To ANSI/HPVA HP-1, CAN/CSA-Z809 or FSC or SFI certified.

.7 Poplar plywood (PP): To CSA O153, standard construction, CAN/CSA-Z809 or FSC or SFI certified.

.8 Interior mat-formed wood particleboard: To ANSI/NPA A208.1, CAN/CSA-Z809 or FSC or SFI certified.

.9 Birch plywood: To AWMAC Grade B/BB for clear finish, CAN/CSA-Z809 or FSC or SFI certified.

.10 Hardboard:
.1 To CAN/CGSB-11.3, CAN/CSA-Z809 or FSC or SFI certified.

.11 MDF (medium density fibreboard) core: to ANSI A208.2, thickness as indicated, density 769 kg/m², CAN/CSA-Z809 or FSC or SFI certified.

.12 Laminated plastic for flatwork: Refer to Section 06440 - Plastic Laminate Finishing.

.13 Edge Banding:
.1 Matching 3 mm / 1/8” thick PVC edging, colour as later selected by Consultant from complete colour range.
.2 Matching 6 mm / 1/4” thick solid wood to match veneer finish. Strip width to match plywood.

.14 Cabinet Hardware: Refer to Section 08700 - Cabinet and Miscellaneous Hardware.

.15 Nails and staples: To CSA B111.

.16 Wood screws: Stainless steel, type and size to suit application.

.17 Splines: Plastic or metal.

.18 Sealant: Refer to Section 07920 - Joint Sealants.

.19 Laminated plastic adhesive:
.1 Adhesive: Contact adhesive to CAN/CGSB-71.20.

2.2 FABRICATED UNITS

.1 Lower Cabinet Units:
- .1 Countertops:
  - .1 Counter tops in all areas unless otherwise indicated: Solid surface on 19 mm / ¾” plywood (DFP).
- .2 Case body, backs, shelving unit inserts, doors and gables: 19 mm / 3/4” birch veneer plywood, unless otherwise noted.
- .3 Drawers: Fronts, sides, back and bottom from 19 mm / 3/4" birch veneer plywood, unless otherwise noted.
- .4 Kickplate: 100 mm x 19 mm / 4’”x 3/4" birch veneer plywood.

.2 Upper Cabinet Units:
- .1 Case body, backs, shelving unit inserts, doors and gables: 19 mm / 3/4” birch veneer plywood, unless otherwise noted.

2.3 FABRICATION

.1 Install architectural woodwork to North American Architectural Woodwork Standards (NAAWS) of the Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Woodwork Institute (WI), Custom grade except where specified otherwise.

.2 Set nails and countersink screws apply stained wood filler to indentations, sand smooth and leave ready to receive finish.

.3 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

.4 Shelving to cabinetwork to be adjustable unless otherwise noted.

.5 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.

.6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.

.7 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

.8 Ensure adjacent parts of continuous laminate work match in colour and pattern.

.9 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 3660 mm / 12’-0”. Keep joints 610 mm / 2’-0” from sink cutouts.

.10 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

.11 Apply laminate backing sheet to reverse side of core of plastic laminate work.

.12 Apply laminated plastic liner sheet to interior of cabinetry where indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.

.1 Visually inspect substrate prior to commencing with work of this section.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Do architectural woodwork to NAAWS of AWMAC/WI.

.2 Install prefinished millwork at locations shown on Drawings.

.1 Position accurately, level, plumb straight.

.3 Fasten and anchor millwork securely.

.1 Supply and install heavy duty fixture attachments for wall mounted cabinets.

.4 Use draw bolts in countertop joints.

.5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.

.6 At junction of back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07920 - Joint Sealants.

.7 Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.

.8 Fit hardware accurately and securely in accordance with manufacturer's written instructions.

.9 Site apply laminated plastic to units as indicated.

.1 Adhere laminated plastic over entire surface.

.2 Make corners with hairline joints.

.3 Use full sized laminate sheets.

.4 Make joints only where indicated and approved by Consultant.

.5 Slightly bevel arises.

.10 For site application, offset joints in plastic laminate facing from joints in core.

.11 Apply joint sealant in accordance with Section 07920 - Joint Sealants.

3.3 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.

.1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.1 Clean millwork and cabinet work inside cupboards and drawers and outside surfaces.

.2 Remove excess glue from surfaces.

.3 Waste Management: Separate Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect millwork and cabinet work from damage until final inspection.

.2 Protect installed Products and components from damage during construction.

.3 Repair damage to adjacent materials caused by architectural woodwork installation.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)
- .1 ANSI 208.1, Particleboard.
- .2 ANSI/NEMA LD3, High Pressure Decorative Laminates (HPDL).

.2 ASTM International:
- .1 ASTM D2832, Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
- .2 ASTM D2369, Standard Test Method for Volatile Content of Coatings.

.3 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Woodwork Institute (WI):
- .1 North American Architectural Woodwork Standards (NAAWS), 4.0.

.4 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-71.20, Adhesive, Contact, Brushable.

.5 CSA International:
- .1 CSA O112.10, Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for laminate, adhesive, and core materials and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit one (1) digital PDF copy of WHMIS SDS.

.3 Samples:
- .1 Submit for review and acceptance of each unit.
- .2 Submit duplicate samples of joints, edging, and cutouts.

.4 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.5 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for laminate work for incorporation into manual specified in Section 01780 - Closeout Submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect laminate, adhesive, and core materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to work of this Section and in accordance with Section 01355 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

.1 This Specification is written on the basis of a laminated plastic finishing system by Wilsonart. Specified manufacturer’s Products establish the minimum acceptable standards for the work of this Section. Approved systems consisting of similar configuration and components by Formica or Arborite will be considered provided they are deemed to be consistent with the system indicated and components listed below. Systems not comprised of similar configuration and components will not be acceptable.

2.2 MATERIALS

.1 Laminated plastic for general flatwork: To NEMA LD3.
- .1 Laminated plastic for horizontal flatwork:
  - .1 Type: General purpose.
  - .2 Grade: HGS.
  - .3 Thickness: 1.2 mm / 0.039” thick.
  - .4 Acceptable Product: ‘Type 107’ General Purpose Laminate by Wilsonart.
- .2 Laminated plastic for vertical flatwork:
  - .1 Type: Vertical surface.
  - .2 Grade: VGS.
  - .3 Thickness: 0.77 mm / 0.030” thick.
  - .4 Acceptable Product: ‘Type 335’ Vertical Surface Laminate by Wilsonart.
- .3 Colour: Multilayered.
- .4 Pattern: Solid, and / or printed pattern, not more than four (4) colours as later selected by Consultant.
- .5 Finish: Satin.

.2 Laminated plastic adhesive: Contact adhesive to CAN/CGSB-71.20.

.3 Sealer: Water resistant sealer or glue acceptable to laminate manufacturer.

.4 Sealants: Refer to Section 07920 – Joint Sealants.

.5 Draw bolts and splines: As recommended by fabricator.

2.3 FABRICATION

.1 Comply with NEMA LD3, Annex A.

.2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

.3 Ensure adjacent parts of continuous laminate work match in colour and pattern.

.4 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up 3660 mm / 12’-0”. Keep joints 610 mm / 2’-0” from sink cutouts.

.5 Form shaped profiles and bends as indicated, using postforming grade laminate to laminate manufacturer's instructions.

.6 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

.7 Apply laminate backing sheet to reverse side of core of plastic laminate work.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for laminate, adhesive, and core materials installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate prior to commencing with work of this Section.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 MANUFACTURER’S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.3 INSTALLATION

.1 Install work plumb, true and square, neatly scribed to adjoining surfaces.

.2 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.

.3 Use draw bolts and splines in countertop joints. Maximum spacing 450 mm / 18” on centre, 75 mm / 3” from edge. Make flush hairline joints.

.4 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.

.5 At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant.

.6 Site apply laminated plastic to units as indicated. Adhere laminated plastic over entire surface. Make corners with hairline joints. Use full sized laminate sheets. Make joints only where indicated on reviewed shop drawings. Slightly bevel arises.

.7 For site application, offset joints in plastic laminate facing from joints in core.

3.4 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.
- .1 Clean to NEMA LD3, Annex B.
- .2 Remove traces of primer, caulking, epoxy and filler materials and clean doors and frames.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Cover finished laminated plastic surfaces with heavy kraft paper or put in cartons during shipment.

.2 Protect installed laminated surfaces in accordance with manufacturer's written recommendations.
- .1 Remove protection only immediately before final inspection.

.3 Protect installed Products and components from damage during construction.

.4 Repair damage to adjacent materials caused by laminate, adhesive, and core materials installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM C365/C365M, Standard Test Method for Flatwise Compressive Properties of Sandwich Cores.
- .2 ASTM D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
- .3 ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- .4 ASTM D638, Standard Test Method for Tensile Properties of Plastics.
- .5 ASTM D695, Standard Test Method for Compressive Properties of Rigid Plastics.
- .6 ASTM D696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer.
- .7 ASTM D785, Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Material.
- .8 ASTM D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- .9 ASTM D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
- .10 ASTM D2240, Standard Test Method for Rubber Property-Durometer Hardness.
- .11 ASTM D2583, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- .12 ASTM D6329, Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.
- .13 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .14 ASTM E228, Standard Test Methods for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer.
- .15 ASTM G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .16 ASTM G22, Standard Practice for Determining Resistance of Plastics to Bacteria.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.3 International Standards Organization (ISO)
- .1 ISO 19712-2, Plastics – Decorative solid surfacing materials.
- .2 ISO 4586-2, High-pressure decorative laminates (HPL, HPDL) – Sheets based on thermosetting resins.

.4 Terrazzo, Tile and Marble Association of Canada (TTMAC)
- .1 2019/2021 Specification Guide - Tile Installation Manual.

.5 Underwriter’s Laboratories of Canada (ULC)
- .1 CAN/ULC-S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

1.2 GENERAL DESCRIPTION

.1 Work in this Section includes interior sill installation and other items utilizing solid surfacing fabrication as shown on the Drawings and as described in this Specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected. Variation in component size and location of openings to be plus or minus 1.5 mm / 1/16".

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed Product literature and data sheets for solid surfacing components and include Product location and characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS SDS in accordance with Section 01350 - Health and Safety Requirements.

.3 Shop Drawings:

- .1 Submit Shop Drawings. Indicate details of construction, profiles, jointing, fastening and other related details.
  - .1 Scales: Profiles and details as required, to Consultant approval, to clearly define the work.
- .2 Indicate materials, thicknesses, finishes and hardware.
- .3 Indicate connections, attachments, anchorage locations and coordination requirements with adjacent work.

.4 Samples:

- .1 Submit for review and acceptance of each unit.
- .2 Submit duplicate samples of a 300 mm wide x 150 mm deep / 1'-0" wide x 6" deep minimum sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples may be retained as a standard for this work to Consultant approval.

1.4 QUALITY ASSURANCE

.1 Mock-up:

- .1 Prior to commencing with the work, provide a full-size mock-up for Consultant approval. Mock-up to include all solid surfacing components required to provide a completed unit. The mock-up shall utilize finishes in patterns and colors indicated on the Drawings.
- .2 Should the mock-up not be approved, re-work or remake mock-up until approval is secured. Remove all rejected units from jobsite.
- .3 Fabricator for welded steel connections to be certified to CSA W47.1.
- .4 Approved mock-up may remain as part of the finished work to Consultant approval.
- .5 Allow 72 hours for inspection of mock-up by Consultant before proceeding with the work.

.2 Qualifications:

- .1 To ensure warranty coverage, solid surfacing fabricators shall be certified with a minimum five (5) years experience working with solid surfacing materials by the solid surfacing material manufacturer. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials listed in this Section only when ready for installation. Deliver materials undamaged, in original packages, containers or bundles bearing manufacturers brand name and identification.

.2 Delivery and Acceptance Requirements:

.1 Minor chipping resulting from shipment, delivery and installation will be grounds for rejection.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, under cover, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Protect from weather, other elements and damage from construction operations and other causes.

.3 Handle solid surfacing components to prevent damage to edges, ends or surfaces. Protect all accessories and trims from being bent or damaged.

.4 Develop Waste Reduction Workplan related to work of this Section and in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.6 SITE ENVIRONMENTAL REQUIREMENTS

.1 Maintain temperature minimum 10 degrees C, maximum 21 degrees C for 48 hours prior to and during installation of solid surfacing, and for at least 48 hours after completion of joint treatment.

.2 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

1.7 EXTENDED WARRANTY

.1 Manufacturer's warranty of ten (10) years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty to cover material and labor for replacement or repair of defective material for a period of ten (10) years after component installation.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Solid surfacing components: Cast, nonporous, homogenous composition of polymer, fillers, and pigments; not coated, laminated or of composite construction with through-body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified to the following physical properties:

.1 Density: 1.7 g/cm³ to ASTM D792.

.2 Thermal Expansion: 3.9 x 10-5 m/m ºC (2.2 x 10-5 in./in. ºF) to ASTM E228.

.3 Hardness – Rockwell “M” Scale: >85 to ASTM D785.

.4 Hardness Barcol Impressor: 56 to ISO 19712-2 (ASTM D2583).

.5 Flexural Modulus: 1.2 x 106 psi to ASTM D790.

.6 Flexural Strength: 10,000 psi to ASTM D790.

.7 Tensile Modulus: 1.5 x 106 psi to ASTM D638.

.8 Tensile Strength: 6,000 psi to ASTM D638.
.9 Tensile Elongation: 0.4% min. to ASTM D638.
.10 Compressive Strength: 16,000 psi to ASTM C365.
.11 Stain/chemical-resistance test: Pass to ISO 19712-2.
.12 Resistance to cigarette burns: Pass to ISO 19712-2.
.13 Resistance to dry heat: Pass to ISO 19712-2.
.14 Resistance to wet heat: Pass to ISO 19712-2.
.15 Hot/cold cycle water-resistance test: Pass to ISO 19712-2.
.16 Load test: Pass to ISO 19712-2.
.17 Dimensional stability: Pass to ISO 4586-2.
.18 Resistance to surface wear: 0.18% wt/25 revolutions to ISO 4586-2.
.19 Fungal resistance: ASTM rating of 0, No Observed growth on Product at 100x power to ASTM G21.
.20 Bacterial resistance: No observed growth on Product at 100x power to ASTM G22.
.21 Microbial resistance: Highly resistant to mold growth to UL 2824 (ASTM D6329).
.22 Flammability: Class A to NFPA 101 - Life Safety Code.
.23 Flame spread index: <25 to ANSI/UL 723 (ASTM E84, NFPA 255).
.24 Flame spread rating: 0 to CAN/ULC-S102.2.
.25 Smoke developed index: <25 to ANSI/UL 723 (ASTM E84, NFPA 255).
.26 Smoke development rating: 5 to CAN/ULC-S102.2.
.27 Superficial damage to a depth of 0.25 mm / 0.010” repairable by sanding and/or polishing.
.28 Acceptable Product:
    .1 ‘Corian Solid Surface’ by Dupont, or ‘Wilsonart Solid Surface’ by Wilsonart, or approved alternate.

2.2 COMPONENTS

.1 Solid surfacing panels: Natural polymer, 12 mm / 1/2" solid, hard and durable, and of uniform strength with 6-8 mm beveled edge between cap and front return.
    .1 Edge Detail: Edge profile as indicated on Drawings.
    .2 Length: One piece to suit application.
    .3 Colour: Not more than four (4) colours from manufacturer’s complete colour range.

.2 Accessories General: Provide accessory Products, as specified below, from the solid surfacing manufacturer or provide Products approved by the solid surfacing manufacturer for intended use.

.3 Seam Adhesive: As required and approved by manufacturer to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid surfacing materials and components to create a monolithic appearance of the fabrication.
    .1 Colour: Colour-match adhesive to the surfaces where solid surfacing materials are being bonded together.

.4 Panel Adhesive: To solid surfacing manufacturer written recommendations for use to bond solid surfacing components to adjacent and underlying substrates, neoprene based, Underwriter's Laboratories (UL) listed.

.5 Sealant: Sealants in accordance with Section 07920 - Joint Sealants unless otherwise indicated.

.6 Mounting Hardware: As required by manufacturer for mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

2.3 MANUFACTURED UNITS

.1 Counter and Vanity Top Splashes: Fabricate backsplashes and end splashes from 12 mm / 1/2" thick solid surfacing material x 100 mm / 4” high to dimensions and shapes as indicated on the Drawings. Provide solid surfacing backsplashes and end splashes to all counter tops and vanity tops as indicated on the Drawings. Fabricate and install backsplashes for permanent installation.

.1 End Splashes: Supply end splashes loose for site installation at the jobsite. Install where indicated.

.2 Counter and Vanity Tops: Fabricate solid surfacing countertop and vanity top components from 12 mm / 1/2” thick material. Provide edge details, dimensions, locations, and quantities as indicated on the Drawings. Fabricate counter tops complete with 100 mm / 4” high permanently attached, 90-degree transition, permanently attached with coved transition backsplash and loose end splashes at locations as indicated on the Drawings. Attach 50 mm / 2” wide reinforcing strip of solid surfacing material under each horizontal countertop seam.

.1 Counter and Vanity Tops with Sinks: Obtain sink and plumbing fixture templates and mounting instructions as furnished by the sink and plumbing fixture manufacturers. Provide counter and vanity tops with cutouts to accept sinks and plumbing fixtures. Fabricate solid surfacing counter and vanity tops to accept manufacturer's standard mounting hardware for, rimless sink and plumbing fixtures. Install sink with watertight seam between sink and counter and vanity tops. Coordinate sink, faucet, and plumbing requirements in accordance with Division 15.

.2 Counter Tops with Cutouts for Hot or Cold Appliances: Obtain templates and mounting instructions as furnished by hot or cold appliance manufacturers. Provide counter tops with reinforced joints and cutouts as required to accept hot or cold appliances. Provide insulation between solid surfacing and all hot or cold appliances. Thermally isolate hot applications from cold applications in accordance with the solid surfacing manufacturer's instructions. Provide expansion joints as necessary to accommodate hot appliances. Where cabinets exist beneath counter tops, provide adequate ventilation to prevent heat build-up.

.3 Shower Wall Panel Enclosure:

.1 Provide shower wall enclosures from solid surfacing components, dimensions as indicated. Include panels, corner trim, recessed soap dish, recessed shampoo shelf, formed barrier-free seat as per Drawings meeting requirements of Ontario Building Code, panel edge trim and other accessories as indicated. Form 6 mm / 1/4" thick sheet panels full width and height with seams occurring only at inside corners of the enclosure. Field cut as required to accept standard manufacturer’s dimensions.

.2 Shower wall enclosures to provide secure backing for grab bars as indicated on Drawings, refer to Section 10800 - Toilet and Bath Accessories.

.3 Colours: As later selected by Consultant from manufacturer’s standard colour range.

.4 Shower Pans:

.1 Provide shower pans from solid surfacing components with minimum wall thickness as follows:

.1 Typical wall thickness unless otherwise indicated: 13 mm / 1/2".

.2 Wall thickness at 300 mm / 12” diameter area around drain, at top of threshold and at shower pan ledges: 19 mm / 3/4".

.2 Water barrier flange (weep edge): 6 mm / 1/4" thick and extend a minimum of 38 mm / 1 1/2" above top of shower pan ledges.

.3 Minimum coving: 38 mm / 1-1/2" radius between shower pan floor and shower pan sidewalls and vertically coving between adjacent shower pan sidewalls.

.4 Slip resistant non-textured surface.

.5 Barrier-free threshold as per Ontario Building Code, refer to Drawings.

.6 Support system: Self-supported with cast integral webbing structure. Foam, fillers, or composite materials for structural support will not be accepted.

.7 Colours: As later selected by Consultant from manufacturer's standard colour range.

2.4 FABRICATION

.1 Shop-fabricate components to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Route contours and radii from site obtained template to provide smooth edges. Defective and inaccurate work will be rejected.

.2 Joints and seams: Form joints and seams between solid surfacing components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

.3 Edge Finishing Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, complete with any inserts, to profiles as detailed on the Drawings. Repair or reject defective or inaccurate work.

PART 3 - EXECUTION

3.1 COORDINATION

.1 Installation of solid surfacing components and assemblies will require sound substrate by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid surfacing fabricator / installer and other trades to ensure structural base support, proper clearances, and other supporting components will be provided for the installation of solid surfacing components as required by the solid surfacing manufacturer. Contractor to coordinate and provide appropriate substrates and staging areas for solid surfacing installations.

3.2 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for solid surfacing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate prior to commencing with work of this Section.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.3 INSTALLATION

.1 Install all components and fabricated units plumb, level, and rigid. Field joints between solid surfacing components to provide a monolithic appearance using solid surfacing manufacturer's approved seam adhesives, with joints inconspicuous in the finished work.

.2 Form field joints using manufacturer's recommended adhesive with joints inconspicuous in finished work. Reinforce joints as required.

.3 Wall Panels, Panel Systems, Enclosures and Pans: Install wall panels, panel systems, enclosures and pans with system components as recommended by surfacing manufacturer. Fasten panels to substrates using panel adhesive. Adhere solid surfacing components to panel systems, enclosures and pans with seam adhesive unless otherwise indicated. Seal all inside corners and expansion joints between solid surfacing components sealant. Seal all joints between solid surfacing components and non-solid polymer surfaces with sealant.

.4 Sealant: In accordance with Section 07920 - Joint Sealants.

3.4 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.
- .1 Clean solid surfacing components and adjacent surfaces.
- .2 Remove excess glue from surfaces.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by solid surfacing installation.

.3 Protect installed Products and components from damage during construction.

.4 Protect solid surfacing components from damage until final inspection.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB):
- .1 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .2 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .3 CAN/CGSB 37.58-M86, Membrane, Elastomeric, Cold-Applied Liquid, for Non-Exposed Use in Roofing and Waterproofing.

.2 Canadian Roofing Contractors Association (CRCA):
- .1 CRCA Roofing Specifications Manual.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Provide two copies of most recent technical waterproofing components data sheets describing materials' physical properties and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide WHMIS SDS for:
  - .1 Primers.
  - .2 Asphalt.
  - .3 Sealers.
  - .4 Fabric.
  - .5 Drainage board complete with accessories.

.3 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

.4 Test and Evaluation Reports:
- .1 Submit laboratory test reports certifying compliance of bitumens, fabric and drainage board with Specification requirements.
- .2 Compatibility of materials: Submit written declaration to Consultant as described in PART 2, PERFORMANCE CRITERIA.

.5 Manufacturer's Installation Instructions: Provide manufacturers complete set of standard details for waterproofing systems including special handling criteria, installation sequence, and cleaning procedures.

.6 Manufacturer's field report:
- .1 Manufacturer's Field Reports: Submit manufacturer's written reports within three (3) Working Days of review, verifying compliance of work, as described in PART 3 - FIELD QUALITY CONTROL.
- .2 Indicate procedures followed, ambient temperatures and wind velocity during application.

1.3 QUALITY ASSURANCE

.1 Perform work in accordance with the printed requirements of the membrane manufacturer and this specification. Advise Consultant of any discrepancies prior to commencement of the work.

.2 Maintain one (1) copy of manufacturer’s literature on site throughout the execution of the work.

.3 At the beginning of the work and at all times during the execution of the work, allow access to site by the waterproofing membrane manufacturer’s representative.

.4 Submit documentation certifying that the primary material complies with CAN/CGSB 37.58.

.5 Materials used in this Section, including, primers, mastics and membranes, asphaltic protection boards, composite drainage boards and expansion joint membranes shall be fully compatible and shall be sourced and or produced by one manufacturer.

.6 Submit copies of the membrane manufacturers current ISO certification including the manufacturing of the membrane, primer, mastics, adhesives and asphaltic protection board.

.7 Convene pre-installation meeting one (1) week prior to beginning waterproofing work, with waterproofing contractor's representative and Consultant in accordance with Section 01320 - Construction Progress Documentation to:

- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

.8 Site Meetings: As part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review work, at stages listed.

- .1 After delivery and storage of Products, and when preparatory work is complete, but before installation begins.
- .2 Twice during progress of work at 25% and 60% complete.
- .3 Upon completion of work, after cleaning is carried out.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

.2 Store cold applied elastomeric membrane in closed containers outdoors.

.3 Store membrane at temperature of 5 degrees C and above to facilitate handling.

.4 Do not use membranes containing petroleum solvents near open flame.

.5 Store role materials horizontally in original packaging.

.6 Store adhesives and primers at temperatures of 5 degrees C and above to facilitate handling.

.7 Keep solvents away from open flame or excessive heat.

1.5 SITE CONDITIONS

.1 Ambient Conditions:

.1 Apply built-up bituminous membranes only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

.2 Do not install built-up bituminous membranes when air and substrate temperature remains below 5 degrees C in accordance with manufacturer's recommendations or when wind chill gives equivalent cooling effect.

.3 Install built-up bituminous membranes on dry substrate, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into system.

.2 Do not perform Work during rainy or inclement weather and on frost or wet covered surfaces.

1.6 EXTENDED WARRANTY

.1 For the Work of this Section, the twelve (12) months warranty period prescribed in subsection GC 12.3 of General Conditions is extended to Ten (10) years.

.2 Contractor hereby warrants that the waterproofing membrane will stay in place and remain leakproof in accordance with GC12.3, but for two (2) years.

.3 Waterproofing membrane manufacturer hereby warrants that the waterproofing membrane will remain in a watertight condition and will not leak as a result of faulty materials for a period of Ten (10) years. Scope of warranty shall include materials required to return the membrane to a watertight condition.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

.1 Provide components and materials from a single-source membrane manufacturer to ensure total system compatibility and integrity.

.2 Compatibility between components of waterproofing system is essential. Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.

2.2 MATERIALS

.1 Asphalt:

.1 For application and curing at temperatures above 5°C: to CAN/CGSB-37.2.

.1 Primary cold applied elastomeric asphalt emulsion waterproofing membrane in compliance with CGSB 37.2, a one component waterproofing compound.

.2 Acceptable Product: ‘Aqua-Bloc 720-38’ Elastomeric Asphalt Emulsion Waterproofing Membrane by Henry Company Canada, or approved alternate.

.2 For application and curing at temperatures below 5°C: To CAN/CGSB-37.16.

.1 Primary cold applied elastomeric waterproofing membrane in compliance with CGSB 37.58, a one-component waterproofing compound.

.2 Acceptable material: ‘Aqua-Bloc 770-06’ Cold Applied Elastomeric Membrane by Henry Company Canada, or approved alternate. Sealing compound: to waterproofing manufacturer's written recommendations.

.2 Fabric:

.1 Polyester reinforced sheet capable of allowing the membrane to bleed through adequately to provide monolithic reinforced membrane system.

.2 Acceptable Product: ‘Polyester Fabric’ or ‘990-06 Yellow Jacket’ by Henry Company Canada, or approved alternate.

.3 Prefabricated Drainage Board (vertical application): Prefabricated Composite Drainage Board, a polypropylene core board with polypropylene fabric attached, having the following physical properties:

.1 Flow rate: 223 L/min/m,

.2 Compressive strength: 15,200 psf.

.3 Thickness: 10 mm / 3/8”.

.4 Acceptable Product: ‘DB 6200’ by Henry Company Canada, or approved alternate.

.4 Prefabricated Drainage Board Accessories

.1 Securement Bars: Continuous 6 mm x 20 mm / 1/4" x 3/4" HDPE bar for screw attachment.

.2 Moulding Strip: Continuous 90 mm / 3 1/2" wide “Z” flashing strip to fit over exposed top edge of drain board.

.3 Drain Board Plugs & Nails: HDPE pre-moulded washer to fit dimples c/w high strength, corrosion resistant concrete nails, UCAN AFH 37 or equal.

.4 Termination Sealant: A polymer-modified sealing compound, compatible with sheet waterproofing membrane, substrate and insulation materials, complies with CGSB 37.29, remains flexible with ageing and chemically resistant to alkalis, calcium chloride, mild acid and salt solutions.

.1 Acceptable Product: ‘Polybitume 570-05’ by Henry Company Canada, or approved alternate.

PART 3 - EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

.1 Comply with manufacturer's written data, including product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for asphalt waterproofing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate prior to commencing with work of this Section.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

.2 Do examination, preparation and waterproofing work in accordance with Waterproofing Manufacturer's Specification Manual.

3.3 PREPARATION

.1 Prior to applying waterproofing:

.1 At all corners and angles, and at the junctions of waterproofing on foundation walls with footings, reinforce membrane with two (2) additional coats of waterproofing membrane and two (2) plies of fabric reinforcement extending at least 100 mm / 4” each side of the junction.

3.4 APPLICATION

.1 Apply waterproofing in accordance with manufacturer's written recommendations except where specified otherwise.

.2 Seal work in accordance with CGSB 37-GP-11M except where specified otherwise.

.3 Prime surfaces in accordance with CGSB 37-GP-15M except where specified otherwise.

.4 Apply waterproofing in accordance with applicable CGSB application standard.

.5

Material	Application	
CAN/CGSB-37.2	use	CAN/CGSB-37.3
CAN/CGSB-37.16	use	CGSB 37-GP-36M

.6 Apply continuous, uniform coating to entire exterior faces of foundation walls from 50 mm / 2” below finished grade level to and including tops of footings.

.7 Apply continuous, uniform coating to exterior side of foundation.

.8 Apply two (2) additional coats of waterproofing to vertical corners and construction joints for a minimum width of 230 mm / 9” on each side, and all around and for 230 mm / 9” along pipes passing through walls.

.9 Lap and seal waterproofing membrane system over below slab vapour retarder to ensure a continuous waterproofing system.

3.5 APPLICATION OF WATERPROOFING MEMBRANE SYSTEM

.1 To all cracks and cold joints less than 3 mm / 1/8” apply a coat of primary waterproofing membrane at a minimum thickness of 2.3 mm / 0.09” and reinforce with fabric reinforcement.

.2 To all cracks greater than 3 mm / 1/8”, prime area and install self-adhered flashing membrane. Overlap end joint of sheet a minimum 75 mm / 3”.

.3 At footing to foundation wall junctions apply a coat of primary waterproofing membrane at a minimum thickness of 2.3 mm / 0.09”and reinforce with fabric reinforcement followed by second coat.

.4 Apply a full and continuous coat of primary waterproofing membrane at approximately 1.5 L/m^2 and embed fabric reinforcement into coating ensuring no fishmouths or wrinkles are created and allow to set. Allow membrane to fully cure/dry prior to subsequent application coatings.

.5 Apply second full and continuous coat of primary waterproofing membrane at 1.5 L/m^2 and allow to cure.

3.6 INSTALLATION OF DRAINAGE BOARD (VERTICAL APPLICATION)

.1 Align and hang drainage up to foundation wall. Position bottom edge of drainage board to be in moderate contact with weeping system.

.2 Secure drainage board to foundation wall with nails and washers spaced 450 mm / 18” o/c horizontally. Install minimum of two (2) rows staggered and spaced 152 mm / 6” apart and minimum 152 mm / 6” from top edge.

.3 Align and install termination strip along top edge with nails spaced 305 mm / 12” o/c and seal with termination sealant.

.4 Align and install moulding strip over completed top edge detail.

.5 Overlap end laps; pull back loose fabric to expose drain core and position core of second panel over the overlap flange of first panel.

.6 Bend drain board to create inside corners and cut board to create outside corners, provide 75 mm / 3” of extra fabric to wrap corner.

.7 Stagger or offset joints of drain board sheets.

.8 Place all subsequent sheets in an overlapping single fashion.

.9 Backfill bottom edge in conjunction with weeping tile system.

3.7 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 Promptly as the work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing work.

3.9 PROTECTION

.1 Protect completed waterproofing from precipitation or contact with ground water until ready for backfilling or simultaneously backfilling after each panel course completed.

.2 Remove protection before backfilling.

.3 Protect waterproofing with protection board from damage by backfilling or other causes.

.4 Protect waterproofing from frost damage in accordance with manufacturer's instructions.

3.10 SCHEDULE

.1 Unless noted otherwise, to all areas scheduled to receive waterproofing apply the following system:
- .1 Asphalt coating.
- .2 Waterproofing Reinforcing Fabric.
- .3 Asphalt coating.
- .4 Drainage Board.

.2 For areas below the slab, apply Under Slab Vapour Retarder in accordance with Section 07260 – Vapour Retarders:

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM):
- .1 ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- .2 ASTM C612, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
- .3 ASTM C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .4 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .5 ASTM C1104/C1104M, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
- .6 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .7 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.
- .8 ASTM E136, Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C.

.2 Canadian General Standards Board (CGSB):
- .1 CGSB 71-GP-24M, Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.

.3 CSA Group:
- .1 CSA B149 PACKAGE-15, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

.5 Underwriters Laboratories of Canada (ULC):
- .1 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S114, Fire Test for Determination of Non-combustibility in Building Materials.
- .3 CAN/ULC-S604, Standard for Type A Chimneys.
- .4 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
- .5 CAN/ULC-S702, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .6 CAN/ULC-S704, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed Product literature, Specifications and data sheet.
- .2 Submit two copies of WHMIS SDS - Safety Data Sheets. Indicate VOC's for insulation Products and adhesives.

.3 Certificates:

.1 Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.4 Test Reports:

.1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01320 - Construction Progress Documentation.

.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordinate with other building subtrades.
.4 Review manufacturer's installation instructions and warranty requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 INSULATION

.1 Extruded polystyrene (XPS) for frost protection, foundation walls where indicated:

.1 Compliance: Closed cell, Type 4 to CAN/ULC-S701.
.2 Compressive strength: 30 psi / 210 kPa.
.3 Thickness: 50 mm / 2”.
.4 R-Value / inch (25.4 mm / 1”): RSI 0.88 / R5.0.
.5 Size: Width to suit application.
.6 Edges: Shiplapped for foundation walls and frost protection and below slabs.
.7 Acceptable Product: 'Styrofoam Brand SM' by Dupont, ‘Foamular C-300’ by Owens Corning, or approved alternate.

.2 Stone/Mineral Wool Insulation for Exterior Cavity Walls:

.1 Compliance: ASTM C612 Type IVB and CAN/ULC-S702 Type 1 mineral fiber insulation.
.2 Fire Performance: ASTM E136 and CAN/ULC-S114, non-combustible.

.3 Fire Performance, Surface Burning Characteristics: ASTM E84 (UL 723) and CAN/ULC S102, flame spread 0 and smoke developed 0.

.4 Water Vapor Transmission: ASTM E96: 27.2 to 33.1 perms (1555 to 1895 mg Pa.s.m^2).

.5 Moisture Resistance: ASTM C1104, moisture sorption: 0.03 to 0.07 percent.

.6 Thermal Resistance to ASTM C518 (C177),

.1 R-value of 4.2 to 4.3 per inch at 75 degrees F (RSI value 0.74 to 0.76 m m2K/W at 24 degrees C).

.7 Corrosive Resistance: ASTM C665, Corrosiveness to Steel - Pass, ASTM C795, Stainless Steel Stress Corrosion Specification as per Test Methods C871 and C692.

.8 Dual Density to ASTM C303, 100 kg/m^3 6.2 / lbs/ft^3 outer layer and 61 kg/m^3 3.8 / lbs/ft^3 inner layer.

.9 Thickness: As indicated on Drawings.

.10 Dimensions: To suit application.

.11 Acceptable Product:

.1 'CavityRock' by Rockwool, 'Thermafiber Rainbarrier 45' or 'Thermafiber Rainbarrier HD' by Owens Corning, or approved alternate.

.3 Semi-Rigid Insulation for Standing Seem Roof System:

.1 Semi-rigid stone wool insulation boards designed for metal roof system. Conform to CAN/ULC-S114 & CAN/ULC S702. CFC and HCFC free.

.2 Dimensions: to suit application

.3 Thickness: as indicated on Drawings.

.4 Material selected must be supported by membrane manufacturer's warranty.

.5 Thermal Clips and z girt in conformance with Section 07410 Preformed Metal Wall and Roof Cladding Systems.

.6 Acceptable Products:

.1 'CavityRock' by Rockwool

.2 Or approved alternate.

2.2 ACCESSORIES

.1 Insulation Fasteners: Mechanically driven insulation fasteners fabricated from high density polyethylene plastic, complete with zinc plated pin, holding diameter and fastener depth as recommended by manufacturer to suit substrate, insulation type and thickness.

.1 Acceptable Product: 'Ramset Insulfast Fastener' by Ramset, 'Grid-Mate PB Mechanical Fasteners' by Grid-Mate, or approved alternate.

.2 Adhesive (for polystyrene): To CGSB 71-GP-24.

.1 Acceptable Product: 'Air-Bloc 21' by Henry Company Canada, or approved alternate.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for board insulation application in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

.2 Prior to commencement of work ensure:

.1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.3 INSTALLATION

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

.4 Keep insulation minimum 75 mm / 3” from heat emitting devices such as recessed light fixtures, and minimum 50 mm / 2” from sidewalls of CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.

.5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.6 Offset both vertical and horizontal joints in multiple layer applications.

.7 Do not enclose insulation until it has been reviewed and accepted by Consultant.

3.4 PERIMETER FOUNDATION INSULATION

.1 Exterior application: Extend boards below grade as indicated on Drawings. Install on exterior face of perimeter foundation wall with adhesive.

3.5 SYSTEM RIGID INSULATION INSTALLATION

.1 Cavity Wall Insulation Installation in Exterior Wythe Masonry:

.1 In locations with exterior wythe masonry, place insulation boards tightly between masonry ties. Secure in place with insulation fasteners, minimum 5 per 603 x 1220 mm / 2’ x 4’ board, locate one (1) at each corner at minimum 150 mm / 6” from edge each edge of board and one in center of board.

.2 Metal Roof System Insulation Installation in thermal clips and adjustable Z-Girt Locations over air / vapour barrier membrane:

.1 Install first layer of insulation tight to air / vapour barrier using adhesive.

.2 Using a notched trowel, trowel air/vapour barrier membrane adhesive in ribbon strips to back of insulation board as required, and as recommended by manufacture, for firm tight contact to air/vapour substrate.

.3 Butter air/vapour barrier membrane adhesive around all board insulation edges to eliminate any potential air gaps between adjacent boards.

.4 Install boards placed tightly together with no gaps between adjacent boards.

.5 Install boards placed tightly with no gaps between back of insulation board and air / vapour membrane.

3.6 ROOF INSTALLATION

.1 Refer to Section 07550 - Modified Bituminous Membrane Roofing.

3.7 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM C553-11, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .2 ASTM C665-12, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .3 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
- .4 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 Canadian Gas Association (CGA)
- .1 CSA ONT GAS CODE 1996 Ontario Gas Utilization Code, 1996 (Includes Energy Act, Regulation and CAN/CGA-B149.1).
- .2 CSA ONT PROPANE CODE 1996 Ontario Propane Code, 1996 (Includes Ontario Energy Act and Regulation and CAN/CGA-B149.2).

.3 Canadian Standards Association (CSA International)
- .1 CSA B111, Wire Nails, Spikes and Staples.

.4 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S604, Type A Chimneys.
- .3 CAN/ULC-S702, Standard for Mineral Fibre Insulation.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's written instructions, printed Product literature, specifications and data sheets for blanket insulation and include Product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Submit two (2) copies of WHMIS SDS - Safety Data Sheets. Indicate VOCs for insulation Products and adhesives.

.3 Certificates:
- .1 Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.4 Test Reports:
- .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in accordance with Waste Management Plan.

1.4 QUALITY ASSURANCE

.1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installations.
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Coordinate with other building sub-trades.
- .4 Review manufacturer's installation instructions and warranty requirements.

PART 2 - PRODUCTS

2.1 INSULATION

.1 Stone / Mineral Wool Fiber Thermal Insulation for Exterior Stud Walls:
- .1 Compliance: CAN/ULC-S702 Type 1 mineral fiber insulation.
- .2 CCMC Evaluation Listing: 07210: Mineral Fibre Batt Insulation.
- .3 Fire Performance: CAN4 S114, non-combustible.
- .4 Fire Performance, Surface Burning Characteristics: ASTM E84 (UL 723) and CAN/ULC S102, flame spread 0 and smoke developed less than 5.
- .5 Thermal Resistance:
  - .1 R-value of 9.5 (RSI 1.68) for 64 mm / 2 1/2".
  - .2 R-value of 13 (RSI 2.3) 89 mm / 3 1/2".
  - .3 R-value of 22 (RSI 3.96) 152 mm / 6”.
- .6 Certification: Greenguard indoor air quality certified.
- .7 Density: To suit R-value.
- .8 Dimensions: To suit stud type and spacing.
- .9 Thickness: As indicated.
- .10 Acceptable material: ‘ComfortBatt’ by Rockwool, or approved alternate.

.2 Stone/Mineral Wool Interior Acoustic and Fire-Rated Partitions:
- .1 Compliance: ASTM C612 Type 1, ASTM C665 Type 1, CAN/ULC-S702 Type 1, UL and ULC Design Numbers.
- .2 Fire Performance: ASTM E136 and CAN4 S114, non-combustible.
- .3 Fire Performance Surface Burning Characteristics: ASTM E84 (UL 723) and CAN/ULC S102, flame spread 0 and smoke developed 0.
- .4 CAN/ULC S129 Smolder Resistance 0.09 percent.
- .5 Air Erosion: UL 181, maximum air velocity 1000 fpm (5.08 m/s).

.6 Thermal Resistance: R-value of 4.1 per inch at 75 degrees F (RSI value 0.72 m2K/W at 24 degrees C).

.7 Acoustic Performance: ASTM E90, ASTM E413, ASTM C423, ASTM E1050.

.8 Corrosive Resistance: ASTM C665, Corrosiveness to Steel - Pass, ASTM C795, Stainless Steel Stress Corrosion Specification as per Test Methods C871 and C692.

.9 Certification: Greenguard Indoor air quality certified.

.10 Density: ASTM C612, 2.8 lbs/ft3 (45 kg/m^3).

.11 Dimensions: to suit application.

.12 Thickness: As indicated.

.13 Acceptable Product: 'MinWool SAFB' by Johns Manville, 'Thermafiber SAFB' by Owens Corning, or 'Rockwool AFB' by Rockwool.

2.2 ACCESSORIES

.1 Nails: galvanized steel, length to suit insulation plus 25 mm / 1", to CSA B111.

.2 Staples: 12 mm / 1/2" minimum leg.

.3 Tape: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for blanket insulation application in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.3 INSULATION INSTALLATION

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C1320.

.2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

.3 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of sound ratings are maintained in partitions identified with STC ratings.

.4 Do not compress insulation to fit into spaces.

.5 Keep insulation minimum 75 mm / 3” from heat emitting devices such as recessed light fixtures, and minimum 50 mm / 2” from CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B and L vents.

.6 Do not enclose insulation until it has been inspected and approved by Consultant.

3.4 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM):
- .1 ASTM C411, Standard Test Method for Hot-Surface Performance of High Temperature Thermal Insulation.
- .2 ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
- .3 ASTM D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- .4 ASTM D1622/D1622M, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- .5 ASTM D1623, Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics (Type C sample).
- .6 ASTM D2842, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- .7 ASTM E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.

.2 Canadian Urethane Foam Contractors' Association Inc. (CUFCA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

.4 Underwriters' Laboratories of Canada (ULC):
- .1 CAN/ULC-S101, Fire Endurance Tests of Building Construction and Materials.
- .2 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S705.1, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.
- .4 CAN/ULC-S705.2, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.
- .5 CAN/ULC-S770, Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
- .6 Canadian Construction Materials Centre (CCMC) Evaluation Report CCMC 13588-L.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed Product literature, specifications, and datasheet and include Product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Submit one (1) digital PDF copy of WHMIS SDS - Safety Data Sheets.

.3 Test Reports:
- .1 Submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with Specifications for specified performance characteristics and physical properties.
- .2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.5 Manufacturer's Reports:

.1 Manufacturer's Field Reports: Submit manufacturer's written reports within three (3) Working Days of review, verifying compliance of work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 QUALITY ASSURANCE

.1 Applicators to conform to manufacturer’s quality assurance program.

.2 Qualifications:

.1 Installer: Person specializing in sprayed insulation installations with five (5) years documented experience, approved by manufacturer.

.2 Applicator's qualifications: Trained and experienced in application of spray urethane insulation and be approved by system manufacturer.

.3 Manufacturer: Company with minimum five (5) years’ experience in producing of material used for work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in work.

.3 Mock-up:

.1 Construct mock-up 10 m²/100 ft² minimum, of sprayed insulation including one (1) outside corner,

.2 Mock-up may be part of finished work.

.3 Allow forty-eight (48) hours for inspection of mock-up by Consultant and manufacturer’s representative prior to proceeding with sprayed insulation work.

.4 Using the polyurethane foam insulation sample that was sprayed in place, verify the following on site conditions:

.1 Core density.

.2 Adhesion between the transition membrane and the substrate.

.3 Cohesion/adhesion between the insulation material and the substrate.

.4 Keep copy on site of spray foam manufacturer’s current installation instructions and the manufacturer’s installation manual or guide for transition membrane installation. Strictly follow manufacturer's instructions.

.5 Conduct tests daily on both core density and cohesion/adhesion to the substrate, following procedures that meet the requirements of CAN/ULC-S705.

.6 Once the curing time required by the membrane manufacturer has elapsed, conduct a test to verify adhesion between the membrane and the substrate. Perform all adhesion tests using COM-TEN INDUSTRIES Series 301N1M equipment or approved alternate. Should adhesion be found to be lower than the required minimum of 110 kPa, mechanically fastened membrane to substrate.

.7 Perform adhesion tests on all corners and building angles, and wall to roof intersections as follows:

.1 One (1) test on every wall less than 30 m / 100’ in length.

.2 Two (2) tests on walls between 30 m/100’ and 60 m / 200’ in length.

.3 One (1) test every 30 m /100’ on walls more than 60 m / 200’ long.

.4 Perform transition membranes adhesion tests at perimeter openings as follows:

.1 Ten (10) openings or more: perform tests on 15% of openings.

.2 Ten (10) openings or less: perform tests on 30% of openings.

.5 Perform adhesion tests on the transition membranes at every tenth column or beam.

.6 Adhesion tests are not required if membrane is adjusted mechanically.

.7 Permit jobsite access to manufacturer’s representative for the purpose of technical assistance or verifying operator certification or the quality of the polyurethane foam application.

.8 Submit copy of all adhesion tests to Consultant prior to making application for payment.

.8 Manufacturer’s Field Services: As part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer’s representative, to review work, at stages listed.

.1 After delivery and storage of Products, and when preparatory work and mock-up is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

.4 Independent Testing Agency:

.1 Arrange for one (1) site review by Manufacturer’s authorized agent.

.2 Using the polyurethane foam insulation sample that was sprayed in place, verify the following on site conditions:

.1 Core density.

.2 Adhesion between the transition membrane and the substrate.

.3 Cohesion/adhesion between the insulation material and the substrate.

.9 Health and Safety Requirements, Worker Protection:

.1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:

.2 Workers must wear gloves, respirators, long sleeved clothing, eye protection, protective clothing when applying foam insulation.

.3 Workers must not eat, drink, or smoke while applying foam insulation.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.5 SITE CONDITIONS

.1 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and twenty-four (24) hours after application to maintain non-toxic, unpolluted, safe working conditions.

.2 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.

.3 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.

.4 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Insulation:
- .1 Spray polyurethane to CAN/ULC-S705.1.
- .2 Performance Requirements:
  - .1 Water Vapour Permeance ASTM E96: 41 ng/ Pa-s-sq m (0.70 Perms).
  - .2 Flame Spread Classification CAN/ULC S102: Flame Spread < 500.
- .3 Hot Surface Performance ASTM C411: Passed when exposed to 93 degree C for 96 hours.
- .4 Fungi Resistance ASTM C1338: No fungal growth after 28-day incubation.
- .5 Long Term Thermal Resistance (LTTR): Conform to the following when tested to CAN/ULC S770.
  - .1 RSI 0.9 @ 25.4 mm/R5.2 @ 1 inch.
  - .2 RSI 1.82 @ 50.8 mm/R10.4 @ 2 inches.
  - .3 RSI 2.77 @ 76.2 mm/R15.8 @ 3 inches.
  - .4 RSI 3.79 @ 100 mm/R21.5 @ 4 inches.
  - .5 RSI 5.13 @ 127 mm/R29.1 @ 5 inches.
  - .6 RSI 6.31 @ 152 mm/R35.8 @ 6 inches.
  - .7 RSI 7.49 @ 178 mm/R42.5 @ 7 inches.
  - .8 RSI 8.84 @ 203 mm/R50.2 @ 8 inches.
- .6 Physical Requirements:
  - .1 Colour: Manufacturer’s standard colour with Indicator Dye Technology.
  - .2 Density ASTM D1622: Minimum 28.9 kg/cu m (1.8 lb/cu ft).
  - .3 Compressive Strength ASTM D1621: 201 kPa (29.2 psi).
  - .4 Tensile Strength ASTM D1623: 325 kPa (47.1 psi).
  - .5 Open Cell Content ASTM D2856: 6.0 %.
  - .6 Water Absorption ASTM D2842: 0.6 % by volume.
- .7 Sustainable Requirements:
  - .1 Zero ozone depleting blowing agents.
  - .2 Minimum Recycled Content: EcoLogo certified; >5% by weight.
  - .3 Eco-efficiency analysis: life cycle assessment approved by NSF or equivalent.
- .8 Use spray foam from the following family of insulation types as per manufacturer’s written recommendations to suit appropriate temperature range:
  - .1 Acceptable Products:
    - .1 ‘Sealtite One’ by Carlisle Spray Foam Insulation.
    - .2 ’Heatlok Soya HP’ by Huntsman.
    - .3 ‘Walltite V5’ by BASF Canada.
    - .4 ‘Insulthane Extreme’ by Elastochem Specialty Chemicals Inc.
    - .5 Or approved alternate.

.2 Primers: In accordance with manufacturer's recommendations for surface conditions.

.3 Mineral Wool Insulation:

.1 Refer to Section 07212 – Board Insulation and Section 07213 – Blanket Insulation.

.4 Expansion/Deflection Joint Angles: Preformed angle comprising at least 0.5 mm / 26 ga steel core zinc coating, as stipulated in ASTM A653/A653M (galvanized steel G-90).

.5 Sheet Metal Horizontal fire stopping: Preformed angle comprising at least 1.2 mm / 18 ga. steel core zinc coating, as stipulated in ASTM A653/A653M (galvanized steel G-90). Allow horizontal section dimensions to extend beyond outside face of spray foam surface. Install 50% compressed mineral fibre firestop insulation to remaining space.

.6 Sheet Metal Vertical fire stopping: Preformed angle comprising at least 0.38 mm / 28 ga. of steel core zinc coating, as stipulated in ASTM A653/A653M (galvanized steel G-90). Close off the cavity by installing section perpendicular to the substrate and extend beyond the face of spray foam surface and full depth of cavity. Mechanically attached sheet steel firestop angles to corners of substrate at 200 mm o/c.

2.2 EQUIPMENT

.1 Comply with CAN/ULC S705.2 and the equipment manufacturer's recommendations for specific type of application.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sprayed insulation application accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 APPLICATION

.1 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and manufacturer's printed instructions.

.2 Use primer where recommended by manufacturer.

.3 Apply sprayed foam insulation in thickness as indicated.

.4 Apply insulation to substrate free of all frost, high moisture content, dust, oil, grease, oxidization, or any other element that may affect this property.

.5 Ensure metallic surfaces are free of oxidization. Apply primer in accordance with manufacturer's written instructions.

.6 Do not apply spray foam insulation until the following work is complete:
- .1 Anchoring for exterior ladder to existing masonry.
- .2 Primer where recommended by manufacturer.
- .3 Transition Membrane and Thru-Wall Flashing Membrane is fully installed and reviewed by Consultant.
- .4 Furring, blocking, and preparation work for window and door frames and mechanical metal louvers.
- .5 Sub-girt clip angles and sub-girt framing angle for exterior cladding.
- .6 Sheet Metal Vertical and Horizontal fire stopping.
- .7 Mechanical and electrical work.
- .8 Adjacent areas have been protected with drop sheets and/or masking tape to adjacent surfaces.

.7 Apply sprayed foam insulation in consecutive layers not less than 12.5 mm / ½" and no more than 50 mm / 2" thick, for a total thickness as indicated.

.8 Do not spray foam over expansion and deflection joints. Install 0.5 mm / 26 ga. sheet metal angle 75 mm / 3" wide x total foam insulation thickness on both sides of joints and install continuous strip of 25% compressed continuous mineral wool insulation in thickness to match depth of spray foam between angles to absorb deflections.

.9 Apply spray foam to a maximum tolerance of +6 mm / ¼" in relation to the specified thickness.

.10 Avoid formation of sub-layer air pockets during spray foam application.

.11 Avoid overspray foam to surfaces other than those indicated. Use drop sheets and/or masking tape to protect adjacent surfaces.

.12 Remove overspray from non-prescribed surfaces once the foam has hardened. Do not damage adjacent surfaces. Assume responsibility for repair should adjacent surfaces become damaged during removal of overspray.

.13 Upon completion of spray foam insulation, remove drop sheets and masking tape and protect spray foam work from other trades.

.14 Complete subsequent coverage to applied insulating foam within the manufacturer's prescribed timeframe.

.15 Apply spray foam in overlapping layers, to obtain a smooth, uniform surface.

.16 Apply spray applied foam as follows to areas exceeding 30 lineal metres in either direction:
- .1 Apply first layer in 3 m / 10'-0" strips at 1 m / 3' intervals. Following a curing period of ± four (4) hours, spray foam to all unfilled spaces.
- .2 In cold weather follow same procedure, for a minimum surface area of 15 lineal metres / 50'.

.17 Do not spray foam any closer than 75 mm / 3" from chimneys, heating vents, steam pipes, recessed lighting fixtures, and other heat sources. Do not spray insides of any exit openings or electrical junction boxes.

.18 In temperatures below +10°C, mechanically adjusted transition membranes to manufacturer’s written instructions.

.19 Cover all mechanical fixtures with spray applied foam to reduce thermal bridges by means of galvanized spring clip for drywall, screwed 200 mm / 8” through the membrane.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.

.2 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

.3 Obtain written reports from manufacturer verifying compliance of work, in handling, installing, applying, protecting, and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM):
- .1 ASTM E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

.2 Vapour Barrier / Vapour Retarder definition: The terms vapour barrier and vapour retarder are to be considered as equivalent throughout these documents.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for vapour retarders and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit copy of WHMIS SDS.

.3 Certificates:
- .1 Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 QUALITY ASSURANCE

.1 Mock-Ups:
- .1 Construct mock-ups in accordance with Section 01430 - Quality Requirements.
- .2 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box.
- .3 Mock-up will be used to judge workmanship, substrate preparation, and material application.
- .4 Locate where directed.
- .5 Allow 72 hours for inspection of mock-up by Consultant before proceeding with vapour barrier work.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work to the approval of the Consultant.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 SHEET VAPOUR BARRIER

.1 Under Slab Vapour Retarder:

.1 Plastic Vapour Retarder: from polyolefin resins puncture resistant, to ASTM E1745:

.1 Permeance: Less than 0.01 Perms in accordance with ASTM E1745.

.2 Strength: ASTM E1745 Class A.

.3 Thickness: 0.38 mm / 15 mil thick minimum.

.4 Joint Sealing Tape: Self-adhesive tape plastic vapour retarder manufacturer for sealing vapour retarder seams and attachment to footings, protrusions, 100 mm / 4" wide.

.5 Acceptable Products:

.1 Sheet Vapour Barrier: ‘Stego Wrap Vapor Barrier’ by Stego Industries, or ‘Perminator’ by W.R. Meadows, or approved alternate.

.2 Accessories:

.1 Vapour Barrier Tape: ‘Stego Tape’ by Stego Industries, or ‘Perminator Tape’ by W.R. Meadows, or approved alternate.

.2 Mastic: ‘Stego Mastic’ by Stego Industries, ‘MEL-ROL LIQUID MEMBRANE’ by W.R. Meadows, or approved alternate.

.3 Vapour Barrier to Concrete Tape: ‘Stego Crete Claw Tape 6”’ by Stego Industries, or approved alternate.

.2 Exterior Wall and Ceiling Vapour Retarder:

.1 Polyethylene film: To CAN/CGSB-51.34, 0.152 mm / 6 mil thick.

.2 Joint Sealing tape: To CCMC #11862-R, 60 mm / 2.4” wide Construction.

.1 Acceptable Product: ‘Sheathing Tape 8808’ by 3M or approved alternate.

.3 Aluminum foil tape: 5 mil nominal dead soft aluminum foil backing combined with a transparent acrylic adhesive.

.1 Acceptable Product: ‘Aluminum Foil Tape’, by 3M or approved alternate.

.3 For rigid insulation, refer to Section 07212 - Board Insulation.

.4 For batt insulation, refer to Section 07213 - Blanket Insulation.

.5 For air barrier, refer to Section 07270 - Air Barriers.

.6 For air / vapour barrier, refer to Section 07280 – Air/Vapour Barriers.

.7 For rigid insulation in modified bituminous roofing, refer to Section 07550 - Modified Bituminous Membrane Roofing.

2.2 ACCESSORIES

.1 Sealant: Refer to Section 07920 - Joint Sealants.

.2 Fasteners: Self-tapping screws with flat fender washers.

.3 Moulded box vapour barrier: Factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for vapour retarder installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

.1 Ensure services are installed and inspected prior to installation of retarder.

.2 Install sheet vapour retarder on warm side of exterior wall assemblies prior to installation of gypsum board to form continuous retarder.

.3 Use sheets of largest practical size to minimize joints.

.4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.3 UNDER SLAB VAPOUR BARRIER

.1 Install vapour barrier under entire interior concrete slabs, typical throughout.

.2 Cut sheet vapour barrier to form complete coverage. Lap sheet vapour over footings and onto vertical wall surface and seal joint with tape.

.3 Overlap all both lateral and butt joints 150 mm / 6” and seal with joint sealing tape. Ensure tape area is free from dust, dirt and moisture prior to placing tape.

.4 At horizontal termination of under slab vapour barrier, seal to concrete.

.5 Seal around all penetrations, including rock anchor penetrations, as per manufacturer recommendations.

.6 Prior to placing concrete slab, repair all damaged areas to manufactures recommendations.

.7 Do not permit concrete floor finishers to puncture sheet vapour barrier.

3.4 EXTERIOR SURFACE OPENINGS

.1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.5 PERIMETER SEALS

.1 Seal perimeter of sheet vapour barrier as follows:
  .1 Apply continuous bead of sealant to substrate at perimeter of sheets.

.2 Lap sheet over sealant and press into sealant bead.

.3 Install screws through lapped sheets at sealant bead into metal substrate.

.4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.6 LAP JOINT SEALS

.1 Seal lap joints of sheet vapour barrier as follows:
  .1 Attach first sheet to substrate.

.2 Apply continuous bead of sealant over solid backing at joint.

.3 Lap adjoining sheet minimum 150 mm / 6” and press into sealant bead.

.4 Install screws through lapped sheets at sealant bead into metal substrate.

.5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.7 ELECTRICAL BOXES

.1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
  .1 Install moulded box vapour barrier.

.2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.8 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.
  .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Underwriters Laboratories of Canada (ULC):
- .1 CAN/ULC-S741, Standard for Air Barrier Materials – Specification.
- .2 CAN-ULC-S742, Standard for Air Barrier Assemblies – Specification.
- .3 ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials
- .4 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 Sealant Waterproofing & Restoration Institute (SWRI), Sealants: The Professionals' Guide.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Submit one (1) digital PDF copy of WHMIS SDS - Safety Data Sheets.

.3 Quality Assurance Submittals:
- .1 Existing Substrate Condition: Report deviations, as described in PART 3 - EXAMINATION in writing to Consultant.
- .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- .4 Manufacturer's Field Reports: Submit manufacturer's written reports within three (3) Working Days of review, verifying compliance of work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 QUALITY ASSURANCE

.1 Qualifications:
- .1 Applicator: Company specializing in performing work of this section with minimum five (5) years documented experience with installation of air/vapour barrier systems.
  - .1 Completed installation must be approved by the material manufacturer.

.2 Mock-Up:
- .1 Construct typical exterior wall panel, incorporating window and frame and sill, insulation, building corner condition, junction with roof system and fascia panel, illustrating materials interface and seals.
- .2 Locate where directed by Consultant.
- .3 Mock-up may remain as part of finished work for Consultant approval.
- .4 Allow forty-eight (48) hours for inspection of mock-up by Consultant before proceeding with air/vapour barrier work.

.3 Site Meetings: As part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review work, at stages listed.
- .1 After delivery and storage of products, and when preparatory work is complete, but before installation begins.
- .2 Twice during progress of work at 25% and 60% complete.
- .3 Upon completion of work, after cleaning is carried out.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.6 COORDINATION

.1 Ensure continuity of the water resistive air barrier throughout the scope of this section.

1.7 AMBIENT CONDITIONS

.1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

.2 Ventilate enclosed spaces.

.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.8 SEQUENCING

.1 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.9 EXTENDED WARRANTY

.1 Provide manufacturer’s three (3) year warranty.

.2 Warranty: Include coverage of installed sealant and sheet materials which:
- .1 Fail to achieve airtight and watertight seal.
- .2 Exhibit loss of adhesion or cohesion.
- .3 Do not cure.

PART 2 - PRODUCTS

2.1 AIR BARRIER SYSTEM

.1 Interwoven spun-bonded olefin fibres in sheet form, perm rating minimum 1100 ng/Pa.s.m^2, to CAN/CGSB-51.32-M; ASTM E96/E96M, Method B.

.1 Acceptable Product: 'Tyvek CommercialWrap', by Dupont Canada, ‘AirOutshield WALL’ by SRP Canada Inc., or approved alternate.

2.2 SELF-ADHERED AIR BARRIER MEMBRANE

.1 Primary water resistive air barrier membrane and window flashing, self-adhering reinforced modified polyolefin tri-laminate sheet air barrier membrane for wall construction, specifically designed to be water resistant and vapour permeable with adhesive backing protected with release film to the following physical properties:

.1 Water Vapour Permeance: Minimum 1100 ng/Pa.m².s (20 perms) to ASTM E96, Method B – Desiccant Method.

.2 Tested to CAN/ULC-S742 for Air Leakage of Air Barrier Assemblies with a rating of A1.

.3 Water Penetration Resistance around Nails: Pass when tested to ASTM D 1970 modified.

.4 Surface Burning Characteristics: tested in accordance with CAN/ULC S102: Flame Spread Rating of 5 and Smoke Development Classification of 15.

.5 Basis Weight: 120 g/m^2, when tested in accordance with TAPPI Test Method T-410.

.6 Tensile Strength: 182N MD and 129N CD per ASTM D828.

.7 Conforms with CAN/ULC S741 (including all properties and exposures)

.8 Acceptable Product: ‘Blueskin VP 160’ as manufactured by Henry Company Canada, ‘AirOutshield SA280’ as manufactured by SRP Canada, or approved alternate.

2.3 MEMBRANE FLASHINGS

.1 Refer to Section 07280 - Air/Vapour Barriers.

.2 Rubberized reinforced asphalt compound, self-adhered membrane, 1.0 mm / 0.04” thick, width to suit application.

.1 Acceptable Product: "Blueskin TWF" by Henry Company Canada or approved alternate.

2.4 SEALANTS

.1 Sealants in accordance with Section 07920 - Joint Sealants.

2.5 ACCESSORIES

.1 Joint Sealing tape: To CCMC #11862-R, 75 mm / 3” wide ‘Construction Sheathing Tape 8808’ by 3M, or approved alternate.

.2 Aluminum foil tape: 5 mil nominal dead soft aluminum foil backing combined with a transparent acrylic adhesive.

.1 Acceptable Product: ‘Aluminum Foil Tape’, by 3M or approved alternate.

.3 Adhesive Primer: To manufacturer's written recommendations.

.4 Termination Sealant: A moisture cure, medium modulus polymer modified sealing compound to ASTM C920 Type S, Grade NS, Class 25.

.1 Acceptable Product: ‘HE925 BES Sealant’ manufactured by Henry Company Canada, ‘Masterseal NP1’ by Sika/Master Builders Solutions, or approved alternate.

.5 Thinner and cleaner: As recommended by sheet material manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

.1 Perform work in accordance with SWRI's Sealants: The Professionals’ Guide requirements for materials and installation.

.2 Perform work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

.3 Perform work in accordance with Canadian Urethane Foam Contractor's Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

3.3 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept work of this Section.

.2 Ensure surfaces are clean, dry, sound, smooth, and continuous and comply with air barrier manufacturer's requirements.

.3 Report unsatisfactory conditions to Consultant in writing.

.4 Do not start work until deficiencies have been corrected.

.1 Beginning of work implies acceptance of conditions.

3.4 PREPARATION

.1 Remove loose or foreign matter, which might impair adhesion of materials.

.2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.

.3 Ensure substrates are free of surface moisture prior to application of self-adhesive membrane and primer.

.4 Ensure metal closures are free of sharp edges and burrs.

.5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

.6 Install Through-Wall Flashing Membrane over all foundations and shelf angles to receive exterior masonry and to other areas as indicated. Lap flashing membrane 300 mm/ 1 ft vertically onto wall surface and over entire horizontal surface. Trim back all exposed to view membrane upon completion of exterior cladding.

.7 Install flashings as per Section 04050 – Common Work Results for Masonry.

3.5 INSTALLATION

.1 Install materials in accordance with manufacturer's instructions.

.2 Secure Air Barrier where indicated with adhesive or tape. Caulk with acoustic sealant to ensure complete seal. Position lap seal over firm bearing.

.3 Install Air Barrier, between flashings at roof membrane and adjacent parapet and seal materials with acoustic sealant. Caulk to ensure complete seal. Position lap seal over firm bearing, as indicated.

.4 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

.5 Parapet and Roof Junction: Lap Air Barrier 150 mm / 6” with firm bearing to adjacent membranes. Seal Air Barrier to roof membrane with continuous bead of acoustic sealant Seal all joints in parapet and roof junction with tape. Provide continuous airtight seal.

3.6 INSTALLATION OF SELF-ADHERED AIR BARRIER MEMBRANE

.1 Adhesive Primer for Primary Water Resistive Air Barrier Membrane:
- .1 Conditions not typically requiring adhesive-primers: Application above 5°C to clean and dry substrate. Ensure substrate and membrane temperatures are above 5°C.
- .2 Conditions requiring use of adhesive-primers:
  - .1 Metal, gypsum sheathing, concrete, concrete unit masonry, and other masonry substrates.
  - .2 Should appropriate adhesion not be obtained due to conditions beyond the control of the installer, the adhesion may be aided by continuous application of adhesive-primer to the substrate and laps. Ensure all primed surfaces are covered in same day.

.2 Inside and Outside Corners:
- .1 Seal inside and outside corners of sheathing boards with a strip of self-adhering vapour permeable membrane extending a minimum of 75 mm / 3” on either side of corner.
- .2 For inside corners, pre-treat the corner with a continuous 13 mm / ½" bead of termination sealant.
- .3 Adhesive prime surfaces where indicated to achieve surface adhesion as per manufacturers’ instructions.
- .4 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm / 2” minimum overlap at all side laps and 75 mm / 3” minimum overlap at all end laps of membrane.
- .5 Roll all laps and membrane with a countertop roller to ensure seal.

.3 Transition Areas:

.1 Tie-in to structural beams, columns, floor slabs, and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials as indicated on Drawings with self-adhered air barrier transition membrane in accordance with Section 07270 - Air/Vapour Barriers.

.4 Windows, Doors and Rough Openings:

.1 Place transition membrane in accordance with Section 07270 - Air/Vapour across window sills. Pre-treat inside corners with a bead of termination sealant. Install window sill pan membrane and end dam terminations, seal cuts and terminations with termination sealant per window manufacturer's instructions and ASTM E 2112.

.2 Wrap head and jamb of rough openings with transition membrane.

.3 Extend specified self-adhered air barrier membrane into rough window openings sufficient to provide a connection to interior vapour retarder.

.1 Prime surfaces where indicated to achieve surface adhesion as per manufacturers' instructions.

.2 Align and position transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm / 2" overlap at all side laps and 75 mm / 3" overlap at all end laps of membrane.

.3 Roll all laps and membrane with a countertop roller to ensure seal.

.5 Through-Wall Flashing Membrane:

.1 Apply through-wall flashing membrane along the base of masonry veneer walls and over lintels.

.2 Prime surfaces and allow to dry, press membrane firmly into place, overlap minimum 50 mm / 2" at all side and end laps. Promptly roll all laps and membrane to ensure the seal.

.3 Form continuous flashing membrane and extend up back-up wall minimum of 200 mm / 8".

.4 Seal the top edge of the membrane where it meets substrate using termination sealant. Trowel-apply a feathered edge to seal termination to shed water.

.5 Install through-wall flashing membrane and extend 13 mm / ½" from outside edge of veneer. Provide "end dam" flashing as detailed.

.6 Sheet Air Barrier Installation:

.1 Apply self-adhering sheet air barrier membrane complete and continuous to substrate in an overlapping shingle fashion in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.

.2 Prime surfaces where indicated to achieve surface adhesion as per manufacturers' instructions and allow to dry.

.3 Align and position self-adhering membrane to substrate, remove top panel of protective release film and press firmly into place.

.4 Ensure alignment, hold membrane in place to avoid wrinkles and sequentially remove remaining panels of protective film and press firmly into place.

.5 Ensure minimum 75 mm / 3" overlap at all ends and 50 mm / 2" side laps of subsequent membrane applications.

.6 Apply pressure to all membrane surfaces, laps, and flashings using an appropriate roller to provide best possible surface adhesion.

.7 At the end of each day's work seal the top edge of the membrane where it meets the substrate with termination sealant. Trowel to a feathered edge to seal termination and shed water.

.7 Application of Termination Sealant:

.1 Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the sheet air barrier membrane and around perimeter edge of membrane terminations at window and door frames with termination sealant.

3.7 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting, and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 PROTECTION OF WORK

.1 Protect finished work.

.2 Do not permit adjacent work to damage work of this section.

.3 Permit damp substrates to dry. Do not expose the backside of the substrate to moisture or rain.

.4 Cap and protect exposed back-up walls against wet weather conditions during and after application of membrane, including wall openings and construction activity above completed air barrier installations.

.5 Water resistive air barrier membranes are not designed for permanent exposure. Cover as soon as possible. Do not exceed 150 days exposure to the elements.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International Inc.:
- .1 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- .2 ASTM D903, Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
- .3 ASTM D1004, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
- .4 ASTM D1876, Standard Test Method for Peel Resistance of Adhesives (T-Peel Test).
- .5 ASTM E2357, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
- .6 ASTM E154, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
- .7 ASTM E2178: Standard Test Method for Air Permeance of Building Materials.
- .8 ASTM E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .9 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- .10 ASTM E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.

.2 Canadian General Standards Board (CGSB):
- .1 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced.
- .2 CAN/CGSB 37.29, Rubber-Asphalt Sealing Compound.
- .3 CAN/CGSB 37.58, Membrane, Elastomeric, Cold-Applied Liquid, for Non-Exposed Use in Roofing and Waterproofing.

.3 Canadian Standards Association (CSA International):
- .1 CSA A371, Masonry Construction for Buildings.

.4 Sealant Waterproofing & Restoration Institute (SWRI), Sealants: The Professionals' Guide.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed Product literature, Specifications and datasheet and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit one (1) electronic copy of WHMIS SDS - Safety Data.

.3 Quality Assurance Submittals:
- .1 Existing Substrate Condition: Report deviations, as described in PART 3 - EXAMINATION in writing to Consultant.
- .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

.4 Manufacturer's Field Reports: submit manufacturer's written reports within three (3) Working Days of review, verifying compliance of work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 QUALITY ASSURANCE

.1 Submit in writing, a document stating that the applicator of the primary air/vapour barrier membranes specified in this Section is recognized by the manufacturer as suitable for the execution of the work.

.2 Perform work in accordance with the manufacturer’s written instructions of the air/vapour barrier membrane and this Specification.

.3 Maintain one (1) copy of manufacturer‘s written instructions on site.

.4 Qualifications:

.1 Applicator: Company specializing in performing work of this Section with minimum five (5) years documented experience with installation of air/vapour barrier systems.

.1 Completed installation must be approved by the material manufacturer.

.5 At the beginning of the work and at all times during the execution of the work, allow access to work site by the air/vapour barrier membrane manufacturers' representative.

.6 Source components used in this Section from one manufacturer, including sheet membrane, air/vapour barrier sealants, primers, mastics and adhesives.

.7 Mock-Up:

.1 Construct mock-up in accordance with Section 01430 - Quality Requirements.

.2 Construct typical exterior wall panel, incorporating window and door frames c/w jamb, sill and head conditions, insulation, building corner condition, junction with foundation wall and roof system(s) and other building conditions as directed by the Consultant; illustrating materials interface and seals.

.3 Locate where directed.

.4 Mock-up may remain as part of finished work to Consultant’s written approval.

.5 Allow 72 hours for inspection of mock-up by Consultant before proceeding with air/vapour barrier work.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and Product.

.3 Store role materials on end in original packaging.

.4 Keep solvent away from open flame or excessive heat.

.5 Protect rolls from direct sunlight until ready for use.

.6 Avoid spillage: Immediately notify Consultant if spillage occurs and start clean-up procedures.

.7 Clean spills and leave area as it was prior to spill.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction Demolition Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.6 SITE CONDITIONS

.1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

.2 Ventilate enclosed spaces in accordance with Section 01510 - Temporary Utilities.

.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.7 SEQUENCING

.1 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.8 EXTENDED WARRANTY

.1 Provide manufacturer’s five (5) year warranty.

.2 Warranty: include coverage of installed sealant and sheet materials which:
- .1 Fail to achieve air-tight and watertight seal.
- .2 Exhibit loss of adhesion or cohesion.
- .3 Do not cure.

PART 2 - PRODUCTS

2.1 AIR/VAPOUR BARRIER SYSTEMS

.1 Obtain air/vapour barrier membrane components and accessories as a single source from the membrane manufacturer to ensure total system compatibility and integrity.

2.2 SELF-ADHERED SHEET MEMBRANE

.1 Primary sheet air/vapour barrier membrane, a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film to the following physical properties:
- .1 Thickness: 1.0 mm / 40 mils.

.2 Air leakage: <0.005 L/s.m² @ 75 Pa to ASTM E283.
.3 Tested to ASTM E2357 for the air barrier assembly.
.4 Water vapour permeance: 1.6 ng/Pa.m².s/0.03 perms to ASTM E96.
.5 Low temperature flexibility: -30°C to CGSB 37-GP-56M.
.6 Elongation: 200% to ASTM D412-modifed.
.7 Acceptable Product:
  .1 For temperatures 4º and greater: ‘Blueskin SA’ as manufactured by Henry Company Canada, ’Sopraseal Stick 1100 T Summer Grade’ by Soprema, or approved alternate.
  .2 For temperatures >4ºC to -12ºC: for application temperatures down to -12°C use ‘Blueskin SA LT’ by Henry Company Canada, ’Sopraseal Stick 1100 T Winter Grade’ by Soprema, or approved alternate.

2.3 TRANSITION SHEET MEMBRANE

.1 Transition Sheet Membrane:
  .1 Thickness: 1.0 mm / 40 mils.
  .2 Air leakage: <0.005 L/s.m² @ 75 Pa to ASTM E283.
  .3 Tested to ASTM E2357 for the air barrier assembly.
  .4 Water vapour permeance: 1.6 ng/Pa.m².s / 0.03 perms to ASTM E96.
  .5 Low temperature flexibility: -30 °C to CGSB 37-GP-56M,
  .6 Elongation: 200% to ASTM D412-modifed.
  .7 Acceptable Product: 'Blueskin SA', by Henry Company Canada, 'Sopraseal 60' by Soprema, or approved alternate.

2.4 THRU WALL FLASHING MEMBRANE

.1 Thru Wall Flashing Membrane:
  .1 Rubberized reinforced asphalt compound, self-adhered membrane, width to suit application.
  .2 Thickness: 1.0 mm / 40 mils,
  .3 Puncture Resistance - Membrane to ASTM E154: 180N minimum / 40 lbf.
  .4 Tear resistance: 200N /13 lbs. MD, to ASTM D1004,
  .5 Tested to ASTM E2357 for the air barrier assembly,
  .6 Water vapour permeance: 1.6 ng/Pa.m².s / 0.03 perms to ASTM E96 Method B,
  .7 Low temperature flexibility: -30 °C to CGSB 37-GP-56M,
  .8 Lap Peel Strength at -4°C. to (ASTM D1876): 8.75N/cm / 5 lbf/in width.
  .9 Adhesion to Concrete to ASTM D903: 8.75N/cm / 5.0 lb/in. width.
  .10 Elongation: 200% to ASTM D412-modifed.
  .11 Acceptable Product: "Blueskin TWF" by Henry, ‘Sopraseal WFM’ by Soprema, or approved alternate.

2.5 PRIMERS AND ADHESIVES

.1 Adhesives and Primers: As recommended by air/vapour barrier manufacturer to suit application.

2.6 SEALANTS

.1 Sealants in accordance with Section 07920 - Joint Sealants unless otherwise indicated.

.2 Termination Sealant in exposed locations: A sealing compound having the following physical properties:
- .1 Compatible with sheet air barrier, roofing and waterproofing membranes and substrate.
- .2 Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
- .3 Complies with ASTM C920, Type S, Grade NS, Class 25.
- .4 Elongation: 450 – 550%.
- .5 Remains flexible with aging.
- .6 Seals construction joints up to 25 mm / 1" wide.
- .7 Colour: As later selected by Consultant from manufacture's standard colour range.
- .8 Acceptable Product: 'HE925 BES Sealant' manufactured by Henry Company Canada, 'Sopramastic ALU' by Soprema, or approved alternate.

.3 Termination Sealant in locations concealed from UV exposure: A sealing compound having the following characteristics:
- .1 Compatible with sheet waterproofing membrane and substrate.
- .2 Solids by volume: 70%.
- .3 Vapour permeance: 2.9 ng/Pa.m²s, ASTM E96.
- .4 Complies with CGSB 37.29.
- .5 Remains flexible with ageing.
- .6 Adheres to wet surfaces.
- .7 Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions.
- .8 Colour: Black.
- .9 Acceptable Product: 'Polybitume 570-05' Polymer Modified Sealing Compound manufactured by Henry Company Canada, 'Sopramastic' by Soprema, or approved alternate.

2.7 ACCESSORIES

.1 Joint Treatment Mesh: Open weave glass fabric yarn saturated with synthetic resins.
- .1 Acceptable Product: '990-06 Yellow Jacket' by Henry Company Canada, or approved alternate.

.2 Thinner and cleaner for Butyl or Neoprene Sheet: As recommended by sheet material manufacturer.

.3 Attachments: Galvanized steel bars and anchors, as recommended by membrane manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

.1 Perform work in accordance with SWRI's Sealants: The Professionals' Guide requirements for materials and installation.

.2 Perform work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

.3 Perform work in accordance with Canadian Urethane Foam Contractor's Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

3.3 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept work of this Section.

.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.

.3 Report unsatisfactory conditions Consultant in writing.

.4 Do not start work until deficiencies have been corrected.
- .1 Beginning of work implies acceptance of conditions.

3.4 PREPARATION

.1 Remove loose or foreign matter, which might impair adhesion of materials.

.2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.

.3 Ensure substrates are free of surface moisture prior to application of self-adhesive membrane and primer.

.4 Ensure metal closures are free of sharp edges and burrs.

.5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

3.5 AIR/VAPOUR BARRIER VOID COVERINGS

.1 Examine substrates of work from other trades that are to receive air/ vapour barrier membranes. Cover all continuous gaps and voids as follows:

.2 Non-Moving Substrate Joint and Crack Treatment:
- .1 Gaps up to 6 mm / 1/4" wide:
  - .1 Sealant Method: Apply building envelope sealant into the joint and strike smooth. Allow to dry prior to application of fluid applied air/vapour barrier membrane.
  - .2 Fluid-Applied Method: Apply a trowel application of fluid applied air/vapour barrier membrane, extending 75 mm / 3" onto face of substrate. Reinforce with 50 mm / 2" wide strip of joint treatment mesh, centered over joint, prior to application of fluid applied air/vapour barrier membrane.

.3 Self-adhered Sheet Method: Apply adhesive and allow to dry. Apply self-adhering sheathing joint / termination membrane and roll in place.

.2 Gaps Between 6 mm / 1/4” and 13 mm / 1/2" wide:

.1 Sealant Method: Apply building envelope sealant into the joint and strike smooth. Allow to dry prior to application of fluid applied air/vapour barrier membrane.

.2 Self-adhered Sheet Method: Apply adhesive and allow to dry. Apply self-adhering sheathing joint / termination membrane and roll in place.

.3 Gaps exceeding 13 mm / 1/2” in width: Cover with prefinished sheet steel securely anchored to substrates in accordance with Section 07620 – Sheet Metal Flashing and Trim.

.3 Examples of gaps and voids required to be covered are, but not limited to:

.1 Control joints.

.2 Expansion joints.

.3 Gaps between dissimilar materials.

.4 Gaps resulting from structural steel erection.

.5 Other similar gaps and voids.

3.6 SELF-ADHERED SHEET MEMBRANE

.1 Adhesive or Primer for Transition and Through-wall Flashing Membrane (Self-Adhering):

.1 Apply adhesive or primer for self-adhering membranes at rate recommended by manufacturer.

.2 Apply to all areas to receive air / vapour barrier membrane, transition sheet and through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30-minute open time. Surfaces not covered by self-adhering transition membrane or self-adhering through-wall flashing membrane during the same day must be re-applied.

.2 Transition Membrane (Self-Adhering):

.1 Apply transition sheet membrane to prepared surfaces as indicated.

.2 Apply transition sheet membrane over all adjoining dissimilar substrate materials such as but not limited to connections of existing masonry block to steel or concrete; drywall or plywood to steel or concrete and all beams, columns, window and door frames etc. using strips as required, lapped a minimum of 75 mm / 3" on both substrates and centered over joint.

.3 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm / 2” overlap at all end and side laps.

.4 Tie-in to window frames, aluminum screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated on drawings.

.5 Promptly roll all laps and membrane with a countertop roller to effect seal.

.6 Ensure all preparatory work is complete prior to applying liquid applied air / vapour barrier membrane.

.3 Through-wall Flashing Membrane (Self-Adhering)

.1 Apply through-wall flashing membrane to prepared surfaces as indicated.

.2 Apply through-wall flashing in accordance with CSA A371 Masonry Construction for Buildings; along the base of masonry veneer walls, over windows, doors and other wall openings required to be protected.

.3 Form flashing membrane applications continuous and extend up back-up wall a minimum 200 mm / 8”. Trim all overhanging material.

.4 At the end of each day’s work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel-apply a feathered edge to seal termination and shed water.

.5 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. At locations where flashing terminates or intersects wall openings including door frames, “end dam” flashing to protect openings and redirect water out. Trim off excess material to Consultant approval.

.6 Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls, self angles and other substrates to be protected, partially remove protective film and roll membrane over surface and up vertically.

.7 Press firmly into place. Ensure minimum 50 mm / 2” overlap at all end and side laps. Promptly roll all laps and membrane to a positive seal.

.8 Ensure all preparatory work is complete prior to applying self-adhering through-wall flashing membrane.

.9 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess to Consultant approval.

.4 Air/Vapour Barrier Membrane:

.1 Apply self-adhering membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.

.2 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 50 mm / 2” overlap at all end and side laps. Promptly roll all laps and membrane with a countertop roller to provide a positive seal.

.3 At the end of each day’s work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic or termination sealant to seal termination and shed water.

.4 Tie-in to window frames, aluminum screens, hollow metal doorframes, roofing system and at the interface of dissimilar materials as indicated on Drawings. Refer also to manufacturers’ standard details.

.5 Ensure all projections, including wall ties, are properly sealed with a caulk application of liquid air seal mastic.

.6 Mechanically fasten membrane through securement bars to all window, door, louvres and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.

.7 For membrane to be applied to underside of substrate surfaces provide special attention to ensure maximum surface area adhesion is obtained.

3.7 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.9 PROTECTION OF WORK

.1 Protect finished work.

.2 Do not permit adjacent work to damage work of this Section.

.3 Ensure finished work is protected from climatic conditions.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI).
- .1 ANSI/ASME B18.6.3, Machine Screws, Tapping Screws, and Metallic Drive Screws.

.2 American Society for Testing and Materials International, (ASTM):
- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM D2244, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
- .3 ASTM D4214, Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.

.3 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB-93.4, Galvanized and Aluminum-Zinc Alloy Coated Steel Siding Soffits and Fascia, Prefinished, Residential.
- .2 CAN/CGSB 93.5, Installation of Metal Residential Siding, Soffits and Fascia.

.4 Canadian Standards Association (CSA International).
- .1 CAN/CSA-S136, North American Specification for the Design of Cold-Formed Steel Structural Members.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product data: Submit manufacturer's printed Product literature, specifications and data sheet.
- .1 Submit two (2) copies of WHMIS SDS - Safety Data Sheets. Indicate VOCs for caulking materials during application and curing.

.3 Shop Drawings:
- .1 Shop Drawings for work of this Section shall bear the stamp and signature of a professional engineer registered in the Province of Ontario, Canada.
- .2 Include in the design, anchorage details for each metal cladding wall, including but not limited to, framing system, framing member sizes, spacing, material thickness exclusive of coatings and wind loading / uplift.
- .3 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, metal furring, and related work.

.4 Samples:
- .1 Submit colour chips in selected colours and finish for approval.
- .2 Submit duplicate 300 x 300 mm / 12” x 12” samples of siding material, of colour and profile specified.

.5 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions.

.6 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.7 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 DESIGN REQUIREMENTS

.1 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

.1 Temperature Change (Range): 20 degrees C, ambient; 40 degrees C, material surfaces.

.2 Design roof system to resist:

.1 Snow loads and snow build-up and rain load. Refer to Structural Drawings.

.2 Wind loads, positive and negative. Refer to Structural Drawings.

.3 The roof panel shall be UL-90 rated in accordance with UL 580 test for wind uplift performance of roof assemblies.

.4 Dead load of roof system.

.3 Deflection of the roof system is not to exceed 1/180th of the span for the specified live loading.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications:

.1 Manufacturer shall have a minimum of five (5) years experience in the production of metal roof cladding systems. Manufacturer shall demonstrate past experience with examples of projects of similar type and exposure.

.2 Installer Qualifications: Authorized by the manufacturer and the work shall be supervised by a person having a minimum of five (5) years experience installing metal wall and roof panels on similar type and size projects.

.3 Mock-ups:

.1 Construct mock-up in accordance with Section 01430 - Quality Requirements.

.2 Construct mock-up 10 m² minimum size showing typical lap joint, one inside corner and one outside corner. Accepted mock-up may form part of complete work.

.3 Allow 72 hours for inspection of mock-up by Consultant before proceeding with roofing work.

1.5 MANUFACTURER'S FIELD SERVICES

.1 Arrange for initial job start-up site attendance, periodic site attendance of membrane manufacturer's technical representative during installation work, together with written report.

.2 The Contractor must at all times enable and facilitate access to the work site by said representative.

.3 Notify Consultant of date and time of inspection, a minimum of 48 hours prior to inspection. Provide one copy of manufacturer's report to the Consultant within 48 hours of inspection being carried out.

.4 Manufacturer's Field Services: As part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review work, at stages listed.

.1 After delivery and storage of Products, and when preparatory work and mock-up is complete, but before installation begins.

.2 As required by membrane manufacture to obtain roof warranty, but as a minimum twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

.2 Divert used metal cut-offs from landfill by disposal into the on-site metals recycling bin removed for disposal at the nearest metal recycling facility.

.3 Divert reusable materials for reuse at nearest used building materials facility.

.4 Divert unused caulking, sealants, and adhesive materials from landfill through disposal at hazardous material depot.

1.7 EXTENDED WARRANTY

.1 Provide manufacturer's written finish warranty commencing from the date of Ready-for-Takeover. Warranty to include:

.1 For non-metallic finishes, failure of factory-applied exterior finish for 40 years warranty period as follows:

.1 Will not crack, chip, or peel (lose adhesion).

.2 Whether Product installed in vertical or non-vertical applications, Product will not chalk in excess of a number six (6) rating for roofing panels and a number eight (8) rating for sidewall panels, in accordance with ASTM D4214 method D659 at any time.

.3 Whether Product installed in vertical or non-vertical applications, Product will not change colour more than seven (7.0) Hunter ΔE units for roofing panels and five (5.0) Hunter ΔE units for sidewall panels as determined by ASTM D2244.

.4 Warranty excludes minute fracturing that may occur during the normal fabrication process.

.2 For metallic finishes, failure of factory-applied exterior finish for 40 years warranty period as follows:

.1 Will not crack, chip, or peel (lose adhesion).

.2 Whether product installed in vertical or non-vertical applications, product will not chalk in excess of a number eight (8) rating, in accordance with ASTM D4214 method A at any time.

.3 Whether product installed in vertical or non-vertical applications, product will not change colour more than five (5.0) Hunter ΔE units as determined by ASTM D2244.

.4 Warranty excludes minute fracturing that may occur during the normal fabrication process.

1.8 METAL CLADDING SYSTEMS DESCRIPTION

.1 Provide the following sheet metal roof cladding system (from exterior to interior):

.1 Metal Roof Cladding System:

.1 Preformed Metal Roofing (c/w Snow and Ice Retention System)

.2 Panel support clip system, depth to suit preformed metal sheet profile, fastened to deck sheathing.

.3 Vapour permeable roof boarding membrane (underlayment), self-adhered.

.4 13 mm / 1/2" deck sheathing mechanically fasted to metal Z-girt.

.5 102 mm / 4" metal Z-girt @ 400 mm / 16" o.c. fastened to thermal clip.

.6 102 mm / 4" mineral wool insulation, adhered and fitted between Z-girts.

.7 102 mm / 4" thermal clip @ 400 mm / 16" o.c. horizontally and 1220 mm / 48" o.c. vertically fastened to steel deck below.

.8 Air/vapour barrier, self-adhered.

.9 16mm / ¾", deck sheathing, adhesive.

.10 Steel deck.

PART 2 - PRODUCTS

2.1 METAL SHEET ROOFING

.1 Manufacturer:

.1 Compatibility between roofing materials is an essential requirement of the Contract. Single source of Products from Vicwest, or equivalent from Agway, or approved alternate.

.2 Preformed Metal Roof Sheet:

.1 Metal Roofing: Prefinished, to CGSB 93-GP-4M, Type A vertical, Class plain.

.2 Fabricated from ASTM A653 structural quality Grade 230 galvanized steel, with Z275 zinc coating, as designated by ASTM A653M. Thickness 0.8 mm / 22 ga.

Profile: Seamed joint at 610 mm / 24" c/c with seams a minimum of 50 mm / 2" above the bottom of the ribbed profile. 'TSR' by Vicwest, or approved alternate.

.3 Finish coating:

.1 Acceptable Product: 'Weather XL' by Vicwest, or approved equivalent by Agway, or approved alternate.

.4 Not more than one (1) colour as later selected by Consultant from manufacturer's standard colour range.

2.2 SNOW AND ICE RETENTION SYSTEM

.1 Product: 'Non- Penetrating Snostop' system by Roofers World, or approved alternate.

.2 Colour: Prefinished metal to match metal roof system.

.3 Design substrate of each roof section to receive a snow and ice retention system to withstand snow load calculations in accordance with OBC.

.4 Design and size snow and ice retention system components to withstand snow and ice live load ratings as calculated in accordance with OBC.

2.3 PANEL SUPPORT CLIP SYSTEM (CLEAT)

.1 Thermally responsive clips, fabricated from structural quality steel with Z275 galvanized zinc coating to ASTM A653/A653M, designed to accommodate expansion and contraction of the roof sheet, minimum base metal thickness and spacing as required for a complete system to withstand required wind loading / uplift.

2.4 METAL FRAMING

.1 Sub-girt System: Structural quality steel with Z275 zinc coating to ASTM A653/A653M, capable of accepting exterior sheet with structural attachment to building frame, minimum base metal thickness and spacing as required for a complete system to withstand required wind loading / uplift.

.2 Locations and spacing for framing system members as determined by Shop Drawing structural engineer, to align with modular panel fasteners, spacing as required to suit manufacturer's panel load data.

2.5 THERMAL CLIP

.1 Solid and adjustable clip shaped similarly to a Z-girt composed of stainless steel to ASTM 240/A480, high-strength polyurethane thermal break pad with a thermal resistance of R-3, 15%-20% of clip volume cut-out to reduce the quantity of conductive material, spacing as required for a complete system to withstand required wind loading / uplift.

- .1 Size: As indicated, to suit insulation thickness
- .2 Finish: Stainless Steel 304/304L
- .3 Solid clip, use adjustable clip as required.
- .4 Acceptable Product: Solid and Adjustable clips 'ACS-S Clip' and 'ACS-A Clip' by Soprema or approved alternate.

2.6 DECK SHEATHING

.1 Deck Sheathing:

- .1 Inorganic complete with a fibreglass mat faced panel with a specially treated gypsum core that resists moisture, surface primed. Panel size 1220 mm x 2440 mm with minimum thickness of 16 mm / 5/8", complies with ASTM C1177/1177M or ASTM C1278/1278M. Acceptable Products:
  - .1 'GlasRoc Roof Board' by CertainTeed.
  - .2 'Securock Roof Board' by CGC, A USG co.
  - .3 'Dens-Deck Roofboard' by Georgia Pacific.

.2 Deck Sheathing Mechanical Securement:

- .1 FM Class I approved screws and galvanized metal plate type fasteners with No. 14 coated screws, supplied or approved by deck sheathing and membrane manufacturer. Fasteners to be of sufficient length to penetrate the upper rib of the steel deck 20 mm ± 5 mm / 3/4" ± 3/16" section of the Z-girt. Acceptable Manufacturers:
  - .1 Dekfast, Olympic or approved alternate by the roof sheathing/insulation panel manufacturer.

2.7 MEMBRANES AND ACCESSORIES

.1 Roof-boarding Membrane (Underlayment):
- .1 Self-adhesive application, vapour-permeable rain-barrier roof underlayment membrane composed of trilaminar polypropylene complex, silicone release film, minimum 0.6 mm / 24 mil thickness.
  - .1 Acceptable Products: ‘Lastobond Stick VP’ by Soprema or approved alternate.

.2 Ice and Water Shield:
- .1 Self-adhesive SBS modified bituminous membrane with a cross-laminated polyethylene film, minimum one (1) mm thickness that is compatible with bitumen. Acceptable Products:
  - .1 ‘ArmourGard Ice and Water Protector’ by IKO Industries.
  - .2 ’Lastobond 195’ by Soprema.

.3 Self-Adhered Membrane Primer:
- .1 Synthetic/Asphalt/Solvent formulated primer to enhance adhesion of self-adhered membranes to substrates. Use summer or winter grade as required. Acceptable Products:
  - .1 “Elastocol Stick” by Soprema
  - .2 ’IKO S.A.M. Primer’ by IKO.
  - .3 Or approved alternate.

.4 Air / Vapour Barrier: Refer to Section 07280 - Air / Vapour Barriers.

2.8 INSULATION

.1 Insulation: Refer to Section 07212 – Board Insulation.

2.9 FASTENERS

.1 Screws: ANSI B18.6.4. Purpose made, self-drilling fasteners #12-14 complete with galvanized heads and neoprene washers, colour to match sheet metal roofing.

2.10 CAULKING

.1 Sealants: Refer to Section 07920 – Joint Sealants

.2 Concealed: Tape or compound, non-skinning, non-drying, butyl rubber as recommended by performed metal cladding manufacturer.

2.11 ADHESIVE

.1 Acceptable Product: ‘Duotack’ by Soprema, or approved alternate.

2.12 ACCESSORIES

.1 Closures:
- .1 Metal and neoprene closures to suit profiles selected.

.2 Prefinished metal flute closures: prefinished, colour, profile and base metal thickness to match metal cladding.

.2 Metal Flashings: Refer to Section 07620 – Sheet Metal Flashing and Trim.

.3 Exposed trim: Valleys, hips, cap strip, drips, trims and starter strip of same material, colour and gloss as sheet metal roofing, with fastener holes pre-punched.
.1 In addition to manufacturer's standard, provide custom shapes as shown.

.4 Non-exposed accessories: galvanized sheet metal.

.5 Isolation coating: alkali resistant bituminous paint.

.6 Plastic cement: to CAN/CGSB-37.5.

.7 Thermal Tape: Low to medium pressure gasket from neoprene rubber and cork blend with a high-strength acrylic adhesive on one side, protected by siliconized liner, with anti-skid properties, 38 mm / 1 1/2" x length to suit.

.8 Cleats: Of same material, and temper as sheet metal: 50 mm / 2" minimum wide.
.1 Thickness same as sheet metal being secured.

.9 Fasteners: Concealed where possible, exposed to Consultant approval.

.10 Pipe boots / flashing: EPDM flashing:
.1 Acceptable Product:
.1 'Dektite Combo Flashing' by Vicwest
.2 'Master Pipe Flashing' by Westman Steel
.3 'Master Pipe Flashing – Hi Temp' by Westman Steel
.4 Or approved alternate.

.11 Washers: Of same material as sheet metal, 1 mm thick with rubber packings.

.12 Touch-up paint: As recommended by sheet metal roofing manufacturer.

2.13 FABRICATION

.1 Fabricate metal cladding components to comply with dimensions, profiles, gauges and details as shown on the Drawings, complete with all companion flashing.

.2 Fabricate all components of the system in the factory, ready for field installation.

.3 Provide cladding and all accessories in longest practicable length to minimize field lapping of joints.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sheet metal roofing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate. Examine work of other trades over which sheet metal roofing will be applied, for conformity to Drawings.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

.4 Examine exterior cladding sheets to be installed. Cull out and remove from site all damaged or marred surfaces and sheets with exposed cut raw edges.

3.3 GENERAL

.1 Apply roofing in accordance with Drawings, Specifications and requirements of jurisdictional authorities and the Canadian Roofing Contractors' Association Roofing Manual.

.2 Regard manufacturer's printed recommendations and specifications as minimum requirement for materials, methods and quality of work not otherwise specified herein.

.3 Make adjustments to specified roofing procedures caused by weather and site conditions only with the Owner's approval.

.4 Maintain equipment in good working order to ensure control of roofing operations and protection of work. Roofing equipment and laying techniques to meet the approval of the Consultant.

.5 At manufacturer's recommended rate, prime all existing surfaces that are to receive new membrane.

.6 When installing insulation, ensure all edges are structurally supported. Stagger joints of insulation boards both horizontally and vertically. Stagger end joints. Butt joints with moderate contact. Leave no gaps or broken boards. Cut and fit neatly at projections and wood blocking.

.7 Use concealed fastenings except where approved in writing by Consultant prior to installation.

.8 Install air / vapour barrier membrane in accordance with manufactures written instructions.

.9 Install sheet metal roof panels using cleats spaced at 610 mm / 24" maximum on centre.

.10 Secure cleats (clip angles) with two (2) fasteners minimum each and cover with cleat tabs.

.11 Stagger transverse seams in adjacent panels.

.12 Flash roof penetrations with material matching roof panels and make watertight.

.13 Form seams in direction of water-flow and make watertight.

3.4 DECK SHEATHING

.1 Ensure that metal deck is clean and free of rust, moisture and debris.

.2 Lay deck sheathing board perpendicular to the flutes of the metal deck and Z-girt metal framing direction. Structurally support all edges and stagger end joints. Butt joints with moderate contact with no gaps.

.3 Use largest practicable pieces but 300 mm x 300 mm / 12” x 12” minimum. Fill in voids between boards larger than 6 mm / 1/4".

.4 On areas where mechanical securement is specified: Loosely lay deck sheathing and mechanically fasten panels to deck flutes with coated screws and metal plates as specified or in accordance with FM 1-90 wind uplift fastening pattern, whichever is more stringent.

.5 On areas where adhesive is specified: Utilize specified adhesive to secure deck sheathing.

.6 Tape all end joints with kraft laminate paper.

3.5 MEMBRANES AND ACCESSORIES

.1 Air / Vapour Barrier: Refer to Section 07280 - Air / Vapour Barriers.

.2 Ice and Water Shield: Install in location indicated on Drawings to manufacturer’s instructions.

3.6 INSULATION, THERMAL CLIP AND METAL FRAMING

.1 Refer to Section 07213 - Board Insulation.

.2 Use a laser to find and mark two level points on the roof for the first row of clips, then use a chalk line to mark the first row of clips.

.3 Secure the first row of thermal clips using the specified fasteners indicated on the approved Shop Drawings.

.4 Place the insulation on top of the clips and push down to mark the insulation where the clips are, then cut and notch the insulation to fit around the clips.

.5 Install the first layer of insulation tight to air / vapour barrier using insulation adhesive.

.6 Install the next row of clips and continue the process for the rest of the roof surface.

.7 Install the Z-girt metal framing to the thermal clips using approved fasteners.

.8 Install second layer of insulation tight to the Z-girt system and second layer of insulation.

.9 Install and adjust to ensure sheathing is straight and in line on plane indicated and fully supported.

3.7 VAPOUR PERMEABLE ROOF-BOARDING MEMBRANE (UNDERLAYMENT)

.1 Ensure that deck sheathing is clean and free of moisture and debris.

.2 Unroll the membrane horizontally, making sure it is properly aligned.

.3 Position the pre-cut membrane piece. Peel back 100 to 150 mm / 4” to 6” of the silicone release paper to hold the membrane in place at the top of the parapet.

.4 Gradually peel back the remaining silicone release paper, pressing down on the membrane with an aluminum applicator to ensure good adhesion. Use the aluminum applicator to ensure a perfect transition between the upstand and the field surface. Smooth the entire membrane surface with a roller for full adhesion.

.5 Ensure straight line application of membrane flashing along the edge of the roof.

.6 Cut off corners at end laps to be covered by the next roll.

3.8 ROOF PANELS

.1 Install exterior preformed metal roof sheets, using manufacturer's proper construction procedure. Ensure preformed metal roof sheet side-lap is positively retained by clips, and proper sheet coverage is maintained.

.2 Where indicated on approved Shop Drawings, secure the end-lap of preformed metal roof sheets in accordance with the manufacturer’s specifications and details to provide a weather-tight seal. Exposed fasteners to match colour of the roof sheet.

.3 Install the seam-cap at all side laps as shown on the approved Shop Drawings. Add sealant as required. Mitre snap-cap as required to resist water entry.

.4 Provide flute closures, sealed against weather penetration, at changes in pitch, and at ridges and eaves, where required.

.5 Install continuous starter flashings, drips and other flashings as indicated for a complete system.

.6 Install flashings as indicated on Drawings and reviewed Shop Drawings. Use concealed fasteners when possible. Exposed fasteners to match colour of roof sheet.

3.9 SNOW AND ICE RETENTION SYSTEM

.1 Install snow and ice retention system to locations where indicated.

.2 Secure snow and ice retention system components with fasteners in accordance with manufacturer’s written recommendations.

3.10 PREFINISHED METAL EAVESTROUGH AND DOWNPIPES

.1 Install Prefinished Metal Eavestrough and Downpipe in accordance with Section 07620 - Sheet Metal Flashing and Trim.

.2 Use 1000 mm / 3’-0” long sheets if section profile of gutter exceeds 1000 mm / 3’-0”. Use 2.4 m / 8’-0” or 3 m / 10’-0” long sheets if sectional profile is less than 1000 mm / 3’-0”.

.3 Longitudinal joints not acceptable.

.4 Secure gutter lining to substrate with screws, washers and expansion shields spaced maximum 1200 mm / 4'-0" on centre along centre of lining.

.5 At roof edges extend gutter lining under metal roofing 150 mm / 6" minimum and terminate in 20 mm / ¾" folded edge secured by cleats. Hook lower end of roofing into lock strip to form 20 mm / ¾" wide loose-lock seam.

3.11 FIELD QUALITY CONTROL

.1 Shop Drawing Design Engineer's Field Services:

.1 Obtain written report from design engineer responsible for Shop Drawings verifying compliance of work, in handling, installing, applying, protecting and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS. Include on the report stamp and seal of Engineer.

.2 Provide Shop Drawing design engineer's field services consisting of Product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits to review work as follows.

.1 After delivery and storage of Products, and when preparatory work is complete but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

3.12 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 Replace any and all damaged panels and components. Touch-up paint will not be acceptable.

.3 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International Inc.
- .1 ASTM C472, Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete.
- .2 ASTM C1177, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .3 ASTM C1278, Standard Specification for Fiber-Reinforced Gypsum Panel.
- .4 ASTM D41/D41M, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- .5 ASTM D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- .6 ASTM E154, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .2 CGSB 37-GP-56M-80b, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.3 Canadian Roofing Contractors Association (CRCA)
- .1 CRCA Roofing Specifications Manual.

.4 Canadian Standards Association (CSA International)
- .1 CSA A123.21, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- .2 CAN/CSA A123.4, Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
- .3 CSA A231.1/A231.2, Precast Concrete Paving Slabs/Precast Concrete Pavers.

.5 Factory Mutual (FM Global)
- .1 FM Approvals - Roofing Products.
- .2 FM APPROVALS 4470, Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction.

.6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.7 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S107, Methods of Fire Tests of Roof Coverings.
- .2 CAN/ULC-S704, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning roofing work, with roofing contractor's representative Consultant in accordance with Section 01320 - Construction Progress Documentation to:
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Provide one (1) digital PDF copy of most recent technical roofing components data sheets describing materials' physical properties and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide WHMIS SDS and indicate VOC content for:
  - .1 Primers.
  - .2 Asphalt.
  - .3 Sealers.
  - .4 Filter fabric.

.3 Provide Shop Drawings:
- .1 Indicate flashing, control joints, tapered insulation details.
- .2 Provide layout for tapered insulation.

.4 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

.5 Test and Evaluation Reports: Submit laboratory test reports certifying compliance of bitumen and roofing felts and membrane with specification requirements.

.6 Manufacturer's Installation Instructions: Indicate special precautions required for seaming the membrane.

.7 Manufacturer's field report: In accordance with Section 01430 - Quality Requirements.

.8 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.4 QUALITY ASSURANCE

.1 Installer qualifications:
- .1 Company or person specializing in application of modified bituminous roofing systems with five (5) years documented experience and approved by manufacturer.
- .2 Installer to be a member in good standing of the Ontario Industrial Roofing Contractors Association (OIRCA) and Canadian Roofing Contractors Association (CRCA).

.2 Conform to CRCA Roofing Specifications and roofing membrane manufacturer's instructions.

.3 Only qualified, certified installers employed by a company with the appropriate equipment may execute roofing work.

.4 Mock-ups:
- .1 Construct mock-up in accordance with Section 01430 - Quality Requirements.
- .2 Construct mock-up 10 m² minimum size showing typical lap joint, one (1) inside corner and one (1) outside corner. Accepted mock-up may form part of complete work.
- .3 Allow 48 hours for inspection of mock-up by Consultant before proceeding with roofing work.

.5 Manufacturer's Field Services: As part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review work, at stages listed.
- .1 After delivery and storage of Products, and when preparatory work and mock-up is complete, but before installation begins.
- .2 As required by membrane manufacture to obtain roof warranty, but as a minimum twice during progress of work at 25% and 60% complete.
- .3 Upon completion of work, after cleaning is carried out.

1.5 FIRE PROTECTION

.1 Fire Extinguishers:
- .1 Maintain one cartridge operated type or stored pressure rechargeable
- .2 Throughout roofing installation, maintain a clean site and have one approved ULC labeled ABC fire extinguisher within 6 metres of each roofing torch.
- .3 Respect all safety measures described in technical data sheets.
- .4 Never place torches near combustible or flammable products.
- .5 Never use torches where flame is not visible or cannot be easily controlled.

.2 Prior to the start of work, conduct a site inspection to establish safe working practices. Ensure all procedures and proposed changes are approved to minimize the risk of fires.

.3 Maintain fire watch for one (1) hour after each day's roofing operations cease. Use a heat detector gun to spot any smouldering or concealed fire. Organize job planning to ensure workers are still on location at least one hour after torch application.

.4 Maintain safety measures in accordance with manufacturer's written recommendations.

.5 Never apply the torch directly to old and wood surfaces.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Storage and Handling Requirements:
- .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
- .2 Provide and maintain dry, off-ground weatherproof storage.
- .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.

.4 Remove only in quantities required for same day use.
.5 Place plywood runways over completed work to enable movement of material and other traffic.
.6 Store sealants at +5°C minimum.
.7 Store materials unless otherwise indicated in accordance with manufacturer's written instructions.
.8 Store insulation protected from daylight and weather and deleterious materials.

.3 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
.2 Fold up metal banding, flatten and place in designated area for recycling.

1.7 SITE CONDITIONS

.1 Ambient Conditions
.1 Do not install roofing when temperature remains below -18°C for torch application, or -5°C to manufacturers' recommendations for mop application.
.2 Minimum temperature for solvent-based adhesive is -5°C.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.8 MANUFACTURER'S FIELD SERVICES

.1 Arrange for initial job start-up site attendance, periodic site attendance of membrane manufacturer's technical representative during installation work, together with written report.

.2 The Contractor must at all times enable and facilitate access to the work site by said representative.

.3 Notify Consultant of date and time of inspection, a minimum of 72 hours prior to inspection. Provide one copy of manufacturer's report to the Consultant within 48 hours of inspection being carried out.

1.9 EXTENDED WARRANTY

.1 For the work of this Section, twelve (12) months warranty period is extended to twenty (20) years.

.2 At no cost to Owner, Contractor shall remedy any defects in work, including work of this and other Sections, due to faults in materials or workmanship provided under this Section of Specifications appearing within a period of two (2) years from date of Ready-for-Takeover. CRCA Standard Form of Guarantee is not acceptable.

.3 Provide manufacturer's twenty (20) year extended system warranty covering all costs for materials and workmanship including watertightness.

.4 Roofing/Waterproofing contractor must provide proof from the manufacturer that they can supply specified manufacturers material and workmanship warranty. Failure to submit may result in tender disqualification.

1.10 DESCRIPTION OF ROOF MEMBRANE SYSTEM

.1 Provide the following roof membrane systems (types) (from top down):
- .1 Roof Type 1:
  - .1 Composite-reinforced cap sheet membrane, torch-applied.
  - .2 Composite-reinforced base sheet, embedded in hot asphalt.
  - .3 6 mm / 1/4" asphaltic overlay board, adhesive applied.
  - .4 Tapered polyisocyanurate insulation backslopes, crickets, and drain sumps, adhesive applied.
  - .5 2-layers 50 mm / 2” thick polyisocyanurate insulation, each adhesive applied.
  - .6 Vapour retarder.
  - .7 Structural Concrete deck.
- .2 Roof Type 4:
  - .1 150 mm granular ‘A’ as per OPSS 1010 98% SPMDD.
  - .2 Filter fabric.
  - .3 75 mm high load rigid insulation.
  - .4 Two layers composite-reinforced base sheet, each embedded in hot asphalt.
  - .5 6 mm / 1/4" asphaltic overlay board, adhesive applied.
  - .6 Structural Concrete deck.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Compatibility between components of roofing system is an essential requirement of the Contract for the purpose of obtaining a manufacturer’s system warranty.
- .1 Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.
- .2 Products specified within this Specification Section by Soprema, unless otherwise noted are to be used for this project. Equivalent systems, single-sourced from the following manufacturers are also acceptable for use:
  - .1 Elevate.
  - .2 GAF.
  - .3 Henry Company Canada.
  - .4 Johns Manville.
  - .5 IKO.
  - .6 Siplast.
  - .7 Tremco.
  - .8 Or approved alternate.

.2 Roofing System: To CSA A123.21 for wind uplift resistance.

2.2 DECK SHEATHING (FIBERGLASS FACED GYPSUM BOARD)

.1 Deck Sheathing (Fiberglass Faced Gypsum Board):
- .1 Inorganic complete with a fibreglass mat faced panel with a specially treated gypsum core that resists moisture, surface primed. Panel size 1220 mm x 2440 mm / 4-0” x 8’-0” with minimum thickness of 16 mm / 5/8”, complies with ASTM C1177/1177M or ASTM C1278/1278M.
  - .1 Acceptable Products: ‘Dens-Deck Roofboard’ by Georgia Pacific, ‘Securock Roof Board’ by CGC, ‘GlasRoc Roof Board’ by CertainTeed, or approved alternate.

.2 Deck Sheathing Mechanical Securement:

.1 FM Class I approved screws and galvanized metal plate type fasteners with No. 14 coated screws, supplied or approved by deck sheathing and membrane manufacturer. Fasteners to be of sufficient length to penetrate the upper rib of the steel deck 20 mm ±5 mm / 3/4" ±1/4". Acceptable Manufacturer:

.1 Dekfast, Olympic or approved alternate by the roof sheathing/insulation panel manufacturer.

2.3 DECK PRIMER

.1 Asphalt primer: To CGSB 37-GP-9Ma and ASTM D41.

.2 Asphalt primer (self-adhered vapour barrier): To CGSB 37-GP-9Ma, ASTM D41 composed of SBS synthetic rubber, adhesive resins and volatile solvents. Used as primer to improve the adhesion of self-adhesive membranes.

.1 Acceptable Product: 'Elastocol Stick' by Soprema, or approved alternate.

2.4 TORCH-GRADE VAPOUR RETARDER

.1 Vapour Barrier / Vapour Retarder definition: The terms vapour barrier and vapour retarder are to be considered as one in the same throughout these documents.

.2 Modified Bitumen Vapour Barrier: Roofing membrane in conformance with CAN/CGSB 37.56, composed of SBS modified bitumen and a composite reinforcement. Both surfaces are sanded.

.1 Acceptable Product: 'Elastophene 180 Sanded' by Soprema, or approved alternate.

2.5 SELF-ADHERED VAPOUR BARRIER

.1 Vapour Barrier / Vapour Retarder definition: The terms vapour barrier and vapour retarder are to be considered as one in the same throughout these documents.

.2 Self-adhered Vapour Barrier: Self-adhesive air/vapour barrier membrane composed of SBS modified bitumen and a tri-laminated polyethylene facer. The underface is covered with a silicone release film.

.1 Acceptable Product: 'Sopravap'r' by Soprema, or approved alternate.

2.6 POLYISOCYANURATE INSULATION

.1 Polyisocyanurate Insulation:

.1 Conform to CAN/ULC-S704. CFC and HCFC free, 1220 mm x 2440 mm / 4'-0" x 8'-0" maximum board size, thickness as indicated on Drawings. Closed cell polyisocyanurate foam with integrally formed and coated inorganic glass fibre mat facers. Material selected must be supported by membrane manufacturer's warranty. Acceptable Products:

.1 'SopraISO Plus' by Soprema.
.2 'IKOTherm III' by IKO Industries.
.3 'ACFoam III' by Atlas Roofing Corporation.
.4 'Flat ENRGY 3 CGF' by Johns Manville.
.5 'Isolex II' by Lexcor.
.6 Or approved alternate.

.2 Tapered Polyisocyanurate Insulation:

.1 Conform to CAN/ULC-S704. 1220 mm x 1220 mm / 4'-0" x 4'-0" maximum board size. Tapered as per Drawings and details. Uniform slope and all panels/corners/hips to be factory cut and labelled for ease of installation. Material to be same type and from same manufacturer as base insulation or approved for use by membrane manufacturer. Acceptable Products:

.1 'Tapered ACFoam III' by Atlas Roofing Corporation.
.2 'IKOTherm III Tapered' by IKO Industries.
.3 'Tapered ENRGY 3 CGF' by Johns Manville.
.4 'Tapered Isolex II' by Lexcor.
.5 'SopraISO Plus Tapered' by Soprema.
.6 Or approved alternate.

2.7 HIGH LOAD RIGID INSULATION

.1 Rigid Insulation for structural applications to CAN/ULC-S701.

.1 Moisture resistant, closed-cell extruded rigid foam insulation below foundation elements or slabs on grade as noted on Drawings.
.2 Minimum compressive strength 275kPa / 40 psi.
.3 Acceptable Product: 'Styrofoam Brand Highload Extruded Polystyrene Foam Insulation' by Dupont, 'Foamular Extruded Polystyrene (XPS) Rigid Foam Insulation' by Owens Corning, 'Sopra-XPS' by Soprema, or approved alternate.

2.8 INSULATION AND OVERLAY BOARD ADHESIVE – HOT APPLIED

.1 Oxidized Asphalt

.1 Description: Bitumen used for waterproofing of multilayer coatings, in conformance with: CAN/CSA-A123.4-F04 (C2008), type as follows:

.1 Type 2 roofing systems with slopes less than 2%.
.2 Type 3 roofing systems with slopes between 2% and 25%.

2.9 MODIFIED PLASTIC CEMENT

.1 Modified Plastic Cement:

.1 Modified plastic cement composed of asphalt, fibres, solvent, crumb rubber and fillers. Asbestos free formulation. To provide weather resistance, flexibility and ease of application. Acceptable Products:

.1 "Sopralastic 121" by Soprema.

2.10 WATERPROOFING MASTICS

.1 Solvent-based mastic:

.1 Solvent based mastic containing SBS modified bitumen, fibres and mineral fillers. Joining mastic providing good waterproofing. Acceptable Products:

.1 "Sopramastic" by Soprema.
.2 "Sopramastic ALU" by Soprema for exposed areas.

2.11 WATERPROOFING OF PENETRATIONS

.1 Waterproofing:
- .1 One-component polyurethane / bitumen resin. Dedicated to roof flashings and details where it is difficult to apply waterproofing membranes. Acceptable Products:
  - .1 “Alsan Flashing” by Soprema.

2.12 ROOF MEMBRANE ADHESIVE – HOT APPLIED

.1 SEBS Bitumen:
- .1 Description: SEBS modified bitumen used in roofing construction as hot-applied adhesive, minimum 1000% elongation, elastic recovery greater than 99%.
- .2 Acceptable Product: ‘Soprasphalte M’ by Soprema.

2.13 OVERLAY BOARD

.1 Overlay Board: Multi-ply, semi-rigid asphaltic roofing substrate board composed of a mineral fortified asphaltic core formed between two asphaltic saturated fibreglass liners. 6.4 mm / 1/4" minimum thickness, size to best suit application.
- .1 Puncture resistance: 500 N to ASTM E154.
- .2 Water Absorption: 0.25% to ASTM D994
- .3 Compressive strength: ≥ 3565 kPa / 517 psi to ASTM C472
- .4 Acceptable Product: “Sopraboard” by Soprema.

2.14 FLAME STOP MEMBRANE

.1 Flame Stop Membrane:
- .1 Self-adhesive application, SBS modified bitumen membrane, 1.6 mm / 1/16” thick, glass fleece reinforcement, sanded surface, silicone release film underface. Conform to CAN/CGSB-37.56M.
  - .1 Strain energy, MD/XD: 0.9 / 1.0 kN/m.
  - .2 Breaking strength, MD/XD: 9.4 / 8.6 kN/m.
  - .3 Ultimate elongation, MD/XD: 4 / 4 %.
  - .4 Low temperature flexibility: -35 °C.
  - .5 Peel resistance on concrete: 2800 N/m.
  - .6 Peel resistance on plywood: 2800 N/m.
  - .7 Accepted Products: “Sopraguard Tape” by Soprema.

2.15 MEMBRANE BITUMEN ADHERED – (HOT ASPHALT) BASE SHEET / HEAT-WELDED (TORCH APPLIED) CAP SHEET

.1 Base sheet: To CAN/CGSB-37.56M, CSA A123.23, Type C, Grade 3, 2.5 mm / 0.098” thick hot bitumen-adhered waterproof sheet membrane composed of composite reinforcement (non-woven polyester & glass grid) and SBS modified bitumen, bottom face sanded, top face covered with a thermofusible poly film, with distinctive lines on top surface to facilitate roll alignment.
- .1 Strain energy, MD/XD: 8 kN/m / 6.5 kN/m.
- .2 Ultimate elongation MD/XD: 65% / 65%.
- .3 Dimensional stability MD/XD: 0.2 % / 0.2%.

.4 Low temperature flexibility, max MD/XD: -27 / -27 °C.

.5 Acceptable Products: “Colply Base 410” by Soprema.

.2 Base Sheet Flashing: To CAN/CGSB-37.56M CSA A123.23, Type C, Grade 3, 3 mm / 0.118” thick self-adhered waterproof sheet membrane composed of composite reinforcement (non-woven polyester and glass grid) and SBS modified bitumen, bottom face self-adhesive and covered with silicone release film, top face covered with a thermofusible poly film, with distinctive lines on top surface to facilitate roll alignment.

.1 Strain energy, MD/XD: 8 kN/m / 6.5 kN/m.

.2 Ultimate elongation MD/XD: 55% / 55%.

.3 Dimensional stability MD/XD: 0.2 % / 0.2%.

.4 Low temperature flexibility, max MD/XD: -27 / -27 °C.

.5 Acceptable Products: “Sopraply Flam Stick” by Soprema.

.3 Cap sheet membrane: To CAN/CGSB-37.56M, CSA A123.23, Type C, Grade 1, 4.0 mm / 0.157” thick heat-welded waterproof sheet membrane composed of composite reinforcement (non-woven polyester & glass grid) and SBS modified bitumen, bottom face covered with a thermofusible poly film, top face covered with ceramic granules.

.1 Strain energy, MD/XD: 7.3 kN/m / 6.5 kN/m.

.2 Ultimate elongation. MD/XD: 60% / 95%.

.3 Dimensional stability MD/XD: 0.6 % / 0.1%.

.4 Low temperature flexibility, max MD/XD: -18 / -18 °C.

.5 Acceptable Products:

.1 ‘Sopraply Traffic Cap’ by Soprema.

.2 ‘Sopraply Traffic Cap FR’ by Soprema for ULC Class A in accordance with CAN/ULC-S107.

2.16 CAP SHEET COLOUR

.1 Cap sheet colour: As later selected by Consultant from manufacturer’s standard colour range.

2.17 SEALERS

.1 Sealing Product: Bitumen/polyurethane waterproofing mono-component resin and polyester reinforcement.

.1 Acceptable Product: ‘Alsan Flashing’ and ‘Alsan Reinforcement’ by Soprema, or approved alternate.

.2 Sealants: Refer to Section 07920 - Joint Sealants.

2.18 CARPENTRY

.1 Refer to Section 06100 - Rough Carpentry.

2.19 ACCESSORIES

.1 Fasteners:

.1 Insulation to deck: Coated insulation fasteners and galvanized plates must meet FM Approval for wind uplift and corrosion resistance, as recommended by insulation manufacturer.

.2 Roof Drains: Refer to Division 15.

.3 Scuppers: Refer to Section 07620 – Sheet Metal Flashing and Trim.

PART 3 - EXECUTION

3.1 QUALITY OF WORK

.1 Do examination, preparation and roofing work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual Ontario Roofing Association Manual, particularly for fire safety precautions.

.2 Prime in accordance with manufacturers written recommendations.

.3 Provide interface between walls and roof assemblies with durable rigid sheet metal as required to provide connection point for continuity of air barrier.

.4 Provide assembly, component and material connections in consideration of appropriate design loads.

.5 Maintain equipment in good working order to ensure control of roofing operations and protection of work.

3.2 GENERAL

.1 Apply roofing in accordance with Drawings, Specifications and requirements of authorities having jurisdiction and the Canadian Roofing Contractor’s Association Roofing Manual.

.2 Use manufacturer's printed recommendations and specifications as minimum requirements for materials, methods and quality of work not otherwise specified herein.

.3 Make adjustments to specified roofing procedures caused by weather and site conditions to Consultant approval.

.4 Reinstall and connect all mechanical and electrical equipment to original function.

.5 Ensure watertight junctions of roof drains, vents and other items passing through the roof.

.6 Install plywood and lumber nailer plates to deck, walls and parapets where required and as indicated.

.7 Install vapour retarder and all field membrane beginning at low point and at right angles to the slope or from roof drain.

.8 Provide interface between walls and roof assemblies with durable rigid sheet metal as required to provide connection point for continuity of air barrier.

.9 Ensure proper tie-ins as indicated.

.10 Install tapered insulation in accordance with manufactured instructions and reviewed Shop Drawings.

.11 Soften and shim edges of tapered insulation as required to provide smooth transition from one level to the next.

.12 Ensure all edges of insulation and cover boards, are structurally supported. Stagger joints of insulation boards both horizontally and vertically. Stagger end joints. Butt joints with no gaps or broken boards. Cut and fit neatly at all projections.

.13 Apply adhesives in accordance with manufacturer's instructions and recommendations.

.14 Install joint sealants in accordance with Section 07920 – Joint Sealants.

.15 Use only manufacturer approved torches in accordance with manufacturer's recommendations.

3.3 EXAMINATION OF ROOF DECKS

.1 Verification of Conditions: Inspect deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.

.2 Evaluation and Assessment: Prior to fastening deck sheathing and/or other roof system components, inspect underside of the deck for conduit locations, fire-proofing material and other potential hazards.

.3 If fastening is specified, assume full responsibility to avoid damaging conduits within the interior space. Utilize all available means to ensure the continued uninterrupted function of electrical/electronic items, including visual reviews and available electronic detection devices.

.4 Ensure decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

.5 Ensure curbs have been built.

.6 Ensure roof drains have been installed at proper elevations relative to finished roof surface.

.7 Assume full responsibility for damages occurring as a result of fastening through the deck and make good all such damages at no additional cost to the Owner.

.8 Do not install roofing materials during rain or snowfall.

3.4 PROTECTION OF IN-PLACE CONDITIONS

.1 Cover walls, walks, and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rainwater off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Consultant.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.

3.5 PRIMING DECK

.1 Apply deck primer to roofing substrate at the rate recommended by manufacturer.

3.6 VAPOUR RETARDER OVER CONCRETE DECK

.1 Adhere vapour barrier to substrate with bitumen in conformance with manufacturer's recommendations.

3.7 TEMPORARY PROTECTION

.1 Apply 1-ply of self-adhered modified bitumen membrane when conditions prevent the installation of the complete membrane assembly.

.2 Remove temporary protection upon resumption of work. Repair / Replace any wet or damaged material shall be prior to continuing with new roof installation.

3.8 FLAME STOP MEMBRANE

.1 Prior to insulation application, apply flame stop membrane continuously at all horizontal/vertical transitions.

.2 Prime surfaces to receive insulation.

3.9 INSULATION INSTALLATION

.1 Insulation Application - General:
- .1 Install roof insulation boards, cut and trimmed to provide plain butt joints at perimeters, parapets, curbs, etc.
- .2 Lay insulation boards in parallel courses, butted together tightly in firm contact with one another, without gaps, complete with staggered end joints.
- .3 Place boards in parallel rows with ends staggered, and in firm contact with one another.
- .4 Cut end pieces to suit.
- .5 Install second layer with joints placed offset and perpendicular from underlying layer.

.2 Tapered insulation application:
- .1 Install tapered insulation as third insulation layer, in accordance with Shop Drawings. Stagger joints between layers 150 mm / 6” minimum.
- .2 Fasten tapered insulation as per manufacturer’s written instructions using same method as described for base insulation.

3.10 OVERLAY BOARD

.1 General Application Method:
- .1 Stagger all vertical joints between boards and insulation.
- .2 Connect panels in perfect connection, without any differences in level and completely adhered all surfaces.

.3 Apply only as many boards as can be covered in the same day.

.2 Hot Applied Asphalt Application: On all insulation surfaces intended for board coverage, apply a coat of hot asphalt at a rate of 1 kg/m2, following methods and temperatures recommended by insulation manufacturer. While asphalt is at recommended temperature, install boards by butting ends snugly and without warping.

3.11 BASE SHEET

.1 Installation of Hot Applied Asphalt Base Sheet:

.1 Unroll base sheet dry onto substrate with first side lap lined up with drain centre (parallel to roof edge).

.2 Overlap side laps by 75 mm / 3”, along lines provided for this purpose, and overlap end laps by 150 mm / 6”. Stagger end joints by at least 305 mm / 12”.

.3 Re-roll base sheet and unroll again onto bed of hot bitumen. Do not apply hot bitumen on side and end laps; they must be torched on the entire length of the selvedge and at end side of roll.

.4 Pour hot bitumen in front of each roll at a temperature of about 230°C and heat in kettle at about 250°C; minimum temperature at point of contact should be 220-230°C.

.5 Do not spread more than 3 m / 10’ of hot bitumen in front of each roll. Below 15°C, do not spread more than 1 m / 3’ of hot bitumen in front of each roll.

.6 Below 10°C, re-heat membrane underside asphalt by sweeping torch over roll's entire width and burn plastic film of top face in a zig-zag fashion. Ensure hot bitumen in kettle is in constant use to avoid distillation. Do not direct flame toward the bitumen.

.7 Apply hot bitumen vertical surfaces at levels higher than 25 mm / 1” from horizontal base-sheet roofing surface.

.8 Avoid forming wrinkles, air pockets or fishmouths.

3.12 CAP SHEET

.1 Installation of Torch-Applied Cap Sheet:

.1 Proceed with cap sheet installation once base sheet is applied with no defects.

.2 Commence with double-selvedge starter roll. If starter roll is not used, side laps covered in granules must be degranulated by embedding side laps in torch-heated bitumen over a 75 mm / 3” width.

.3 Unroll cap sheet at drain. Carefully align first side lap (parallel to roof edge).

.4 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.

.5 Avoid overheating.

.6 Joints between the layers to be staggered 300 mm / 12” minimum.

.7 Overlap cap sheet side laps by 75 mm / 3”, and end laps by 150 mm / 6”. Cut off corners at end laps to be covered by next roll. Degranulate all overlap surfaces.

.8 Complete perfect welds between two membranes. Leave no zone unwelded. In cold weather, adjust welding time to obtain homogenous seam (it may be necessary to slow down in certain cases.)

.9 Once cap sheet is installed, review all overlapped joints for positive seals.

.10 During installation, take care to avoid excessive bitumen bleed-out at joints.

3.13 FLASHINGS

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Apply base and cap sheet onto substrate in 1 metre / 3’-3” wide strips using same method as base and cap sheet applications.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm / 6” and seal by using same method as base sheet applications.

.4 Lap flashing cap sheet to membrane cap sheet 250 mm / 10” minimum using same method as cap sheet applications.

.5 Provide 75 mm / 3” minimum side lap and seal.

.6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.7 Do work in accordance with manufacturer's recommendations and Section 07620 - Sheet Metal Flashing and Trim.

3.14 EXPANSION JOINT MEMBRANE

.1 Install all components of the system in accordance with the manufacturer’s instructions.

.2 Encapsulate the expansion joint membrane material in a bed of trowel grade cold adhesive. Embed bottom fleece surface into cold adhesive in accordance to the manufacturer’s recommendations.

.3 Use flat head nails to secure expansion joint membrane to the substrate. Place nails 50 mm / 2” away from the edge expansion joint membrane, within the fleece.

.1 Fastening pattern: 200 mm / 8” o.c. staggered on both salvage edges.

.4 Coat the top fleece surface of expansion joint membrane, with trowel grade cold adhesive and lay in the roofing / waterproofing membrane in the cold adhesives in accordance with manufacturer’s application procedures to form a continuous monolithic waterproof barrier and not obstruct water flow across its surface.

.5 Protection:

.1 Protect joint by means of an overlap membrane adhered to one side of the joint.

3.15 ROOF PENETRATIONS

.1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

.2 Ensure substrate is clear of loose granules and all foreign substances that can impair adhesion.

.3 Place prefabricated curbs in the desired location and mark outside edge for reference. Place curbs at least 25 mm / 1” away from the penetration.

.4 Wire brush area around penetration to remove loose materials and contaminants.

.5 Seal base of penetration with specified sealant to prevent the mastic from flowing through openings.

.6 Apply a bead of sealant to the substrate where curbs will be placed.

.7 Apply a bead of sealant to locking joint of the curb.

.8 Set the curbs in place and apply equal pressure to assure positive contact with roof membrane. Strike away excess sealant.

.9 Dispense a small amount of mastic to ensure proper mix and fill inside prefabricated curb until full.

3.16 DRAINS

.1 Prior to proceeding with drain installation, ensure all rainwater leaders are properly secured. Inspect underside of deck as required.

.2 Make opening water and vapour tight at vapour retarder. Apply spray foam insulation to fill voids between existing drain bowl and new insulation. Install drains and seals in accordance with the manufacturer's printed instructions.

.3 Flash with 2-ply bitumen membrane. Extend first ply 152mm / 6”, second ply 305 mm / 12” beyond flange.

.4 Stop membrane flashing 25 mm / 1” from strainer ensuring drainage openings at base of strainer are kept clear.

.5 Ensure strainer dome is in place and secure.

3.17 PIPE SUPPORTS

.1 Place one additional cold cap sheet membrane below pipe supports supporting heavy loads, colour different from field membrane as later selected by Consultant from manufacturer’s standard colour range.

.2 Center support below conduits pipes and ducts squarely over pipe stand.

.3 Adjust supports level and plumb as required to ensure uniform load with other supports.

.4 Place pipe and ducts on support without dropping or causing undue impact.

3.18 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

- .1 Obtain written reports from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

3.19 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 Remove bituminous markings from finished surfaces.

.3 In areas where finished surfaces are soiled caused by work of this Section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

.4 Repair or replace defaced or disfigured finishes caused by work of this Section.

.5 Perform daily clean up to collect all wrappings, empty containers, and other debris from the project site.

.6 Upon completion, all debris must be disposed of in a legally acceptable manner. Dispose of all debris/ waste in approved containers and transfer to approved municipal and/or provincial disposal site(s).

.7 Prior to the final inspection, perform pre-inspection to review all work and to verify completion of all flashings and sealant applications.

.8 Leave roof clean of debris, spills, etc.

3.20 MAINTENANCE MATERIAL

.1 Granules:

.1 As supplied by membrane manufacturer, colour to match membrane granule, provide to Owner one full pail of granules at end of project.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 The Aluminum Association (AA)
- .1 Aluminum Design Manual.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A446, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) By The Hot-Dip Process, Structural (Physical) Quality.
- .2 ASTM D822, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

.3 Canadian Roofing Contractors Association (CRCA)
- .1 Roofing Specifications Manual.

.4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-37.5, Cutback Asphalt Plastic Cement.

.5 Canadian Standards Association (CSA International)
- .1 CSA B111, Wire Nails, Spikes and Staples.

.6 Green Seal Environmental Standards
- .1 Standard GS-03, Anti-Corrosive Paints.
- .2 Standard GS-11, Architectural Paints.
- .3 Standard GS-36, Commercial Adhesives.

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's printed Product literature for sheet metal flashing systems materials, specifications and datasheet and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit one (1) digital PDF copy WHMIS SDS - Safety Data Sheets.

.3 Shop Drawings:
- .1 Submit Shop Drawings in accordance with Section 01330 – Submittal Procedures.

.4 Samples:
- .1 Submit duplicate 50 x 50 mm / 2” x 2” samples of each type of sheet metal material, finishes and colours.

.5 Quality assurance submittals: Submit following in accordance with Section 01430 - Quality Requirements.
- .1 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.3 QUALITY ASSURANCE

.1 Provide mock-up of window sill conditions where directed by Consultant. Do not proceed with installation of window sills until approved in writing by the Consultant. Allow 72 hours for inspection of mock-up by Consultant before proceeding with the work.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PREFINISHING METAL FLASHINGS

.1 Prefinished Metal Flashing (Flat Stock): Galvanized steel, minimum temper rolled accordance with ASTM A446, to profiles indicated, type, colour and thickness to match metal cladding. Factory applied silicone modified polyester finish shall be Series 5000 pre-coating by Dominion Foundries and Steel Limited or the Steel Company of Canada Limited.

.1 Class F1S.

.2 Prefinished 'Standard' and 'Extended' Colour Ranges series:

.1 Acceptable Product 'WeatherXL' by Vicwest, or equivalent by Agway, or Ideal Roofing.

.3 Colours: Refer to Section 07410 - Preformed Metal Wall and Roof Cladding Systems.

.2 Prefinished Metal Sills: Full length, of type and size and profile indicated, 0.76 mm / 22 gauge metal c/w drip, chairs, anchoring devices and end dams.

.1 Colours: Refer to Section 07410 - Preformed Metal Wall and Roof Cladding Systems.

.2 Coating thickness: Not less than 20 micrometers.

.3 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:

.1 Outdoor exposure period 500 hours.

.2 Humidity resistance exposure period 500 hours.

.4 Shape and Size: As detailed on Drawings, with minimum 2% drainage slope to exterior.

2.2 PREFINISHING METAL SCUPPER

.1 Form scuppers from 0.91 mm / 20 gauge, prefinished sheet metal.

.2 Sizes and profiles as indicated.

2.3 PREFINISHED METAL EAVESTROUGHS COMPLETE WITH INTEGRAL SCUPPER DOWNPIPE

.1 Form eaves troughs and downpipes, 0.91 mm / 20 gauge, prefinished sheet metal.

.2 Form ‘U’ bracket from 1.9 mm / 14 gauge, prefinished sheet metal.

.3 Sizes and profiles as indicated.

.4 Fabricate eaves troughs complete with downpipes and necessary fastenings as indicated.

2.4 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: To CAN/CGSB 37.5.

.3 Underlay for metal flashing: Refer to Section 07270 - Air / Vapour Barriers.

.4 Sealants: Refer to Section 07920 - Joint Sealants.

.5 Cleats: Of same material and temper as sheet metal, minimum 50 mm / 2” wide. Thickness to be one (1) gauge number thicker than sheet metal being secured.

.6 Fasteners: Of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

.7 Washers: Of same material as sheet metal, 1 mm / 0.039” thick with rubber packings.

.8 Touch-up paint: As recommended by prefinished material manufacturer.

2.5 FABRICATION

.1 Form flashings, copings and fascias to sizes and profiles indicated.

.2 Fabricate metal flashings, sills and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.

.3 Fabricate aluminum flashings, sills and other sheet aluminum work in accordance with AA Aluminum Design Manual.

.4 Form pieces in 2440 mm / 8’-0” minimum lengths.
.1 Make allowance for expansion at joints.

.5 Form sills in full window width pieces, in profiles as indicated, c/w end caps and end dams. Round off all sharp edges within 2000 mm / 6’ 7” off ground level.

.6 Fabricate sills to suit individual window openings and to accommodate concealed end dams where possible to Consultant approval.

.7 Hem exposed edges on underside 12 mm / 1/2".
.1 Mitre and seal corners with sealant.

.8 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.9 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install sheet metal work in accordance with CRCA FL series details and as detailed.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal.
- .1 Secure in place and lap joints 100 mm / 4”.

.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
- .1 Flash joints using S-lock forming tight fit over hook strips, as detailed.

.5 Lock end joints and caulk with sealant.

.6 Insert metal flashing under cap flashing to form weathertight junction.

.7 Caulk flashing at cap flashings with sealant. Do not seal where water is intended to drain from the building system / components.

.8 Install pans, where shown around items projecting through roof membrane.

3.3 SILL INSTALLATION

.1 Set sills with uniform design drainage slope to exterior, level in length. Where possible extend sills past jambs as required to conceal end dams behind adjacent exterior wall finish and provide watertight joint with sealant concealed from the elements.
- .1 At masonry locations fit sills to provide snug fit. Set end dams and against masonry in bed of sealant in accordance with Section 07920 – Joint Sealants and provide watertight joint concealed from the elements.

.2 Cut sills to fit 150 mm / 6” longer than window opening. Set sills with uniform design drainage slope to exterior, level in length. Extend sills past jambs and provide watertight joint concealed from the elements.

.3 Secure sills in place with anchoring devices located at ends and joints and evenly spaced at maximum 610 mm / 2’-0” maximum between.

.4 Provide one-piece sill flashing where practicable.
- .1 Where joints are required, keep joints to a minimum and locate to provide equal sill lengths. Provide a 200 mm / 8” long sill piece sill below window sill and embed exposed sill fully into bed of sealant over sill piece for a water tight connection. Do not surface caulk joints.

.5 Provide adequate space between butt ends of sill lengths to allow for thermal expansion. For sills over 1220 mm / 4'-0" in length, maintain 3 to 5 mm / 1/8" to 3/16" expansion space at each end. Provide securely fastened concealed flashing below exposed sill and make watertight with sealant concealed from the elements for longevity.

.6 Return and close exposed ends of sill flashings watertight complete with drip, angled and chamfered as required to eliminate all sharp edges.

3.4 PREFINISHED METAL SCUPPERS

.1 Install scuppers as indicated on Drawings.

3.5 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.

3.6 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
- .1 ASTM A506, Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled.
- .2 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 The Master Painters Institute (MPI)
- .1 Architectural Painting Specification Manual - current edition.
  - .1 MPI #76, Primer, Alkyd, Quick Dry, for Metal.

1.2 DESIGN REQUIREMENTS

.1 Roof hatches to withstand live and snow loads without damage to unit or permanent deformation to seals. Refer to Structural Drawings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for roof hatches and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit one (1) electronic PDF copy of WHMIS SDS.

.3 Shop Drawings:
- .1 Submit Shop Drawings in accordance with Section 01330 - Submittal Procedures.
- .2 Indicate size and description of components, materials, attachment devices, description of frame and finish, and construction details.

.4 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions.

.5 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Submit operation and maintenance data for hardware complete with pertinent details, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect roof hatches from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to work of this Section and in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.6 EXTENDED WARRANTY

.1 Roof hatch manufacturer hereby warrants that the roof hatch will remain in a watertight condition and will not leak as a result of faulty materials and remain free from material or workmanship defects for five (5) years from the date of Ready-for-Takeover.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Steel sheet: Regular quality alloy steel to ASTM A506.

.2 Galvanized steel sheet: Commercial quality to ASTM A653, Z275 designation zinc coating.

.3 Gaskets: Extruded resilient neoprene, with full recovery after 50% compression.

.4 Hardware and Fasteners: Stainless steel.

.5 Sealants: Refer to Section 07920 - Joint Sealants.

.6 Primers, Paints, Coating: In accordance with manufacturer's recommendations for surface conditions.
- .1 Primer paint for steel: To MPI #76.

.7 Isolation coating: Alkali resistant bituminous paint or epoxy solution.

.8 Finish painting: Refer to Section 09900 – Painting.

2.2 ROOF HATCH

.1 Roof Hatch Size:
- .1 Sizes as indicated on Drawings.

.2 Deck Opening Size: Correspond to hatch size.

.3 Curb and door(s) Construction:

.1 To all locations unless otherwise indicated:

.1 1.89 mm / 14 ga. primer coated galvanized steel c/w factory finished with red primer.

.2 3.0 mm / 11 ga. mill finished aluminum.

.3 1.89 mm / 14ga. Type 304 stainless steel.

.4 Door Insulation: 83.8 mm / 3 1/4" polyisocyanurate.

.5 Door Liner of 1.2 mm / 18 ga. Type 304 stainless steel.

.4 Curb:

.1 Height: As indicated on Drawings.

.2 Flange: 89 mm / 3 1/2" wide, pre-punched flanges.

.5 Accessories:

.1 Hardware: Heavy duty pintle hinges, torsion bar operated doors / heli coil operated doors, latching mechanisms, interior (and exterior) padlock hasps and neoprene draft seal, automatic hold-open arm c/w a foam rubber grip handle. Padlock hasps to be on exterior and lockable and operable from exterior where indicated.

.2 Hardware finish: Stainless steel.

.3 Wind Gust Control: Mounted on the side of the hatch.

.4 Safety Bar Handle: 35 mm / 1-3/8” diameter Safety Bar coated with 20 mil PVC colour coating, mounted on corner of hatch curb without impeding operation of the door.

.5 Safety Rail System: Equip hatch with safety rail system and self-closing gate that provides a permanent means of fall protection.

.6 Acceptable product: “Type J-Channel Frame-300 PSF” by Bilco, “R-140” by Lexsuco Corporation, or approved alternate.

2.3 FABRICATION

.1 Fabricate components free of twists, bends, or visual distortion and insulated. Weld corners and joints.

.2 Assemble roof hatch components as indicated.

.3 Ensure continuity of weather-tight seal.

.4 Design stainless steel extrusions to collect and lead off accumulated condensation.

.5 Zinc plate hardware and attachments and shop prime ready for field painting.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof hatch installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.3 INSTALLATION

.1 Erect components plumb, level and in proper alignment.

.2 Ensure continuity of building envelope air barrier and vapour retarder systems.

.3 Adjust and seal assembly with provision for expansion and contraction of components.

.4 Secure prefabricated curb assembly to structure.

.5 Coat aluminum in contact with dissimilar materials, with isolation coating.

.6 Secure and seal frame to curb.

3.4 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
  .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by roof hatch installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  .1 Safety Data Sheets (SDS).

.2 Underwriter's Laboratories of Canada (ULC):
  .1 ULC-S115, Fire Tests of Fire Stop Systems.

1.2 DEFINITIONS

.1 Fire Stop Material: Device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

.2 Single Component Fire Stop System: Fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.3 Multiple Component Fire Stop System: Exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): Penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.
  .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
  .1 Submit manufacturer's printed Product literature, specifications and datasheet and include Product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit electronic copy of WHMIS SDS - Safety Data Sheets.

.3 Shop Drawings:
  .1 Submit Shop Drawings to show locations, proposed material, reinforcement, anchorage, fastenings and method of installation.
  .2 Construction details should accurately reflect actual job conditions.

.4 Samples:
  .1 Submit duplicate 300 x 300 mm / 12’ x 12’ samples showing actual fire stop material proposed for project.

.5 Quality assurance submittals:
  .1 Test reports: In accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
    .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

.2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.3 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
.4 Manufacturer's Field Reports: Submit to manufacturer's written reports within three (3) Working Days of review, verifying compliance of work, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 QUALITY ASSURANCE

.1 Qualifications:
.1 Installer: Company and person specializing in fire stopping installations with five (5) years documented experience, approved by manufacturer.

.2 Manufacturer’s Field Services: As part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer’s representative, to review work, at stages listed.
.1 After delivery and storage of Products, and when preparatory work and mock-up is complete, but before installation begins.
.2 Twice during progress of work at 25% and 60% complete.
.3 Upon completion of work, after cleaning is carried out.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
.2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.

.2 Storage and Protection:
.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

.3 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

PART 2- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers of rated systems include:
.1 3M Canada Inc.
.2 Hilti Canada Corp.
.3 Or approved alternate.

2.2 MATERIALS

.1 Fire stopping and smoke seal systems: In accordance with CAN/ULC-S115.
- .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
- .2 Fire stop system rating: To correspond with tested assemblies, or acceptable calculation procedures to provide fire resistance ratings as indicated.

.2 Service penetration assemblies: Systems tested to CAN/ULC-S115.

.3 Service penetration fire stop components: Certified by test laboratory to CAN/ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with OBC.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: Elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: To manufacturer's recommendation for specific material, substrate, and end use.

.8 Water (if applicable): Potable, clean and free from injurious amounts of deleterious substances.

.9 Damming and backup materials, supports and anchoring devices: To manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.10 Sealants for vertical joints: Non-sagging.

.11 Sealants / Silicone: To manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction, colour as later selected by Consultant from manufacturer’s complete colour range.

.12 Fire Stop Insulation: Mineral wool insulation as per sealant manufacturer written recommendations for intended use.

.13 Fire Stop Mortar: Non-combustible, fibre reinforced, foamed cement mortar, ULC labelled.

.14 Sheet Metal Fire Stopping in accordance with OBC 3.1.11.7(2).
- .1 Sheet Metal Fire Stopping: Minimum 0.38 mm / 28-gauge sheet metal size and shape to suit opening. Provide continuous supports to all joints.

.15 Identification Labels: Purpose made by manufacturer for permanent attachment to fire stop substrate area. Clearly identify manufacturer, Product name, maximum hour rating, ULC rating number, installation date, approved installer name and company c/w phone and fax number, and location number.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
  .1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Fire stop sealant
  .1 Provide silicone fire stop sealant in concealed locations as determined in writing by Consultant.
  .2 Provide water-based paintable acrylic fire stop sealant at all exposed to view locations.
  .3 Provide fire stop sealant over fire stop insulation.
  .4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

.6 As the work progresses, permanently mark all penetration seals with identification plate in visible locations next to seal. Review all exposed to view locations with Consultant prior to installing identification plates.

3.4 SEQUENCE OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by Consultant.

.2 Install floor fire stopping before interior partition erections.

.3 Metal deck bonding: ire stopping to precede spray applied fireproofing to ensure required bonding.

.4 Mechanical pipe insulation: Certified fire stop system component.
  .1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

.1 Inspections: Notify Consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.2 Manufacturer's Field Services:
- .1 Obtain written reports from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

.1 Fire stop and smoke seal including but not limited to:
- .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
- .2 Top of fire-resistance rated masonry and gypsum board partitions.
- .3 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
- .4 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
- .5 Openings and sleeves installed for future use through fire separations.
- .6 Around mechanical and electrical assemblies penetrating fire separations.
- .7 Rigid ducts greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
- .8 At other locations as indicated on Drawings.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International
- .1 ASTM C834, Standard Specification for Latex Sealants.
- .2 ASTM C920, Standard Specification for Elastomeric Joint Sealants.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 19-GP-5M, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
- .2 CAN/CGSB-19.13, Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .3 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
- .4 CAN/CGSB-19.17, One-Component Acrylic Emulsion Base Sealing Compound.
- .5 CAN/CGSB-19.24, Multi-component, Chemical Curing Sealing Compound.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for joint sealants and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Manufacturer's Product to describe:
  - .1 Caulking compound.
  - .2 Primers.
  - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .3 Submit one (1) digital PDF copy of WHMIS SDS.

.3 Samples:
- .1 Submit two (2) samples of each type of material and colour.
- .2 Cured samples of exposed sealants for each colour where required to match adjacent material.

.4 Manufacturer's Instructions:
- .1 Submit instructions to include installation instructions for each Product used.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Operation and Maintenance Data: Submit operation and maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

.1 Qualifications:
- .1 Subcontractor: Possess a copy of and be familiar with all standards specified. A person specializing in work specified with minimum five (5) years documented experience approved by Manufacturer.
- .2 Installer: A person specializing in installing sealants in exposed joints with minimum one (1) year documented experience approved by Manufacturer.

.2 Mock-ups:
- .1 Construct mock-up in accordance with Section 01430 - Quality Requirements.
- .2 Construct mock-up to show location, size, shape and depth of joint(s) complete with back up material, primer, caulking and sealant.
- .3 Mock-up will be used to judge workmanship, substrate preparation, operation of equipment and material application.
- .4 Locate where directed by Consultant.
- .5 Allow seventy-two (72) hours for inspection of mock-up by Consultant before proceeding with sealant work.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished Work if deemed acceptable by Consultant.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect joint sealants from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

.1 Ambient Conditions:
- .1 Proceed with installation of joint sealants only when:
  - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
  - .2 Joint substrates are dry.
  - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Joint-Width Conditions:
- .1 Proceed with installation of joint sealants only where joint widths do not exceed those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:
- .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to Health Canada.

.2 Arrange for ventilation system to be operated on maximum outdoor air and exhaust during installation of caulking and sealants. Ventilate area of work as required with use of approved portable supply and exhaust fans.

1.8 EXTENDED WARRANTY

.1 Provide a written warrantee signed and issued in the name of the Owner, stating that caulking work of this Section is guaranteed against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion and staining adjacent surfaces, for a period of two (2) years from date of Consultant's Certificate of Ready-for-Takeover.

PART 2- PRODUCTS

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

.3 Where sealants are qualified with primers use only primers as recommended by sealant manufacturer for type of surface and conditions being primed.

.4 Joint Filler and Back-Up: Circular cross section unless shown as slab or sheet, minimum 25% wider than joint, semi-rigid: closed cell polyethylene or polyurethane product, rubber tubing or non-migrating plasticized vinyl having a shore "A" hardness of 20 and tensile strength of 130-200 kPa, compatible with sealant and as recommended by sealant manufacturer.

.5 Bond Breaker: As recommended for use by sealant manufacturer.

.6 Vent Tubes: Rigid clear extruded plastic, min. 6 mm / 1/4" ID and 9 mm / 3/8” OD.

.7 Preformed compressible and non-compressible back-up materials:
- .1 Polyethylene, urethane, neoprene or vinyl foam:
  - .1 Extruded closed cell foam backer rod.
  - .2 Size: Oversize 30 to 50 %.
- .2 Neoprene or butyl rubber:
  - .1 Round solid rod, Shore A hardness 70.
- .3 High density foam:
  - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
- .4 Bond breaker tape:
  - .1 Polyethylene bond breaker tape which will not bond to sealant.

.8 Sealant Colours: Colours of exposed sealants as later selected by Consultant from manufacturer's standard colour range.

2.2 SEALANT MATERIAL / DESIGNATIONS

.1 Exterior Use:

- .1 All areas unless specified otherwise: One Part moisture curing polyurethane, Self-Leveling to CAN/CGSB-19.13, class MC-2-25-B-N:
  - .1 Acceptable Product: 'Dymonic 100' by Tremco Ltd, or approved alternate.
- .2 All areas unless specified otherwise: Multi-component, polyepoxide urethane sealant meeting CGSB specification CAN/CGSB-19.24-M90, Type 2, Class B:
  - .1 Acceptable Product: 'Dymeric' by Tremco Ltd or approved alternate.
- .3 Prefinished Metal to Prefinished Metal: one part blend of synthetic rubber and resin, self-leveling to CAN/CGSB 7.1:
  - .1 Acceptable Product: 'Gutter Seal' by Tremco or approved alternate.
- .4 Sealants in contact with air/ vapour barrier membranes: Refer to Section 07280 Air / Vapour Barriers.

.2 Interior Use:

- .1 Lap Joints in Plastic Sheet Vapour Barrier and around mechanical piping and conduit in concealed to view spaces in partitions identified with an STC rating: non-skinning, non-hardening, non-oxidizing, non-bleeding synthetic rubber sealant sealing and bedding compound for acoustical purposes and concealed joints conforming to CAN/CGSB 19-GP-21:
  - .1 Acceptable Product: 'Acoustical Sealant', by Tremco, or approved alternate.
- .2 Joints around holes or voids made by through penetrations including but limited to mechanical piping and conduit in exposed to view spaces in partitions identified with an STC rating: easy gunning, non-staining, paintable acrylic polymer conforming to ASTM C834:
  - .1 Acceptable Product: 'Tremflex 834', by Tremco, or approved alternate.
- .3 Interior General Application (all areas unless specified otherwise): to CAN/CGSB-19.14M:
  - .1 Acceptable Product: 'Tremflex 834' by Tremco or approved alternate.
- .4 Wet Areas and Washroom Fixtures: Mildew resistant, one component neutral cure silicone sealant to CGSB-19GP22M:
  - .1 Acceptable Product: 'Tremsil 200" by Tremco or approved alternate.
- .5 Interior non-moving joint applications to be painted: One component, paintable acrylic latex sealant to CGSB-19-GP-17M:
  - .1 'Tremflex 834' by Tremco or approved alternate.
- .6 Interior Fire Stop application:
  - .1 All locations unless otherwise noted:
    - .1 Acceptable Product: To CAN4-S115M, 'Tremstop Acrylic (GG)' by Tremco or approved alternate.
    - .2 For ULC rated systems: Refer to Section 07840 – Fire Stopping.
- .7 Expansion Joints at:
  - .1 Existing slab on grade:
    - .1 Two-component, self-levelling, premium-grade, polyurethane-based, elastomeric sealant, capable of ± 50% joint movement.
      - .1 Acceptable Product: 'Sikaflex 2c SL' by Sika, or approved alternate.
  - .2 Vertical walls above & below grade and exterior cladding and at existing ground level and roof slab:
    - .1 Two-component, non-sag, premium-grade, polyurethane-based, elastomeric sealant, capable of ± 50% joint movement.
      - .1 Acceptable Product: 'Sikaflex 2c NS EZ Mix' by Sika, or approved alternate.

2.3 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.

.2 Primer: In accordance with sealant manufacturer's written recommendations.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

.1 Sealant:
- .1 Apply sealant in accordance with manufacturer's written instructions.
- .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .3 Apply sealant in continuous beads.
- .4 Apply sealant using gun with proper size nozzle.
- .5 Use sufficient pressure to fill voids and joints solid.
- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:
- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealants until proper curing has taken place.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01741 – Cleaning.
- .1 Leave Work area clean at end of each day.
- .2 Clean adjacent surfaces immediately.
- .3 Remove excess and droppings, using recommended cleaners as work progresses.
- .4 Remove masking tape after initial set of sealant.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

3.8 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by joint sealants installation.

3.9 SCHEDULE

.1 Apply sealant at the following exterior locations:
- .1 Between dissimilar materials in locations except where specifically indicated otherwise.
- .2 Control joints in masonry elements.
- .3 Joints between precast elements and between precast concrete elements and adjacent Work.
- .4 Below thresholds (double bead).
- .5 At perimeter of door, screen and louver frames.
- .6 At penetrations through exterior building elements.
- .7 Where indicated.

.2 Apply sealant at the following interior locations:
- .1 Between dissimilar materials in exposed locations except where specifically indicated otherwise.
- .2 Perimeter of exterior door, louver and screen frames.
- .3 Between interior door frames and wall.
- .4 Control joints in masonry elements, and joints between bearing and non-bearing masonry walls.
- .5 Building expansion joints, except where expansion joint covers are required.
- .6 At ceramic tile control joints.

.7 Perimeter of firehose cabinets, access panels, and control panels.
.8 Between vanities / countertops / u/s of window sills and walls.
.9 Between interior door frame and flooring.
.10 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints.
  .1 At locations required to have an STC rating, ensure continuity and integrity of sound ratings are maintained.
.11 Where shown.

.3 At interior locations use acrylic emulsion sealant except:
.1 At floor control joints use self-leveling polyurethane.
.2 At vanities / countertops and at ceramic wall tile control joints use silicone sealant.
.3 Where expected joint movement exceeds movement capacity of acrylic emulsion sealant, use sealant specified for exterior use, as directed by Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM E330/E330M, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.

.3 Canadian Standards Association (CSA International)
- .1 CSA-G40.20-04/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .3 CSA A440-11, AAMA/WDMA/CSA 101/I.S.2/A440-11, North American Fenestration Standards/Specification for Windows, Doors and Skylights.
- .4 CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS # North American Fenestration Standard/Specification for windows, doors, and skylights, Includes Update No. 1 (2013).

.4 Canadian Steel Door Manufacturers' Association (CSDMA)
- .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
- .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.

.5 National Fire Protection Association (NFPA)
- .1 NFPA 80, Standard for Fire Doors and Fire Windows.
- .2 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

.6 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .2 CAN/ULC-S702, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .3 CAN/ULC-S704, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .4 CAN/ULC-S104, Standard Method for Fire Tests of Door Assemblies.
- .5 CAN/ULC-S105, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.

1.2 SYSTEM DESCRIPTION

.1 Design Requirements:
- .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
- .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
- .3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104, NFPA 252 for ratings specified or indicated.
- .4 Provide fire labelled frames for openings requiring fire protection ratings. Test Products in conformance with CAN/ULC-S104, NFPA 252 and listed by nationally recognized agency having factory inspection services.

.5 Fenestration performance grades for doors:
.1 In accordance with the CSA A440SI Canadian Supplement, Clause (1)(b) appropriate for the conditions and geographic location in which the doors will be installed.
.2 Conform to performance grades selected under CSA A440SI Canadian Supplement, Sentence (2) when tested in accordance with the standard referenced in Clause (1)(a).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Provide Product data: In accordance with Section 01330 - Submittal Procedures.

.3 Provide Shop Drawings: In accordance with Section 01330 - Submittal Procedures.
.1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvred, arrangement of hardware and fire rating and finishes.
.2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating finishes.
.3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
.4 Submit test and engineering data, and installation instructions.
.5 Verify actual opening sizes and field conditions by field measurement before fabrication. Shop Drawings to reflect measurements and conditions provided, and Product shall be manufactured accordingly. Coordinate field measurements with fabrication and construction schedules to avoid delays.

.4 Samples: Submit one 305 x 305 mm / 12” x 12” corner sample of each type of frame.
.1 Show butt cutout glazing stops 305 mm / 12” long removable mullion connection snap-on trim with clips.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer’s written instructions.

.2 Storage and Handling Requirements:
.1 Store materials off floor, in well ventilated room, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry area.
.2 Store and protect metal doors and frames from dents, nicks, scratches, and blemishes, well-ventilated area.
.3 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Hot dipped galvanized steel sheet: To ASTM A653M, ZF75, and ZF120, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.2 Reinforcement channel: To CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75, and ZF120.

2.2 DOOR CORE MATERIALS

.1 Structural full, 32 mm / 1-1/4", cell size resin impregnated fibrous 'honeycomb'.

.2 Mineral fibre insulation with a minimum face density of 24 kg/m^3 / 1.5 lbs/ft^3.

.2 Exterior doors:

.1 Face sheets laminated.

.2 Expanded polystyrene insulation: CAN/ULC-S701, polystyrene, rigid expanded, closed cell board and heat resistant. Density; 16 to 32 kg/m^3, thermal values; RSI 1.0 (R 6.0) minimum, Type 1, in accordance with ASTM C578.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.2 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Section 09900 – Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

.1 Door silencers: Single stud rubber/neoprene type.

.2 Exterior and interior top and bottom caps: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Door bottom seal: Refer to Section 08710 - Door Hardware and door hardware schedule.

.5 Metallic paste filler: to manufacturer's standard.

.6 Fire labels: metal, riveted and clearly visible.

.7 Sealant: Refer to Section 07920 – Joint Sealants.

.8 Glazing: Refer to Section 08800 – Glazing.

.1 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.

.2 Design exterior glazing stops to be tamperproof.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Exterior frames: 1.6 mm / 16 ga. welded thermally broken type construction.

.4 Interior frames:
.1 1.6 mm / 16 ga. welded type construction, unless otherwise indicated.

.5 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.6 Protect mortised cutouts with steel guard boxes.

.7 Prepare frame for door silencers, three (3) for single door, two (2) at head for double door.

.8 Manufacturer's nameplates on frames and screens are not permitted.

.9 Conceal fastenings except where exposed fastenings are indicated.

.10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.11 Insulate entire interior of exterior frame components with polyurethane foam insulation.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide two (2) anchors for rebate opening heights up to 1520 mm / 5’-0” and one (1) additional anchor for each additional 760 mm / 2’-6” of height or fraction thereof.

.4 Locate anchors for frames in existing openings not more than 150 mm / 6” from top and bottom of each jamb and intermediate at 660 mm / 26” on centre maximum.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in two (2) temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: Swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Exterior doors: Insulated hollow steel construction, size as indicated x 45 mm / 1 3/4" thick, unless otherwise indicated.

.3 Interior doors: Honeycomb hollow steel construction, size as indicated x 45 mm / 1 3/4" thick, unless otherwise indicated.

.4 Doors and transom panels to have rabbeted edges to facilitate removable transom as noted in drawings.

.5 Fabricate doors with longitudinal edges welded. Grind welded seam joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.6 Doors: Manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketting and hardware in accordance with ASTM E330.

.7 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

.8 Factory prepared holes 12.7 mm / 1/2" diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.9 Reinforce doors where required, for surface mounted hardware. Provide inverted, recessed, spot welded channels to top and bottom of interior and exterior doors and finish with flush PVC top and bottom caps.

.10 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.11 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC-S104, NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.12 Manufacturer's nameplates on doors are not permitted.

2.11 HOLLOW STEEL CONSTRUCTION

.1 Form face sheets for exterior doors from 1.6mm / 16 ga. sheet steel.

.2 Form face sheets for interior doors from 1.6 / 16 ga. sheet steel.

.3 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm / 6” on centre maximum.

.4 Fill voids between stiffeners of exterior doors with polystyrene core.

.5 Fill voids between stiffeners of interior doors with honeycomb core.

2.12 THERMALLY BROKEN DOORS AND FRAMES

.1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.

.2 Thermal break: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.

.4 Apply insulation to entire frame interior.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1220 mm / 4’-0” wide. Remove temporary spreaders after frames are built in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material in accordance with Section 07920 – Joint Sealants.

.6 Maintain continuity of air / vapour barrier. Provide continuous air / vapour barrier seal between thermal break of thermally broken frame and air / vapour barrier of exterior wall system with air / vapour barrier transition membrane. Refer to Section 07280- Air / Vapour Barriers.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08710 - Door Hardware.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
- .1 Hinge side: 1.0 mm / 3/64”.
- .2 Latchside and head: 1.5 mm / 1/16”.
- .3 Finished floor, top of carpet, non-combustible sill, and thresholds: 13 mm / 1/2".

.3 Adjust operable parts for correct function.

.4 Install louvres.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08800 – Glazing.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Architectural Manufacturers Association (AAMA)
- .1 AAMA 609/610, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.

.2 ASTM International
- .1 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.3 Canadian General Standards Board (CGSB)
- .1 CGSB 1.40, Anticorrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-12.1, Tempered or Laminated Safety Glass.
- .3 CAN/CGSB-12.20, Structural Design of Glass for Buildings.

.4 CSA International
- .1 CSA G40.20-04/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA A440, AAMA/WDMA/CSA 101/I.S.2/A440-11, North American Fenestration Standards/Specification for Windows, Doors and Skylights.
- .3 CSA A440S1, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS # North American Fenestration Standard/Specification for windows, doors, and skylights, Includes Update No. 1 (2013).

1.2 DESIGN CRITERIA

.1 Design frames and doors in exterior walls to:
- .1 Accommodate expansion and contraction within service temperature range of -35 to 35 degrees C.
- .2 Limit deflection of mullions to maximum 1/175th of clear span when tested to ASTM E330 under wind load of 1.2 kPa submit certificate of tests performed.
- .3 Movement within system.
- .4 Movement between system and perimeter framing components or substrate.
- .5 Fenestration performance grades:
  - .1 In accordance with the CSA A440SI Canadian Supplement, Clause (1)(b) appropriate for the conditions and geographic location in which the doors will be installed.
  - .2 Conform to performance grades selected under CSA A440SI Canadian Supplement, Sentence (2) when tested in accordance with the standard referenced in Clause (1)(a).

.2 Include continuous air / vapour barrier through door system. Primarily in line with inside pane of glass and heel bead of glazing compound.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for doors and frames and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered and licensed in Province of Ontario, Canada.
- .2 Indicate materials and profiles and provide full-size, scaled details of components for each type of door and frame. Indicate:
  - .1 Interior trim and exterior junctions with adjacent construction.
  - .2 Junctions between combination units.
  - .3 Elevations of units.
  - .4 Core thicknesses of components.
  - .5 Type and location of exposed finishes, method of anchorage, number of anchors, supports, reinforcement, and accessories.
  - .6 Location of caulking.
  - .7 Each type of door system including location.
  - .8 Arrangement of reinforcing for hardware and joints.
  - .9 Arrangement of hardware and required clearances.

.4 Samples:
- .1 Submit for review and acceptance of each unit.
- .2 Samples may be returned for inclusion into work.
- .3 Submit one 305 x 305 mm / 12” x 12” corner sample of each type door and frame.
- .4 Submit sample showing glazing detail, reinforcement, finish and location of manufacturer's nameplates.
- .5 Frame sample to show glazing stop, door stop, jointing detail, finish, and wall trim where indicated.

.5 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Certifications: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.7 Manufacturer’s Reports:
- .1 Manufacturer's Field Reports: Submit manufacturer's written reports within three (3) Working Days of review, verifying compliance of work, as described in Part 3 - FIELD QUALITY CONTROL.

.8 Waste Management and Disposal:
- .1 Separate and recycle waste materials in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.
- .4 Divert used metal cut offs from landfill by disposal at nearest metal recycling facility.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Operation and Maintenance Data: Submit operation and maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Manufacturer's Field Services: As part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review work, at stages listed.
- .1 After delivery and storage of Products, and when preparatory work and mock-up is complete, but before installation begins.
- .2 Twice during progress of work at 25% and 60% complete.
- .3 Upon completion of work, after cleaning is carried out.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Use coatings that are easy to remove and residue free.
- .2 Leave protective covering in place until final cleaning of building.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect aluminum doors and frames from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to work of this Section and in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Aluminum extrusions: To Aluminum Association alloy AA 6063-T5 or T6 anodizing quality.

.2 Sheet aluminum: 1.5 mm / 1/16" minimum thick to Aluminum Association alloy AA 1100 - H14 or AA 5005 - H32 or H34 anodizing quality.

.3 Steel reinforcement: To CSA G40.20/G40.21, grade 300 W.

.4 Fasteners: Stainless steel, finished to match adjacent material.

.5 Weatherstrip: Replaceable mohair and metal backed wool pile.

.6 Door bumpers: Black neoprene.

.7 Door bottom seal: Operable and automatic door seal of anodized extruded aluminum frame and vinyl weather seal, recessed in door bottom, closed ends, automatic retract mechanism when door is open.

.8 Isolation coating: Alkali resistant.

.9 Glazing materials: Refer to Section 08800 – Glazing.

.10 Sealants: Colour as later selected by Consultant in accordance with Section 07920 - Joint Sealants.

2.2 ALUMINUM DOORS

.1 Exterior Thermally Broken Aluminum Entrance Doors:
- .1 Construct doors of porthole extrusions with minimum wall thickness of 3.0 mm / 0.125”.
- .2 Door depth: 57 mm / 2 1/4".
- .3 Door stiles nominal 108 mm / 4 1/4” wide plus or minus 6 mm / 1/4".
- .4 Top rail nominal 108 mm / 4 1/4” wide plus or minus 6 mm.
- .5 Bottom rail nominal 165 mm / 6 1/2" wide plus or minus 6 mm / 1/4".
- .6 Mid rail nominal 152 mm / 6” wide plus or minus 6 mm / 1/4".
- .7 Reinforce mechanically joined corners of doors to produce sturdy door unit.
- .8 Acceptable Product: ‘AA 425 wide stile’, by Kawneer, or equivalent by Alumicor Canada limited, or Oldcastle BuildingEnvelope, or approved alternate.

.2 Glazing stops: Interlocking snap-in type for dry glazing. Exterior stops: tamperproof type.

.3 Hardware: Refer to Section 08710 – Door Hardware.

2.3 ALUMINUM FRAMES

.1 Construct thermally broken and insulated frames of aluminum extrusions with minimum wall thickness of 5 mm / 13/64” at all hardware attachment points.

.2 Frame Members:
- .1 Exterior: thermally broken, 50 mm x 115 mm / 2” x 4 1/2" nominal size, for flush glazing.
- .2 Interior: 45 mm x 115 mm / 1 3/4" x 4 1/2" nominal size, for flush glazing.

.3 Sidelite Base: width to match frame, height to match bottom rail of adjacent door.

.4 Acceptable Product:
- .1 Exterior Frame: 'Trifab 451UT' by Kawneer, or equivalent by Alumicor Canada limited, or Oldcastle Building Envelope, or approved alternate.
- .2 Interior Frame: '450', by Kawneer, or equivalent by Alumicor Canada limited, or Oldcastle BuildingEnvelope, or approved alternate.

2.4 ALUMINUM FINISHES

.1 All door and frame finishes unless otherwise noted to be as follows:
- .1 Class 1, AA-M10C21A41, clear anodized coating, 0.7 mils minimum thickness.
- .2 Acceptable Product: Kawneer #14 by Kawneer, or equivalent by Alumicor Canada Limited, or Oldcastle BuildingEnvelope, or approved alternate.

.2 Appearance and properties of anodized finishes designated by Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

2.5 STEEL FINISHES

.1 Finish steel clips and reinforcing steel with steel primer to CGSB 1.40.

2.6 FABRICATION

.1 Doors and framing to be by same manufacturer.

.2 Fabricate doors and frames to profiles and maximum face sizes as indicated. Provide minimum 22 mm / 7/8” bite for insulating glazed units.

.3 Provide structural steel reinforcement as required.

.4 Fit joints tightly and secure mechanically.

.5 Conceal fastenings.

.6 Mortise, reinforce, drill and tap doors, frames and reinforcements to receive hardware using templates provided under Section 08710 - Door Hardware.

.7 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum doors and frames installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate. Examine work of other trades over which aluminum framing will be applied, for conformity to Drawings. Report all discrepancies to Consultant prior to commencing with work for aluminum doors and framing systems.
  .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

.2 Set frames plumb, square, level at correct elevation in alignment with adjacent work.

.3 Anchor securely.

.4 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.

.5 Adjust door components to ensure smooth operation.

.6 Make allowances for deflection of structure to ensure that structural loads are not transmitted to frames.

.7 Glaze aluminum doors and frames in accordance with Section 08800 – Glazing.

.8 Seal joints to provide weathertight seal at outside and air, vapour seal at inside.

.9 Apply sealant in accordance with Section 07920 - Joint Sealants. Conceal sealant within the aluminum work except where exposed use is permitted by Consultant.

3.3 FIELD QUALITY CONTROL

.1 Have manufacturer of Products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its Products, and submit written reports in acceptable format to verify compliance of work with Contract.

.2 Manufacturer's Field Services: Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.

.3 Manufacturer's Field Services:
- .1 Obtain written reports from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.
- .2 Perform cleaning of aluminum components in accordance with AAMA 609.1 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.
- .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .4 Clean aluminum with damp rag and approved non-abrasive cleaner.
- .5 Remove traces of primer, caulking, epoxy and filler materials, clean doors and frames.
- .6 Clean glass and glazing materials with approved non-abrasive cleaner.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by aluminum door and frame installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Aluminum Association (AA):
- .1 AA DAF 45, Designation System for Aluminum Finishes.

.2 ASTM International:
- .1 ASTM A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardenable.

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-1.105, Quick-Drying Primer.
- .2 CAN/CGSB-1.213, Etch Primer (Pretreatment Coating or Tie Coat) for Steel and Aluminum.
- .3 CAN/CGSB-1.181, Ready-Mixed, Organic Zinc-Rich Coatings.

.4 CSA International:
- .1 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.5 National Fire Protection Association (NFPA):
- .1 NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

1.2 DESIGN REQUIREMENTS

.1 Design exterior door assembly to withstand wind load of 1 kPa with a maximum horizontal deflection of 1/240 of opening width.

.2 Design door panel assemblies with thermal insulation factor 2.84 RSI / R 16.4.

.3 Design door assembly to withstand minimum 50,000 cycles per annum, and ten (10) years total life cycle.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for doors, hardware, and accessories and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Indicate sizes, service rating, types, materials, operating mechanisms, glazing locations and details, hardware and accessories, required clearances and electrical connections.
- .2 Provide Shop Drawings prepared, signed and stamped by a professional Engineer registered and licensed in the Province of Ontario, Canada.

.4 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Construction Waste Management:
.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
.2 Submit listing of recycled content Products used, including details of required percentages or recycled content materials and Products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Operation and Maintenance Data: Submit operation and maintenance data for sectional metal doors for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meetings:
.1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation, with Contractor to:
.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordination with other construction subtrades.
.4 Review manufacturer's written installation instructions and warranty requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect sectional metal doors, hardware and accessories from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.7 EXTENDED WARRANTY

.1 Provide a written warranty for work of this Section from manufacturer for failure due to defective materials and from Contractor for failure due to defective installation workmanship, for ten (10) years respectively.

PART 2- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 The following Products are acceptable for use on this project to requirements prescribed within:
- .1 'Haas-Therm 716' by Atlas.
- .2 'Thermacore 592' by Overhead Door Corporation.
- .3 'Thermatite 175' by Richard-Wilcox.
- .4 'Thermostop Mark II' by Thermostop Inc.
- .5 'Thermospan 200' by Wayne Dalton.

2.2 MATERIALS

.1 Galvanized steel sheet: Commercial quality Z275 zinc coating.

.2 Steel sheet: Commercial quality to ASTM A1008/A1008M.

.3 Aluminum sheet: Mill finish utility sheet.

.4 Anodized aluminum sheet: Anodizing quality aluminum sheet.

.5 Aluminum extrusions: Aluminum Association alloy AA 6063-T5.

.6 Primer: to CAN/CGSB-1.105 for steel CAN/CGSB-1.213 for aluminum and CAN/CGSB-1.181, for galvanized steel surfaces.

.7 Insulation: To meet design requirements.

.8 Glazing: Refer to Section 08800 – Glazing.

.9 Cable: Multi-strand galvanized steel aircraft cable.

2.3 DOORS

.1 Fabricate minimum 50 mm / 2" thick insulated flush panel doors of interlocking roll formed steel sections as indicated.

.2 Doors to be sized as indicated on door schedule including jack shaft operators with power lock mechanism.

.3 Fabricate panel frames in a continuous box frame with vertical stiffeners at 600 mm centres.

.4 Panels:
- .1 Exterior Surface: 0.55 mm / 0.02", hot-dipped galvanized.
- .2 Interior Surface: 0.55 mm / 0.02", hot-dipped galvanized.
- .3 Exterior Surface: Flush embossed.

.5 Fabricate 610 mm / 24" door sections with continuous RSI 2.8 / R 16 minimum foamed-in-place polyurethane lamination process resulting in a homogenous sandwich on even textured polyurethane insulation of metal, foam construction formed to produce a thermal break at panel edges.

.6 Form joints to prevent accumulated water from flowing down inside of door when opened.

.7 Provide 1.6 mm / 16 ga. minimum hot dipped galvanized steel end caps for bracket and hinge attachment and continuous internal reinforcement for mounting of hardware.

.8 Install glazing for vision panels. Sizes and number of vision panels as indicated.

.9 Assemble components by means of spot or arc welding or coated rivet system or adhesive and self-tapping screws to manufacturer's recommendations.

.10 Apply shop coat of primer after fabrication of door. Fabricate doors from pre-painted steel stock.

2.4 COUNTERBALANACING SYSTEM

.1 Equip doors with helical wound torsion, 50,000 cycle springs formed from high tensile wire.

.2 Supply door system with 25 mm / 1” minimum hollow steel shaft keyed the entire shaft length, in accordance with manufacturer’s specifications.

2.5 COMMERCIAL DUTY HARDWARE

.1 Track: High lift hardware with 50 mm / 2” size minimum 1.9 mm / 14 ga. minimum core thickness galvanized steel track.

.2 Track Supports: 2.3 mm / 12 ga. minimum core thickness continuous galvanized steel angle track supports.

.3 Spring counter balance: Heavy duty oil tempered torsion spring with manufacturers standard brackets.
.1 Drum: 100 mm / 4” diameter die cast aluminum.
.2 Shaft: 25 mm / 1” diameter galvanized steel.

.4 Top roller carrier: Galvanized steel minimum 2.28 mm / 12 ga. minimum thick adjustable.

.5 Rollers: Full floating, grease packed, hardened steel, ball bearing minimum 50 mm / 2” diameter, stamped tire.

.6 Roller brackets: Adjustable, galvanized steel, minimum 2.5 mm / 12 ga. minimum thick.

.7 Hinges: Commercial duty minimum 1.9 mm / 5/64” minimum thick stainless.

.8 Cable: Minimum 3 mm / 1/8” minimum diameter galvanized steel aircraft cable with 8:1 safety factor.

.9 Cable drum: Cast aluminum cable drums grooved to receive proper diameter cable for weight of door c/w two (2) extra safety straps and dual locking screws.

2.6 ACCESSORIES

.1 Overhead horizontal track and operator supports: galvanized steel, type and size to suit installation.

.2 Track guards: 5 mm / 3/16” minimum thick formed sheet 1530 mm / 5’-0” high track guards.

.3 Pusher springs.

.4 Handles:
.1 Flat bar door latch and electric interlock switch.
.2 Handles: Interior handle operated from outside, handle operated from inside.
.3 Drop ring: Outside drop ring handle for high lift doors.

.5 One horizontal sliding lock bolts on interior.

.6 Weatherstripping:
.1 Sills: Double contact full width extruded neoprene weatherstrip.
.2 Jambs and head: Extruded aluminum and arctic grade vinyl weatherstrip to manufacturer's standard.

.7 Finish ferrous hardware items with minimum zinc coating of 300 g/m² to CAN/CSA-G164.

.8 Electric safety eye.

.9 Bottom safety edge.

2.7 PREFINISHED STEEL SHEET

.1 Suitably clean and pretreat door surfaces to manufacturer’s written recommendations.

.2 Apply one coat of primer.

.3 Top coat exposed door surfaces with thermosetting powder coat system, colour for interior panel and exterior panel as later selected by Consultant, not more than two (2) colours.

2.8 OPERATORS

.1 Equip doors for operation by:
.1 Hand, two (2) handles on inside face of door.
.2 Chain hoist.

.2 Cable fail safe device.
.1 Able to stop door immediately if cable breaks on door free fall. Braking capacity 500 kg / 1100 lbs.

2.9 ELECTRICAL OPERATORS

.1 For each door provide door manufacturer’s extra heavy duty, gear drive, 3-phase electric operator of size recommended by door manufacturer, based on door size, weight and use including but not limited to the following:
.1 Prewired control panel fused disconnect, starter, transformer.
.2 Adjustable automatic friction clutch.
.3 Precision type micro switches.
.4 Auxiliary hand chain hoist incorporated through operator.
.5 Remote three-button control station open/close/stop) with stainless steel plate at location directed by Consultant. Provide door opening action upon momentary contact of ‘open’ button. Door closing operation to require constant pressure on ‘close’ button.
.6 Electro-mechanical safety bar at bottom of door activating instant reverse action if doors meet an obstruction.
.7 Provide jackshaft operator.

.8 Double electric safety beam mounted at 305 mm / 12” and 610 mm / 24” above finished floor.
.9 Provide flashing light and buzzer activation during door opening operation.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for sectional overhead door installation in accordance with manufacturer's written instructions.
  .1 Examine work of other trades over which sectional overhead doors will be applied, for conformity to Drawings. Report all discrepancies to Consultant prior to commencing with work for sectional overhead doors.
  .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

.2 Install doors and hardware in accordance with manufacturer's instructions.

.3 Rigidly support rail and operator and secure to supporting structure.

.4 Touch-up steel doors with primer where galvanized finish damaged during fabrication.

.5 Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

.6 Lubricate and adjust door operating components to ensure smooth opening and closing of doors.

.7 Adjust weatherstripping to form a weather tight seal.

.8

.9 Adjust doors for smooth operation.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01741 – Cleaning.
  .1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.
  .1 Remove traces of primer, clean doors and frames.
  .2 Clean glass and glazing materials with approved non-abrasive cleaner.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 - Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by sectional metal door installation.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 Aluminum Association (AA):
- .1 AA DAF 45, Designation System for Aluminum Finishes.

.2 ASTM International:
- .1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip galvanized) Coatings on Iron and Steel Products.
- .2 ASTM E1748, Standard Test Method for Evaluating the Engagement Between Windows and Insect Screens as an Integral System.

.3 Canada Green Building Council (CaGBC):
- .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package for New Construction and Major Renovations (including Addendum 2007).
- .2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide for Commercial Interiors.
- .3 LEED Canada 2009 for Design and Construction-2010, LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.
- .4 LEED Canada for Existing Buildings, Operations and Maintenance-2009, LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.

.4 CSA Group:
- .1 AAMA/WDMA/CSA 101/I.S.2/A440-11, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
- .2 CSA A440S1, Canadian Supplement to AAMA/WDMA/CSA 101/1.S.2/A440, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
- .3 CAN/CSA-A440.4, Window, Door, and Skylight Installation.
- .4 CAN/CSA-A440.2/A440.3, Fenestration energy performance/User guide to CSA A440.2, Fenestration energy performance.
- .5 CAN/CSA-Z91, Health and Safety Code for Suspended Equipment Operations.
- .6 CAN/CSA-Z809, Sustainable Forest Management.

.5 Forest Stewardship Council (FSC):
- .1 FSC-STD-01-001 FSC Principle and Criteria for Forest Stewardship.

.6 Green Seal Environmental Standards (GS):

SPEC NOTE: Green Seal Environmental Criteria for Anti-Corrosive Paints, GC-3 is included in the revised GS-11, 2010 3rd Edition, Paints and Coatings.
- .1 GS-11, Paints and Coatings.

.7 Master Painters Institute (MPI):
- .1 Architectural Painting Specification Manual
  - .1 MPI #79, Primer, Alkyd, Anti-Corrosive for Metal.

.8 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards:
- .1 SCAQMD Rule 1113, Architectural Coatings.
- .2 SCAQMD Rule 1168, Adhesives and Sealants Applications.

.9 Sustainable Forestry Initiative (SFI):
- .1 SFI Standard.

.10 Screen Manufacturers Association (SMA):
- .1 SMA 1201R, Specification for Insect Screens for Windows, Sliding Doors and Swinging Doors.

1.2 DESIGN REQUIREMENTS

.1 Fenestration performance grades for windows:
- .1 In accordance with the CSA A440SI Canadian Supplement, Clause (1)(b) appropriate for the conditions and geographic location in which the doors will be installed.
- .2 Conform to performance grades selected under CSA A440SI Canadian Supplement, Sentence (2) when tested in accordance with the standard referenced in Clause (1)(a).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for windows and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim, junction between combination units, elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.

.4 Samples:
- .1 Submit colour chips.

.5 Certifications: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.6 Test and Evaluation Reports:
- .1 Submit test reports from approved independent testing laboratories, certifying compliance with Specifications.
- .2 All test reports that reference the NAFS must include, on the first page, a summary of the results including, at minimum:
  - .1 The Product manufacturer.
  - .2 The type of Product.
  - .3 The model number/series number.
  - .4 The primary Product designation.

.5 The secondary Product designation.
.1 Positive design pressure.
.2 Negative design pressure.
.3 Water penetration resistance test pressure.
.4 Canadian air infiltration and exfiltration levels.
.6 The test completion date.

.3 The report will also contain the following information:
.1 Test dates.
.2 Report preparation dates.
.3 Test information retention period.
.4 Location of testing facilities.
.5 Full description of test samples, including:
.1 Anodized finish and weathering characteristics.
.2 Condensation resistance.
.3 Forced entry resistance.
.4 Mullion deflection - combination and composite windows.
.6 Complete description of amendments, as applicable.
.7 Conclusion.
.8 Drawings signed by the testing laboratory, if provided.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Submit operation and maintenance data for windows for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect windows from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01355 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Materials: To CSA-A440/A440.1 supplemented as follows:
.1 All window systems and components are to be provided by a single manufacturer to ensure a single source of responsibility for the work of this Section.

.2 Sash: Aluminum thermally broken.

.3 Main frame: Aluminum thermally broken.

.4 Aluminum Support Angles: Design and fabricate aluminum support angles at sill jambs and head in accordance with OBC and manufacturers requirements.

.2 Glass: In accordance with Section 08800 - Glazing.

.3 Flashings: Refer to Section 07620 - Sheet Metal Flashing and Trim.

.4 Sills: Refer to Section 07620 - Sheet Metal Flashing and Trim.

.5 Aluminum facings: Brake formed, 1.5 mm / $^{1}/_{16}$" thick, clear anodized aluminum panel laminated to 19 mm / ¾" thick plywood.

.6 Isolation coating: Alkali resistant bituminous paint.

.7 Sealants: Refer to Section 07920 - Joint Sealants.

2.2 WINDOW TYPE

.1 Types:

.1 Fixed Window Unit: Fixed window unit, 127 mm / 5" wide, c/w thermal break.

.1 Acceptable Product: 'Kawneer 518' fixed framing, or 'Series 970' by Alumicor, or equivalent Oldcastle Building Envelope, or approved alternate.

2.3 FABRICATION

.1 Fabricate in accordance with CSA-A440/A440.1 supplemented as follows:

.1 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm / $^{1}/_{16}$" for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm / 1/8" for units with a diagonal measurement over 1830 mm / 6"-0".

.2 Face dimensions detailed are maximum permissible sizes.

.3 Brace frames to maintain squareness and rigidity during shipment and installation.

.4 Finish steel clips and reinforcement with shop coat primer to MPI #79, CAN/CGSB-1.40, 380 g/m² zinc coating to ASTM A123/A123M.

2.4 ALUMINUM FINISHES

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.

.1 Finish coatings: finish all exposed surfaces of interior and exterior aluminum sections with anodic oxide treatment in accordance with Aluminum Association specification AA-M12c22A31, "No. 17 Clear" by Kawneer, or equivalent by Alumicor Canada limited, or Oldcastle Building Envelope, or approved alternate.

2.5 ISOLATION COATING

.1 Primers, Paints, and Coatings: In accordance with manufacturer's recommendations for surface conditions.

.2 Isolate aluminum from following components, by means of isolation coating:
- .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
- .2 Concrete, mortar and masonry.
- .3 Wood.

2.6 GLAZING

.1 Glazing: Refer to Section 08800 – Glazing.

2.7 AIR BARRIER /VAPOUR BARRIER SEAL

.1 Provide positive air / vapour / watertight seal between window frames and exterior wall system using air / vapour barrier transition strip as per Section 07280 - Air / Vapour Barriers.

PART 3 – EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for Product installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate to verify dimensions, tolerances, and method of attachment with other work.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 AIR/VAPOUR BARRIER CONNECTIONS

.1 Prior to installing windows, prepare window system to provide a continuous air / vapour seal from the window system to the wall air / vapour barrier system.

.2 Apply a continuous strip of 305 mm / 12” wide ‘Self-Adhered Sheet Membrane’ as described in Section 07280 – Air / Vapour Barriers around on all sides of window opening. Apply sheet membrane lapped in a ‘shingle like manner’ to shed water. Ensure a positive continuous seal is provided to wall framing.

.3 Provide a second overlapping lapping layer of ‘Self-Adhered Sheet Membrane’ at each corner as required to seal all air leaks at corner conditions.

3.3 INSTALLATION

.1 Window installation:
- .1 Install in accordance with CSA-A440/A440.1.
- .2 Arrange components to prevent abrupt variation in colour.
- .3 Do not exceed 3 mm / 1/8" in 3.0 m / 10' variation from plumb and level.

.2 Aluminum Support Angles:
- .1 Design and fabricate aluminum angles in accordance with OBC and manufacturers requirements. Provide slotted clip angle connection where deflection is anticipated.

.3 Sill installation: Refer to Section 07620 - Sheet Metal Flashing and Trim.

.4 Caulking:
- .1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.
- .2 Apply sealant in accordance with Section 07920 - Joint Sealants. Conceal sealant within window units except where exposed use is permitted by Consultant.

3.4 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by window installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
- .1 ANSI/BHMA A156.9, Cabinet Hardware.
- .2 ANSI/BHMA A156.11, Cabinet Locks.
- .3 ANSI/BHMA A156.16, Auxiliary Hardware.
- .4 ANSI/BHMA A156.18, Materials and Finishes.
- .5 ANSI/BHMA A156.20, Strap and Tee Hinges and Hasps.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for cabinet hardware and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Hardware List:
- .1 Submit contract hardware list.
- .2 Indicate specified hardware, including make, model, material, function, finish and other pertinent information.

.4 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: Submit manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Operation and Maintenance Data: Submit operation and maintenance data for cabinet hardware for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 Storage and Handling Requirements:
- .1 Store cabinet hardware in locked, clean, dry area, off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect cabinet hardware from nicks, scratches, and blemishes.
.3 Protect prefinished surfaces with wrapping strippable coating.
.4 Replace defective or damaged materials with new.

.5 Develop [Waste Reduction Workplan] related to work of this Section and in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

PART 2- PRODUCTS

2.1 HARDWARE ITEMS

.1 Cabinet hardware listed within provides a 'standard of acceptance' for the specified item. Equivalent Products by Richelieu, Häfele, Hettich, or approved alternate are acceptable for use on this project.
.1 Use one manufacturer's Product for all similar items.

2.2 CABINET HARDWARE

.1 Cabinet hardware: To CAN/CGSB-69.25, as listed below:
.1 Hinges: Soft close hinge, 120º swing.
.1 Acceptable Product: '71T Series' hinge with 'Blumotion 973A', by Richelieu, model type to suit cabinet.
.2 Drawer and Door Pulls:
.1 Modern Stainless Steel Pull
.1 Acceptable Product: 527-BP527160195, by Richelieu.
.3 Drawer Slides:
.1 'Type 2': File Drawer and Pullout Shelf Slide, heavy duty, 68 Kg / 150 lb. capacity, zinc finish, length to suit drawer for full extension
.1 Acceptable Product: 'Accuride 4034 Full Extension Slide', by Richelieu.

.2 Shelf Supports:
.1 Acceptable Product:
.1 Metal Pilaster: 'No. 2552G', by Richelieu, 16 mm / 5/8" wide x total length. zinc finish.
.2 Pilaster Shelf Clip: 'No. CP2562G', by Richelieu, heavy-duty., zinc finish.

.3 Cable Entry Plug (Grommets):
.1 Acceptable Product: 'No. 20694170', by Richelieu, two-part grommet in zamac, bushed stainless steel finish, 16.5 mm / 5/8" high x 74.5 mm / 3" overall diameter.

.4 Door & Drawer Bumpers:
.1 Acceptable Product: 'No. MP30311' by Richelieu, clear nylon, 3 mm / 1/8" height x 9 mm / 3/8" diameter, peel and stick bumpers.

2.3 FASTENINGS

.1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.2 Exposed fastening devices to match finish of hardware.

.3 Use fasteners compatible with material through which they pass.

PART 3- EXECUTION

3.1 INSTALLATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

.2 Install hardware to standard hardware location dimensions in accordance with manufacturer's recommendations and to project design requirements.

.3 Make all shelves in cabinets adjustable, unless otherwise indicated.

.4 Install drawer slides to all drawers, number as required to suit application.

.5 Install drawer & drawer bumpers to all doors and drawers.

3.2 ADJUSTING

.1 Adjust cabinet hardware for optimum, smooth operating condition.

.2 Lubricate hardware and other moving parts.

.3 Adjust cabinet door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.
- .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
- .3 Remove protective material from hardware items where present.
- .4 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 35 50 - Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 DEMONSTRATION

.1 Keying System Setup and Cabinet:
- .1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
- .2 Place file keys and duplicate keys in key cabinet on their respective hooks.
- .3 Lock key cabinet and turn over key to Consultant Owner.

.2 Maintenance Staff Briefing:
- .1 Brief maintenance staff regarding:
  - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
  - .2 Description, use, handling, and storage of keys.

.3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by cabinet and miscellaneous hardware installation.

3.6 SCHEDULE

.1 All cabinet drawers, unless otherwise noted:
- .1 One (1) set full extension drawer slides: ‘Type 2’.
- .2 Lock, where indicated.
- .3 One (1) pull per drawer.
- .4 Drawer bumpers.

.2 Cabinet swing doors:
- .1 One (1) pull per door
- .2 One (1) set of hinges, number as recommended by manufacturer to suit condition.
- .3 Door bumpers.

.3 Shelf supports:
- .1 Four (4) recessed metal standards per unit.
- .2 Four (4) pilaster shelf clips per shelf.

.4 Cable entry plug (grommet):
- .1 One (1) at each location as indicated on millwork drawings.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA):
- .1 ANSI/BHMA A156.1, American National Standard for Butts and Hinges.
- .2 ANSI/BHMA A156.2, Bored and Preassembled Locks and Latches.
- .3 ANSI/BHMA A156.3, Exit Devices.
- .4 ANSI/BHMA A156.4, Door Controls - Closers.
- .5 ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
- .6 ANSI/BHMA A156.6, Architectural Door Trim.
- .7 ANSI/BHMA A156.8, Door Controls - Overhead Stops and Holders.
- .8 ANSI/BHMA A156.10, Power Operated Pedestrian Doors.
- .9 ANSI/BHMA A156.12, Interconnected Locks and Latches.
- .10 ANSI/BHMA A156.13, Mortise Locks and Latches Series 1000.
- .11 ANSI/BHMA A156.14, Sliding and Folding Door Hardware.
- .12 ANSI/BHMA A156.15, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
- .13 ANSI/BHMA A156.16, Auxiliary Hardware.
- .14 ANSI/BHMA A156.17, Self-closing Hinges and Pivots.
- .15 ANSI/BHMA A156.18, Materials and Finishes.
- .16 ANSI/BHMA A156.19, Power Assist and Low Energy Power - Operated Doors.
- .17 ANSI/BHMA A156.20, Strap and Tee Hinges and Hasps.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA):
- .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames.

1.2 DESIGN REQUIREMENTS

.1 Use only ULC listed and labelled hardware for labelled doors in fire separations and exit doors.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for door hardware and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Hardware List:
- .1 Submit contract hardware list.
- .2 Indicate hardware proposed, including make, model, material, function, size, finish and other pertinent information.
- .3 List shall be compiled by a registered A.H.C. member and shall bear their name and certification as to the appropriateness of all items.
- .4 Submit catalogue cuts of all hardware items.

.4 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: Submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for door closers, locksets, door holders and fire exit hardware for incorporation into manual.

.2 Extra Stock Materials:
- .1 Supply maintenance materials.
- .2 Tools:
  - .1 Supply two (2) sets of wrenches for door closers, locksets, and fire exit hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Store finishing hardware in locked, clean and dry area.

.2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

1.6 INSPECTION

.1 The A.H.C. member in the employ of this trade shall be directly responsible for inspecting and directing the installation and commissioning of this work. Inform the Consultant in writing of such inspections, pointing out errors, omissions, etc., so that same may be corrected.

.2 At completion of the work, the A.H.C. member shall check the installation of all finish hardware, shall assist in making minor adjustments required, supervise all hardware replacements required and report to the Consultant on completeness of the installation.

.3 Use tradesmen competent in the installation of finishing hardware. Adjust, clean, and make good all finishing hardware to the satisfaction of the Consultant and A.H.C. member.

1.7 EXTENDED WARRANTY

.1 For the work of this Section, the twelve (12) month warranty period prescribed in General Conditions is extended to two (2) years. Provide a written guarantee in the name of the Owner.

PART 2- PRODUCTS

2.1 HARDWARE ITEMS

.1 Use one manufacturer's Products only for all similar items. Hardware shall conform to the following minimum general requirements except as noted otherwise.

.2 Stainless steel items: AISI Type 302 or 304.

.3 Butts: To CAN/CGSB-69.18-M90/ANSI/BHMA A156.1.

.1 Butts to be Hager Hinge, 4½ x 4 stainless steel, ball bearing hinges. Equivalent items by Stanley Works or MontHard are acceptable.

.2 Use 1½ pair per door. Use 2 pair for doors over 2180 mm high. Use non-removable pins on exterior doors. Butts to be minimum BB1279.

.4 Continuous Hinges:

.1 ANSI/BHMA A156.26.

.2 Continuous hinges for aluminum doors are to be full mortised aluminum gear type extruded from aluminum alloy.

.3 Continuous hinges are to have pair-matched hinge leaves, lifetime lubrication and a continuous lifetime warranty.

.4 The finish is to be anodized after matching.

.5 Latches, Locksets and Cylinders: To ANSI 156.2 Series 4000 Grade 1.

.1 Locks will be heavy duty bored with lever handles and removable core except as noted. Strikes will be provided as required for latches and locksets specified. Non-ferrous components will be used for all doors. Finish C26D.

.2 Acceptable Manufacturer:

.1 Sargent.

.2 Schlage.

.3 Stanley.

.6 Exit Devices:

.1 To CAN/CGSB-69-19/ANSI/BHMA A156.3 modern (touch bar) design. Hardware supplier to coordinate exact catalogue number and trim required. Unless otherwise noted, all removable mullions to be fire rated type. All mullions to incorporate stabilizer blocks. All devices to be doggable unless fire rated; provide cylinder dogging on interior of all non-fire rated devices. Cylinders to be masterkeyed. Finish C32D bar, C32D body.

.2 Acceptable Product: ‘80 Series’ by Sargent with ET trim as indicated.

.7 Door Closers and Accessories:

.1 ANSI/BHMA A156.4.

.2 Door closers are to be Grade 1 with cast iron bodies, full rectangular plastic covers, fully adjustable spring power and have separate adjusting valves for backcheck, sweep and latching.

.3 Closers are to be capable of adjustment to require no greater than 22 Newtons of force to open interior doors and no more than 34 Newtons of force to open exterior doors.

.4 Advanced variable backcheck (AVB) and spring stop arms are to be supplied where requested in the schedule.

.5 Closers are to be 10,000,000 cycle tested.

.6 Provide mounting plates where required for proper mounting of closers.

.7 Finish 628 Clear Anodized Aluminum.

.8 Door Operators:

.1 ANSI/BHMA A156.19.

.2 Automatic door operators shall be heavy-duty c/w 2-year warranty, built-in adjustable heavy-duty doorstop, field adjustable speed control, electronic backcheck, built-in electric strike interface, onboard 1 amp power supply and sequencing board.

.3 Actuator buttons are to be 101 mm / 4” diameter stainless steel and are to have LOGO ONLY, no wording.

.4 Provide weather resistant (WR) gasketing for all exterior mounted actuators.

.5 The operators and their related components are to be supplied and installed as a package by this section.

.6 Finish 628 Clear Anodized Aluminum.

.9 Door Pull:

.1 D-pull, 4612-1, Type # 2, finish 630.

.10 Push Plate:

.1 125 mm x 500 mm / 5” x 20” stainless steel plate, finish 630 with female or male pictogram.

.11 Door Stops:

.1 Floor stops shall be cast bronze or stainless steel. Gallery #200B, 218B, 233 or 250 as applicable, or alternate by CBH or Hager. Finish C15 or C32D.

.2 Overhead stops and holders, concealed; Glynn Johnson, use 100LP series for aluminum and metal doors. Equivalent Products by Sargent or Rixson are acceptable. Set angle to suit each door situation. Finish 26D.

.12 Kick Plates / Mop Plates:

.1 Stainless Steel. Provide stainless steel screws. Finish C32D.

.2 Kickplates: 1.6 mm thick x 203 mm high x full width of door except to clear stops; Gallery #80B or Hager HA 9551. Provide on all doors with closers.

.3 Mop Plates: 1.6 mm thick x 203 mm high x full width of door except to clear stops; Gallery #80B or Hager HA 9551. Provide as noted.

.13 Thresholds:

.1 Acceptable Product: ‘CT32’ and ‘CT16’ by KN Crowder.

.2 Extend thresholds for full width of door frame.

.14 Weatherstripping:

.1 Weatherstripping: ‘W20V’ by KN Crowder, at jambs, head.

.2 Sweeps: ‘W24S’ by KN Crowder.

.3 Astragal: ‘W40-40P’ by KN Crowder or ‘845W x 846S’ by Hager.

.4 Or approved alternate by: KNC, Thomas, Pemko, Unique, Hager.

.15 Flush Bolts:

.1 Provide a pair of 305 mm / 12” flush bolts for inactive leaf. Hager #HA1250, Gallery 401, Ives 458 or Glynn-Johnson FB-6. Finish C32D.

.16 Signage:

.1 Emergency Sign: “CM-SE21A x CM-SE20A” by Camden Door Controls, or approved alternate.

.2 Tactile Sign: Male + Female + HDCP logo and braille description in French and English. Acrylic. Colour TBD.

2.2 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.3 KEYING

.1 Follow Owner’s keying schedule, type and system.

PART 3- EXECUTION

3.1 INSTALLATION

.1 Furnish manufacturer's instructions for proper installation of each hardware component.

.2 Install hardware to standard hardware location dimensions in accordance with Canadian Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturer's Association.

.3 Set exterior thresholds in two continuous beads of butyl caulking to requirements of Section 07920.

.4 Cope thresholds around mullions and abutting door frames.

.5 Install kickplates, push plates, and weather/sound stripping after the final coat of paint completely dried and cured.

.6 Set angle for stops, holders, and stays to best suit each situation. Mount floor stops out of line of travel. Mount wall stops to strike bottom of pulls.

.7 Set closers and exit device strikes over weatherstripping so weatherstripping is uninterrupted.

3.2 SCHEDULE

.1 Group 1 – Single Exterior Door
  .1 Exit device with exterior ET lever handle trim, ANSI F-09.
  .2 Self-closing device with O.H. stop.

.3 1½ pair B.B. hinges, N.R.P.
.4 S.S. kickplate.
.5 Aluminum threshold.
.6 Full perimeter weatherstrip.

.2 Group 2a – Double Exterior Door
.1 Exit device with exterior ET lever handle trim, ANSI F-09.
.2 3 pair B.B. hinges, N.R.P.
.3 Top and bottom flushbolts.
.4 Self-closing device, with hold open.
.5 Pair S.S. kickplates.
.6 Astragal.
.7 Full perimeter weatherstrip.

.3 Group 2b – Double Exterior Door
.1 Exit device with exterior ET lever handle trim, ANSI F-09.
.2 4 pair B.B. hinges, N.R.P.
.3 Top and bottom flushbolts.
.4 Self-closing device, with hold open.
.5 Pair S.S. kickplates.
.6 Astragal.
.7 Full perimeter weatherstrip.

.4 Group 3 – Single Interior Office Door
.1 Lever handle lockset ANSI F-82.
.2 1½ pair B.B. hinges.
.3 S.S. kickplate.
.4 Floor or wall stop.

.5 Group 4 - Single Interior Door
.1 Lever handle latchset ANSI F-75
.2 1½ pair B.B. hinges.
.3 S.S. kickplate.
.4 Floor or wall stop.

.6 Group 5 – Single Fire Rated Door
.1 Lever handle latchset ANSI F-75.
.2 1½ pair B.B. hinges.
.3 Self-closing device.
.4 S.S. kickplate.
.5 Floor or wall stop.
.6 Smoke seals.

.7 Group 6 – NOT USED

.8 Group 7 – Washrooms/Vestibule Door
.1 Push plate.
.2 Door pull.
.3 Self-closing device.

.4 S.S. kickplate.
.5 S.S. mop plate.
.6 Floor or wall stop.
.7 1½ pair B.B. hinges.

.9 Group 8 – Universal Washroom
.1 Lever handle lockset ANSI F-07.
.2 S.S kickplate.
.3 S.S mop plate.
.4 Floor or wall stop.
.5 1½ pair B.B. hinges.
.6 Emergency sign.
.7 Tactile sign.
.8 Relay (refer to Electrical).
.9 Auto Operator ANSI/BHMA A156.19 c/w power supply.
.10 Electric Strike E09321.
.11 Door operator / push to lock button (refer to Electrical).
.12 Door operator push button (refer to Electrical).
.13 Door contact (refer to Electrical).
.14 Emergency call system (refer to Electrical).

Mode of operation:
Push to lock button deactivates outside actuator.
Exit by lever or actuator – inside actuator active at all times.

.10 Group 9 – Single Exterior Aluminum Door
.1 Continuous Hinge A31021B x 2125.
.2 Flush Bolt by Door and Frame Supplier.
.3 Offset Door Pull.
.4 Electric Strike E09321.
.5 Power Transformer concealed in frame rebate and door edge.
.6 Lockset E0231 x Lever.
.7 Lock Protector C02041.
.8 Auto Operator ANSI/BHMA A156.19.
.9 Actuator 101 mm dia. Stainless steel Logo only.
.10 Actuator 101 mm dia. Stainless – WR steel Logo only.
.11 Aluminum threshold.
.12 Full perimeter weatherstrip.

Note: Low voltage, low voltage wiring, conduit where required and electrical back boxes by electrical.

.11 Group 10 – Single Vestibule Aluminum Door
.1 Continuous Hinge A31021B x 2125.
.2 Offset Door Pull.
.3 Electric Strike E09321.
.4 Power Transformer concealed in frame rebate and door edge.
.5 Auto Operator ANSI/BHMA A156.19.
.6 Actuator 101 mm dia. Stainless steel Logo only.
.7 Floor or wall stop.

Note: Line voltage, low voltage wiring, conduit where required and electrical back boxes by electrical.

.12 Group 11 – NOT USED

.13 Group 12 – NOT USED

.14 Group 13 – NOT USED

.15 Group 14 – Single Fire Rated Exterior Door
- .1 Exit device with exterior ET lever handle trim, ANSI F-09.
- .2 Self-closing device.
- .3 1½ pair B.B. hinges, N.R.P.
- .4 S.S. kickplate.
- .5 Aluminum threshold.
- .6 Full perimeter weatherstrip

.16 Group 15 – Single Fire Rated Exit Door
- .1 Exit device with ET lever handle trim, ANSI F-75.
- .2 1½ pair B.B. hinges.
- .3 Self-closing device.
- .4 S.S. kickplate.
- .5 Floor or wall stop.
- .6 Smoke seals.

.17 Group 16 – Storeroom Door
- .1 Lever handle latchset ANSI F-86.
- .2 1½ pair B.B. hinges.
- .3 Self-closing device with O.H. stop.
- .4 S.S. kickplate.
- .5 Floor or wall stop.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM C542, Standard Specification for Lock-Strip Gaskets.
- .2 ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- .3 ASTM D2240, Standard Test Method for Rubber Property - Durometer Hardness.
- .4 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .5 ASTM E2010, Standard Test Method for Positive Pressure Fire Tests of Window Assemblies.
- .6 ASTM E2074, Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.

.2 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-12.1, Safety Glazing.
- .2 CAN/CGSB-12.2, Flat, Clear Sheet Glass.
- .3 CAN/CGSB-12.3, Flat, Clear Float Glass.
- .4 CAN/CGSB-12.4, Heat Absorbing Glass.
- .5 CAN/CGSB-12.8, Insulating Glass Units.
- .6 CAN/CGSB-12.9, Spandrel Glass.
- .7 CAN/CGSB-12.10, Glass, Light and Heat Reflecting.
- .8 CAN/CGSB-12.11, Wired Safety Glass.

.3 Glass Association of North American (GANA):
- .1 GANA Glazing Manual.
- .2 GANA Laminated Glazing Reference Manual.

.4 National Fire Protection Association (NFPA):
- .1 NFPA 80: Fire Doors and Windows.
- .2 NFPA 257 – Fire Tests of Window Assemblies.

.5 Underwriters Laboratories, Inc. (UL):
- .1 UL 9 – Fire Tests of Window Assemblies.

.6 Underwriters' Laboratories of Canada (ULC):
- .1 CAN/ULC-S104, Standard Method for Fire Tests of Door Assemblies.
- .2 CAN/ULC-S106, Standard Method for Fire Tests of Window and Glass Block Assemblies.

1.2 DESIGN REQUIREMENTS

.1 Provide continuity of building enclosure air / vapour barrier using glass and glazing materials as follows:
- .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.2 Fire-rated ceramic clear glazing (wireless):
- .1 Fire-rated glass ceramic clear and wireless glazing material listed for use in non-impact safety-rated window lites with fire rating requirements of 90 minutes with required hose stream test.
- .2 Passes positive pressure test standards UBC 7-2 and UBC 7-4.

.3 Thickness and glass types specified and as indicated on Drawings are minimum. Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure as measured in accordance with ANSI/ASTM E330.

.4 Provide glass type and thickness in accordance the OBC.

.5 Limit glass deflection to 1/200 flexural limit of glass with full recovery of glazing materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for glass, sealants, and glazing accessories and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit Shop Drawings stamped and signed by professional engineer registered and licensed in Province of Ontario, Canada.

.4 Samples:
- .1 Submit for review and acceptance of each unit.
- .2 If requested, samples may be returned for inclusion into work.
- .3 Submit duplicate 305 x 305 mm / 12” x 12” size samples of glazing units and sealant material.

.5 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.6 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .1 Submit testing and analysis of glass under provisions of Section 01430 - Quality Requirements.
- .2 Submit shop inspection and testing for glass.

.7 Construction Waste Management:
- .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
- .2 Submit listing of recycled content Products used, including details of required percentages or recycled content materials and Products.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Operation and Maintenance Data: Submit operation and maintenance data for glazing for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Fire-rated ceramic clear glazing (wireless):
- .1 Glazing Standards: GAMA Glazing Manual and FGMA Sealant Manual.
- .2 Each lite shall bear permanent, non-removable label of UL certifying it for use in tested and rated fire protective assemblies.

.2 Pre-Installation Meetings:
- .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation, with Contractor's Representative and Consultant to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's written installation instructions and warranty requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
- .3 Protect prefinished aluminum surfaces with wrapping strippable coating.
- .4 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to work of this Section and in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.7 SITE CONDITIONS

.1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.

.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

.3 When temperature of glazing surfaces is below 10 degrees C, obtain from Consultant and material manufacturer approval of glazing methods and protective measures which will be used during glazing operations.

1.8 EXTENDED WARRANTY

.1 Submit an extended warranty for insulating glass units in accordance with General Conditions, except that warranty period is extended to ten (10) years from the date of Ready-for-Takeover.
- .1 Warrant against failure to meet the design criteria and specified requirements.
- .2 Coverage: Labour and materials to repair or replace insulating glass units as required to correct deficient work and meet specified requirements including affected adjacent work.

.2 Warranty to cover full replacement including stops, trims, caulking, sealants, all at no cost to the Owner.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Flat Glass:
- .1 Float glass: To CAN/CGSB-12.3, colour clear.

.2 Safety glass: to CAN/CGSB-12.1, transparent complete with polished edges, to minimum thickness as follows:
- .1 Type 1: Tempered, 6 mm / ¼" thick minimum.
- .2 Type 2: Laminated with 0.76 mm / $^{5}/_{64}$" minimum PVB interlayer, 6 mm / ¼" thick.

.3 Insulating Glass Units (all exterior glazing):
- .1 Insulating glass units: To CAN/CGSB-12.8, double unit, 25 mm / 1" overall thickness, safety glass both lites where indicated.
  - .1 Glass: To CAN/CGSB-12.3, CAN/CGSB-12.1, CAN/CGSB-12.2, CAN/CGSB-12.4, CAN/CGSB-12.10. Edges of glass to be straight cut, free of nicks and other imperfections conducive to breakage
  - .2 Glass thickness: To requirements of OBC for condition and glazing type indicated, but to minimum type and thickness as indicated.
  - .3 Inter-cavity space thickness: To suit overall thickness and glass thickness, argon filled, with non-conductive spacers and atmospheric pressure equalized to prevent bowing of the glass panes in the vertical position.
  - .4 Glass coating: Sputter Low “E” on no. 2 surface.
  - .5 Inert gas fill: Argon.
  - .6 Properties:
    - .1 Outer pane 6 mm thick, colour cool-grey.
    - .2 Inner pane, 6 m thick, clear tempered.
    - .3 Shading coefficient of glass: 0.36 minimum.
    - .4 ASHRAE U value winter 0.29.
    - .5 ASHRAE U value summer 0.27.
    - .6 Visible light transmission: 51%.
    - .7 Ultraviolet transmission 14%.
    - .8 Solar transmission 25%.
    - .9 Solar heat gain coefficient 0.32 and relative heat gain 74.
  - .7 Acceptable Product: ’Solarban 60’ by Vitro Architectural Glass, or approved alternate.

.4 Sealant: in accordance with Section 07920 - Joint Sealants.

2.2 FIRE PROTECTIVE GLASS

.1 Ceramic fire-rated and impact-safety rated glass: polished premium surface, 5 mm with applied safety film to CAN/ULC-S104, CAN/ULC-S106 and ANZI-97 Cat II.
- .1 Sheet sizes based on surface finish: to suit window frame size as indicated on Drawings.
- .2 Labeling: Permanently label each piece of fire-rated ceramic clear glass with the UL logo and fire rating.
- .3 Fire Rating: Fire rating listed and labeled by UL for fire rating scheduled at opening locations on Drawings, when tested in accordance with ASTM E2074 and ASTM E2010. CAN/ULC-S104 and CAN/ULC-S106 NFPA 257 and UL 9 and UL 10B.
- .4 Acceptable Products:
  - .1 ‘Pyran Platinum F’ by Schott North America.
  - .2 ‘Firelite NT’ by TGP (Technical Glass Products).
  - .3 ‘Keralite Select F’ by Vetrotech.
  - .4 Or approved alternate.
- .5 Accessories:
  - .1 Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,393 sq. inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.
  - .2 Glazing Compound: DAP 33 putty.
  - .3 Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
    - .1 Available Products: ’Dowsil 795’ by Down, or Silglaze-II 2800’ by General Electric Co., or ‘Spectrem 2’ by Tremco Inc., or approved alternate.

.4 Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
.5 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

Rating	Assembly	Maximum Exposed Area (sqm)	Maximum Width of Exposed Glazing (mm)	OR	Maximum Height of Exposed Glazing (mm)
20 to 60 min.	Other than doors	2.145 m^2 / 23 ft^2	2413 mm / 95”		2413 mm / 95”
90 min.	Other than doors	1.69 m^2 / 18.24 ft^2	1435 mm / 56½"		1435 mm / 56½”

2.3 ACCESSORIES

.1 Setting blocks: EPDM Shore A durometer hardness to ASTM D2240, as recommended by manufacturer to suit glazing method, glass light weight and area.

.2 Spacer shims: Neoprene, Shore A durometer hardness to ASTM D2240, 75 mm / 3” long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.

.3 Glazing tape:
.1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; 6 mm wide x 3 mm thick / 1/4" wide x 1/8” thick size; black colour.
.1 Acceptable Product: ‘Polyshim II Tape’ by Tremco.

.4 Glazing splines: Resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, black colour.

.5 Glazing clips: Manufacturer's standard type.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate:
.1 Verify that openings for glazing are correctly sized and within tolerance.
.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
.2 Visually inspect substrate.
.3 Inform Consultant of unacceptable conditions immediately upon discovery.
.4 Proceed with installation only after unacceptable conditions have been remedied.

3.3 PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.4 INSTALLLATION: EXTERIOR WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

.1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.

.2 Cut glazing tape to length and set against permanent stops, 6 mm / 1/4" below sight line. Seal corners by butting tape and dabbing with sealant.

.3 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.

.4 Place setting blocks at 1/4 points, with edge block maximum 150 mm / 6” from corners.

.5 Rest glazing on setting blocks and push against tape and heel head of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.

.6 Install removable stops with spacer strips inserted between glazing and applied stops 6 mm / 1/4" below sight line. Place glazing tape on glazing light or unit with tape 16 mm / 5/8” below sight line.

.7 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 9 mm / 3/8” below sight line.

.8 Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.5 INSTALLATION: INTERIOR – DRY METHOD (TAPE AND TAPE)

.1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.

.2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm / 1/16” above sight line.

.3 Place setting blocks at 1/4 points, with edge block maximum 150 mm / 6” from corners.

.4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.

.5 Place glazing tape on free perimeter of glazing in same manner described.

.6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

.7 Knife trim protruding tape.

3.6 FIRE PROTECTIVE GLASS

.1 Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.

.2 Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.

.3 Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.

.4 Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.

.5 Place setting blocks located at quarter points of glass with edge block not more than 6 inches from corners.

.6 Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.

.7 Place glazing tape on free perimeter of glazing in same manner described above.

.8 Install removable stop and secure without displacement of tape.

.9 Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.

.10 Install so that appropriate UL markings remain permanently visible.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.
  - .1 Remove traces of primer, caulking.
  - .2 Remove glazing materials from finish surfaces.
  - .3 Remove labels.
  - .4 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 After installation, mark each light with an "X" by using removable plastic tape or paste.

.3 Repair damage to adjacent materials caused by glazing installation.

3.9 SCHEDULE

.1 Exterior Entrance Doors, Sidelights, Windows, and Transoms, unless otherwise indicated: Insulating Glass Units, glass types as indicated.

.2 Interior Screens and Transoms: Tempered.

.3 Labeled doors and screens: As indicated on door and screen schedule.

.4 Security Film were indicated on Drawings.

.5 Fire Protective Glazing:

.1 Install fire-rated ceramic clear glazing where indicated on Drawings.

END OF SECTION

1.1 REFERENCES

.1 ASTM International
- .1 ASTM C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2 ASTM C645, Standard Specification for Nonstructural Steel Framing Members.
- .3 ASTM C754, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .4 ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.
- .5 ASTM C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .6 ASTM C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.

.2 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for gypsum, framing, sealants and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Construction Waste Management:
  - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

.3 Shop Drawings:
- .1 Submit Shop Drawings stamped and signed by professional engineer registered and licensed in Province of Ontario, Canada.
  - .1 Indicate design loads, member sizes, materials, design thickness exclusive of coatings, coating specifications, connection and bracing details.
  - .2 Indicate locations, dimensions, openings and requirements of related work.
- .2 Submit reflected ceiling plans for suspended framing as indicated.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed instructions.
- .3 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.

.4 Store and protect partition materials from nicks, scratches, and blemishes.
.5 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to work of this Section and in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Standard Board: To ASTM C1396/C1396M regular and Type X, thickness as indicated, 1220 mm / 4'-0" wide x maximum practical length, ends square cut, edges rounded and bevelled.
.1 Acceptable Products:
.1 'Sheetrock Brand Gypsum Panels' by CGC.
.2 'Regular' or 'Type X' by CertainTeed Gypsum, Inc.
.3 'Tough Rock Fireguard Gypsum Board', by Georgia-Pacific.
.4 'Firecheck' by Lafarge Canada Inc.

.2 Water / Mold Resistant Board: To ASTM C1396, ASTM D3273 and CAN/CSA-A82.27, moisture and mold resistant board, 15.9 mm / 5/8" thick Type X, 1200 mm / 4'-0" wide x maximum practical length.
.1 Acceptable Products:
.1 'Mold Tough Interior Panel' by CGC.
.2 'M2Tech Moisture & Mold Resistant Gypsum Board' by Certainteed Gypsum, Inc.
.3 'Tough Rock Mold-Guard Gypsum Board', by Georgia-Pacific.
.4 Or approved alternate.

.3 Tile Backer Board: Moisture and mould resistant, fully embedded glass mat gypsum tile backer to ASTM D3273, ASTM C1178/C1178M, 15.9 mm / 5/8" thick Type X, 1200 mm / 4'-0" wide x maximum practical length.
.1 Acceptable Products:
.1 'Fiberrock Acua-Tough Tile Backerboard' by CGC.
.2 'GlasRoc Tile Backer' by CertainTeed Gypsum, Inc.
.3 'DensShield Tile Backer', by Georgia-Pacific.

.4 Exterior Grade Gypsum Sheathing (Fiberglass Faced Gypsum Board): To ASTM C1177/C1177M regular and Type X, thickness as indicated, 1220 mm / 4'-0" wide x maximum practical length.
.1 Acceptable Products:
.1 'Securock Glass-Mat Sheathing', by CGC.
.2 'Glasroc Sheathing by CertainTeed Gypsum, Inc.
.3 'Dens-Glass Sheathing', by Georgia Pacific.
.2 Refer to Section 07410 – Preformed Metal Wall and Roof Cladding Systems and Section 07550 – Modified Bituminous Membrane Roofing.

.5 Non-structural Metal Framing:
.1 Non-load bearing channel stud framing: To ASTM C645, stud / framing sizes as determined by Shop Drawing engineer to suit project conditions, roll formed from 0.53 mm minimum thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board.
.2 Tracks: to ASTM C645, in widths to suit stud sizes, 32 mm / 1 1/4" flange height.

.6 Metal furring runners, hangers, tie wires, inserts, anchors: To CSA A82.30, ASTM C1280.

.7 Drywall furring channels: 22 mm x 70 mm x 0.5 mm / 7/8” x 2 3/4" x 25 ga. core thickness galvanized steel channels for screw attachment of gypsum board.
.1 Acceptable Product: ‘D-1001 Drywall Furring Channels’ by Bailey Metal Products Limited, or approved alternate.

.8 Casing Beads, Corner Beads, J Beads, Control Joints and Edge Trim: To ASTM C1047, fill type only (non-fill type will not be accepted), 0.5 mm / 25 ga. base thickness, perforated flanges, one piece length per location.

2.2 ACCESSORIES

.1 Sealants: In accordance with Section 07920 - Joint Sealants.

.2 Joint Reinforcement for Water Resistant Board and Tile Backer Board: Glass-fibre mesh tape, alkali-resistant self-adhering glass-fibre tape, 50 mm / 2” wide, 390 by 390 or 390 by 780 threads / m / 10 by 10 or 10 by 20 threads/inch.

.3 Joint Compound: To ASTM C475, asbestos-free. Acceptable Products:
.1 Interior use, all locations unless otherwise noted: ‘All Purpose Joint Compound’, by CGC, or ‘ProRoc All Purpose Joint Compound’ by CertainTeed, or ‘Rapid Coat’ by Continental Building Products.
.2 Interior use, all locations to receive Water / Mold Resistant Board: ‘Mold Resistant Lite All-Purpose Joint Compound’ by CertainTeed, or approved alternate.
.3 Interior use, all locations to receive abuse board or cement board: ‘Durabond 90’, by CGC, or ‘ProRoc Moisture and Mold Resistant 90’ by CertainTeed, or ‘Rapid Coat 90’ by Continental Building Products.
.4 Exterior use: ‘Durabond 90’, by CGC, or ‘ProRoc Moisture and Mold Resistant 90’ by CertainTeed, or ‘Rapid Coat 90’ by Lafarge Canada Inc.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for Product installation in accordance with manufacturer's written instructions prior to partition installation.
.1 Examine work of other trades partitions assemblies will be applied, for conformity to Drawings.
.2 Report all discrepancies and unacceptable conditions immediately upon discovery to Consultant prior to commencing with work for partitions.
.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 ERECTION OF FRAMING

.1 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.

.2 Place studs vertically at 400 mm / 16” on centre and at each side of openings and corners. Position studs in tracks. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.3 Erect metal studding to tolerance of 1:1000.

.4 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.5 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.6 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use double track slip joint.

.7 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.8 Install insulating strip under studs and tracks around perimeter of sound control partitions.

3.3 ERECTION OF GYPSUM BOARD

.1 Install Gypsum Board in direction that will minimize number of end-butt joints. Stagger end joints 250 mm / 10” minimum.

.2 Apply gypsum sheathing to ASTM C1280.

3.4 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.

.2 At metal deck locations where gypsum board assemblies are identified to be installed to underside of structure, scribe top of gypsum board to fit tightly into metal deck profile.

.3 Apply single layer gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 305 mm / 12” on centre.

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.4 Apply water/mold resistant gypsum board in washrooms, kitchens, janitors’ closets, where adjacent to slop sinks, at all window head and jamb returns and where indicated. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.

.5 Construct fire rated assemblies to ULC design numbers where indicated. In case of conflict between the provisions of the tested assembly and the assembly noted in the Contract Documents, the more stringent provisions shall apply.

.6 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm / 10”.

.7 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.8 Install gypsum board with face side out.

.9 Do not install damaged or damp boards.

.10 Locate edge or end joints over continuous supports. Stagger vertical joints over different studs on opposite sides of wall.

.11 Install Gypsum Sheathing to receive air/vapour barrier membrane sound and free of sharp protrusions, gaps, and voids exceeding 19 mm / 3/4" in width. Use repair materials and methods acceptable to air/vapour barrier membrane manufacturer. For voids that exceed 13 mm / 1/2" in width. Refer also Section 07 28 00 - Air/Vapour Barrier for air/vapour barrier void coverings.
.1 Provide metal framing backing as required to accept air/vapour barrier void coverings.

3.5 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm / 6” on centre.

.2 Install fill type casing beads around perimeter of suspended ceilings.

.3 Install fill type casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Install access doors to electrical and mechanical fixtures specified in respective Sections.
.1 Rigidly secure frames to furring or framing systems.

.6 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.7 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.8 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.9 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.6 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by partition installation.

3.8 SCHEDULE

.1 Construct fire rated assemblies to ULC design numbers where indicated. In case of conflict between the provisions of the tested assembly and the assembly noted in the Contract Documents, the more stringent provisions shall apply.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
- .1 ANSI A108.1, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).
- .2 CTI A118.3, Specification for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1).
- .3 CTI A118.4, Specification for Latex Cement Mortar (included in ANSI A108.1).
- .4 CTI A118.5, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1).
- .5 CTI A118.6, Specification for Ceramic Tile Grouts (included in ANSI A108.1).

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM C 144-11, Specification for Aggregate for Masonry Mortar.
- .2 ASTM C 207-06(2011), Specification for Hydrated Lime for Masonry Purposes.

.3 Canadian General Standards Board (CGSB)
- .1 CGSB 71-GP-22M, Adhesive, Organic, for Installation of Ceramic Wall Tile.
- .2 CAN/CGSB-25.20, Surface Sealer for Floors.

.4 Canadian Standards Association (CSA International)
- .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.5 Terrazzo Tile and Marble Association of Canada (TTMAC)
- .1 Tile Specification Guide 09 30 00, Tile Installation Manual.
- .2 Tile Maintenance Guide.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets indicating:
  - .1 Ceramic tile, marked to show each type, size, and shape required.
  - .2 Chemical resistant mortar and grout (Epoxy and Furan).
  - .3 Cementitious backer unit.
  - .4 Dry-set cement mortar and grout.
  - .5 Divider strip.
  - .6 Elastomeric membrane and bond coat.
  - .7 Reinforcing tape.
  - .8 Levelling compound.
  - .9 Latex cement mortar and grout.
  - .10 Commercial cement grout.
  - .11 Organic adhesive.
  - .12 Slip resistant tile.
  - .13 Waterproofing isolation membrane.
  - .14 Fasteners.

.3 Provide samples in accordance with Section 01330 - Submittal Procedures.
.1 Base tile: Submit duplicate, 100 x 300 mm / 4 x 12” sample panels of each colour, texture, size, and pattern of tile.
.2 Floor tile: Submit duplicate, 300 x 300 mm / 12” x 12” sample panels of each colour, texture, size, and pattern of tile.
.3 Wall tile: Submit duplicate, 300 x 300 mm / 12” x 12” sample panels of each colour, texture, size, and pattern of tile.
.4 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.
.5 Adhere tile samples to 11 mm / 7/16” thick plywood and grout joints to represent project installation.
.4 Manufacturer's Instructions: Submit manufacturer's installation instructions.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling, and Unloading:
.1 Deliver, store, and handle materials in accordance with manufacturer’s written instructions.

.2 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.4 SITE CONDITIONS

.1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 °C for 48 hours before, during, and 48 hours after, installation.

.2 Do not install tiles at temperatures less than 12 °C or above 38 °C.

.3 Do not apply epoxy mortar and grouts at temperatures below 15 °C or above 25 °C.

1.5 MAINTENANCE

.1 Extra Materials:
.1 Provide maintenance materials in accordance with Section 01780 - Closeout Submittals.
.2 Provide minimum 5% of each type and colour of tile required for project for maintenance use. Store where directed.
.3 Maintenance material same production run as installed material.

PART 2- PRODUCTS

2.1 FLOOR TILE

.1 Ceramic Floor Tile for all locations unless otherwise noted: 305 mm x 610 mm / 12” x 24”.
.1 Acceptable Product: ‘Terre Toscane Series’, colour Gaiole by Tierra Sol, or approved alternate.

2.2 WALL TILE

.1 Ceramic Wall Tile: To CAN/CGSB 74.1, 100 mm x 400 mm / 4” x 16” size, straight edges, horizontal stacked pattern.

.1 Acceptable Product: ‘Colour Dimension Series’, colour Arctic White, Bright finish, by Olympia Tile or approved alternate.

2.3 BASE TILE

.1 Ceramic Base Tile: 305 mm x 610 mm / 12” x 24”, cut tile, with factory finish exposed to view, (no cove, no radius top).

.1 Acceptable Product: ‘Terre Toscane Series’, colour Gaiole by Tierra Sol, or approved alternate.

2.4 TRIM SHAPES

.1 Corner Joint: Clear satin anodized aluminum, profile for inside corners and at floor and wall transitions, coved-shaped capable of absorbing movement, c/w corner and end cap adaptors, and all accessories for complete system.

.1 Acceptable Product: ‘DILEX-AHK’ by Schluter, or approved alternate.

.2 Transition Trim: Purpose-made metal extrusion; satin anodized aluminum beads and trims at all outside corners, floor, wall and floor base transitions, and edge protection.

.1 At location where ceramic floor tile meets adjacent floor finishes.

.1 Acceptable Product: ‘Schiene’, by Schlüter or approved alternate.

.2 At all outside corner locations and above all ceramic floor tile bases.

.1 Acceptable Product: ‘Jolly’, by Schlüter or approved alternate.

2.5 TILE UNDERLAYMENT

.1 Tile Underlayment (Waterproof Membrane): 0.508 mm / 20-mil thick, sheet applied polyethylene waterproof membrane and vapour retarder for tiled floors and walls, anchoring fleece laminated to both sides, water vapor permeance of 0.18 perms, as listed by cUPC and evaluated by ICC-ES. Refer to drawings for extent of underlayment.

.1 Accessories: As required for a complete system as recommended by manufacturer to provide waterproof membrane including but not limited to preformed seamless inside / outside corners, seamless corners for waterproofing floor / wall / ceiling / shower base connections, prefabricated sections with overmolded rubber gaskets to seal pipe protrusions through the waterproofing membrane (e.g., at showerheads and faucets) and protect moisture-sensitive backing panels at the mixing valve.

.1 Acceptable Product: ‘Kerdi-DS’, by Schlüter or approved alternate.

2.6 MORTAR AND ADHESIVE MATERIALS

.1 Cement: To CAN/CSA-A3000.

.2 Sand:

.1 To ASTM C144.

.2 Crushed or pit run consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.3 Gradations to be within limits specified when tested to ASTM C136. Sieve sizes to CAN/CGSB 8.1.

.4 Table:

Sieve Designation	% Passing
4.75 mm / # 4	100
2.36 mm / # 8	95 - 100
1.18 mm / # 16	60 - 100
0.600 mm / # 30	35 - 80
0.300 mm / # 50	15 - 50
0.150 mm / # 100	2 - 15
0.075 mm / # 200	0 - 5

.3 Hydrated lime: To ASTM C207.

.4 Latex additive: Formulated for use in cement mortar.

.5 Water: Potable and free of minerals which are detrimental to mortar and grout mixes.

.6 Dry set mortar:
.1 To ANSI A108.1.
.2 Water retentive cement mortar.

.7 Elastomeric adhesive: To CGSB-71-GP-29M.

.8 Epoxy adhesive: To CGSB-71-GP-30M, Type 1.

.9 Modified mortar adhesive: To CGSB-71-GP-30M, Type 2.

.10 Furan resin mortar: To ANSI/CTI A108.1.

.11 Colour pigment: non-fading mineral oxides, unaffected by lime or cement and which will not stain tile.

2.7 GROUT

.1 Epoxy Grout (Chemical-Resistant): 100% solids epoxy grout, stain resistant, crack and shrink resistant, mold and mildew resistant, to ANSI A118.3, not more than two (2) colours as later selected by Consultant.
.1 Initial Cure: 24 hours.
.2 Final Cure: 7 days.
.3 Tensile Strength: 8.4 MPa (1220 psi).
.4 Compressive Strength: 60.0 MPa (8700 psi).
.5 Thermal Shock: 3.9 MPa (565 psi).
.6 Shore D Hardness (24hr.): 85.
.7 Linear Shrinkage: 0%.
.8 Specific Gravity (paste): 1.40.
.9 Acceptable product: ‘Flex-Epoxy 100’ by Flextile, or equivalent by Mapei, or Latacrete, or approved alternate.

2.8 ACCESSORIES

.1 Reinforcing Mesh: 50 x 50 x 1.6 x 1.6 mm / 2” x 2” x 1/16” x 1/16” galvanized steel wire mesh, welded fabric design, in flat sheets.

.2 Sealant: In accordance with Section 07920 - Joint Sealants.

.3 Floor Sealer and Protective Coating: For intended use, to CAN/CGSB-25.20, Type 1 to tile and grout manufacturer’s recommendations.

.4 Thresholds: Granite, thickness for flush floor transition, rounded edges bevelled one side, honed finish to exposed surfaces, size to suit door opening and frame width. Colour to be determined by Consultant from manufacturer’s standard colour range.

2.9 MIXES

.1 Cement:
- .1 Scratch coat: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand, 1 part water, and latex additive where required. Adjust water volume depending on water content of sand.
- .2 Slurry bond coat: Cement and water mixed to creamy paste. Latex additive may be included.
- .3 Mortar bed for floors: 1 part cement, 4 parts sand, 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
- .4 Mortar bed for walls: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand and 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
- .5 Levelling coat: 1 part cement, 4 parts sand, minimum 1/10 part latex additive, 1 part water including latex additive.
- .6 Bond or setting coat: 1 part cement, 1/3 part hydrated lime, 1 part water.
- .7 Measure mortar ingredients by volume.

.2 Dry Set Mortar: Mix to manufacturer's instructions.

.3 Organic Adhesive: Pre-mixed.

.4 Mix bond and levelling coats, and grout to manufacturer's instructions.

.5 Adjust water volumes to suit water content of sand.

2.10 PATCHING AND LEVELLING COMPOUND

.1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

.2 Have not less than the following physical properties:
- .1 Compressive strength - 25 MPa.
- .2 Tensile strength - 7 MPa.
- .3 Flexural strength - 7 MPa.
- .4 Density - 1.9.

.3 Capable of being applied in layers up to 50 mm thick / 2”, being brought to feather edge, and being trowelled to smooth finish.

.4 Ready for use in forty-eight (48) hours after application.

2.11 CLEANING COMPOUNDS

.1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.

.2 Materials containing acid or caustic material are not acceptable.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 WORKMANSHIP

.1 Do tile work in accordance with TTMAC Tile Installation Manual, "Ceramic Tile", except where specified otherwise.

.2 Tile Underlayment: Install tile underlayment where indicated in accordance with manufacturer’s written instructions.

.3 Apply tile or backing coats to clean and sound surfaces.

.4 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.

.5 Maximum surface tolerance 1:800.

.6 Make joints between tile uniform and approximately 1.5 mm / 1/16” wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.

.7 Lay out tiles so perimeter tiles are minimum 1/2 size.

.8 Sound tiles after setting and replace hollow-sounding units to obtain full bond.

.9 Make internal angles square, external angles rounded.

.10 Use round edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.

.11 Install transition trims at junction of tile flooring and dissimilar materials.

.12 Allow minimum twenty-four (24) hours after installation of tiles, before grouting.

.13 Clean installed tile surfaces after installation and grouting cured.

.14 Control Joints:
- .1 Make control joints at 8 m / 25’ in each direction and at abutting dissimilar materials. Make joint width same as tile joints. Fill control joints with sealant in accordance with Section 07920 - Joint Sealants. Keep building expansion joints free of mortar and grout.
- .2 Install control joints as recommended by material manufacturer. Set control joints slightly lower than finish tile surface.

3.3 FLOOR AND WALL TILE

.1 Do tile work in accordance with Installation Manual 200, "Ceramic Tile", produced by Terrazzo Tile and Marble Association of Canada (TTMAC), except where specified otherwise.

3.4 FLOOR SEALER AND PROTECTIVE COATING

.1 Apply in accordance with manufacturer's instructions.

3.5 GRANITE THRESHOLDS

.1 Do work in accordance with guidelines by Terrazzo Tile and Marble Association of Canada (TTMAC), except where specified otherwise.

3.6 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.
  - .1 Clean flooring surfaces to flooring manufacturer's printed instructions.

.2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 - Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International
- .1 ASTM C635/C635M, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .2 ASTM C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- .3 ASTM E1264, Standard Classification for Acoustical Ceiling Products.
- .4 ASTM E580/E580M, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-92.1, Sound Absorptive Prefabricated Acoustical Units.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.4 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S102.2, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 DESIGN REQUIREMENTS

.1 Design acoustical suspension system with maximum deflection of 1/360th of span to ASTM C635/ASTM C635M deflection test.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for ceiling panels and ceiling suspension system and include Product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit one (1) electronic PDF copy WHMIS SDS.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered and licensed in Province of Ontario, Canada. Include in the design, anchorage details for each wall / ceiling / bulkhead connections, as per seismic requirements. Submit reflected ceiling plans for special grid patterns as indicated.
- .2 Indicate layout, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, change in level details, access door dimensions, and locations and acoustical unit support at ceiling fixture lateral bracing and accessories.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed instructions.
- .3 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.
- .4 Store and protect acoustic ceiling materials from nicks, scratches, and blemishes.
- .5 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 ACOUSTIC CEILING PANEL

.1 Acoustic units for suspended ceiling system, Type 1: to CAN/CGSB-92.1, non-fire rated, wet-formed mineral fibre acoustic ceiling panels with factory applied vinyl latex paint.
- .1 Type: Square lay-in.
- .2 Class: A.
- .3 Perforated: Type XX, Pattern CEG.
- .4 Flame spread rating: 0 in accordance with ASTM E84 Surface Burning Characteristics.
- .5 Smoke developed: 0 in accordance with ASTM E84 Surface Burning Characteristics.
- .6 Noise Reduction Coefficient (NRC): designation of 0.5.
- .7 Ceiling Attenuation Class: (CAC) rating 40, in accordance with ASTM E 1264
- .8 Edge type: square.
- .9 Colour: white.
- .10 Size: 15.8 mm / 5/8” thick, size as indicated.
- .11 Shape: flat.
- .12 Acceptable material: ‘Radar Ceramic Panels’ by USG.

2.2 ACOUSTICAL SUSPENSION SYSTEM

.1 Heavy duty system to ASTM C635/ASTM C635M.

.2 Basic materials for suspension system: Commercial quality cold rolled steel, zinc coated.

.3 Suspension system: Fire rated, two directional exposed tee bar grid.

.4 Exposed tee bar grid components: Shop painted with baked polyester or enamel finish, satin sheen, white colour. Components die cut. 38 mm / 1-1/2” high steel main tee with double web, rectangular bulb and 25 mm / 1” rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.

.5 Hanger wire: Galvanized soft annealed steel wire, 2.9 mm / 9-gauge diameter for access tile ceilings.

.6 Hanger inserts: Purpose made.

.7 Accessories: Splices, clips, wire ties, retainers and wall moulding flush, and trim as required to complement suspension system components, as recommended by system manufacturer.

.8 Acceptable Product: 'Prelude XL 15/16"' by Armstrong Ceilings Canada, '15/16" EZ Stab Classic' by CertainTeed Ceilings Canada, 'Donn DX/DXL' by CGC Inc., or 'Traditional Seismic 1220' / 48" System by Chicago Metallic.

2.3 ACCESSORIES

.1 Touch-up paint: in accordance with manufacturer's recommendations for surface conditions.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and suspension system installation in accordance with manufacturer's written instructions.
- .1 Examine work of other trades that acoustical suspension systems will be applied, for conformity to Drawings.
- .2 Report all discrepancies and unacceptable conditions immediately upon discovery to Consultant prior to commencing with work for acoustical suspension systems.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Installation: In accordance with ASTM C636 except where specified otherwise.

.2 Install suspension system to manufacturer's instructions, ASTM C636/C636M, and ASTM E580/E580M, unless otherwise indicated.

.3 Suspension System:
- .1 Erect ceiling suspension system after work above ceiling has been inspected by Consultant.
- .2 Secure hangers to overhead structure using attachment methods as indicated acceptable to Consultant.
- .3 Install hangers spaced at maximum 1220 mm / 24" centres and within 150 / 6" mm from ends of main tees.
- .4 Lay out centreline of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width and according to reflected ceiling plan.
- .5 Install wall moulding to provide correct ceiling height.
- .6 Completed suspension system to support super-imposed loads, such as lighting fixtures diffusers grilles and speakers.
- .7 Support at light fixtures diffusers with additional ceiling suspension hangers within 150 / 6" mm of each corner and at maximum 610 mm / 24" around perimeter of fixture.
- .8 Interlock cross member to main runner to provide rigid assembly.
- .9 Ensure finished ceiling system is square with adjoining walls and level within 1:1000.

.4 Acoustic Panels:

.1 Install acoustical panels and tiles in ceiling suspension system.

.2 Co-ordinate ceiling work with work of other Sections such as interior lighting, fire protection communication, and intrusion and detection systems.

3.3 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.

.1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by acoustical ceiling installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM):
- .1 ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- .2 ASTM F1066, Standard Specification for Vinyl Composition Floor Tile.
- .3 ASTM F1344, Standard Specification for Rubber Floor Tile.
- .4 ASTM F1700, Standard Specification for Solid Vinyl Floor Tile.
- .5 ASTM F1861, Specification for Resilient Wall Base.
- .6 ASTM F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- .7 ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for resilient tile flooring and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:
- .1 Submit duplicate samples in size specified of:
  - .1 300 mm x 300 mm / 12” x 12” long tile.
  - .2 300 mm / 12” long base.
  - .3 300 mm / 12” long nosing.
  - .4 300 mm / 12” long Feature strips, treads, edge strips.

.4 Test Reports:
- .1 Submit one (1) digital copy of test report in PDF format to show conformance with ASTM F1869.
- .2 Submit one (1) digital copy of test report in PDF format to show conformance with ASTM F2170.

1.3 CLOSEOUT SUBMITTALS:

.1 Operation and Maintenance Data: Submit operation and maintenance data for resilient flooring for incorporation into manual.

1.4 MAINTENANCE

.1 Extra Materials:
- .1 Provide 10 m² / 100 ft² of each colour, pattern and type flooring material required for this project for maintenance use.

.2 Extra materials from same production run as installed materials.
.3 Identify each container of floor tile and each container of adhesive.
.4 Deliver to Owner, upon completion of the work of this Section.
.5 Store where directed by Owner.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect specified materials from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

.1 Ambient Conditions:
.1 Maintain air temperature and structural base temperature at flooring installation area above 20 degrees C for 48 hours before, during and for 48 hours after installation.

.2 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Luxury vinyl tile (LVT): to ASTM F1700, Class III, Type B.
.1 Material Properties:
.1 Thickness: 3 mm / 1/8”.
.2 Wear layer thickness: 0.5 mm / 20 mils.
.3 Size: 457 x 457 mm / 18” x 18” size.
.4 Colour: As later selected by Consultant from manufacturer’s standard colour range, not more than four (4) colours.
.2 Acceptable Product: ‘Textured Stones’ by Interface Inc., or iD Latitude Stone & Concrete by Tarkett, or approved alternate by Armstrong Flooring.

.2 Resilient base (RB): To ASTM F1861, 3 mm / 1/8” thick, 100 mm / 4” height, coloured vinyl base, coved base, unless noted otherwise. Provide flat base at millwork, colour as later selected by Consultant from full range of colours, not more than two (2) colours.
.1 Acceptable manufacturer: Coloured vinyl base by Tarkett, or Flexco.

.3 Sub-floor filler and leveller: As recommended by flooring manufacturer for use with their Product.

.4 Transition trim:

.1 Luxury Vinyl Tile (LVT) to Sealed Concrete (S.CONC): 'Johnsonite RRS-XX-C', reducer by Tarkett or approved alternate.

.5 Metal edge strips: Aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.6 Primers and adhesives: Low-VOC, waterproof, as recommended by flooring manufacturer for specific material on applicable substrate.

.7 Cleaner, Sealer and Finisher: LVT Cleaner, Sealer and Finisher: as recommended by flooring manufacturer's printed instructions. Coordinate Product selection with Owner's maintenance team.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSPECTION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for resilient tile flooring work in accordance with manufacturer's written instructions.

.1 Examine work of other trades that resilient flooring systems will be applied, for conformity to Drawings.

.2 Visually inspect substrate.

.3 Report all discrepancies and unacceptable conditions immediately upon discovery to Consultant.

.4 Proceed with installation only after unacceptable conditions have been remedied.

.2 Conduct the following tests on concrete slab before Product installation:

.1 Moisture Test: Moisture emissions from concrete subfloors (cured for a minimum of 28 days) must not exceed 3 lbs per 1000sf per 24 hours (1.4 kg H2O/24 hr/93 m^2) for acrylic adhesive and 5lbs for polyurethane adhesive in accordance with ASTM F1869.

.2 Internal Relative Humidity Test: Perform internal relative humidity testing in accordance with ASTM F2170. Results shall not exceed 80% RH.

.3 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer.

3.3 SUB-FLOOR TREATMENT

.1 Prepare concrete subfloors in accordance with ASTM F710.

.2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.

.3 Prime / Seal sub-floor. Prepare and finish to resilient flooring manufacturer's printed instructions.

3.4 SUB FLOOR FILLER AND LEVELER

.1 Where resilient flooring abuts other flooring of different thickness, provide cementitious underlayment allowing for smooth and level transition between finished floor surfaces.

.2 Mix, apply and finish underlayment in accordance with latex admixture manufacturer's recommendations.

3.5 GENERAL

.1 Provide adaptors, filler strips, edge guards, transition strips, & reducers to manufacturers written instructions, at all locations where floor covering changes material, or terminates. Provide cove caps at top of all integral (flash cove) floor bases.

.2 Install resilient flooring on all floor surfaces including under all millwork and equipment.

3.6 TILE APPLICATION

.1 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.2 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.

.3 Install flooring to square grid pattern with joints aligned with pattern grain parallel for units and parallel to width of room.

.4 Border tiles: Half tile width minimum.

.5 As installation progresses and after installation, roll flooring with roller to ensure full adhesion using methods and roller weight to manufacturer's written recommendations.

.6 Cut tile and fit neatly around fixed objects. Caulk joint neatly with clear opaque sealant in accordance Section 07920 - Joint Sealants for sealant type.

.7 Install feature strips and floor markings where indicated. Fit joints tightly.

.8 Install flooring in pan type floor access covers. Maintain floor pattern.

.9 Unless otherwise indicated, cut flooring around fixed objects.

.1 Continue flooring over areas which will be under built-in furniture.

.2 Continue flooring through areas to receive plumbing fixtures such as but not limited to water closets without interrupting floor pattern. Caulk joint neatly with clear opaque sealant in accordance with Section 07920 – Joint Sealants for sealant type.

.3 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

.4 Continue flooring through areas to receive millwork without interrupting floor pattern.

.10 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

.11 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.7 BASE APPLICATION

.1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.

.2 Clean substrate and prime with one coat of adhesive.

.3 Apply adhesive to back of base.

.4 Set base against wall and floor surfaces tightly by using 3 kg/ 6.5 lbs. hand roller.

.5 Install straight and level to variation of 1:1000.

.6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.

.7 Cope internal corners. Use premoulded corner units for right angle external corners.

3.8 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.

3.9 PROTECTION

.1 Protect new floors from time of final set of adhesives until final inspection.

.2 Prohibit traffic on floor for forty-eight (48) hours after installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM C811, Standard Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacings.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 – Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for resinous epoxy flooring and include Product characteristics, performance criteria, technical data, application instructions, physical size, finish and limitations. Indicate special handling criteria, installation sequence, and cleaning procedures.
- .2 Submit one (1) electronic copy in PDF format WHMIS SDS - Safety Data Sheets. WHMIS SDS acceptable to Labour Canada and Health and Welfare Canada for high build glazed coatings. Indicate VOC content.

.3 Samples:
- .1 Submit duplicate 200 x 410 mm / 8” x 16” samples of each colour and finish and decorative effects, coating applied to smooth hardboard.

.4 Provide installer / applicator certification from manufacturer complete with a list of completed projects of similar size and complexity.

.5 Reports: Submit manufacturer’s acceptance of substrate prior to installation in writing. Submit verification of moisture content of floor prior to installation.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Submit operation and maintenance data for coatings for incorporation into manual.

1.4 QUALITY ASSURANCE

.1 Installer Qualifications: Engage an installer / applicator that is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project.
- .1 Installer / applicator must be certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated and have completed at least ten (10) projects of similar size and complexity.

.2 Mock-ups:

.1 Apply full-thickness coating of each finish and decorative effect to 10 m² / 100 sq.ft. area of surface to be treated.

.1 Include minimum 1 m / 3 ft length of integral cove base.

.2 Allow forty-eight (48) hours for inspection of mock-up by Consultant before proceeding with coating work.

.3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work to Consultant approval.

.3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review work, at stages listed.

.1 After delivery and storage of Products, and when preparatory work is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver and store materials in manner to prevent damage and deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

.2 Ensure materials remain in original wrapping and containers until used.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.in accordance with Section 01335 – Construction/Demolition Waste Management and Disposal.

1.6 SITE CONDITIONS

.1 Safety:

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of materials.

.2 Ensure no open flame heating devices are used.

.3 Discourage occupancy of treated space until volatile materials are no longer being emitted and there is no odour.

.4 Provide adequate respiratory protection to exposed individuals.

.2 Ventilation:

.1 Provide ventilation continuously during and after coating application. Run system twenty-four (24) hours per day during application; provide continuous ventilation for seven (7) days after completion of application.

.3 Environmental Limitations:

.1 Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

.2 Maintain material and substrate temperature between 18 and 30 degrees C during resinous flooring application and for not less than twenty-four (24) hours after application.

.4 Lighting:
.1 Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

.5 Close spaces to traffic during resinous flooring application and for not less than twenty-four (24) hours after application, unless manufacturer recommends a longer period.

.6 Concrete substrate shall be properly cured for a minimum of thirty (30) days. A vapour barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Interior resinous epoxy flooring coating materials:
.1 System Characteristics:
.1 Wearing Surface: Standard smooth.
.2 Integral Cove Base.
.3 Overall System Thickness: Nominal 6 mm / 1/4".
.2 System Components:
.1 Primer:
.1 Resin: Epoxy.
.2 Formulation Description: Two (2) components, 100 percent solids.
.3 Application Method: Squeegee and roller.
.4 Number of Coats: One (1).
.5 Acceptable Product: As per manufacturer’s recommendations.
.2 Mortar Base:
.1 Resin: Epoxy.
.2 Formulation Description: Three (3) components, 100 percent solids.
.3 Application Method: Metal Trowel.
.1 Thickness of Coats: Nominal 6 mm / 1/4".
.2 Number of Coats: One (1).
.4 Aggregates: Pigmented Blended aggregate.
.3 Top Coat:
.1 Resin: Epoxy.
.2 Formulation Description: Two (2) component, 100 percent solids.
.3 Type: Pigmented.
.4 Finish: Manufacturer’s standard.
.5 Number of Coats: One (1).
.3 Finish:
.1 Solid colour.
.2 Glaze coat: Clear, high gloss finish.
.3 Not more than two (2) colours as later selected by Consultant.
.4 Acceptable Products:
.1 ‘Stonclad GS’ with ‘Stonkote GS4’ Top Coat by The Stonhard Group, ‘Sikafloor-217’ by Sika, or approved alternate.

.2 System Physical Properties:
.1 Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

.1 Compressive Strength: 10,000 psi after 7 days per ASTM C579.
.2 Tensile Strength: 1,750 psi per ASTM C307.
.3 Flexural Strength: 4,000 psi per ASTM C580.
.4 Water Absorption :< 1% per ASTM C413.
.5 Impact Resistance :> 160 in. lbs. per ASTM D2794.
.6 Flammability: Class 1 per ASTM E648.
.7 Hardness: 85 to 90, Shore D per ASTM D2240.

.3 Accessory Materials:
.1 Patching and Fill Material: Resinous Product as per resinous flooring manufacturer written recommendation to suit application.
.2 Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated, including but not limited to joint fill material and concrete crack treatment.
.3 Adaptors, Filler strips, Edge Guards, Transition Strips, Reducers and Cove Caps: Thickness and width to suit floor thickness and condition,
.1 Acceptable manufacturer: Tarkett or approved alternate.

2.2 MIXES

.1 Mix coatings according to manufacturer's instructions.

PART 3 – EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXAMINATION

.1 Examine substrate surfaces to receive resinous epoxy flooring.
.1 Visually inspect substrate prior to commencing with work of this Section.
.2 Verify that substrate conditions which have been previously installed under other Sections or Contracts, are acceptable for Product installation in accordance with manufacturer’s instructions prior to installation of resinous epoxy flooring coatings.
.3 Inform Consultant of unacceptable conditions immediately upon discovery.
.4 Proceed with installation only after unacceptable conditions have been remedied.

3.3 PREPARATION

.1 Prepare surfaces in accordance with coating material manufacturer's instructions.

.2 Substrate shall be sound, non-dusting, and free of grease, oil, dirt and other matter detrimental to adhesion and appearance of coating. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

.3 Where resinous epoxy flooring is applied over existing floor surfaces, remove existing coatings / finishes and prepare substrates in accordance with manufacturer's written recommendations.

.4 Concrete Substrates:
- .1 Mechanically prepare substrates as follows:
  - .1 Comply with ASTM C811, unless manufacturer's written instructions are more stringent.
- .2 Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
- .3 Verify that concrete substrates are dry and ready to accept resinous epoxy flooring coating system in accordance with manufacturer's written requirements.

.5 Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

.6 Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

.7 Treat control joints and other non-moving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

.8 Mask surrounding surfaces to provide neat, clean juncture lines.

.9 Protect adjacent surfaces and equipment from damage by overspray.

3.4 APPLICATION

.1 General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
- .1 Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum inter-coat adhesion.
- .2 Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

.2 Integral Cove Base: Apply cove base mix mortar to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, of cove base. Round internal and external corners.
- .1 Integral Cove Base Height: As indicated on Drawings.

.3 Terminations:
- .1 Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.
- .2 Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
- .3 Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- .4 Treat floor drains by chasing the flooring system to lock in place at point of termination.

.4 Joints and Cracks:
- .1 Treat control joints to bridge potential cracks and to maintain monolithic protection.
- .2 Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.

.3 Discontinue floor coating system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.5 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of work, in handling, installing, applying, protecting and cleaning of Product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of Product use recommendations and periodic site visits for inspection of Product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .2 CAN/CGSB-92.1, Sound Absorptive Prefabricated Acoustical Units.

.3 Canadian Standards Association (CSA International)
- .1 CSA B111, Wire Nails, Spikes and Staples.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for work of this Section and include Product characteristics, procedures for cleaning and removal of stains, performance criteria, physical size, finish and limitations.

.3 Test Reports: Submit certified test reports from recognized test laboratories.

.4 Certificates: Submit manufacturer’s certificate that Products meet or exceed specified requirements.

.5 Samples.
- .1 Submit duplicate full size 152 × 152 mm / 6” × 6” sample of each type acoustical unit, showing full range of exposed texture to be expected in completed work and one (1) 203 × 254 mm / 8” × 10” sample for each fabric color is available.

1.3 QUALITY ASSURANCE

.1 Mock-ups:
- .1 Construct one representative mock-up of each type acoustical wall treatment system.
- .2 Construct mock-up 10 m² minimum to indicate method of assembly, installation and fixing.
- .3 Construct mock-up where directed.
- .4 Allow 72 hours for inspection of mock-up by Consultant before proceeding with work.
- .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work to Consultant approval.

1.4 SITE CONDITIONS

.1 Commence installation after building is enclosed, with HVAC system operational and when dust generating activities are completed.

.2 Permit wet work to dry prior to commencement of installation.

.3 Locate materials onsite at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.

.4 Maintain uniform minimum temperature of 15 degrees C and relative humidity of 20- 40% prior to, during and after installation.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed instructions.

.3 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.

.4 Store and protect acoustic ceiling materials from nicks, scratches, and blemishes.

.5 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to work of this Section.

.5 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide extra materials of cementitious wood fibre acoustic units and adhesive in accordance with Section 01780 - Closeout Submittals.

.2 Provide acoustical units for maintenance use amounting to 5% of gross wall area for each pattern and type required for project.

.3 Provide sufficient adhesive to install extra material provided.

.4 Extra materials from same production run as installed materials.

.5 Identify each package of acoustical units including colour and type, and each container of adhesive.

.6 Deliver to Owner, upon completion of the work of this Section.

.7 Store where directed by Owner.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Cementitious wood fibre acoustic units: to CAN/CGSB-92.1.
- .1 Material: Aspen wood fibers bonded with inorganic hydraulic cement.
- .2 Thickness: 51 mm / 2”.
- .3 Edge: Long and end panels edge – beveled. Tongue-and-groove edges, beveled ends.
- .4 Width: 1213 mm / 47 3/4".
- .5 Length: To suit layout.
- .6 Color: Factory painted white.
- .7 Mounting Style: Laid on 76 mm / 3" furring strips with acoustical insulation: ‘Mounting C-40’ by Tectum Inc., or approved alternate.
- .8 Performance Requirements:
  - .1 Provide acoustical ceiling panel assembly designed and tested to provide surface burning characteristics as follows to ASTM E84:
    - .1 Flamespread: 0.
    - .2 Smoke Developed: 0.
  - .2 Provide acoustical wall panel system which has been manufactured, fabricated and installed to provide Noise Reduction Coefficient (NRC) rating of 1.00.
- .9 Acceptable Product: ‘Tectum Direct-Attach Ceiling and Wall Panels’ by Armstrong or approved alternate.

.2 Furring Strips: 38 x 89 mm, stacked as indicated on Drawings. Refer to Section 06100 - Rough Carpentry.

.3 Acoustical Insulation:
- .1 Semi-rigid mineral wool, thickness as indicated on drawings.
  - .1 Acceptable Product: ‘Rockwool AFB’ by Rockwool, or approved alternate.

.4 Adhesive: Type recommended by acoustic unit manufacturer.

.5 Staples, nails and screws: To CSA B111, non-corrosive finish, type recommended by acoustic unit manufacturer.

.6 Polyethylene: To CAN/CGSB-51.34, 0.15 mm / 6 mil thick.

2.2 ACCESSORIES

.1 Painted Head Drywall Screws:
- .1 Material: Steel.
- .2 Length: As recommended by manufacturer to suit panel depth.
- .3 Color: Prefinished to match panel colour.

.2 Touch-Up Paint: to match prefinished panel.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable to receive acoustical treatment system in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate.
- .2 Verify dimensions, tolerances, and method of attachment with other work.
- .3 Inform Consultant of unacceptable conditions immediately upon discovery.
- .4 Proceed with installation only after unacceptable conditions have been remedied.

3.3 INSTALLATION

.1 Install materials in accordance with governing regulations, fire resistance rating requirements and industry standards applicable to work.

.2 Ensure substrate surface is straight to tolerance of plus or minus 3 mm over 3000 mm.

.3 Install acoustic units to clean, dry and firm substrate using screws as per manufacturer’s written instructions.

.4 Install acoustic units plumb and aligned. Arrange units symmetrical on each wall as indicated. Cut units to be at least 50% of unit width.

.5 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

.6 Install fibrous acoustical media and spacers over entire area behind acoustic units.

3.4 CLEANING

.1 Proceed in accordance with Section 01741 – Cleaning.

.2 Keep acoustic installation and all components clean. Remove blemishes immediately.

3.5 PROTECTION

.1 Use polyethylene to protect finished acoustical wall treatment from damage.

.2 Remove prior to Ready-for-Takeover.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Safety Data Sheets (SDS).

.2 The Master Painters Institute (MPI)
  .1 Architectural Painting Specification Manual.
  .2 Maintenance Repainting Manual.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
  .1 Submit manufacturer's instructions, printed Product literature and data sheets for paint and coating Products and include Product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit one (1) digital copy in PDF format of WHMIS SDS.

.3 Samples:
  .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  .2 Submit duplicate 203 x 305 mm / 8” x 12” sample panels of each paint, stain, clear coating, special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on following substrate materials:
    .1 3 mm / 1/8” plate steel for finishes over metal surfaces.
    .2 13 mm / 1/2" birch plywood for finishes over wood surfaces.
    .3 50 mm / 2” concrete block for finishes over concrete or concrete masonry surfaces.
    .4 13 mm / 1/2” gypsum board for finishes over gypsum board and other smooth surfaces.
  .3 When approved, samples will become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

.4 Certificates: Submit Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 CLOSEOUT SUBMITTALS

.1 Submit maintenance data for incorporation into manual:
  .1 Product name, type and use.
  .2 Manufacturer's Product number.
  .3 Colour numbers.
  .4 MPI Environmentally Friendly classification system rating.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Provide and maintain dry, temperature controlled, secure storage.
- .2 Store painting materials and supplies away from heat generating devices.
- .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.

.4 Store temperature sensitive Products above minimum temperature as recommended by manufacturer.

.5 Remove paint materials from storage only in quantities required for same day use.

.6 Fire Safety Requirements:
- .1 Supply one (1) 9 kg / 20 lb Type ABC dry chemical fire extinguisher adjacent to storage area.
- .2 Store oily rags, waste Products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.7 Develop Waste Reduction Workplan related to work of this Section and in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.5 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:
- .1 Ventilate enclosed spaces.
- .2 Co-ordinate use of ventilation system with Consultant and ensure its operation during and after application of paint as required.
- .3 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- .4 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:
- .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
- .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
- .4 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.

.3 Additional application requirements:
- .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
- .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Consultant such that painted surfaces will have dried and cured sufficiently before occupants are affected.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Supply paint materials for paint systems from single manufacturer.

.2 Conform to latest MPI requirements for painting work including preparation and priming.

.3 Materials in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.

2.2 COLOURS

.1 Consultant will provide Colour Schedule after Contract award.

.2 Base colour schedule on selection as follows: One (1) base colour, two (2) accent colours, one (1) colour for doors, and one (1) colour for frames.

.3 Selection of colours from manufacturers' full range of colours.

.4 Where specific Products are available in restricted range of colours, selection based on limited range.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Consultant for tinting of painting materials.

.2 Use and add thinner in accordance with paint manufacturer's recommendations.

.1 Do not use kerosene or similar organic solvents to thin water-based paints.

.3 Thin paint for spraying in accordance with paint manufacturer's written recommendations. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.

.4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level - Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - (Matte Finish)	Max. 5	Max. 10
Gloss Level 2 - (Velvet)	Max. 10	10 to 35
Gloss Level 3 - (Eggshell)	10 to 25	10 to 35
Gloss Level 4 - (Satin)	20 to 35	min. 35
Gloss Level 5 (Semi-Gloss)	35 to 70	
Gloss Level 6 - (Traditional Gloss)	70 to 85	
Gloss Level 7 - (High Gloss)	More than 85	

.2 Gloss level ratings of painted surfaces as indicated and as noted on Finish Schedule.

2.5 EXTERIOR PAINTING SYSTEMS

.1 Galvanized Metal: not chromate passivated (doors, and frames)
  .1 EXT 5.2C – Inorganic zinc rich paint.

2.6 INTERIOR PAINTING SYSTEMS

.1 Concrete horizontal surfaces: Resinous Epoxy Coating for floors where identified on room finish schedule:
  .1 Refer to Section 09670 – Resinous Epoxy Flooring.

.2 Concrete masonry units: Smooth block:
  .1 INT 4.2A - Latex semi-gloss finish.

.3 Metal Fabrications: Miscellaneous metal, stairs and railings.
  .1 INT 5.1A - Quick dry enamel semi-gloss finish.

.4 Galvanized Metal: Doors, and frames.
  .1 INT 5.3L - Alkyd semi-gloss finish (over non-cementitious primer).

.5 Galvanized Metal: Mechanical and electrical steel, pipes, conduits, etc.
  .1 Refer to Section 09960 - High Performance Coatings.

.6 Wood casework: Millwork:
  .1 INT 6.4Y - Clear lacquer satin finish.

.7 Plaster and gypsum board: Gypsum board ceiling finishes:
  .1 INT 9.2B - High performance architectural latex matt gloss level finish.

PART 3- EXECUTION

3.1 GENERAL

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and data sheets.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.2 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Proceed with painting only after unacceptable conditions have been remedied.

.3 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3 PREPARATION

.1 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.

.2 Protection of in-place conditions:
- .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Consultant.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished Products and equipment.

.3 Surface Preparation:
- .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
- .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
- .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Consultant.
- .4 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual specific requirements and coating manufacturer's recommendations.
- .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.7 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
  .1 Apply wood filler to nail holes and cracks.
  .2 Tint filler to match stains for stained woodwork.
.8 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
.9 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
.10 Touch up of shop primers with primer as specified.

3.4 APPLICATION

.1 General:
  .1 Finish all exposed to view unfinished materials and all previously painted surfaces in area of new work and as scheduled.
  .2 Finish paint all primed surfaces.
  .3 Do not paint baked enamel, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory.
  .4 Provide finish uniform in sheen, colour and texture, free from streaks, shiners and brush or roller marks or other defects.
  .5 Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas, which have been cut and patched. Patch paint will not be accepted.
  .6 Sand smooth enamel and varnish undercoats prior to recoating.
  .7 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.
  .8 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
  .9 Apply coats of paint continuous film of uniform thickness.
    .1 Repaint thin spots or bare areas before next coat of paint is applied.
  .10 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
  .11 Sand and dust between coats to remove visible defects.
  .12 Finish surfaces both above and below sight lines as specified for surrounding surfaces.
  .13 Finish closets and alcoves as specified for adjoining rooms.
  .14 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

.2 Apply paint by brush, roller, air sprayer, or airless sprayer. Method of application to be as approved by Consultant.
  .1 Brush and Roller Application:
    .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
    .2 Work paint into cracks, crevices and corners.
    .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
    .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
    .5 Remove runs, sags and brush marks from finished work and repaint.
  .2 Spray application:
    .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
    .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
    .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.

.4 Brush out immediately all runs and sags.
.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
.6 Spray paint all doors and frames scheduled to be painted. Final coat may be brushed or rolled to accommodate finished adjacent surfaces.
.7 Spray paint overhead doors.

3.5 RESTORATION

.1 Clean and reinstall hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

3.6 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
.1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.4 Place paint stains primer defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.2 SSPC Steel Structures Painting Council, Standards.
- .1 SSPC-SP1, Solvent Cleaning.
- .2 SSPC-SP6, Commercial Blast Cleaning.
- .3 SSPC-SP10, Near-White Blast Cleaning.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

.3 Product Data:
- .1 Submit WHMIS SDS - Safety Data Sheets. WHMIS SDS acceptable to Labour Canada and Health and Welfare Canada for high build glazed coatings. Indicate VOC content.

.4 Samples:
- .1 Submit colour samples of required colours in this Section and referenced in Division 15 and 16.
  - .1 Submit 200 mm x 300 mm / 8” x 12” colour samples of selected colours.

1.3 CLOSEOUT SUBMITTALS:

.1 Provide maintenance data for coatings for incorporation into manual specified in Section 01780 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Construct mock-ups in accordance with Section 01430 - Quality Requirements.
- .1 Apply coating of each finish and decorative effect to 10 m² / 100 sq. ft. area of surface to be treated.
- .2 Allow 72 hours for inspection of mock-up by Consultant before proceeding with coating work.
- .3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work to Consultant approval.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer’s written instructions.
- .1 Deliver and store materials in manner to prevent damage.
- .2 Ensure materials remain in original wrapping and containers until used.

.3 Provide C02 fire extinguishers of minimum 9 kg capacity in storage areas.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.6 SITE CONDITIONS

.1 Safety:

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of materials.

.2 Ensure no open flame heating devices are used.

.3 Discourage occupancy of treated space until volatile materials are no longer being emitted and there is no odour.

.4 Provide adequate respiratory protection to exposed individuals.

.2 Ventilation:

.1 Provide ventilation continuously during and after coating application. Run system 24 hours per day during application; provide continuous ventilation for seven (7) days after completion of application.

.3 Temperature:

.1 Do not apply emulsion systems unless uniform minimum 10 degrees C air temperature at installation area for 24 hours prior to and after application.

.2 Maintain minimum temperature 10 degrees C within area of installation until final acceptance of building.

1.7 OFF-SITE QUALITY CONTROL

.1 For all items painted off-site, provide a Painting Quality Control report. Including the following items:

.1 Initial condition of the item to be painted (clean, muddy, mill scale present, salt contaminated, oily, greasy, etc.).

.2 Description of the decontamination procedures (solvent wipe, detergent cleaned, water blasted, steam cleaned, etc.).

.3 Ambient conditions during dry abrasive blasting operation (start to finish, temperature, humidity, weather conditions if outside).

.4 Time of dry abrasive blasting (start and finish, date, time).

.5 Ambient conditions during priming (start to finish, temperature, humidity, weather conditions if outside).

.6 Time of priming (start and finish, date, time).

.7 Material conditions (material temperature, batch numbers, supplier, and invoice number).

.8 Spray equipment used (brand, model, features, age, general condition).

.9 Ambient conditions during curing (start to shipping, temperature, humidity, weather conditions if outside).

.10 Description of place where each step of paint curing occurred (shop, yard, covered yard).

.11 Shipping date and time.

.2 Off-site painting procedures may be reviewed by the Consultant or their agent.

1.8 ON-SITE QUALITY CONTROL

.1 Verify appropriate wet film thickness to achieve specified dry film thickness by means of wet film gauges, allowing for solvent loss, during application. Adjust application thickness in accordance with manufacturer's guidelines.

.2 Recoat all painted surfaces with less than the minimum dry film thickness to achieve the specified requirements.

PART 2- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Compatibility between components of roofing system is an essential requirement of the Contract for the purpose of obtaining a manufacturer's system warranty.
- .1 Products specified within this Specification Section by Carboline, unless otherwise noted are to be used for this project. Equivalent systems, single-sourced from the following manufacturers are also acceptable for use:
  - .1 Ameron
  - .2 International Paint

.2 Products for Steel:
- .1 Inorganic Zinc Primer: Inorganic Zinc Silicate, 'Carbozinc 11' by Carboline.
- .2 Organic Zinc Primer: Organic Zinc-Rich Epox, 'Carbozinc 859' by Carboline.
- .3 Hot Dipped Galvanized Primer: Polymeric epoxy amine, 'Rustbond' or 'Rustbond FC' by Carboline, depending on temperature.
- .4 Base Coat: Phenalkalamine epoxy, 'Carbomastic 615HS' by Carboline, 5-10 mils DFT.
- .5 Interior Top Coat: Cycloaliphatic Amine Epoxy, 'Carboguard 890' by Carboline, 4-7 mils DFT.
- .6 Exterior Top Coat: Aliphatic Polyurethane, 'Carbothane 133HB' by Carboline, 3-5 mils DFT.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for high performance coatings in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with painting only after unacceptable conditions have been remedied.

3.3 PREPARATION

.1 Check all surfaces with a moisture meter and confirm that the moisture content is acceptable to the manufacturer.

.2 Remove dust, grease, rust, insects and extraneous matter from all surfaces.

.3 Provide metal pans or adequate tarpaulin to protect floors in area assigned for the storage and mixing of paints.

.4 Use sufficient drop cloths and protective coverings for the full protection of floors, walls, and all work not being painted. Protect mechanical, electrical and special equipment, hardware, all other components of the building which do not require painting, from paint spotting and other soiling during the painting process.

.5 Leave above areas clean and free from evidence of occupancy upon completion of painting.

.6 Protect paint materials from fire and freezing.

.7 Keep waste rags in metal drums containing water and remove from building at the end of each working shift.

3.4 SURFACE PREPARATION, PRIMING, AND BASE COAT

.1 New Steel Surfaces:
- .1 Surfaces to be clean and dry, free of oil, grease, dirt, or other contaminants prior to commencing surface preparation. Comply with the requirements of SSPC, SP-1.
- .2 Sandblast to SSPC SP-10 to achieve a surface profile of 1.0 to 3.0 mil.
- .3 Apply zinc primer to freshly prepared surface before formation of any flash rust. Where items are shop primed, but field top-coated, use inorganic zinc primer. Where top coats are shop applied, organic zinc primer may be used.
- .4 Touch-up any inadequate areas before top-coating with organic zinc primer.
- .5 Achieve a Dry Film Thickness of 3.0 to 6.0 mils.

.2 New Hot-Dipped Galvanized Surfaces (Brush-Blast Possible):
- .1 Clean surface to SSPC SP-1.
- .2 Brush-Blast surface to SSPC SP-7.
- .3 Prime surface with base coat.

.3 New/Existing Hot-Dipped Galvanized Surfaces (Brush-Blasting Not Possible):
- .1 Clean surface to SSPC SP-1.
- .2 Prepare surface to SSPC SP-3, removing all surface imperfections.
- .3 Prime with hot dipped galvanized primer as dictated by temperatures.
- .4 Apply base coat.

3.5 TOP COAT

.1 Apply top coats in accordance with coating manufacturer's written application instructions and specifications.

3.6 HARDWARE

.1 Remove finishing hardware, electric plates, and accessories. Mask any that are not removable. Replace these when paint is dry and clean them. Do not clean hardware with solvent that will remove permanent lacquer finish.

3.7 APPLICATION

.1 Paint all items identified in Drawings and in Divisions 15 and 16, except aluminum or stainless steel materials, as per this Section.

.2 Equipment supplied in a factory finish which does not match the colour code of its related process shall be repainted to the appropriate colour as per Divisions 15 and 16.

.3 Apply coatings with no runs, laps, voids, or other marks or irregularities, and with uniform colour, sheen and texture.

.4 Apply each successive coat only after the previous coat has dried.

.5 Refinish entire coated surface where finish is damaged or otherwise unacceptable. Surfaces exhibiting pin holes or other defects shall be recoated.

.6 Finishes and number of coats specified in the Schedule are intended to cover surfaces completely. If they do not, apply further coats until complete coverage is achieved as required.

.7 Any areas exhibiting incomplete or unsatisfactory coverage shall have the entire plane painted. Patching will not be acceptable.

.8 Spraying in existing occupied areas will not be allowed without written approval. Provide details of program to control overspray and odours.

.9 Arrange to have traffic barred from completed areas wherever possible.

.10 Apply materials in strict accordance with manufacturer's directions and specifications and be familiar with those directions and specifications. Do not use adulterants.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International:
- .1 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 CSA Group:
- .1 CSA B651, Accessible Design for the Built Environment.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for phenolic toilet compartments and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit one (1) electronic PDF copy of WHMIS SDS. Shop Drawings:
- .1 Indicate fabrication details, plans, elevations, hardware, and installation details.

.4 Samples:
- .1 Submit duplicate 300 x 300 mm / 12” x 12” samples of panel showing finish on both sides, two finished edges and core construction.
- .2 Submit duplicate representative samples of each hardware item, including brackets, fastenings and trim.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect specified materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Doors, panels, and pilasters: Decorative surface sheet with solid phenolic core of melamine resin impregnated kraft paper fused under high temperature and pressure; edges machine sanded with a 45 degree radius edge.

.2 Stainless steel sheet metal: to ASTM A167, Type 304 with brushed finish.

2.2 COMPONENTS

.1 Doors and Panels: 19 mm / 3/4" thick x 1397 mm / 55" high straight cut with fine radius edges.

.2 Plasters: 19 mm / 3/4" thick x 2083 mm / 82" high straight cut with fine radius edges.

.3 Headrail: 32 mm / 1-1/4" x 44 mm / 1-3/4" extruded anodized aluminum with anti-grip design with 1.5 mm x 1/16" wall thickness securely anchored to wall and pilasters with manufacturer's recommended fittings as required for rigid installation. Fabricate all required joints in headrails at a pilaster location only.

.4 Pilaster Fastening:
- .1 Securely and rigidly fastened pilasters to floor with 76mm / 3" high stainless steel anchor shoes with stainless steel brackets for pilaster to wall connection.

.5 Hardware & Fittings:
- .1 Door Hinges: Install doors with 14 gauge thick stainless steel continuous hinges fasten to door and pilaster with tamper-proof security head stainless steel thru-bolts and fastened to the edge of the door and pilaster with stainless steel screws. Provide top hinges with adjustable nylon cams.
- .2 Strike-keeper and throw latch: Stainless steel surface mounted with emergency access feature.
- .3 Panel brackets:
  - .1 Panel to wall connection: Three (3) stainless steel brackets.
  - .2 Panel to pilaster connection: Full-height continuous stainless channel.
- .4 Finish: No. 4 brushed stainless steel.
- .5 Swing: As indicated.
- .6 Adjustable to hold door open at any angle up to 90 degrees.
- .7 Emergency access feature.
- .8 Door pull: Barrier-free type suited for outswinging doors stainless steel.
- .9 Provide convex style panel mounted door stop for toilet partition doors.
- .10 Coat hook / door stop: combination stainless steel hook and rubber door bumper.

.6 Finish:
- .1 Color as later selected by Consultant from manufacturer's complete colour range, not more than two (2) colours.

.7 Acceptable Product:
- .1 'Phenolic (Black Core) Floor Anchored/Overhead Braced Toilet Compartments' by ASI Global Partitions, or equivalent by Bobrick, Bradley Corporation, General Partitions, or approved alternate.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for phenolic toilet compartments installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.3 INSTALLATION

.1 Ensure supplementary anchorage, if required, is in place.

.2 Do work in accordance with CSA-B651.

3.4 ERECTION

.1 Partition erection:

.1 Install partitions secure, plumb and square.

.2 Leave 12 mm / 1/2" space between wall and panel or end pilaster.

.3 Anchor mounting brackets to masonry or concrete surfaces using screws and shields, to hollow walls using bolts and toggle type anchors, to steel supports with bolts in threaded holes.

.4 Attach panel and pilaster to brackets with through type sleeve bolt and nut.

.5 Provide for adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with stainless steel shoes.

.6 Equip each door with hinges, latch set, and each stall with coat hook mounted on partition wall, mounting heights as indicated. Adjust and align hardware for proper function. Adjust and align hardware for easy, proper function. Set door open position at 30 degrees to front. Install door bumper on wall as required to prevent projections from damaging partitions or adjacent walls.

.7 Equip out-swinging doors with door pulls on inside and outside of door in accordance with CSA-B651.

.8 Install hardware including grab bars.

.2 Floor supported and overhead braced partition erection:

.1 Attach pilasters to floor with pilaster supports and level, plumb, and tighten installation with levelling device.

.2 Secure pilaster shoes in position.

.3 Secure headrail to pilaster face with not less than two fasteners per face.

.4 Set tops of doors parallel with overhead brace when doors are in closed position.

.3 Privacy / Urinal screens erection:

.1 Provide urinal stall screens consisting of panel and post, pilaster and headrail as specified for toilet compartments.

.2 Anchor wall-hung screen panels to walls with full height panel brackets and vertical upright consisting of tubular headrail stock and end sockets, anchored to floor.

3.5 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.

.1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by phenolic toilet compartment installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-44.40, Steel Clothing Locker.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
  .1 Provide manufacturer's printed Product literature and data sheets for metal lockers and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
  .1 Indicate on drawings: type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, rods, hooks, shelves, bases, trim, numbering, filler panels, end/back panels, door handles, locking method, ventilation method, finishes.

.4 Construction Waste Management:
  .1 Submit copy of Waste Reduction Workplan for project highlighting recycling and salvage requirements in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:
  .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
  .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect metal lockers from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: Remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01355 - Construction/Demolition Waste Management and Disposal.

PART 2- PRODUCTS

2.1 MANUFACTURED UNITS

.1 Lockers: To CAN/CGSB-44.40.
  .1 Type 1 – Single Tier: Class 1 - One complete locker, freestanding.
  .2 Size: 455 mm / 18” wide x 455 mm / 18“ deep x 1830 mm / 72” high.
  .3 Steel thickness: 1.6 mm / 16 ga.
  .4 Assembly: Welded.

.5 Top: 1.6 mm / 16 ga. sloped.
.6 Base: Pre-manufactured 1.6 mm / 16 ga.
.7 Inside accessories (each compartment): One (1) shelf and three (3) hooks. Place shelf to provide 25 mm / 1" air space between shelf and back of locker for ventilation. Place shelf 305 mm / 12" from top.
.8 Doors: Louvered, steel thickness 1.6 mm / 16 ga.
.9 Accessories:
  .1 Rubber bumpers riveted to door to act as door stop.
  .2 Door equipped with steel lock keeper welded to door frame to accept padlock (NIC).
    .1 Clear anodized number plate on each locker, number as later directed by Consultant.
.10 Door handle: Recessed handle, stainless steel with brushed No 304 finish.
.11 Door Hinge: Continuous piano hinge welded to frame and riveted to door.
.12 Filler panels / false fronts: 1.6 mm / 16 ga. thick, place where required, colour to match door.
.13 End Panels: Where ends of lockers are exposed, provide 1.6 mm thick / 16 ga. end panels attached with concealed fasteners.
.14 Colour as later selected by Consultant from manufacturer's standard colour range. Frames/bodies of metal lockers to be different colour from colour of metal locker doors. Allow for not more than four (4) colours.
.15 Acceptable Products:
  .1 Solid Panel Doors:
    .1 'Traditional Collection' by ASI Storage Solutions, or 'Décor Tri-lok Titan' by General Storage Systems (GSS), or 'Emperor' by Hadrian, or approved alternate.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates and surfaces to receive metal lockers previously installed under other Sections or Contracts are acceptable for Product installation in accordance with manufacturer's instructions prior to metal locker installation.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Assemble and install lockers in accordance with manufacturer's written instructions.

.2 Securely fasten lockers to grounds and nailing strips.

.3 Install wall trim around recessed locker banks.

.4 Install filler panels (false fronts) where indicated and where obstructions occur.

.5 Install finished end panels to exposed ends of locker banks.

.6 Install all miscellaneous panels:
  .1 Fascia panels or sloped tops as indicated.
  .2 Other panels required to provide a neat, finished appearance.

.7 Install locker numbers.

3.3 ADJUSTING

.1 Adjust metal lockers for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
  .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal locker installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International
- .1 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM B456, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.81, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
- .2 CAN/CGSB-1.88, Gloss Alkyd Enamel, Air Drying and Baking.
- .3 CGSB 31-GP-107MA, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.

.3 Canadian Standards Association (CSA International):
- .1 CAN/CSA-B651.2, Accessible Design for the Built Environment.
- .2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Provide manufacturer's printed Product literature and data sheets and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01780 - Closeout Submittals.

1.4 MAINTENANCE

.1 Tools:
- .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01780 - Closeout Submittals.
- .2 Deliver special tools to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Sheet steel: To ASTM A653/A653M with ZF001 designation zinc coating.

.2 Stainless steel sheet metal: to ASTM A167, Type 304, with satin finish.

.3 Stainless steel tubing: To AISI No. 4, commercial grade, seamless welded, 1.2 mm wall thickness, satin luster finish.

.4 Fasteners: Concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 ACCEPTABLE MANUFACTURER

.1 Products specified are manufactured by Frost unless otherwise indicated. Should an alternate Product to Frost be specified, provide only the specified Product or an approved alternate.

.2 Equivalent Products by Bobrick or ASI Group Canada will be acceptable to Frost Products unless otherwise indicated.

.3 Provide all accessories with concealed fasteners and concealed tamperproof screws.

2.3 COMPONENTS

.1 Toilet tissue dispenser (TTD): Multi-roll toilet tissue dispenser, reserve roll, 152 mm / 6” long x 305 mm / 12” high x 152 mm / 6" deep, surface mounted, stainless steel, capacity of 500 sheet double ply roll.
.1 Acceptable Product: ‘Code 150’ by Frost.

.2 Surface-mounted combination towel dispenser / waste receptacle (CTDWR): Type 304 stainless steel, surface mounted towel dispenser and waste receptacle, will dispense C-fold or multifold paper towels without adjustment, rounded towel tray has hemmed opening to dispense paper towels without tearing, removable waste receptacle for servicing, c/w towel accessory to allow paper towels to dispense one at time without bulging or sagging, or falling through the towel tray opening and towel guide to prevent papers from falling forward and out when door is opened for servicing, approximately 710 mm / 28” high x 360 mm / 14-1/4" wide x 110 mm / 4-1/4"” deep:
.1 Acceptable Product: ’B-3699’ by Bobrick.

.3 Soap dispenser (SD): Surface mounted horizontal soap dispenser, 20 gauge stainless steel No 4 finish complete with push bar, sight window, refillable from top filler cap, 203 mm / 8" wide, 120 mm / 4-3/4" high x 97 mm / 3-7/8" deep:
.1 Acceptable Product: 'Code 710A' by Frost.

.4 Sanitary napkin disposal bin (SND): Surface mounted, 203 mm / 8" wide x 336- mm / 13-1/4" high x 114 mm / 4-1/2" deep, stainless steel, type 304 No.4 brushed finish:
.1 Acceptable Product: 'Code 622' by Frost.

.5 Hand / Hair dryer (HD): Listed under re-examination service of ULC and CSA approved, hands free, surface mounted, brushed steel finished, 194 mm / 7.6" wide x 308 mm / 12.3" high x 100 mm / 3.9" deep.
.1 Acceptable Product:
.1 'Code 1199' by Frost.

.6 Shower Curtains: 100% polyvinyl chloride (PVC), 3 mm /1/8" thick, mildew proof and cold crack treated to -15°C, ring grommets reinforced with concealed aluminum, white in colour, c/w stainless steel hooks and hold back hook and chain:
.1 Acceptable Products:
.1 Shower curtain (SC): 1220 mm x 1980 mm / 48" x 78", 'Code 1144-502' by Frost.
.2 Curtain Hooks: Quantity to suit, 'Code 1144-501L' by Frost.

.7 Shower rods (SR): 32 mm / 1-1/4" diameter, 18 ga., stainless steel c/w concealed fasteners, heavy duty, length as required.
.1 Acceptable Product: "Code 1145-S" by Frost.

.8 Grab bars: 38 mm / 1-1/2" diameter, 18 ga. wall tubing of stainless steel, 83 mm / 3-1/4" diameter wall flanges, exposed concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grip. Grab bar material and anchorage to withstand downward pull of 2.2 kN.
.1 Acceptable Product: 'Code 1000 series', by Frost.
.1 GRB1: 610 mm / 24" long straight bar.
.1 Acceptable Product: 'Code 1001-24' by Frost.
.2 GRB2: L-shaped, 760 mm x 760 mm / 30" x 30" long.
.1 Acceptable Product: 'Code 1003-30" x 30"' by Frost.

.9 Robe hook (RH): Stainless steel, double robe hook.
.1 Acceptable Product: 'Code 1139S' by Frost.

.10 Fixed Mirror (MIR): One-piece stainless steel channel frame with mitered corners, bright anneal finish, vandal resistant, concealed fastening, 4 mm / 5/32" glass with shock resistant full galvanized back panel, size as indicated.
.1 Acceptable Product:
.1 610 mm x 915 mm / 24" x 36", 'Code 941-2436' by Frost.

.11 Mop and Broom Holder with Shelf: Formed channel, 20 ga., Type 304 No. 4 brushed finish, three (3) mop holders, two (2) pail hooks and 8 mm / 5/16" diameter chrome plated rod, size as indicated.
.1 Acceptable Product: (MBH): 914 mm / 36" long x 203 mm / 8" deep. 'Code 1115' by Frost.

2.4 FABRICATION

.1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.

.2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.

.3 Brake form sheet metal work with 1.5 mm / 1/16” radius bends.

.4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

.5 Back paint components where contact is made with building finishes to prevent electrolysis.

.6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.

.7 Shop-assemble components and package complete with anchors and fittings.

.8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.

.9 Provide steel anchor plates and components for installation on studding and building framing.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for Product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install and secure accessories rigidly in place as follows:
- .1 Hollow masonry units, existing plaster or drywall: Use toggle bolts drilled into cell or wall cavity.
- .2 Solid masonry, marble, stone or concrete: Use bolt with lead expansion sleeve set into drilled hole.
- .3 Toilet and shower compartments: Use male to female through bolts.

.2 Install grab bars on built-in anchors provided by bar manufacturer.

.3 Use concealed tamper proof screws/bolts for fasteners.

.4 Fill units with necessary supplies shortly before final acceptance of building.

.5 Install mirrors in accordance with manufacturer’s instructions.

3.3 ADJUSTING

.1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
  .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by toilet and bathroom accessories installation.

3.6 SCHEDULE

.1 Locate accessories where indicated on Drawings. Exact locations determined by Consultant.

.2 Dispensing height of accessories in washrooms with barrier-free facilities not to exceed 1.2 m / 48” above floor.

.3 Provide units as shown on Drawings and in the following minimum quantities.
  .1 Toilet Tissue Dispensers: One per water closet.
  .2 Towel Dispenser and Disposal: One per washroom.
  .3 Soap Dispensers: One per washroom.
  .4 Sanitary Napkin Disposal Bin: One per toilet.
  .5 Unit Mirrors: One per sink.
  .6 Shower Rod and Curtain: One per shower.
  .7 Surface-mounted automatic hand dryer: One per washroom.
  .8 Mop and Broom Holders: One per janitor room.
  .9 Robe Hooks: All office doors and where indicated on Drawings.
  .10 Other accessories where indicated and on Drawings.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Aluminum Association (AA):
- .1 AA DAF 45, Designation System for Aluminum Finishes.

.2 ASTM International:
- .1 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.3 CSA International:
- .1 CAN/CSA-B651.2-07(R2012), Accessible Design for the Built Environment.
- .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Provide manufacturer's printed Product literature and data sheets and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame.

.4 Samples:
- .1 Submit samples if requested by Consultant.
- .2 Samples will be returned for inclusion into work.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for miscellaneous specialties for incorporation into manual specified in Section 01780 - Closeout Submittals.

1.4 MAINTENANCE

.1 Tools:
- .1 Provide special tools required for assembly, disassembly or removal for miscellaneous specialties.
- .2 Deliver special tools to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect miscellaneous specialties from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Sheet steel: To ASTM A653/A653M with ZF001 designation zinc coating.

.2 Stainless steel sheet metal: To ASTM A167, Type 304, with satin finish.

.3 Fasteners:
- .1 Concealed screws and bolts hot dip galvanized unless otherwise indicated.
- .2 Exposed fasteners to match face of unit, unless otherwise indicated.
- .3 Expansion shields fibre, lead or rubber as recommended by miscellaneous manufacturer for component and its intended use.

2.2 PREMANUFACTURED CHANGE ROOM BENCH

.1 Premanufactured Change Room Bench:
- .1 Seat: Two pieces, solid Birch hardwood, 38 mm / 1-1/2” x 140 mm / 5-1/2” x length as indicated on Drawings, edges rounded and sanded, finished in clear lacquer (one coat sealer and one top coat).
- .2 Metal frame supports: 9.5 mm / 3/8” x 100 mm / 4” hot-rolled, steel flat welded into rectangular shape 250 mm / 10” wide x 387 mm / 15-1/4” high with holes predrilled for attachment to seat and floor. Powder coat finish as later selected by Consultant from manufacturer’s standard colour range.
- .3 Anchor benches to floor where indicated with stainless steel bolts.
- .4 Acceptable Product: ’Fixed (Stationary) Bench’ by AccessSMT, or approved alternate.

2.3 FABRICATION

.1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.

.2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.

.3 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

.4 Back paint components where contact is made with building finishes to prevent electrolysis.

.5 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.

.6 Shop-assemble components and package complete with anchors and fittings.

.7 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.

.8 Provide steel anchor plates and components for installation on studding and building framing.

.9 Manufacturer's or brand names on face of units not acceptable.

PART 3- EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrates and surfaces to receive miscellaneous specialties previously installed under other Sections or Contracts are acceptable for Product installation in accordance with manufacturer's instructions prior to miscellaneous specialties installation.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install and secure miscellaneous specialties rigidly in place, level and true where required in accordance with manufacturer’s instructions.

.2 Use concealed fasteners where possible.

3.3 PREMANUFACTURED CHANGE ROOM BENCH

.1 Premanufactured Change Room Bench:
- .1 Install premanufactured change room benches where indicated on Drawings in accordance with manufacturer’s written instructions.
- .2 Anchor benches to floor with stainless steel bolts.

3.4 ADJUSTING

.1 Adjust miscellaneous specialty components and systems for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.5 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.
- .1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by miscellaneous specialties installation.

.3 Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.7 DEMONSTRATION

.1 Demonstrate and train owner's maintenance personnel on procedures and schedules related to operation, troubleshooting, servicing, inspection, and maintenance.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Includes the supply, installation, commissioning and testing of positive displacement metering pumps, required controls for feeding chemicals to the process.

.2 Includes the supply and commissioning of chemical feed system appurtenances.

.3 Pump performance and quantities scheduled.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the references indicated shall be the latest standard adopted by the regulatory agency as of the tender date.

- .1 Hydraulic Institute Standards (HI).
- .2 National Electrical Manufacturers Association (NEMA).
- .3 Ontario Electrical Safety Code (OESC).
- .4 Canadian Standards Association (CSA):
  - .1 CSA Z432 – Safeguarding of Machinery.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15 requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Provide spare parts in accordance with procedures in Division 1.

.2 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment.

.3 For Peristaltic pumps, provide the following spare parts:

- .1 One (1) pump head and rotor assembly.
- .2 Three (3) 15 m rolls of appropriate diameter tube for each pump set.
- .3 Two (2) extra tube rollers per pump set.
- .4 Any specialty tools required for teardown.

1.6 QUALITY ASSURANCE

.1 Chemical metering pump manufacturer's factory trained representative to provide a written certification on OEM letterhead stating that the pump(s) is installed to their standards.

.2 Pump manufacturer's plant to be ISO 9001 certified.

.3 Pumps to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to the Ontario Electrical Safety Code.

.4 All guarding to be to CSA 7432 and to OSHA standards.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Chemicals to be handled by specified pumps are as follows:

.1 Ferric Sulfate Solution:

DESCRIPTION	ALUM
Chemical Formula	$FeCl_3$
Concentration	13.3%
Density @ 20°C	1.4 kg/L
Temperature	18-25°C
pH	<2

.2 The chemical feed system is to come as a pre-mounted, pre-piped, pre-wired, and pressure tested system. The components are as outlined on the drawings and detailed herein.

2.2 PERISTALTIC PUMP

.1 Pumps to be positive displacement with a single spring or non-spring loaded pump head and integral variable speed drives.

.2 Pumps to be capable of dry self-prime to 15 m total suction lift and capable of running dry indefinitely without damage to pump or tube.

.3 Flow to be in the direction of the rotor rotation which can be reversed and shall be proportional to the rotor speed.

.4 Minimum pump turndown to be 2500:1 with a minimum pumping accuracy of +1% over entire pumping range.

.5 Pump Head:

.1 Pump head to consist of a fixed track, hinged guard door and roller rotor assembly. Pump tubing to be in contact with the inside diameter of the track through an angle of 180 degrees. At all times, one roller must be fully engaged with the tubing providing complete compression and preventing backflow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate tubing and shall not require adjustment.

.2 Pump head guard to be transparent for the purpose of viewing direction of rotation. When closed, the pump head guard shall seal against the pump track for leak containment and controlled waste through the pump head waste port in the event of a tube failure.

.6 Rotor Assembly:

.1 Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance via a minimum of two roller arms, each fitted with a 316 stainless steel compressing roller, minimum 18 mm in diameter, for occlusion of the tube twice per revolution.

.2 Provide non-compressing guide rollers.

.3 Rotor to be complete with central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch to automatically re-engage rotor to gearbox upon one complete revolution.

.4 To prevent slip, rotor assembly to be axially secured to the dogged output shaft of the gearmotor via a slotted collet and central retaining screw.

.7 Tubing:

.1 Pump to be equipped with a self-locating tube element with moulded quick-release fittings. Tube element shall be in contact with inside diameter of the track (housing) through an angle of not less than 180 degrees and held in place on suction and discharge by element fittings. Tubing shall be replaceable without the use of tools and with disassembly of the pump head.

.2 Tube material and size to be selected by the pump manufacturer to suit the chemical being pumped and maximize tube service life.

.3 Supply one (1) tube element of the specified size per pump.

.4 Supply two (2) one metre long flexible EPDM hoses for connection of pump to suction and discharge process lines. Flexible hose to have a PVDF female quick-release fitting for connection to the Loadsure Element and male quick-release fitting for connection to NPT adaptor with built-in shut-off valve for ease of maintenance and connection to process lines.

.5 Supply two (2) quick-release to 12 mm NPT adaptors.

.8 Pump Drive:

.1 Pumps to be designed for 24 hour operation at an ambient temperature. Range of 5°C to 40°C with humidity between 10 and 100% RH.

.2 Electrical requirements as scheduled.

.3 Brushless DC motor with 100% duty cycle, integral gearbox and drive, and tachometer feedback. Circuitry to be complete with temperature and load compensation and protection.

.4 Enclosure to be NEMA 4X unless otherwise specified. Housing to be polyester coated cast aluminum. Unpainted housings will not be accepted.

.5 Pumps to provide the following interface/functionality:
- .1 Backlit graphical LCD to display pump speed, running status, flow rate and programming instructions.
- .2 Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
- .3 Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
- .4 Programmable “Auto Start” feature to resume pump status in the event of power outage interruption.
- .5 Programmable “Keypad Lock” to allow operator lockout of all keys except emergency start/stop.
- .6 Programmable “Maximum Speed” to allow operator to set the maximum speed of the pump.
- .7 Connections for all required external control inputs and outputs.

.9 Controls:
- .1 Supply auto control features to meet the following minimum functionality requirements for use with the SCADA system. All control features must be located internally to the pump. Pumps not meeting this minimum functionality or that require additional external control boxes are not acceptable.
- .2 Remote Control Inputs:
  - .1 Speed Control:
    - .1 Analog 4-20 mA with input signal trimmable and speed scalable over any part of the drive speed range.
    - .2 Provisions for alternative remote accessory potentiometer (if supplied by others).
  - .2 Stop/Start Control: Via dry contact – configurable command sense allowing open to equal run or open to equal stopped.
  - .3 Forward/Reverse Control: via dry contact.
  - .4 Auto/Man Mode Control: via dry contact.
  - .5 Leak Detector Run/Stop Control: via dry contact.
- .3 Status Outputs:
  - .1 Form C dry contact relays each rated for 120 VAC with a minimum load of 120 VA to indicate the following:
    - .1 Running/Stopped status.
    - .2 Forward/Reverse status.
    - .3 Auto/Manual status.
    - .4 General Alarm status.
    - .5 Leak Detected status.
  - .2 Speed Output: Analogue 4-20 mA.
- .4 Termination: supply screw down terminals suitable for a range of 18 AWG to 12 AWG, field wired and accessible through glanded cable entry points on the pump.

.10 Pump Performance:
- .1 Operating Point A: 60 L/hr @ 15 m TDH

.11 Specified Product: ProMinent DULCOFLEX DFYa Series

.12 Alternate Manufacturers:
- .1 Watson Marlow
- .2 Approved equal.

2.3 APPURTENANCES

.1 Calibration Columns:

.1 Provide where indicated on drawings.

.2 Rugged, transparent, Schedule 40 PVC construction.

.3 Column to be in mL and standard 10 mL divisions.

.4 Column to be sealed and vented.

.5 Shop fabricated products are not acceptable.

.6 Size according to the following:

CALIBRATION COLUMN SIZE	PUMP SIZE
(mL)	(4hr.)
500	60
1000	125
2000	250
4000	450

.7 Specified Product: Primary Fluid Systems Accudraw.

.8 Alternate Product:

.1 Griffco Valve.

.2 Milton Roy.

.2 Pulsation Dampers:

.1 Provide where indicated on drawings.

.2 Hydro pneumatic bladder type, oriented in vertical position.

.3 Pulsation dampener to be constructed with two chambers, a fluid chamber and pressure chamber separated by an elastomeric bladder.

.4 Design the damper for a minimum 4:1 burst pressure to maximize pressure ratio.

.5 Design the damper to handle the pump's maximum stroke or revolution volume.

.6 Pulsation damper to be equipped with a gas fill valve and pressure gauge.

.7 Specified Product: Primary Fluid Systems Accupulse.

.8 Alternate Manufacturers:

.1 Griffco Valve.

.2 Milton Roy.

2.4 SPILL CONTROL PALLETS

.1 One unit is required for the ferric chloride fill station.

.2 Designed to hold 1-55 gallon drums (1-210 L) with a minimum sump capacity of 66 gallons (250 L) load capacity of 2268 kg.

.3 Pallet dimension not to exceed 650 mm square. Contractor to confirm dimensions prior to ordering. Refer to drawings for dimensional requirements.

.4 Construction materials compatible with ferric chloride.

2.5 PIPING/TUBING

.1 Refer to Section 15349 – Process Piping.

2.6 VALVES

.1 Refer to Section 15100 – Process Valves and Actuators.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install chemical feed pump and appurtenances in accordance with manufacturer's written instructions.

.2 Provide equipment identification tags consistent with P&ID drawings and Section 15020.

.3 Provide minimum 300 mm length of flexible tubing complete with camlock couplings at the inlet and outlet of each chemical feed pump.

3.2 PIPING

.1 All tubing to be routed in secondary containment piping unless indicated otherwise.

.2 Piping to all tanks to be arranged for convenient dismantling.

.3 Arrange piping to feed pumps so that pumps can be conveniently dismantled.

3.3 SUPPLEMENTS

.1 Chemical Feed Pump Schedule included at the end of this section.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section pertains to the supply, installation and testing of chemical storage tanks.

.2 Quantity, location and tank configuration as indicated herein and on drawings.

.3 The chemicals requiring storage include:
.1 Ferric Chloride Solution:

Description	Ferric Chloride
Chemical Formula	$FeCl_3$
Concentration	13.3%
Density @ 20°C	1.4 kg/L
Temperature	18-25°C
pH	<2

.4 Tank general parameters:

Tank Tag	Nominal Diameter (m)	Nominal Height (m)	Volume L (gal)
TH-7101	7’-1” (2.16)	9’-11 “ (3.02)	12,279 (2,701)
TH-7102	7’-1” (2.16)	9’-11 “ (3.02)	12,279 (2,701)

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
.1 American Society of Mechanical Engineers (ASME):
.1 B-16.5 – Pipe Flanges and Flanged Fittings.
.2 D638 – Tensile Properties of Plastics.
.2 American Society of Testing and Materials (ASTM):
.1 D638 – Tensile Properties of Plastics.
.2 D883 – Standard Definitions of Terms Relating to Plastics.
.3 D1505 – Density of Plastics by the Density-Gradient Technique.
.4 D1525 – Test Method for Vicat Softening Temperature of Plastics.
.5 D1693 – ESCR Specification Thickness 0.125” F50-10% Igepal.
.6 F412 – Standard Terminology Relating to Plastic Piping Systems.
.7 D-1998 – Standard Specification for Polyethylene Upright Storage Tanks.
.3 National Sanitation Foundation (NSF):
.1 NSF 61 – Drinking Water System Components.
.4 Association of Rotational Molders (ARM):
.1 Low Temperature Impact Test, Falling Dart Test Procedure.
.5 Ontario Building Code (OBC).
.6 Occupational Safety and Health Administration (OSHA) Standards.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15 requirements.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all:

- .1 Product Data:
  - .1 Tank fabrication details.
  - .2 Tank layout, overall dimensions, locations and sizes of openings, restraints, supports, fittings and accessories.
  - .3 Electrical heat tracing and insulation information (if utilized).
- .2 Operation and Maintenance Data:
  - .1 Operation and Maintenance Manuals – refer to Division 1, Section 01730 for requirements.
  - .2 Installation requirements and/or recommendations.
- .3 Quality Control Data:
  - .1 Manufacturer's certified testing results, including:
    - .1 Resin gel testing.
    - .2 Wall thickness verification.
    - .3 Visual inspection.
    - .4 Impact test.
    - .5 24-hour hydrostatic test.
  - .2 Manufacturer's certificate confirming proper installation.
- .4 Manufacturer's qualifications.
- .5 Calculations stamped by an Ontario licenced professional engineer confirming the appropriate wall thickness for each application.
- .6 Sample wall section.
- .7 Factory test summary report

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment and components.

.2 Provide one (1) manway gasket for each supplied tank.

1.6 QUALITY ASSURANCE

.1 Tank manufacturer to have a minimum of ten (10) years of tank design and fabrication of polyethylene tank experience.

.2 Tank manufacturer to provide a written certification stating that the tank(s) have been installed to their satisfaction.

.3 Tanks to be manufactured from virgin materials.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

.2 Perform a field 24-hour hydrostatic test prior to commissioning.

.3 Factory testing to include the following:
- .1 Material Testing:
  - .1 Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.
  - .2 Degree of cross-linking. Use Method C of ASTM D 1998 – Section 11.4 to determine the orthoxylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.
- .2 Tank Testing:
  - .1 Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, to be per ASTM D 1998. Fitting placement tolerance to be + 12 mm in vertical and + 1 degree radial.
  - .2 Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing and cracking.
  - .3 Hydrostatic Test: following fabrication, the bottom tanks, including inlet and outlet fittings shall be hydraulically tested with water by filling to the top sidewall for a minimum of one (1) hour and inspected for leaks. Following successful testing, tank to be emptied and cleaned prior to shipment.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide tanks as scheduled, detailed on drawings and described herein.

.2 Coordinate with Contractor's Seismic Restraint Designer to provide attachments, reinforcement, anchor bolts or hold-down devices to meet all requirements of Division 1 and Section 15241. A cable restraint system shall be provided with each tank. Anchoring of system shall be limited to the floor unless specifically permitted by the Consultant.

.3 Ultrasonic or radar level indication to be by Division 17.

2.2 VERTICAL POLYETHYLENE STORAGE TANKS

.1 All polyethylene storage tanks to be designed and fabricated in accordance with ASTM D 1998. Wall thickness for a given hoop stress to be calculated in accordance with this standard. Tanks to be designed using a hoop stress no greater than 600 psi. In no case shall the tank thickness be less than design requirements per ASTM D 1998.

.2 Tanks shall be rotationally molded, double wall, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section and vertical with flat bottoms. Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories. The assembly consists of one cylindrical, closed top inner primary tank and one cylindrical, open top containment outer tank. The assembly shall be designed to prevent rainwater and debris from entering the containment tank. Tanks to be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

.3 High density cross-linked polyethylene resin used in the tank manufacture to contain ultraviolet stabilizer as recommended by resin manufacturer. Where black tanks are indicated, the resin shall have a carbon black compounded into it. Tank material shall be rotationally molded and be a resin that is commercially available at the time of tank manufacture.

.4 Tank fittings to be in accordance with schedule. Threaded fittings to use American Standard Pipe Threads. If tanks are insulated, fittings to be installed at the factory prior to application of the insulation.

.5 Integrally molded flanged outlet fittings: these outlets must be an integral part of the tank, molded from the same material as the tank and provide complete drainage of liquid through the sidewall of the tank. Metal and allow inserts shall not be used.

.6 Bolted flange fittings to be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads are to be colour coded for visual ease of identifying the bolt material by on-site operators. All materials to be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets to be supplied.

.7 Down pipes and fill pipes: down pipes and fill pipes to be supported at 6’ maximum intervals. Down pipes and fill pipes to be PVC or material compatible with the chemical stored.

.8 All fittings on the 1/3 lower sidewall of tanks with capacities ≥ 3500 L to be equipped with an expansion joint. Expansion joint to have a minimum of three convulsions, stainless steel limit cables and FRP composite flanges. Galvanized parts will not be accepted.

.9 Expansion joint to meet the following minimum performance requirements:
- .1 Axial Compression ≥ 17 mm
- .2 Axial Extension ≥ 17 mm
- .3 Lateral Deflection ≥ 12.9mm
- .4 Angular Deflection ≥ 14°
- .5 Torsional Rotation ≥ 4°.

.10 Tank Accessories: provide where scheduled:
- .1 Visual Level Indication (Reverse Float):
  - .1 Level indicator to be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear UV resistant PVC site tube and necessary pipe supports. Level indicator to act inversely to tank contents and shall not allow entrance of tank contents into site tube at any time. Indicator to be neon orange for visual ease for on-site operations.
  - .2 Ladder:
    - .1 Fiberglass access ladders shall be provided with the polyethylene chemical storage tanks at for access to the top hatch. Safety cages to be added to ladders as required per OSHA.

.2 Ladders must be secured to tank and secured to concrete to allow for tank expansion/contraction due to temperature and loading changes. Use proper chemical resistant materials when anchoring to tank dome or sidewall.

.3 All ladders to be designed to meet applicable OSHA standards.

.3 Heat Tracing:

.1 Heat tracing system for temperature maintenance to be designed to maintain a desired product temperature, not to exceed 37°C. Each system shall include tank heating pads and a temperature controller. The quantity and type of heat tracing is determined by the size of the tank, the desired temperature maintenance and environmental conditions. Systems shall be available in 30, 60 or 100 degrees F. Tanks are supplied with the heating panels and a controller installed by the tank manufacturer. Power supply to be the only field installation required:

.1 Pads to operate on 120 VAC single phase with a maximum power density of 0.08 watts/cm2 (0.5 watts/sq.in.).

.2 Silicone pad heaters must comply fully with the National Electric Code.

.3 Temperature controller to be supplied with two electronic thermostats switching the heating system via one solid state relay. Primary thermostat to control desired product temperature and secondary thermostat to provide over temperature protection at 65°C.

.4 Insulation:

.1 Tanks requiring insulation will be factory applied by the tank manufacturer unless otherwise indicated.

.2 Insulation used to be polyurethane foam with a density of 40 kg/m3 (2.5 lb./ft3) with a minimum “R” value of 2.48 cm (6.3”). Foam to be applied with a nominal thickness of 150 mm to the external tank surfaces except the tank bottom.

.3 Upon completion of application and curing of the insulation, two full coverage coats of latex mastic coating to be applied to the surface of the insulation in such a manner as to seal the insulation from the outside environment.

.11 Specified Product: Poly Processing company IMFO upright high density cross-lined polyethylene tanks.

.12 Alternate Manufacturers:

.1 Fabco Plastics.

.2 ACO Container Systems Ltd.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Tanks to be installed in accordance with the drawings and the manufacturer’s written instructions.

3.2 SUPPLEMENTS

.1 Tank Identification: identify each tank with the fabricator’s name, capacity in litres, design maximum temperature, deign pressure, chemical service, including concentration, specify gravity, vessel tag number, vessel name, resin type (if applicable) and date of manufacture. Refer to the requirements of Section 15020.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the supply, installation, testing and commissioning of the end suction centrifugal type pumps c/w appurtenances as specified herein.

.2 Refer to the Pump Schedule for pump quantities and design operating parameters.

.3 Refer also to the drawings for additional installation requirements.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 ASTM International (ASTM):
  - .1 A48: Standard Specification for Gray Iron Castings.
  - .2 A276: Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
  - .3 A436: Standard Specification for Austenitic Gray Iron Castings.
  - .4 A532: Standard Specification for Gray Iron Castings.
  - .5 A743: Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Nickel-Base Corrosion Resistant, for General Application.
- .2 American Iron and Steel Institute (AISI):
  - .1 Type 416 Stainless Steel.
  - .2 Type 1045 Carbon Steel.
- .3 American Bearing Manufacturers Association (ABMA).
- .4 Hydraulic Institute Standards (HIS):
  - .1 HIS 11.6: Standard for Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Tests.
  - .2 HIS 14.6: Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
  - .3 HIS 40.6: Standard for Rotodynamic Pump Efficiency Testing.
- .5 Institute of Electrical and Electronics Engineers (IEEE):
  - .1 IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators.
- .6 National Electrical Manufacturer's Association (NEMA):
  - .1 NEMA MG 1: Motors and Generators.
- .7 Ontario Building Code (OBC).
- .8 Ontario Electric Safety Code (OESC).
- .9 Canadian Standards Association (CSA).
  - .1 International Organization for Standardization (ISO):ISO 10816-3: Mechanical Vibration-Evaluation of Machine Vibration by Measurements on Non-Rotating Parts; Part 3, Industrial machines with nominal power above 15 kw and nominal speeds between 120 r/min and 15000 r/min when measured in situ.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all.
  .1 Product Data:
    .1 Relevant information to confirm that the specifications have been met.
    .2 Identify construction materials for all pump components.
    .3 Relevant data illustrating full range of operation (on pump curves) including speed curves, if applicable.
    .4 Electrical motor information and specification.
    .5 Loading imparted to the pump base.
    .6 Permissible range of vibration.
    .7 Factory finishing details.
    .8 Noise characteristics of equipment.
    .9 Anchoring requirements.
  .2 Operation and Maintenance Data:
    .1 Operation and Maintenance Manuals. Refer to Division 1 for requirements.
    .2 Manufacturer's installation requirements.
  .3 Quality Control Data:
    .1 Manufacturer's certified testing results.
    .2 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed pumps.

.2 For each pump model and size, provide the following spare parts:
  .1 One complete set bearings.
  .2 One complete set gaskets and O-ring seals.
  .3 One complete set of shaft sleeves.
  .4 One complete set keys, dowels, pins, etc.
  .5 One complete mechanical seal.

.3 Provide any specialty tools required to maintain the pump.

1.6 QUALITY ASSURANCE

.1 Pump manufacturer to provide a written certification stating that the pump(s) has(have) been installed to their standards.

.2 Pumps and associated equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to the Electrical Safety Code.

.3 Pump manufacturer to have proven established network of service centres in Eastern Ontario. Service centres to be specialized in manufacturer's line of pumps and stock spare parts. Each service centre to be capable of removing, transporting and repairing the pump in addition to supplying a rental or temporary unit.

.4 Pumps to be factory tested to HI 14.6 Standard Grade 3B.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

.2 All components including the pumps, motors, and controls will be non witness tested at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards 11.6, 14.6 and 40.6 at the specified head, capacity, rated speed and horsepower. Provide a 7 point performance test against a grade 3B test parameter. Factory operational test shall duplicate actual anticipated performance.

.3 Commission the pump to attain the widest flow range practical.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 All PART 2 – PRODUCTS equipment will require training.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Frame mounted horizontal end suction pump designed for the pumping of sludge typical to municipal wastewater treatment plants. Pump performance as indicated herein.

.2 Single passage, clog-free pump, utilizing a screw-centrifugal impeller. The overall pump design shall combine high efficiency, low required Net Positive Suction Head (NPSH), a large solid passage, the ability to handle fibrous material without plugging and handle high solids concentrations efficiently. The dry pit design shall be suitable for horizontal mounting.

.3 The hydraulic design of the impeller shall combine the action of a positive displacement screw with the action of a single vane centrifugal impeller to provide a single, non-bifurcated flowstream with only gradual changes in flow direction.

.4 The suction flange or impeller shall contain a machined spiral groove on the rear face to channel trapped fiber into the casing.

.5 Impeller and suction piece shall be conical, to enable axial adjustment of the impeller to cause the clearance between the impeller and suction piece to change uniformly along the entire length of the impeller.

.6 All guarding to be to CSA Z432 and to OSHA standards.

.7 Coordinate with Contractor's designer for seismic support systems and provide all necessary attachments and reinforcing of equipment.

2.2 PERFORMANCE REQUIREMENTS

.1 The pumps shall be designed for continuous operation and will be operated continuously under normal service. To minimize operation power costs, the hydraulic efficiencies listed for each pump are the minimum acceptable and are to be guaranteed by the manufacturer.

.2 Minimum non-compressible solids passage: In excess of 60mm diameter.

.3 Pump Performance as tabled below for Pump P-715:

	Flow (l/s)	TDH (m)	Total Solids (%)	Rated Pump Speed (RPM)	Pump Efficiency	Shutoff Head (m)	NPSHr (m)
Design Condition	35.5	8.4	0.5 – 5.0	1265	49.41%	16.6	1.4

2.3 PUMP FABRICATION

.1 Pump Casing:
- .1 Pump volute, backplate, suction cone, and impeller hub shall be made of ASTM A48 Class 30 close grained cast iron.
- .2 Provide tapped and plugged case vent and drain connections.
- .3 Suction Diameter: 150 mm.
- .4 Discharge Diameter: 150 mm.

.2 Impeller:
- .1 Screw type ASTM A532-Class III type A high chrome iron impeller c/w a regulable liner.

.3 Suction Liner:
- .1 Fabricated of ASTM A532-Class III Type A high chrome iron with a minimum 450 Brinell hardness.
- .2 The suction piece shall be externally adjustable to compensate for wear by means of three stainless steel regulating screws so that the necessary running clearances between the liner and impeller can be maintained for optimum hydraulic efficiency

.4 Bearing Housing
- .1 The bearing housing shall be of cast iron, ASTM A 48CL-30 and shall be of the back pull out design so that the bearing housing and impeller can be removed without disconnecting the casing from the suction and discharge piping

.2 The shaft shall be AISI 1045 steel and provided with suitable bearings capable of taking all mechanical and hydraulic loads. Bearings shall provide a minimum ABMA B10 bearing life of 50,000 hours without credit for hydraulic balancing by pump-out vanes, grooves, or wear rings

.3 The stuffing box shall be isolated from contaminants in the pumped media by a labyrinth fit between the impeller backside and the volute backplate, as well as by pump-out grooves machined into the impeller back shroud and into the volute backplate, to prevent debris from reaching the shaft seal.

.5 Shaft Sealing

.1 Tandem Mechanical Seal Arrangement Requiring No External Flush. Shaft sealing shall be by independently mounted, tandem mechanical seals contained in an oil chamber that is formed as an intrinsic part of the bearing frame and allows the seals to be completely submerged in and lubricated by the oil bath.

.2 The mechanical seal nearest the bearing shall utilize carbon/ceramic faces and shall isolate the seal cooling oil from the bearing frame. When mounted in a vertical configuration, this shall allow the pump to operate continuously submerged within 4" of the upper bearing cap.

.3 The mechanical seal nearest the impeller shall be a stainless steel or rubber bellows-type construction firmly attached to the rotating face and clamped to the shaft, to prevent contaminants from contacting the stainless-steel spring which loads the seal face. The seal faces shall be a solid tungsten-carbide rotating face running against a solid silicon-carbide stationary face

.4 The mechanical seal nearest the impeller shall be contained in a seal chamber formed by the impeller flange and a recess cast into the motor frame. Provide a flush port so that an external water flush can be supplied directly into the seal chamber.

.5 The mechanical seal nearest the impeller shall be isolated from contaminants in the pumped media by a labyrinth-fit between the backside of the impeller and the backplate, as well as by pump-out grooves cast into the impeller back shroud and into the backplate, to minimize debris reaching the shaft seal

.6 Suction & Discharge Flanges

.1 Suction and discharge flanges shall be drilled to meet ANSI 125 lb. bolting.

.7 Rotating Assembly

.1 Entire rotating assembly, which includes bearings, shaft, seal and impeller, shall be removed as a unit without disturbing pump casing or piping. Means shall be provided for external adjustment of the impeller to the wear well.

.8 Unit Base:

.1 Horizontal mounting with direct-coupled motor to pump. The pump manufacturer shall provide a common pump and motor base constructed of a minimum 9.5 mm (3/8")thick fabricated steel, suitably reinforced to support the full weight of pump and motor.

.2 Base shall incorporate openings for access to all internal cavities to permit complete grouting of unit base after installation.

.3 Unit to be equipped with lifting lugs.

2.4 COATINGS

.1 Pump to be coated with Manufacturer standard finishing with wear resistant non-lift primer and acrylic alkyd wear resistant enamel.

.2 Any surface preparation and field painting to be done in accordance with Section 15020 and Division 9.

2.5 DRIVE UNIT AND TRANSMISSION

.1 TEFC inverter duty premium efficiency motor with suitable electrical ratings to suit classifications shown on drawings.

.2 Motor size 7.5 kW (10 HP), 575 V/3ph/60 hz.

.3 Motor to meet the requirements of Section 15053.

.4 Variable speed drives to be provided by Division 16.

.5 An approved steel coupling guard painted safety yellow shall be furnished and installed to safety enclose the coupling.

.6 The pump supplier shall furnish and install a flexible spacer coupling between the motor shaft and pump shaft.

2.6 CONTROLS

.1 Refer to the Contract Drawings and Process Control Narrative for the proposed control methodology.

.2 The pumps will be controlled through a Programmable Logic Controller (PLC). The PLC will be provided as part of Division 16.

.3 Pump starters will be provided as part of Division 16.

2.7 SPECIFIED PRODUCT

.1 Vaughan Triton Series as provided by John Brooks Company Ltd.

2.8 ALTERNATE MANUFACTURERS

.1 Wemco.

.2 Hayward Gordon.

.3 Weir.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Pumps complete with all accessories are to be installed in accordance with manufacturer’s written instructions.

.2 Properly balance, align and mount the pump assembly. Install the pump assembly so that the vibrations do not exceed the limits of ISO 10816 and that of the factory acceptance test.

3.2 FIELD QUALITY CONTROL

.1 General:
- .1 Pump supplier shall complete Manufacturer's Certificate of Proper Installation upon satisfactory installation of the equipment.
- .2 Refer to Division 1 for additional testing requirements.
- .3 Pump supplier shall calibrate instruments, sensors, and meters supplied for testing.

.2 Functional Testing:
- .1 Functional testing shall be conducted after the installation of the pump(s) and all related appurtenances are complete, to verify proper operation of all the equipment and controls under wet-run conditions.
- .2 The Equipment Supplier, in coordination with the Contractor, will provide all temporary measures required for the functional tests. Written test procedures shall be submitted to the Consultant for approval a minimum of 60 days prior to testing.
- .3 The functional tests shall determine the characteristics of each unit and demonstrate the units:
  - .1 Have not been damaged by transportation or installation.
  - .2 Have been properly installed.
  - .3 Have no mechanical defects.
  - .4 Are in proper alignment.
  - .5 Have been properly connected.
  - .6 Are free of overheating of any parts.
  - .7 Are free of objectionable vibration and noise as specified.
  - .8 Are free of overloading of any parts.
  - .9 Are properly lubricated.
  - .10 Respond properly to all start-up and shutdown sequences.

.3 Vibration Test: Vibration testing shall be conducted during field functional testing in accordance with Hydraulic Institute standards. The Equipment Supplier shall verify operations are within tolerances and the vibration signature recorded over the frequency domain.
- .1 Provide vibration signature test data for each pump and drive assembly for comparison to factory testing data.

.4 Test each unit to ensure pump delivers rated capacity in Consultant's presence.

.5 Test electrical loading to ensure pump operates efficiently without electrical overload.

.6 Noise Test: Perform noise testing in the field with equipment installed and operating at peak capacity to verify noise produced by the equipment. Noise from equipment to be less than or equal to those listed by the manufacturer.

3.3 IDENTIFICATION

.1 Pumps are to be tagged consistent with the Contract Drawings and the requirements of Section 15020.

3.4 SUPPLEMENTS

.1 Pump Schedule included at the end of this section.

END OF SECTION

BRIGHTON WWT SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO
JLR No.: 32296-001

PROCESS CENTRIFUGAL PUMP SCHEDULE

SECTION:11304.01

SHEET 1 OF 1

I.D.	DESCRIPTION	OPERATING POINT 'A'			OPERATING POINT 'B'			FLUID TYPE	RPM	MOTOR			FIELD WORK				COMMENTS
		FLOW	TDH	EFF.	FLOW	TDH	EFF.			RATING	VOLT	PH	SUPPLIED BY	INSTALLED BY	WIRED BY	COMM. BY	
		L/s	m	%	L/s	m	%			HP	V						
P 5101	SLUDGE PUMP NO, 1	35.5	8.4		25	4.2		SLUDGE	1200	10	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.
P 5102	SLUDGE PUMP NO. 2	35.5	8.4		25	4.2		SLUDGE	1200	10	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.
P 5103	SLUDGE PUMP NO. 3	35.5	8.4		25	4.2		SLUDGE	1200	10	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.
P 5104	SLUDGE PUMP NO. 4	35.5	8.4		25	4.2		SLUDGE	1200	10	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.

FIELD WORK NOTATION

M = MECHANICAL CONTRACTOR
E = ELECTRICAL CONTRACTOR
G = GENERAL CONTRACTOR
EX = EXISTING EQUIPMENT

PLOT DATE: Thursday, April 24, 2025 2:45:17 PM

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the supply, installation, testing and commissioning of submersible rail mounted pumps.

.2 Refer to the Pump Schedule for duty points, quantities and specific accessories required.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- .2 American Society for Testing and Materials (ASTM):
  - .1 ASTM A48: Standard Specification for Gray Iron Castings.
  - .2 ASTM E165: Standard Practice for Liquid Penetrant Examination for General Industry.
- .3 American Iron and Steel Institute (AISI).
- .4 Hydraulic Institute Standards:
  - .1 HI 11.6: Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Test.
- .5 International Organization for Standardization (ISO):
  - .1 ISO 9906: Rotodynamic Pumps – Hydraulic Performance Acceptance Test.
- .6 National Electrical Manufacturer's Association (NEMA).
- .7 Ontario Electrical Safety Code (OESC).
- .8 Canadian Standards Association (CSA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS.

.3 Product Data:
- .1 Relevant information to confirm that the specifications have been met. Identify all deviations.
- .2 Identify construction materials for all pump components.
- .3 Relevant data illustrating full range of operation (on pump curves) including speed curves, if applicable.
- .4 Electrical motor information and specification.
- .5 Loadings imparted to the pump base.
- .6 Permissible range of vibration.
- .7 Factory finishing details.
- .8 Anchoring requirements.

.9 A motor performance chart exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. Chart to also include date on motor starting and no-load characteristics.

.4 Operation and Maintenance Data:
.1 Operation and Maintenance Manuals. Refer to Division 1 for requirements.
.2 Manufacturer's installation requirements.

.5 Quality Control Data:
.1 Manufacturer's certified testing results.
.2 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed pumps. This includes verification that adequate cable length is provided to allow complete pump extraction from the wet well.

.2 For each pump model and size, provide the following spare parts:
.1 One set of bearings.
.2 One set of mechanical seals.
.3 One set of gaskets.
.4 One impeller bolt.
.5 Two leak detection relays.

.3 Provide any specialty tools required to maintain the pump.

1.6 QUALITY ASSURANCE

.1 Pump manufacturer to provide a written certification stating that the pump(s) has(have) been installed to their standards.

.2 Pumps and associated equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to the Electrical Safety Code.

.3 Pump manufacturer to have proven established network of service centres in Eastern Ontario. Service centres to be specialized in manufacturer's line of pumps and stock spare parts. Each service centre to be capable of removing, transporting and repairing the pump in addition to supplying a rental or temporary unit.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

.2 In addition to the requirement noted in the section above, the following Factory Pump Tests are required:
  .1 Hydraulic test to confirm that pump(s) meet the operating conditions in accordance with HI 11.6 or ISO 9906.
  .2 Baseline Vibration Testing in accordance with HI 11.6 or ISO 9906.
  .3 All welds, cast or forged components to be inspected for cracks, shrinkage, porosity or other defects by means of a liquid dye penetrant to ASTM E165 standards.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Pumps to be wet pit bottom suction, non-clog, submersible design with direct coupled motor installed vertically. Pump to be mounted on a rail extraction system.

.2 Sealing of pump unit for the discharge connection to be accomplished via a metal to metal, watertight contact.

.3 Pumps to be suitable for the hazard classification as indicated on the Classification Drawing.

2.2 PUMP FABRICATION

.1 Pump Casing:
  .1 Fabricate of ASTM A48 Class 35 cast iron.
  .2 Non-concentric design with smooth passages to pass any solids that may enter the impeller.
  .3 To have a replaceable suction cover insert ring in which there are spiral shaped grooves.

.2 Impeller:
  .1 Fabricated of ASTM A48 Class 35B cast iron.
  .2 Non-clog type.
  .3 Impeller to be statically and dynamically balanced, semi-open, back swept multi-vane screw shape design.
  .4 Leading edge of impeller to be automatically cleaned on each revolution as it passes over suction cover.
  .5 Impeller leading edge to be hardened to minimum Rockwell Rc 45 and designed to handle solids and fibrous material typically found in municipal wastewater.
  .6 Impeller to volute clearance to be adjustable.
  .7 Impeller to be locked to the shaft by an impeller bolt.
  .8 Impeller to be coated with an alkyd resin primer.

.3 Shaft:
  .1 Fabricated of AISI Type 431 stainless steel.
  .2 Provide a common pump/motor single piece shaft.

.4 Mechanical Seal:
  .1 Provide two (2) independent tandem shaft seals each with independent springs.
    .1 Provide one (1) stationary and one (1) positively driven rotating seal ring for both the upper and lower secondary seals.
  .2 All seal rings to be individual solid sintered rings.
  .3 Seals shall not depend upon direction of rotation for sealing.
  .4 Each pump to be provided with a lubricant chamber for the shaft sealing system. Lubricant chamber to be designed to prevent overfilling and to provide capacity for lubricant expansion. Seal lubricant chamber to have one drain and one inspection plug that is accessible from the exterior of the motor unit. Seal system shall not rely on the pumped media for lubrication.
  .5 A separate seal leakage chamber to be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor's lower bearing. Leakage chamber to be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

.5 Bearings:
  .1 Pump shaft to rotate on two (2) bearings.
  .2 Motor bearings to be sealed and permanently grease lubricated with high temperature grease.
  .3 Upper bearing to be a double row angular contact bearing designed to radial loads.
  .4 Lower bearing to be a double row angular contact ball bearing to handle both thrust and radial forces.
  .5 Bearing L10 life to be 100,000 hrs.

.6 Discharge Assembly:
  .1 Fabricated of ASTM A-48 Class 35B cast iron.
  .2 Provided as part of the pump manufacturer's supply.
  .3 Discharge assembly to consist of a discharge elbow designed to be anchored to the wet well invert unless otherwise indicated.
  .4 Sealing of the discharge assembly to the pump per Article 2.1.2 of this section.
  .5 Discharge elbow to terminate in a flange drilled to ASME B16.1 Class 125 standards.

.7 Pump Cooling System:
  .1 Each pump to be provided with an integral motor cooling system.
  .2 A motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation
  .3 An impeller, integral to the cooling system and driven by the pipe shaft, shall provide the necessary circulation of the cooling liquid through the jacket. Coolant to be a mixture of water and mono-propylene glycol.
  .4 Cooling system to have one fill port and one drum port integral to the cooling jacket.
  .5 Cooling system to provide for continuous pump operation in liquid or ambient temperatures of up to 40°C (104°F). Operational restrictions at temperatures below 40°C (104°F) are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted externally to the pump motor are not acceptable.

.8 Coatings:
  .1 Shop coat pumps per manufacturer's standard finish system and colour.

2.3 MOTOR

.1 Introduction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B Type. Stator winding and leads to be insulated with moisture resistant Class H insulation rated for 180°C; designed for continuous duty handling pumped media of 40°C and capable of up to 15 evenly spaced starts per hour; rotor bars and short circuit rings to be made of cast aluminum.

.2 Motors to be suitable for variable frequency drives.

.3 Three thermal switches to be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

.4 Service factor of 1.15, a voltage tolerance of plus or minus 10%. Motor to be designed for operation up to 40°C ambient and with a temperature rise not to exceed 80°C.

.5 Motor horsepower to be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

2.4 RAIL EXTRACTION SYSTEM

.1 Pump to be mounted on a rail extraction assembly allowing the removal of the pumps from the wet well without the need for tank entry, tank unwatering or the need for anchor bolt removal.

.2 Rails to be fabricated of 304 stainless steel and to span the entire depth of the wet well as indicated on the drawings. Rail size and intermediate rail supports as recommended by pump manufacturer. Rails to be supported at the top of the wet well by a bracket designed to maintain guide rail alignment.

.3 Single rail and cable guide systems will not be acceptable.

.4 Provide a stainless steel extraction chain complete with a stainless steel hook to securely hold the chain in place when not in use. Safe working load of chain to be at least 40% greater than the weight of the pump.

2.5 POWER CABLE

.1 Cable entry seal to be designed to ensure a watertight and submersible seal. Cable entry to consist of a single, cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.

.2 Assembly to allow the changing of the cable when necessary, using the same entry seal. Cable entry junction chamber and motor to be separated by a stator lead sealing gland or terminal board that will isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones or other secondary sealing systems will not be considered acceptable.

.3 Provide shielded power and control cables for each pump sized according to the OESC and CSA standards and to be of sufficient length to reach the junction box without the need of any splices (coordinate with Electrical subcontractor).

.4 Outer jacket of cable to be oil resistant, chloroprene rubber. Motor and cable to be capable of continuous submergence underwater without loss of watertight integrity to a depth of 20 metres, minimum. Control cable to be provided with a minimum of twelve conductors, minimum. Exact length and conductor count to be coordinated with site requirements.

2.6 PUMP PROTECTION

.1 A leakage sensor shall be provided in both the pump electrical junction box and the seal leakage chamber.

.2 Provide a supervisory relay to monitor both motor winding temperature switches and leakage sensors.

.3 Supervisory relay shall be provided with a minimum 5A at 120 VAC Form C dry contact rating and shall be suitable for remote interfacing with pump control circuits and installation by the Electrical Contractor into the plant's motor and starter cabinets. Supervisory relay power supply to be 120 VAC or 24 VAC/DC and shall be finalized during shop drawing review.

2.7 CONTROLS

.1 Refer to the Contract Drawings and Process Control Narratives for the proposed pump control methodology.

.2 Pumps will be controlled through a programmable logic controller (PLC). The PLC will be provided as part of Division 16.

.3 Pump starters and variable frequency drives will be provided as part of Division 16.

.4 Unless otherwise noted, all instrumentation external to the pump, as well as any instrumentation mounting accessories, will be provided as part of Division 17.

2.8 SPECIFIED PRODUCT

Pump	**Specified Model**
Raw Sewage Wet Well Pumps	Flygt, NP 3153 and 3202 Series complete with minicas monitoring system as provided by Xylem (Flygt)
Decant Wet Well Pumps	Flygt. NP 3085 Series complete with minicas monitoring system as provided by Xylem (Flygt)

2.9 ALTERNATE MANUFACTURERS

.1 Alternate Manufacturers:
  .1 Sulzer ABS.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Pump and associated accessories are to be installed as per manufacturer's written instructions.

.2 Install pump assembly so that vibrations do not exceed the limits recommended in the Hydraulic Institute Standards.

.3 Surface preparation and field painting to be in accordance with Section 15020 and Division 9 requirements.

3.2 IDENTIFICATION

.1 Pumps to be tagged consistent with the Contract Drawings and the requirements of Section 15020.

3.3 SUPPLEMENTS

.1 Pump Schedule included at the end of this section.

END OF SECTION

BRIGHTON WWT SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO
JLR No.: 32296-001

PROCESS SUBMERSIBLE PUMP SCHEDULE

SECTION: 11306.01

SHEET 1 OF 1

I.D.	DESCRIPTION	OPERATING POINT 'A'			OPERATING POINT 'B'			FLUID TYPE	RPM	MOTOR			FIELD WORK				COMMENTS
		FLOW	TDH	EFF.	FLOW	TDH	EFF.			RATING	VOLT	PH	SUPPLIED BY	INSTALLED BY	WIRED BY	COMM. BY	
		L/s	m	%	L/s	m	%			HP	V						
P 1101	RAW SEWAGE PUMP NO. 1	62.5	10.3	77	22	7.7	57	RAW SEWAGE	1760	15	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.
P 1102	RAW SEWAGE PUMP NO. 2	62.5	10.3	77	22	7.7	57	RAW SEWAGE	1760	15	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.
P 1103	RAW SEWAGE PUMP NO. 3	125	11.8	79	43	7.7	62	RAW SEWAGE	1170	35	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.
P 1104	RAW SEWAGE PUMP NO. 4	125	11.8	79	43	7.7	62	RAW SEWAGE	1170	35	600	3	M	M	E	G	PROVIDE INVERTER DUTY MOTOR SUITABLE FOR USE WITH A VFD.
P 7301	DECANT PUMP NO. 1	9.0	13.3	51				DECANT	3440	4	600	3	M	M	E	G	
P 7302	DECANT PUMP NO. 2	9.0	13.3	51				DECANT	3440	4	600	3	M	M	E	G	

FIELD WORK NOTATION

M = MECHANICAL CONTRACTOR
E = ELECTRICAL CONTRACTOR
G = GENERAL CONTRACTOR
EX = EXISTING EQUIPMENT

PLOT DATE: Thursday, April 24, 2025 2:45:15 PM

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the design, pre-fabrication, supply, pre-assembly, installation, testing and commissioning of a complete fiberglass reinforced plastic (FRP) sewage pump station to be installed in the vertical position with concrete buoyancy ring placed around the circumference of the station as per the Drawings.

.2 The station shall consist of an all FRP tank, including top and bottom, all internal piping, including valves, electric submersible pumps, electrical, and other components and accessories necessary for a complete functional and reliable operation.

.3 Pump station will receive raw sanitary sewage overflow and WAS supernatant from the EQ Lagoon.

.4 Prefabricated pump station controls, including instrumentation supply will be by Division 17.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250.
  - .2 ASME RTP-1 - Reinforced Thermoset Plastic Corrosion-Resistant Equipment.
- .2 American Society for Testing and Materials (ASTM):
  - .1 ASTM A48: Standard Specification for Gray Iron Castings.
  - .2 ASTM A126: Standard Specification for Gray Iron Casting for Valves, Flanges and Pipe Fitting.
  - .3 ASTM D3299: Standard Specification for Filament Wound Glass Fiber Reinforced Thermoset Resin Corrosion Resistant Tanks.
  - .4 ASTM D4097: Standard Specification for Contact Molded Glass Fiber Reinforced Thermoset Resin Corrosion Resistant Tanks.
- .3 Amec:
  - .1 Amec 4S-10.01 Manufacture and Installation for FRP Structures
- .4 American Water Works Association (AWWA):
  - .1 AWWA C-590-01: Standard for Fiberglass Pressure Pipe
- .5 Ontario Ministry of Labour.
- .6 Ontario Electrical Safety Code.

1.3 INFORMATIONAL SUBMITTALS

.1 Product Data:

- .1 Pump station fabrication details.
- .2 Pump station general arrangement drawing including overall dimension, location and sizes of openings, restraints, supports, fittings, weight, ladders and accessories.
- .3 Submit pump, valving and piping data in accordance with referenced specification sections.

.4 Submit FRP tank drawings showing all design loads and standards stamped by a professional engineer, licensed in the province of Ontario. Drawings to include design and detailing of all structural components associated with the tank, including but not limited to; buoyancy anchorage, tank walls and slabs, ladders, platforms, guardrails, hatches, anchorage, etc.

.2 Operation and Maintenance Data:
- .1 Operation and Maintenance Manuals. Refer to Division 1, Section 01780 for requirements.
- .2 Installation requirements.
- .3 Copy of all Product Data information.
- .4 Start-up, operating and safety instructions for the system.
- .5 Operating and maintenance information for all supplied equipment.
- .6 Recommended tank inspection intervals.

.3 Quality Control Data:
- .1 Manufacturer's certificate confirming proper installation.
- .2 Manufacturer's certified testing results including:
  - .1 Resign gel testing.
  - .2 Wall thickness testing.
  - .3 Visual inspection.
  - .4 24-hour hydrostatic test.

.4 Manufacturer to provide a summary of all tank calculations stamped by an engineer licensed in the province of Ontario.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment.

.2 The Contractor shall verify and demonstrate that pumps are provided with adequate cable length for complete extraction out of the pump station.

.3 Refer to Section 11306 for pump maintenance and spare parts requirements.

1.6 QUALITY ASSURANCE

.1 Pump station manufacturer to have a minimum of 10 years of pump station design and fabrication experience.

.2 Manufacturer to provide a written certification stating that the tanks have been installed to their satisfaction.

.3 Equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to Electrical Safety Code.

1.7 COMMISSIONING

.1 Refer to Division 1 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide a prefabricated FRP duplex sewage pump station intended for direct burial installation in the vertical position as illustrated on the drawings and as specified herein.

.2 Pump station to consist of an FRP wet well, electrical submersible pumps, all internal process piping and valves, and all accessories required for a complete and functioning operation with the exception of controls provided by Division 17.

.3 Supplier shall be responsible to provide attachments, reinforcement, anchor bolts or hold down devices to resist buoyancy uplift.

.4 All materials in station to be of a non-corrosive nature to minimize long term corrosion.

.5 Station to be pre-assembled with all equipment installed except for the pumps and electrical hook-ups.

2.2 FRP WET WELL CHAMBER

.1 Tank(s) to be designed and fabricated in accordance with ASTM D3299 and/or ASTM D4097 unless modified by this section.

.2 A safety factor of four (4) on the minimum ultimate tensile strength of the laminate to be used in designing the wall, bottom and roof thickness of the station, taking into account all normally imposed loads arising from flotation, soil pressure, normal backfill, handling loads, operating loads and static loads imposed by equipment used in hoisting the pumps in and out of the station.

.3 The anchorage of the FRP Wet Well Chamber to the concrete buoyancy slab shall be designed for a factored load of 1.25 x buoyancy uplift force calculated for groundwater table below grade (noted on drawings) or 1.1 x buoyancy uplift force calculated for groundwater table taken at grade, whichever is greater.

.4 Main chamber to be a vertical cylinder made integrally with a reinforced bottom capable of withstanding a full hydrostatic head from the exterior of the tank while the station is completely empty.

.5 Station bottom to include 150 mm at minimum, knuckle radius smooth molded corners to minimize build-up of solids. Bottom to be cored for stiffness with solid sections where pump anchor bolts are located. These bolts are to be permanently laminated into the solid section and sealed.

.6 The shell section will be made of FRP using the filament winding process. Chamber will also be constructed to handle external ground load inherent at its proposed installation location and also withstand both corrosive environments of liquids inside and outside the wet well. Filament wound external reinforcing ribs to be provided for additional strength against buckling and also provide a method of securing the support lugs. Quantity and size of these ribs to be calculated for each application. Main chamber is for mounting and removal of submersible pumps. Interior finish to be a smooth gel coat finish.

.7 Construction:

.1 Interior finish to be a 100-mil thick vinyl ester epoxy coating suitable for a sanitary sewage environment. Resin for the corrosion liner and structural layers to be a premium grade isopthalic polyester at minimum and must be able to resist the corrosive effect of the installation. Glass fibre reinforcing materials other than surfacing veil to be commercial Grade “E” type glass.

.2 All FRP laminates to have a corrosion liner on surfaces that are exposed to the corrosive environment and a structural laminate. Tank shell and its external reinforcing ribs to use the filament winding process for the structure. Structural laminate to be by the hand lay-up method for all sections or parts other than the tank shell.

.3 Surface of liner exposed to corrosive medium to be resin rich reinforced with a “C” grade surfacing veil. Veil to be saturated with white pigmented resin or ISO-NPG white gelcoat. Layer to be .25 mm thickness. Liner behind surface to have a minimum thickness of 2.54 mm and to be reinforced with not less than 20% and not more than 30% by weight of non-continuous chopped strand mat. Inside surface to be a smooth molded surface. Corrosion liner to be free of air and voids for optimum corrosion resistance.

.4 Once liner is completed and cured, remainder of wall thickness of FRP laminates to be built up to provide sufficient strength to meet mechanical requirements.

.5 All inside surfaces should be smooth and free of cracks and crazing. Inside surface will be pigmented or gel coated to a bright white finish. All surfaces other than those made in contact with the mold surface to be coated with air-inhibited resin or gelcoat, this includes any cut edges of laminates.

.6 All external surfaces to be resin coated with an air inhibited resin coat, including any drilled holes, ground areas or cut edges. Portion of station above ground level to be painted using a gelcoat with UV inhibitors and air inhibitor additives. Field coordinate colour with Consultant.

.7 All bolting hardware to ASTM A276 316 stainless steel.

.8 Provide minimum four stainless steel lifting lugs capable of lifting the entire pump station as required during transportation and installation. All lugs are to be below grade once backfilling has been completed.

.9 Provide sufficient amount of lugs to secure the pre-fabricated station to the concrete base. Materials and design shall be similar to the lifting lugs, with the exception that a bolt through lug is not allowed near the station bottom, unless a base support skirt is part of the tank. The bottom external reinforcing rib shall be placed as near to the bottom as possible to encapsulate this rib in the second concrete pour.

2.3 INTERMEDIATE SERVICE PLATFORM

.1 Wet well to be provided complete with an intermediate Aluminum or FPP platform capable of withstanding a specified concentrated load of 250 kg plus the dead weight of one of the pumps will form a service area with sufficient servicing space in the upper section of the main chamber. All bolting hardware to be 316 stainless steel minimum. Hinged access hatches within the platform to be sized for the removal of pumps furnished and capable of handling the weight of one. Valves to be located above platform to facilitate operation and maintenance. Any bolting through the tank wall is to be sealed and laminated over on the exterior to prevent internal or external seepage.

.2 The guardrails around the service platform shall be designed in accordance with Ontario Building Code 2012 for access ways to equipment platforms. This shall include a specified load of 1.0 kN applied at any point on the guardrail to produce the most critical effect as well as vertically applied specified load of 1.5 kN/m applied at the top of every required guard. These loads need not be considered to act simultaneously.

2.4 ACCESS LADDER

.1 Wet well to be complete with 316 stainless steel access ladder to provide safe access to station bottom and intermediate platform complete with safety post. Ladder construction and supports to be capable of holding two people at one time (2 x 1.1kN specified load on consecutive attachment points or 1.1 kN specified load on a rung). Access ladder to meet or exceed the requirements of the Ontario Ministry of Labour for Fixed Access Ladders. Provide removable access panel to access ladder to station bottom as required.

2.5 ACCESS HATCHES

.1 Provide three (3) aluminum lockable entrance covers sized for pump removal and wet well access. Access cover to be non-slip, gasketed, and weathertight complete with 316 stainless steel hardware. Refer to drawings for additional requirements. Each access cover shall be suitable to support a concentrated load of 18 kN (over 120 mm x 120 mm) or a uniformly distributed load 14.4 kPa, whichever is greater effect. Cover doors are to be designed to be maintained in the vertical position when open by cover stays or pneumatic cylinders.

2.6 INFLUENT AND DISCHARGE CONNECTIONS

.1 Refer to drawings for all influent and discharge connections and their respective locations. All connections to tank wall to be machined spigot and fabricated from FRP and laminated to tank wall with inside and outside lay-ups using laminated resins equivalent to rein used in shell construction. Machined spigot to be 12 mm thick minimum. A 150 mm long portion of machined end is required for proper fit-up to field connections.

2.7 AIR VENTS

.1 Pump station to be complete with 316 stainless steel inlet and exhaust vent approximately sized based on the incoming flow rates. Locate the inlet and exhaust location to prevent short circuiting of the ventilation air with one vent terminating just above the high-water level elevation and the other terminating just below the wet well cover. Provide gooseneck c/w 316 stainless steel birdscreen on both inlet and exhaust vents to an elevation minimum 1 m above the top of the wet well.

2.8 PUMPS

.1 Pumps are scheduled and specified in Section 11306; however, they are to be provided by the pump station supplier to ensure a complete and functioning system.

.2 Pumps to be submersible mounted on a rail extraction system.

.3 Pump station manufacturer to include an integrally mounted stainless-steel hook for each pump to support the pump extraction chain. Locate hooks near top access hatch. Coordinate with drawings.

.4 Pumps for the pump station are to match the other pumps on site provided under Section 11306.

2.9 PROCESS PIPING

.1 Refer to Specification Section 15349 for all process piping requirements.

.2 Refer to Specification Section 15060 for pipe supporting requirements.

.3 Pipe material within pump station to be Stainless Steel:
.1 To Section 15349 requirements.

2.10 VALVES

.1 Refer to Specification Section 15100 for all valve requirements.

.2 Valve types as scheduled.

.3 Valves provided for the pumps station are to be of the same manufacturer and model for the valve type as the rest of the valves on the site provided under Section 15100.

.4 Provide all valves and components indicated on P701.

2.11 CONTROLS

.1 Pump controls to be provided by Division 17 Contractor.

.2 Level control will be accomplished through a station mounted ultrasonic level sensor provided by Division 17. Provide all mounting hardware are required. coordinate exact placement of sensor with manufacturer prior to installation.

.3 A backup station mounted radar level sensor will be provided by Division 17.

.4 An additional high level flow sensor will be provided by Division 17. Provide stainless steel mounting hooks and hardware to hang the cables as required and allow for maintenance removal of the instrument without entry into the wet well. Pump station manufacturer to provide and factory install stainless steel float hanger as well as intermediate stainless steel sway rings.

.5 Coordinate with Division 17 contractor for instrument details.

.6 Refer to the process instrumentation diagram and Section 17500 – Control Narratives General Overview for the control intent of the prefabricated pump station system.

2.12 ELECTRICAL

.1 Only equipment essential for the operation of the pump shall be installed inside. Where possible, all switches and junction boxes, etc., to be located outside to avoid corrosion or flood damage. All electrical wiring of the pump station will be designed and supplied by the manufacturer in accordance with The Ontario Electrical Code Latest Edition. Pump power cables to be provided in sufficient length to run directly to the junction box via an external conduit provided by others. Conduit fittings and strain relief connectors to be provided in sufficient number and size to permit installation within the pump station. Electrical conduit piercing tank wall to be done in a watertight fashion.

.2 Lighting in wet well to be an explosion-proof system installation. Provide two (2) explosion-proof LED type light fixtures of sufficient size to illuminate pumping station above the platform. Provide accessible light switch in close proximity to access ladder. Provide PVC coated rigid conduit, junction boxes and fittings as is necessary to allow for final terminations by the installation contractor from below grade conduit.

.3 Hatches, ladder and electrical conduit to be provided in a manor that will permit electrical bonding from two (2) below grade bare4/0 AWG ground wires.

.4 Embed fibreglass unistrut in well perimeter above platform to facilitate the installation of 8x103 mm RPVC conduit by the electrical contractor without damage to wetwell. Provide 360’ coverage at 1 m intervals at elevation of below grade conduit penetrations.

2.13 SPECIFIED PRODUCT

.1 Barski Industries: Xylem Barski Custom Pump Station.

2.14 ALTERNATE MANUFACTURER

.1 Precision Service & Pumps complete with ABS pumps.

.2 Grundfos.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install pump station in accordance with both the manufacturer's and O&M written instructions.

.2 Manufacturer to confirm location and elevation of all piping connections with the Contractor prior to fabrication. Obtain Consultant approval prior to any modifications resulting from discrepancies.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the supply, installation, testing and commissioning of a vertical wet pit re-circulator chopper pump.

.2 Refer to the Pump Schedule for pump quantities and design operating parameters.

.3 Refer also to the drawings for additional installation requirements.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
  .1 American Society of Mechanical Engineers (ASME):
  .2 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
.2 American Society for Testing and Materials (ASTM):
  .1 ASTM A48: Standard Specification for Gray Iron Castings.
  .2 ASTM E165: Standard Practice for Liquid Penetrant Examination for General Industry.
.3 American Iron and Steel Institute (AISI).
.4 Hydraulic Institute Standards:
  .1 HI 14.6: Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
.5 International Organization for Standardization (ISO):
  .1 ISO 9906: Rotodynamic Pumps – Hydraulic Performance Acceptance Test.
.6 National Electrical Manufacturer's Association (NEMA).
.7 Ontario Electrical Safety Code (OESC).
.8 Canadian Standards Association (CSA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.
.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all PART 2 – PRODUCTS.
.3 Product Data:
  .1 Relevant information to confirm that the specifications have been met.
  .2 Identify construction materials for all pump components.
  .3 Relevant data illustrating full range of operation (on pump curves) including speed curves, if applicable.
  .4 Electrical motor information and specification.
  .5 Loading imparted to the pump base.
  .6 Permissible range of vibration.
  .7 Factory finishing details.
  .8 Anchoring requirements.
.4 Operation and Maintenance Data:
  .1 Operation and Maintenance Manuals. Refer to Division 1 for requirements.
  .2 Manufacturer's installation requirements.

.5 Quality Control Data:
  .1 Manufacturer's certified testing results.
  .2 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed pumps.

.2 For each pump model and size, provide the following spare parts:
  .1 One set of bearings.
  .2 One set of mechanical seals.
  .3 One set of gaskets.
  .4 One set of cutter bars.
  .5 One impeller.

.3 Provide any specialty tools required to maintain the pump.

1.6 QUALITY ASSURANCE

.1 Pump manufacturer to provide a written certification stating that the pump(s) has(have) been installed to their standards.

.2 Pumps and associated equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to the Electrical Safety Code.

.3 Pump manufacturer to have proven established network of service centres in Eastern Ontario. Service centres to be specialized in manufacturer's line of pumps and stock spare parts. Each service centre to be capable of removing, transporting and repairing the pump in addition to supplying a rental or temporary unit.

.4 Pumps to be factory tested to HI 14.6 Standard Grade 3B.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 All pumps will require training

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Chopper pump to be capable of pumping scum typically found in municipal wastewater.

.2 All guarding to be to CSA Z432 and to OSHA standards.

.3 Coordinate with Contractor's designer for seismic support systems and provide all necessary attachments and reinforcing of equipment.

.4 Nuts, bolts and other fasteners to be Type 316 stainless steel.

.5 Pumps to be suitable for the hazard classification as indicated on the Classification Drawing.

2.2 PUMP FABRICATION

.1 Pump Casing:
- .1 Fabricate of ductile cast iron.
- .2 Casing to be of volute or semi-volute design. Casing to be smooth and free of blow holes and imperfections.
- .3 Casing to include a replaceable steel cutter with a Rockwell C Hardness of Rc 60. Cutter to have adjustable clearance between it and the impeller for debris removal.

.2 Impeller:
- .1 Fabricated of cast alloy steel with a Rockwell Hardness of Rc 60.
- .2 Impeller to be a semi-open type with pump out vanes to reduce seal area pressure.
- .3 Chopping of material to be accomplished by the action of the cupped and sharpened leading edges of the impeller moving across the cutter mounted on the pump suction opening.
- .4 Impeller to be keyed to the shaft and secured to the shaft with a Hardened Rockwell Rc 60 cutter nut. Nut to be designed to prevent binding of debris.

.3 Cutter Bar Plate:
- .1 Fabricated of heat-treated alloy steel with a Rockwell Rc 60 Hardness.
- .2 Cutter bat to be recessed into the pump bowl and have at least two (2) shear bars mounted across the pump inlet.

.4 Upper Cutter:
- .1 Fabricated of heat treated AISI 4140 allow steel with a Rockwell Rc 60 Hardness.
- .2 Cutter to be threaded into the casing behind the impeller and designed to cut against the impeller.
- .3 Cutter teeth to be positioned close to the centre of the shaft rotation in order to minimize cutting torque.
- .4 The ratio of the upper cutter diameter to shaft diameter to be 3.0 or less.

.5 Recirculation Nozzle Assembly:
- .1 Valve body fabricated of ductile iron.
- .2 Valve disk fabricated of 316 stainless steel.
- .3 Chopper pump to be fitted with a recirculation nozzle assembly to permit wet well contents to be fluidized prior to being discharged.
- .4 Recirculation nozzle to have a minimum adjustable range of 180 degrees horizontally and 45 degrees vertically.
- .5 Automated valve to be connected to the pump discharge to direct flow either to the nozzle or to the discharge flange.
- .6 Automatic Valve Actuator:
  - .1 Locate actuator on pump base. Actuator to be suitable for exterior installation with a NEMA 7 and NEMA 4X rating.
  - .2 Actuator to be suitable for an electrical classification of Class 1 Zone 2.
  - .3 Linear ball screw type actuator to be used to provide intermittent valve positioning.
  - .4 Actuator to have a free-wheeling feature to prevent over-travel and the end of the stroke.
  - .5 Capacitor used for motor starting to be included in the design.
  - .6 Square nut actuator to be included to override the actuator for manual operation.
- .7 Operating levers to extend through the pump deck plate for manual control of nozzle direction.

.6 Pump Shaft:
- .1 Fabricated of heat-treated alloy steel.
- .2 Shaft column to be minimum 100 mm diameter and to be leaktight.
- .3 Shaft coupling to be elastomeric type with a minimum 1.5 service factor based on the rated pump horsepower.

.7 Bearings:
- .1 Bearings with limited accessibility to be oil bath lubricated.
- .2 Readily accessible bearings may be grease lubricated.
- .3 Bearing to be either a double row angular contact ball bearing or two (2) back-to-back mounted single row angular contact ball bearings.
- .4 Bearing life rated for L10 100,000 hrs.

.8 Seals:
- .1 Cartridge-type mechanical seal with Viton O-rings, silicon carbide faces and integral stainless steel sleeve.

.9 Oiler:
- .1 Pump to be provided with an automatic oiler to be located in an accessible location outside of the wet well.
- .2 Oiler to shut pump down on low oil level.

.10 Pump Discharge:
- .1 Pump assembly to be mounted vertically and terminate with an ASME B16.5 Class 150 flange.
- .2 Provide a pressure gauge on the discharge piping above the deck plate.

.11 Pump Box Plate:
- .1 Fabricated minimum 12 mm carbon steel coated as indicated herein.

2.3 COATINGS

.1 Pump to be factory finished with epoxy primer and epoxy finish coating; each with an average 5-8 mm thickness.

.2 Any surface preparation and field painting to be done in accordance with Section 15020 and Division 9.

2.4 MOTOR

.1 TEFC motor suitable for an electrically rated Class 1 Zone 2 environment.

.2 Motor to meet the requirements of Section 15053.

.3 Size requirement as scheduled.

.4 Motor to be supplied with drip cover for outdoor installation.

2.5 CONTROLS

.1 Refer to the Contract Drawings and Process Control Narrative for the proposed control methodology.

.2 The pumps will be controlled through a Programmable Logic Controller (PLC). The PLC will be provided as part of Division 16.

.3 Pump starters will be provided as part of Division 16.

.4 Unless otherwise noted all instrumentation external to the pump, as well as any instrumentation mounting accessories, will be provided as part of Division 17.

2.6 SPECIFIED PRODUCT

.1 Vaughan Model V4KR.

.2 Alternate Manufacturers

.1 Hayward Gordon.
.2 Approved Equal.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Chopper pumps complete with all accessories are to be installed in accordance with manufacturer's written instructions.

3.2 IDENTIFICATION

.1 Pumps are to be tagged consistent with the Contract Drawings and the requirements of Section 15020.

3.3 SUPPLEMENTS

.1 Pump Schedule included at the end of this section.

END OF SECTION

BRIGHTON WWT SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO
JLR No.: 32296-001

CHOPPER PUMP SCHEDULE

SECTION: 11313.01

SHEET 1 OF 1

I.D.	DESCRIPTION	OPERATING POINT 'A'			OPERATING POINT 'B'			FLUID TYPE	RPM	MOTOR			FIELD WORK				COMMENTS
		FLOW	TDH	EFF.	FLOW	TDH	EFF.			RATING	VOLT	PH	SUPPLIED BY	INSTALLED BY	WIRED BY	COMM. BY	
		L/s	m	%	L/s	m	%			HP	V						
P 5201	SCUM PUMP	11.8	5.4	29				SCUM	1200	5	600	0	M	M	E	G	

FIELD WORK NOTATION

M = MECHANICAL CONTRACTOR
E = ELECTRICAL CONTRACTOR
G = GENERAL CONTRACTOR
EX = EXISTING EQUIPMENT

PLOT DATE: Thursday, April 24, 2025 2:45:15 PM

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 The General Contractor is to provide complete screening system within the Headworks Building in compliance with these specifications and as shown on the Drawings.

.2 Screening system provisions include one (1) manual bar screen c/w drying pan and rake, one (1) inline channel grinder, one (1) mechanical cylindrical auger screen, one (1) horizontal screenings conveyor, a screenings bagging system, and a centralized screening system local control panel serving all the above equipment. Coordinate equipment supply with this specification and the drawings.

.3 The Screening Equipment Supplier is to provide a complete package to include all necessary components, including mounting brackets, supports, drives, guards, controls and electrical to limits indicated herein. Generally, unless indicated otherwise, the supplier is to provide a complete and working system to satisfy performance requirements and general intent specified in these documents.

.4 Unless noted otherwise. all electrical components installed in the Headworks Building shall be suitable for a CEC Zone 1, Group D electrical classification.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.
- .1 American Iron and Steel Institute (AISI).
- .2 American Gear Manufacturers Association: (AGMA).
- .3 American Society of Mechanical Engineers (ASME):
- .4 Canadian Electrical Code(CEC)
- .5 Canadian Standards Association: (CSA):
  - .1 CSA Z432 – Safeguarding of Machinery.
- .6 National Electrical Manufacturers Association: (NEMA).
- .7 Underwriters Laboratory (UL and cUL).
- .8 Hydraulic Institute Standards:

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15.

.2 Informational submittal required for all PART 2 – PRODUCTS specified herein.

.3 In addition to the submittal requirements of Division 1 and Division 15, submit the following:
- .1 Product Data
  - .1 Identify construction materials for all screening system components.
  - .2 Relevant data illustrating full range of operation including speed curves, if applicable.
  - .3 Electrical motor information and specification.
  - .4 Loadings imparted to each piece of equipment.

.5 Permissible range of vibration.
.6 Factory finishing details.
.7 Anchoring requirements.
.8 A motor performance chart exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. Chart to also include data on motor starter and no-load characteristics.
.9 Noise characteristics of equipment.
.10 Provide Instrumentation and Control Systems submittals including, but not limited to the following:
  .1 Piping and Instrumentation Diagrams (P&IDs).
  .2 General Arrangement Drawing (GA).
  .3 Process Control Narrative.
  .4 Control Panel layout complete with component bill of materials.
  .5 Panel product shop drawings for utilized PLC controllers, power supplies, controller cards, touch screen interface, intrinsically safe relays, terminal block, surge protective devices, starters and drives.
  .6 Field instrumentation product shop drawings and data sheets.
  .7 Control Panel schematics and wiring diagrams, including field loop diagrams and network schematics.
  .8 All HMI screens.
  .9 PLC program.
  .10 Field instrument classification ratings as well as specific installation details.

.2 Maintenance Data:
  .1 Operation and Maintenance Manuals in accordance with Division 1.
  .2 Manufacturer's installation requirements.
  .3 The Screening Equipment Supplier is to submit all operating constraints and design requirements related to the successful commissioning of the screening system equipment.

.3 Quality Control Data:
  .1 A certificate of proper installation submitted on OEM letterhead, signed by the Manufacturer or their representative and certifying that the equipment has been installed in accordance with their installation instructions.
  .2 Factory testing reports.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Refer to Division 1 for delivery, storage and handling requirements.

.2 All equipment delivered to the site shall be stored in accordance with the manufacturer's instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.6 MAINTENANCE AND SPARE PARTS

.1 Maintenance and spare parts to be in accordance with Division 1 requirements.

.2 Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

.3 Provide the following spare parts for the screening system:
  .1 One (1) auger brush kit.

.4 Provide any specialty tools required for maintenance.

1.7 QUALITY ASSURANCE

.1 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier's cost if proper supporting evidence cannot be provided.

.2 Provide all equipment from Single Manufacturer where applicable.

.3 Manufacturers of screening equipment to be regularly engaged in production of equipment of type and size specified. Provide list of references with a minimum of 5-10 years of continuous operating experience demonstrating equipment use in similar installations.

.4 Manufacturer to have service center located in Eastern Ontario capable of undertaking equipment servicing, inspections and repairs as well as stocking non-custom spare parts.

.5 Guarding to meet OSHA and CSA Z432 requirements.

.6 All electrical installation and components shall comply with CSA and local electrical authority.

.7 Electrical Equipment not bearing a CSA label requires an ESA field approval.

.8 Where required by Authority having jurisdiction, equipment shall bear a ULC or UL label.

1.8 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

.2 Following installation and initial checkout by the installation Contractor, the manufacturer is to provide a factory trained technician to commission the screening system.

.3 Screening manufacturer to provide a checklist of items to be completed by the General Contractor prior to beginning commissioning

.4 Factory Testing:
  .1 Factory test centralized control panel in conjunction with related process equipment in order to verify a complete and operational system as well as related interlocks and operational sequencing prior to shipping. Network connectivity as well as PLC based monitoring and alarming shall be fully verified. Factory testing to be carried out in the presence of the Consultant.
  .2 Controls and motors to be factory tested and reports are to be provided to the Consultant and the Owner prior to shipment of the equipment.

.5 Manufacturer's Services:

.1 Screening PLC Control System Review Meeting: The Screening Equipment Supplier shall allow for three (3) meetings each consisting of four (4) hours on site to review and coordinate Screening System PLC control narratives, alarming, screen layouts, and remote monitoring over the construction of the new Screening System. These meetings are to be at the 60%, 90% and 99% programming completion stages.

1.9 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Training required for the grinder, mechanical screen, screenings conveyor and associated appurtenances.

.3 Only following commissioning and acceptance of screen installation by the Consultant, the factory technician is to provide training in the operation and maintenance of the equipment using the maintenance manual provided.

1.10 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

.2 The Manufacturer shall provide a warranty for the equipment specified in this Section. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts. The Manufacturer shall provide a warranty for a minimum period of 1 year from Substantial Completion.

PART 2– PRODUCTS

2.1 GENERAL

.1 A clean operation is required. Screenings are to be removed from raw sewage flow in an open channel, conveyed and deposited cleanly in a plastic bag inside the waste disposal bin.

.2 Raw sewage to pass through an inline channel grinder prior to the mechanical auger screen in order to reduce the size of large solids and protect downstream screening equipment.

.3 Include measures that effectively prevent retention of screenings on the screen, discharge blade, chute, cleaning mechanism or drive train.

.4 Include measures to remove organics from screenings prior to depositing screenings in waste disposal bin.

.5 Screenings to be deposited by the auger screen into a horizontal screenings conveyor leading to a waste disposal bin provided by others. Screenings quality to be suitable for disposal to landfill without any additional treatment or processing.

.6 Manual screen to provide redundant solids removal capacity when mechanical screening equipment requires maintenance.

.7 Provide all instrumentation required for a complete and functional system, whether or not specifically shown on the Contract Documents, at no additional cost to the Owner.

.8 Refer to Section 17100 and Table of Devices for specific instrumentation requirements.

2.2 OPERATING CONDITIONS

.1 Capacity:
- .1 Annual Average Day Flow: 4,600 m^3/d.
- .2 Peak instantaneous Flow: 21,600 m^3/d.

.2 Maximum headloss at under peak flow: 750 mm.

.3 Installation Geometry:
- .1 Equipment Clearance: Floor to underside of structure: 4,200 mm.
- .2 Grinder and Mechanical Screen Channel Dimensions: 914.4 mm wide x 2,340 mm deep.
- .3 Mechanical Screen Inclination Angle: 35 Degrees.
- .4 Manual Screen Channel Dimensions: 914.4 mm wide x 1,300 mm deep.
- .5 Refer to the Drawings for additional layout and installation details.

2.3 GRINDER & MECHANICAL SCREEN

.1 Description:
- .1 Inline grinder, mechanical inclined auger screen and manual bar screen to be designed for installation in an open channel inside the Headworks Building.
- .2 Grinder to include installation frame and drives for integral rotating screen as well as two counter-rotating shafts stacked with individual cutters for the separation and size reduction of large solids.
- .3 Mechanical screen to include integrated spray wash system, auger drive, and structural frame.
- .4 Design to ensure that day-to-day maintenance may be accomplished from the Headworks Building floor. The screen auger is to pivot in place to permit insitu maintenance and accessibility.
- .5 The grinder and mechanical screen are each to be factory assembled and tested. Equipment shall be ready for installation and shall not require field assembly except where partial disassembly is required for transportation or protection of components.

.2 Grinder
- .1 General:
  - .1 The inline grinder shall be two-shaft design with integral rotating screen and capable of continuous operation, processing wet or dry.
  - .2 Two-shaft design shall consist of two parallel shafts alternately stacked with individual intermeshing cutters and spacers positioned on the shaft to form a helical pattern. The two shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft.
  - .3 Cutters shall consist of two defined zones. Zone 1 cutters for high abrasion resistance and Zone 2 cutters for shearing and particle size control.

.4 Rotating screen trough to have minimum perforation size of 6 mm (1/4-inch) diameter with 58% open area).
.5 Design to be mounted for easy removal from a frame mounted in the channel.

.2 Components:
.1 Housings:
.1 End housings shall be fabricated of Cast ASTM A536-84 ductile iron with cast integral busing deflector to direct solids away from the mechanical seal and bearing cartridge bushings.
.2 Cover:
.1 Top Cover shall be fabricated of Cast ASTM A536-84 ductile iron and Bottom Cover shall be ASTM A36 hot rolled plates.
.3 Shaft:
.1 Grinder drive and driven shafts shall be made of AISI 4140 Heat Treated Hexagon Steel with a tensile strength rating of not less than 1,027 MPa. Each shaft hex shall be a minimum of 51 mm.
.4 Side Rail:
.1 Side Rail shall be fabricated of Cast ASTM A536-84 ductile iron.
.2 Side rail to consist of evenly spaced horizontal fingers and flow channels positional on the upstream side of the grinder and terminating even with the center of the cutter providing free discharge.
.3 Integrated guide slots to allow for secure installation into channel frame without additional fasteners.
.5 Screen Side Rail and Brush:
.1 Screen Side Rail shall be fabricated of Cast ASTM A536-84 ductile iron.
.2 Vertical brush with PVC backing and nylon bristles to be mounted to screen side rail for rotating screen perforation cleaning.
.6 Cutter Stack Tightening:
.1 Cutter stack compression shall be maintained without removal of the grinder from the channel.
.7 Individual Cutters and Spacers:
.1 Cutters shall be fabricated of AISI 4130 Heat Treated Alloy Steel; through-hardened to a minimum of 45-52 Rockwell C.
.2 Spacers shall be fabricated of AISI 4130 Heat Treated Alloy Steel; through-hardened to a minimum of 34-52 Rockwell C.
.3 Individual 7-tooth cam style cutters to be provided for Zone 1 and 17-tooth Serrated Cam style cutters to be provided for Zone 2.
.8 Intermediate Shaft Collar with Vertical Support:
.1 Intermediate shaft collars to be mounted on vertical support with adjustable brackets.
.2 Intermediate shaft collar housing and vertical supports to be fabricated of AISI 304L stainless steel.
.3 Shaft collar bushing and rotating element to be lubricated with high temperature marine grade grease.
.9 Bearings and Seals:
.1 Seals and bearing to be incorporated into a cartridge style design requiring no external seal flush or lubricants to operate wet or dry.
.2 Cartridge housing shall be fabricated of AISI stainless steel, dynamic and static steal faces to be Tungsten carbide with 6% nickel binder. O-rings to be Buna-N.
.10 Gaskets to be cork and neoprene rubber.
.11 Transfer Gears:
.1 Transfer gears shall be fabricated of heat treated and hardened AISI 4140 alloy steel,
.2 Number of teeth on gears creates ratio of cutter tip speed on low-speed shaft to cutter tip speed of high-speed shaft greater than 0.90 and less than 1.00 to promote cleanout of processed material in cutting stack.

.12 Lifting Hoist Rings:
- .1 Hoist rings shall be fabricated of drop forged steel and rated for 580 kg.
- .2 Must be suitable to bear the side loads associated with laying the grinder down in any direction.

.13 Couplings:
- .1 Low-speed coupling to be of two-piece, 3-jaw interlocking design and fabricated of hardened AISI 4140 alloy steel.
- .2 High-speed coupling to be of Type L, 3-jaw design with elastomer and fabricated of Buna-N spider.

.14 Speed Reducer:
- .1 Speed reducer for grinder and rotating screen to be grease lubricated cycloidal design with “Heavy Shock” load classification. The reduction ratio shall be 29:1.

.15 Motor:
- .1 Power requirements:
  - .1 Grinder: 5HP, 575V, 60Hz, 3 Phase.
  - .2 Integrated Rotating Screen: 1 HP, 575V, 60Hz, 3 Phase.
- .2 Motor shall be of TEFC design, explosion proof (suitable for CEC Class I Zone 1 environment) with 1.15 S.F. (minimum) Class F, insulation type (minimum) per Section 15053.
- .3 No electrical drive components shall be located below the maximum liquid level of the channel. Refer to the project hydraulic profile for these values.

.3 Frame Assembly:
- .1 Fabricated of minimum 5 mm AISI type 304L stainless steel.
- .2 The frame assembly shall be designed to fit into the channel without the need for recessed channel walls or channel invert.
- .3 Frame design to use guides that engage integral guide slots of side rails to allow grinder to be lifted or lowered in and out of frame with no removal of fasteners.
- .4 Anchors to be provided by Contactor for installation.

.3 Mechanical Screen

.1 General:
- .1 Mechanical cylindrical auger screen to be installed immediately downstream of inline grinder.
- .2 Intermittent auger reversal sequences shall be controlled through the use of a timer.
- .3 A minimum liquid level of 200 mm will be maintained in the channel downstream of the mechanical auger screen.

.2 Transport Casing Segments:
- .1 Includes transition segment with wear bars for support of the auger, straight transition segment(s) with wear bars for support of the auger and discharge segment.
- .2 Casing to be fabricated of 10-gauge grade AISI 304L stainless steel.
- .3 Inspection covers shall be provided for segments longer than 1000 mm.

.3 Components:
- .1 The auger casing, flanges, end plates, and outlet shall be AISI 304L stainless steel.
- .2 Perforated Screen Trough:
  - .1 Replaceable, constructed of AISI 304L stainless steel, electropolished.
  - .2 Perforations to have nominal size of 6 mm to separate liquids from solids as the screening material is washed and conveyed out of the channel. Manufacturer to replace with larger perforation diameter screen if necessary to reduce organic loading in the screened material.
  - .3 Base plate to sit flat on the channel floor, position the trough at a 35-degree inclination such that liquids drain during transport.

.3 Spiral
  .1 Auger spiral to be made of a high wear-resistant, alloy carbon steel and be equipped with replaceable brush/wiper to clean and protect the screen trough from excessive wear.
  .2 Brush to be a single piece, helically wound with nylon bristles and stainless steel backing.
  .3 Spiral tip speed shall not be more than 0.29 m/s.
  .4 Spiral transport speed shall be not more than 0.033 m/s.
.4 Motor:
  .1 Electric drive motor mounted at the discharge end of the auger, combination ball-bearing motor and speed reducer.
  .2 Power requirements: Power requirements: 2 HP, 575V, 60Hz, 3 Phase.
  .3 Motor shall be of TEFC design, explosion proof (suitable for CEC Class I Zone 1 environment) with 1.15 S.F. (minimum) Class F, insulation type (minimum) per Section 15053.
  .4 Flange mount speed reducer shall have a reduction ratio of 160:1.
  .5 No electrical drive components shall be located below the maximum liquid level of the channel. Refer to the project hydraulic profile for these values.
.5 Spray Wash System
  .1 An integrated stainless steel spray wash system shall be provided to rinse the organic material from the processed solids back into the waste stream.
  .2 Plant effluent water supply connection to be 25 mm, at a minimum pressure of 137.9 kPa.
  .3 Automatically energize wash water to spray into the screen segment whenever the auger spiral is in operation.
  .4 Provide ASCO slow closing solenoid valve to control the wash water flow.
  .5 Solenoid and ball valve to be as per Section 15100.
  .6 Strainer to be as per Section 15400.
.6 Frame Assembly
  .1 Frame assembly shall be fabricated of AISI 304L stainless steel, include pivoting support that holds the auger screen at the proper inclination angle and provides a mechanism for lowering or raising the screen.
  .2 The frame assembly shall be designed to fit into the channel without the need for recessed channel walls or channel invert.
  .3 Design frame to permit access to all components requiring inspection and/or maintenance. Include lifting lugs to permit loading, unloading, and transportation

.4 Discharge Chute:
  .1 Fabricated of minimum 1.5 mm AISI type 304 stainless steel.
  .2 Designed to fully enclose screenings up to and including the screenings conveyor.
  .3 Complete with hinged access door that is accessible from the cannel floor slab for inspection and to facilitate cleaning and maintenance without disassembling equipment.
  .4 Designed to provide closed transition to screenings conveyor.

.5 Controls:
  .1 A centralized stainless steel NEMA 7 local control panel (LCP) will be provided for the grinder, mechanical screen, and all screening conveyors. LCP to be located near the screening system equipment. Panel to be designed in accordance with 17051 Requirements.
  .2 Control panel to include the following for simultaneous operation of the grinder, mechanical screen and screenings conveyor:
    .1 HOA switch pilot.
    .2 Forward/reverse switch pilot light.
    .3 Emergency stop button.

.3 The following signals related to the mechanical cylindrical auger screen is required between the Equipment Manufacturer's Motor Starter Panel and PLC Panel:
  .1 Auger Screen fault (input).
  .2 Auger Screen running reverse (input).
  .3 Auger Screen running forward (input).
  .4 Auger Screen in auto (input).
  .5 Auger Screen reverse command (output).
  .6 Auger Screen forward command (output).
  .7 Auger Screen disconnect open(input).

.4 The following signals related to the inline grinder is required between the Equipment Manufacturer's Motor Starter Panel and PLC Panel:
  .1 Grinder fault (input).
  .2 Grinder running reverse (input).
  .3 Grinder running forward (input).
  .4 Grinder in auto (input).
  .5 Grinder reverse command (output).
  .6 Grinder forward command (output).
  .7 Grinder disconnect open(input).

.6 Specified Product: JWC Environmental Inc. Auger Monster ACE5010-480 model as provided by ACG Envirocan.

.7 Alternate Manufacturers:
  .1 Approved Equal.

2.4 SCREENINGS CONVEYOR

.1 Description:
  .1 Provide complete factory assembled and tested screenings screw conveyor to transfer screenings from the mechanical screen auger discharge to the waste disposal bin bagging system.
  .2 Assembly shall include pre-formed liners, bolted lids, inlet flanges & associated inlet hoppers that match the respective screening system discharges, a flanged axial outlet that bolts to the bagging system including gasket, trough mounting/supporting brackets that are pre-welded to the conveyor trough, vertical supports including base plates, spiral complete with coupling disk, gear drive adapter assembly, and a drive shaft complete with drive plate to mate to the gear drive and motor.
  .3 Refer also to the drawings for layout and installation details.
  .4 The unit is to be factory assembled and tested. Equipment shall be ready for installation and shall not require field assembly except where partial disassembly is required for transportation or protection of components.

.2 Operating Conditions:
  .1 Inlet feed rate: sized to match the screenings throughput of the connected mechanical screen.

.3 Shaftless Screw:
  .1 Spiral flighting for the shaftless screw conveyor shall be designed to convey material with only a single bearing at the drive end.
  .2 The spiral flighting shall be formed in sections from one continuous flat bar and fabricated of AISI 304L stainless steel welded to the shaft.

.3 Conveyor spiral flighting shall have full penetration V-groove lap welds at all splice connections. Welds are to be ground to provide a smooth riding and conveying/pushing surface.

.4 The conveyor unit shall have satisfactory spiral hold-down provisions in order to prevent its spiral from lifting within the trough

.5 Spiral to be 170 mm in diameter and constructed of carbon steel with a minimum Brinell hardness of 220.

.4 Collecting Trough:

.1 Fabricated of minimum 3 mm AISI 304L stainless steel.

.2 Drive end mounting plates shall be a minimum of 10 mm AISI 304L stainless steel.

.5 Wear Liners:

.1 The inner trough surface of the conveyor unit shall be lined with a layer of high-density polyethylene (HDPE) or UHMW. The liner shall be supplied in maximum 1400 mm long sections to provide ease of replacement. The liner shall be held in place with conveyor-length continuous stainless steel square bars to each side of the trough wall; no fasteners, glues or other methods will be permitted. Liner thickness shall be at a minimum 8 mm thick for the 170 mm dia. conveyor trough.

.6 Equipment Supports:

.1 The conveyor unit shall be furnished complete with supports suitable for mounting as shown on the Contract Drawings and as required by the supplier's design. Supports shall be of 304L stainless steel C sections, minimum 3 mm thick complete with 5 mm thick base plates. The supports shall be shop fabricated from structural stainless steel shapes and plates. Support brackets shall be pre-installed onto all units. Vertical supports are supplied with a rectangular plate with bolt holes that are welded to the support bracket assemblies.

.7 Gear Drive Unit:

.1 The conveyor unit shall be driven by a constant-speed gear reducer motor drive unit mounted to an adapter flange mounted to the end plate of the trough endplate

.2 The adapter flange shall not allow the leakage of any material from the conveyor into the gear reducer/motor drive unit.

.3 The gear reducer shall be AGMA Class II, single or double reduction, helical gear units with high-capacity roller bearings. Bearings shall be designed for the thrust loads from the fully loaded start-up condition and shall have an AFBMA B-10 life of 30,000 hours minimum.

.8 Bagging System:

.1 Adapter fabricated of AISI 304L stainless steel and designed to be mounted on screenings conveyor discharge flange to waste disposal bin.

.2 Cassette bag holder assembly to be mounted to adapter flange with AISI 316 Stainless Steel ring clamp with retaining spring for easy removal and replacement.

.3 Cassette bag to be fabricated as minimum 200 ft of continuous, non-porous, three-ply, co-extruded polyethylene with thickness not to exceed 1.8 mm.

.9 Safety Instrumentation:

.1 Motion Failure Alarm Unit: Each conveyor shall be supplied with an external-to-trough mounted motion failure alarm (alternately known as "zero speed" or "under-speed" switch) to detect spiral or drive shaft failure. The transmitter shall be a Milltronics MFA-4P provided in a NEMA 4X polycarbonate enclosure. The sensor shall be a Milltronics XPP-5, Aone 1 unit supplied with 15 metres of factory-sealed cable and mounting bracket.

.2 Pull Cable Switch: The conveyor unit shall be furnished with a tension break protection emergency pull cord and safety switch Zone 1, Group D/NEMA 7 rated. The pull cable switch shall include the pull cable switch, support bracket, orange Nylon-coated cable, AISI 304 stainless steel eye bolts for welding to the side of the conveyor trough by the installing contractor according to manufacturer instructions, cable ends, and spring tensioning assembly complete with turnbuckle. The cord shall run the full length of the conveyor unit. The trip switch shall be wired to the main screening system control panel and shall immediately stop the conveyor when the switch is actuated.

.10 Electrical

.1 Provide all starters and drives necessary for a complete and operational system and are to be located within a centralized screening system control panel. All starters and drives provided shall conform with the requirements of Section 17051.

.2 The motor shall be high efficiency totally enclosed, fan cooled (TEFC), designed in accordance with section 15053 motor specifications. Motor to be 1 HP, 575 volt, 3 phase, 60 Hz. Motor to be constant speed and shall have a minimum 1.15 service factor and are to be Zone 1, Group D rated & CSA certified.

.11 Controls

.1 A centralized stainless steel NEMA 7 local control panel (LCP) will be provided for the screenings conveyor, grinder and mechanical screen. LCP to be located near the screening system equipment. Panel to be designed in accordance with 17051 Requirements

.2 LCP to include the following:

.1 HOA switch pilot.

.2 Forward/reverse switch pilot light.

.3 Emergency stop button.

.3 The following signals related to the screenings conveyor are required between the Equipment Manufacturer's Motor Starter Panel and PLC Panel:

.1 Conveyor forward command (output).

.2 Conveyor reverse command (output).

.3 Conveyor in auto (input).

.4 Conveyor running forward (input).

.5 Conveyor running reverse (input).

.6 Conveyor fault (input).

.7 Conveyor disconnect open(input).

.12 Specified Product: Nordic Water XC200 as provided by ACG Envirocan.

.13 Alternatives:

.1 Approved Equal.

2.5 MOTOR STARTER PANEL

.1 Electrical

.1 All equipment and devices not located within the centralized screening system control panel shall be rated for Class I Zone 1, Group D operation, within the Headworks Building.

.2 Provide all starters and drives necessary for a complete and operational Screening System within the centralized screening system motor control panel. All starters and drives provided shall conform with the requirements of Section 17051.

.2 Controls
  .1 The motor starter control panel shall be a NEMA 7 painted steel control panel.
  .2 Motor Starter Control Panel to include the following, refer to section 17051 for acceptable components.
    .1 Overload relays, contactors, power distribution blocks, control transformer, terminal blocks to terminate all field wiring.
    .2 Operator interfacing devices to be located on the door of the panel. This includes but not limited to multi-position selector switches, pilot lights, lapse time metres, and push buttons.
    .3 Wire/terminal block.
    .4 Motor starters/drives.
    .5 Miscellaneous control components.
  .3 Refer to the individual equipment sections above as well as the project P&ID's for required control interface.
  .4 The panel enclosure will be equipped with an internal bonded steel divider that separates high 575VAC voltage components from lower 120VAC and 24VDC controls components.
  .5 Refer to Section 17051 for further requirements of the motor starter control panel.

.3 Specified Manufacturer: ACG Envirocan.

2.6 CENTRALIZED SCREENING SYSTEM CONTROL PANEL (PLC PANEL)

.1 Electrical
  .1 All equipment and devices not located within the Centralized screening system control panel shall be rated for CEC Class I Zone 1, Group D operation, within the Headworks Building.
  .2 Provide all starters and drives necessary for a complete and operational screening system within the centralized screening system motor control panel. All starters and drives provided shall conform with the requirements of Section 17051.

.2 Controls
  .1 The centralized screening system control panel shall be a NEMA 7 painted steel control panel.
    .1 Control panel to include the following, refer to section 17051 for acceptable components.
      .1 Allen-Bradley CompactLogix PLC based monitoring and control.
      .2 HMI colour touch screen interface.
      .3 CAT6 networking.
      .4 Wire/terminal block.
      .5 Motor starters/drives.
      .6 Miscellaneous control components
  .2 The equipment, monitoring and control requirements noted in the Contract Documents are minimum requirements, and the Screening Equipment Supplier is to provide any materials and equipment necessary, whether or not specifically noted in the Contract Documents, at no additional cost to the Owner to provide a complete and functional system.
  .3 All control, monitoring, alarm or operational information associated with the Screening System shall be available for remote monitoring and control by the overall facility control system. All I/O data, calculated data, alarms, and setpoints in the screening system PLC shall be mapped to registers for reading and writing by the remote PLC controllers via Ethernet/IP.
  .4 PLC programming, pre-startup verification, commissioning and integration assistance of the screening and compactor sub-system will be performed by the Screening Equipment Supplier. The Screening Equipment Supplier is to provide a Process Control Narrative (PCN) that fully describes the operation of the Grinder, Mechanical Screen and Screenings Conveyor sub-system as well as how the centralized controller will be integrated into the overall facility PLC architecture. The Screening Equipment Supplier shall provide assistance to the System Integrator as necessary to ensure that the required system monitoring and control is implemented and operates the equipment

in a manner acceptable to both the Supplier and the Consultant.

.5 Refer to Section 17051 for further requirements of the central control panel.

.3 Specified Manufacturer: ACG Envirocan.

2.7 MANUAL BAR SCREEN

.1 One (1) manual bar rack in all AISI 304 stainless steel construction shall be supplied for installation in a bypass channel as shown in the Project Drawings. The design shall incorporate lifting lugs and the ability to pivot the bar rack out of channel. A matching AISI 304L stainless steel rake shall also be supplied.

.2 Screen Design Parameters include the following:

.1 Channel width: 914.4 mm

.2 Channel depth: 1,300 mm (must allow for 50 mm removable grating section over the screen)

.3 Bar Spacing: 25 CNTRS

.4 Bars: Flat Type, 12 mm x 12 mm

.5 Inclination Angle: Min 45 Degree from horizontal

.6 Screen Height: 1,160 mm. 140 mm lower than TOC in order to enable installation of channel covering above manual rack when not in use

.3 Supply to include perforated plate screenings drying platform and a purpose-built removal rake. All mounting hardware for screen and drying platform to be included. Perforated drying pan (Length x Width): 700 mm x 914.4 mm.

.4 Specified Manufacturer: ACG Envirocan.

.5 Alternatives:

.1 Approved Equal.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Install PART 2 - PRODUCTS equipment in accordance with manufacturer’s instructions.

.2 Provide anchor bolts, fasteners, washers, and templates required for installation of Screening System equipment.

.3 Screening Equipment Supplier shall assist with the work of the Installation Contractor including but not limited to installation of the following components:

.1 All interconnecting control/power wiring.

.2 Verify all field wiring and PLC I/O connections made by Installation Contractor to their respective termination points.

.3 Inspect, test, and verify communications links from respective control panels, drives and equipment to plant SCADA.

3.2 FIELD QULAITY CONTROL

.1 General:

.1 Screening Equipment Supplier shall complete Manufacturer's Certificate of Proper Installation upon satisfactory installation of equipment.

.2 Refer to Division 1 for testing requirements.

.3 Screening Equipment Supplier shall calibrate instruments, sensors, and metres supplied for testing.

.4 Instrumentation and Controls Testing: After installation of the Screening System equipment and prior to commissioning, the Screening Equipment Supplier, in coordination with the Contractor, shall test all instrumentation and control function and verify conformance with approved sequence of operation and system documentation. The Contractor shall also coordinate the Screening Equipment Supplier and the System Integrator to test all interface signals and interlocks between drives, local control panels, and the plant-wide SCADA system over the Ethernet Network.

.2 Functional Testing:

.1 Functional testing shall be conducted after the installation of the Screening System equipment and all appurtenances is complete, to verify proper operation of all the equipment and controls under wet-run conditions using plant water for equipment feed. Each complete unit shall be subject to field functional tests under wet-run conditions to determine that operation is satisfactory.

.2 The Screening Equipment Supplier, in coordination with the Contractor, will provide all temporary measures required for the functional tests. Written test procedures shall be submitted to the Consultant for approval a minimum of 60 days prior to testing.

.3 The functional tests shall determine the characteristics of each unit and demonstrate the units:

.1 Have not been damaged by transportation or installation.
.2 Have been properly installed.
.3 Have no mechanical defects.
.4 Are in proper alignment.
.5 Have been properly connected.
.6 Are free of overheating of any parts.
.7 Are free of objectionable vibration and noise as specified.
.8 Are free of overloading of any parts.
.9 Are properly lubricated.
.10 Respond properly to all start-up and shutdown sequences.

.3 Vibration Test: Vibration testing shall be conducted during field functional testing. The Screening Equipment Supplier shall verify operations are within tolerances and the vibration signature recorded over the frequency domain.

.1 Provide vibration signature test data for each piece of equipment and drive assembly to meet performance requirements specified.

.2 Test Duration: Refer to Section 15010.

.4 Noise Test: Perform noise testing in the field with equipment installed and operating at peak capacity to verify noise produced by the equipment. Noise from equipment to be less than or equal to those listed by the manufacturer.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section includes the supply, installation, testing and commissioning of an ultraviolet (UV) disinfection system as described herein.

.2 The General Contractor is to provide a UV disinfection system in compliance with these specifications and as shown on the Drawings.

.3 UV disinfection system provisions to include one (1) duty UV bank, one (1) standby UV bank, support racks, two (2) level control weirs, two (2) power distribution centers, one (1) hydraulic system center, and one (1) system control center serving all the above equipment. Coordinate equipment supply with this specification and the drawings.

.4 Disinfection Equipment Supplier to provide a complete package to include all necessary components, including accessories, controls and electrical to limits indicated herein. Generally, unless indicated otherwise, the supplier is to provide a complete and working system to satisfy performance requirements and general intent specified in these documents.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.
- .1 American Iron and Steel Institute (AISI).
- .2 National Water Research Institute (NWRI):
  - .1 Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse
- .3 United States Environmental Protection Agency (US EPA):
  - .1 EPA/625/1-86/021– Design Manual: Municipal Wastewater Disinfection.
- .4 Canadian Standards Association (CSA).
- .5 Electrical Safety Authority (ESA).
- .6 National Electrical Code (NEC).
- .7 Electric and electronic Manufacturers Association of Canada (EEMAC).
- .8 Ontario Electrical Safety Code (OESC).
- .9 Underwriters Laboratory (UL or cUL).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15.

.2 Informational submittal required for all PART 2 – PRODUCTS specified herein.

.3 In addition to the submittal requirements of Division 1 and Division 15, submit the following:
- .1 Product Data:
  - .1 Descriptive information including catalogue cuts and manufacturers' specifications for major components.
  - .2 Dimensions.
  - .3 Anchoring requirements.

.4 Lifting frame requirements.
.5 Hydraulic calculations demonstrating compliance with the required hydraulic characteristics.
.6 Independent bioassay validation and dosage calculations demonstrating compliance with the specified dose requirements.
.7 Provide Instrumentation and Control Systems submittals including, but not limited to the following:
  .1 Piping and Instrumentation Diagrams (P&IDs).
  .2 General Arrangement Drawing (GA).
  .3 Process Control Narrative.
  .4 System control center layout complete with component bill of materials.
  .5 System control center shop drawings for utilized controllers, power supplies, controller cards, touch screen interface, intrinsically safe relays, terminal block, surge protective devices, starters and drives.
  .6 Field instrumentation product shop drawings and data sheets.
  .7 System control center schematics and wiring diagrams, including field loop diagrams and network schematics.
  .8 All HMI screens.
  .9 System control center program.
  .10 Field instrument classification ratings as well as specific installation details.

.2 Operation and Maintenance Data:
  .1 Operation and Maintenance Manuals in accordance with Division 1.
  .2 Manufacturer's maintenance and installation requirements.
  .3 Safety information data for maintenance staff prior to performing maintenance requirements.
  .4 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the Manufacturer.
  .5 Any maintenance requirements that may affect the warranty periods of the associated equipment.

.3 Quality Control Data:
  .1 Manufacturer protocol for Microbiological Performance Testing.
  .2 A certificate of proper installation submitted on OEM letterhead, signed by the Manufacturer or their representative and certifying that the equipment has been installed in accordance with their installation instructions.
  .3 Performance testing reports.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Refer to Division 1 for delivery, storage and handling requirements.

.2 All equipment delivered to the site shall be stored in accordance with the manufacturer's instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.6 MAINTENANCE AND SPARE PARTS

.1 Maintenance and Spare Parts in accordance with Division 1 requirements.

.2 Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

.3 Provide the following spare parts for the UV disinfection system:
  .1 Four (4) UV lamps.
  .2 Four (4) quartz sleeves.
  .3 One (1) ballast.
  .4 One (1) 4L jug of Vendor recommended cleaning solution.
  .5 Four (4) wiper seals.

.4 Provide any specialty tools required for maintenance.

1.7 QUALITY ASSURANCE

.1 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier's cost if proper supporting evidence cannot be provided.

.2 Provide all equipment from single Manufacturer where applicable.

.3 Manufacturer of UV disinfection equipment to have a minimum of five (5) years experience and be regularly engaged in the design, manufacture, supply, installation and commissioning of UV disinfection systems. Manufacturer to provide written documentation of previous experience with municipal UV disinfection systems in wastewater applications.

.4 Documentation of Manufacturer's service capabilities to be provided, including location and experience.

.5 Provide written lifetime performance guarantee indicating the total suspended solids and E.coli treatment limits that will be achieved by the UV disinfection system.

.6 All electrical installation and components shall comply with CSA and local electrical authority.

.7 Electrical Equipment not bearing a CSA label requires an ESA field approval.

.8 Where required by Authority having jurisdiction, equipment shall bear a ULC or UL label.

.9 The basis for evaluating the UV dose delivered by the UV equipment will be the Manufacturer's bioassay as carried out by an independent third party. Bioassay validation methodology to follow protocols described in NWRI – Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse or US EPA Design Manual – Municipal Wastewater Disinfection (EPA/625/1-86/021), without exception. At a minimum, the following parameters shall be included in the validation test:
  .1 UV Transmittance.
  .2 UV Intensity.
  .3 Flow rate per lamp.
  .4 Power consumption.
  .5 Headloss across UV banks.

1.8 COMMISSIONING

.1 Refer to Division 1 for commissioning requirements.

.2 UV disinfection equipment manufacturer to provide a checklist of items to be completed by the General Contractor prior to beginning commissioning

.3 Following installation and initial checkout by the General Contractor, the Manufacturer is to provide a factory trained technician to commission the UV disinfection system.

1.9 TRAINING

.1 Refer to Division 1 for Training requirements.

1.10 WARRANTY

.1 Refer to Division 1 for warranty requirements.

.2 The Manufacturer shall provide a warranty for a minimum period of one (1) year from Substantial Completion. All UV disinfection equipment supplied by the Manufacturer shall:

.1 Be free from defects in design, materials, and workmanship, including damages that may be incurred during shipping.

.2 Maintain the minimum performance requirements as specified herein.

.3 The UV lamps shall be warranted for a minimum of 12,000 operating hours in automatic mode (pro-rated after 9,000 hours) from date of Substantial Completion.

.4 The UV lamp manufacturer shall ensure disposal of returned lamps (old or used) during the warranty period at no cost to Owner upon receipt of returned lamps at the manufacturing headquarters.

.5 Electronic Ballasts shall be warranted for a minimum period of five years (pro-rated after one year) from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 GENERAL

.1 The disinfection equipment will be installed indoors and designed for open channel, gravity flow, low pressure high intensity ultraviolent lamp (UV) treatment.

.2 All material in contact with effluent water will be Type 316 stainless steel or quartz. All materials above the effluent water level will be Type 304 stainless steel.

.3 All material exposed to UV light will be stainless steel, anodized aluminum, quartz 214 or Teflon™.

.4 All wires connecting the lamps to the ballasts will be enclosed inside the frame of the UV module or Teflon™ coated to prevent degradation. Each new UV bank to be supplied complete with an automatic chemical / mechanical cleaning system and variable output electronic ballasts.

2.2 PERFORMANCE REQUIREMENTS

.1 The UV equipment shall conform to or exceed the following performance requirements:

.1	Peak design flow (per UV channel):	17,813 m^3/day.
.2	Average design flow:	4,600 m^3/day.
.3	Minimum Flow:	<1,000 m3/day.
.4	Minimum UV transmittance:	65% at 253.7 nm.
.5	Total Suspended Solids Limit:	15 mg/L (based on 30-day average grab sample).
.6	Disinfection Limit:	100 E. coli per 100 mL (based on 30 Consecutive daily grab samples).
.7	Design Dose:	30 mJ/cm2 (bioassay validated).
.8	Effluent Temperature Range:	33 to 86 °F (0.5 to 30 °C)

.2 The UV modules supplied will be arranged in the following manner:

.1	Number of Channels:	1
.2	Number of UV banks:	2 (1 duty, 1 redundant)
.3	Number of Modules per Bank:	7
.4	Number of Lamps per Module:	8
.5	Total number of UV lamps:	112 (including 56 for redundancy)
.6	Maximum Power Draw:	14.2 kW
.7	Channel Length Required:	25 ft 4 in
.8	UV Channel Width:	28 in
.9	UV Channel Depth:	62 in

2.3 UV MODULE

.1 Materials of construction: Type 316 stainless steel, anodized aluminum, quartz 214 and Teflon™ UL, with a UV module rating of Type 6P.

.2 Each UV lamp will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal and holder. The quartz sleeve shall not extended beyond or come into contact with any steel in the frame.

.3 Each UV module to be provided completely pre-assembled, containing lamps, quartz sleeves and to be electrically wired to each electronic ballast.

.4 Each UV module to be provided with a 2-point lifting frame to facilitate removal from channel for maintenance/cleaning. Lifting device to be provided by others.

2.4 UV LAMPS

.1 UV Lamps will be of high intensity, low pressure amalgam design, preheated to promote longevity. Lamp filament to be of clamped design to withstand shock and vibration.

.2 UV lamps to be designed for complete immersion in effluent water, including both electrodes and the full length of the lamp tube.

.3 The lamp array configuration will be uniform, with all lamps parallel to each other and to the flow.

.4 90% of UV output will be within the wavelengths of 233.7 to 23737 nm.

.5 The operating life of the lamp will be guaranteed for 12,000 hours, pro-rated after 9,000 hours.

.6 The UV dose will be adjusted using an end of lamp life factor to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. Independent validation of end of life lamps factor is required.

2.5 LAMP END SEAL AND LAMP HOLDER

.1 The open end of the lamp sleeve will be sealed by means of a sleeve nut which threads onto a sleeve cup and compresses the sleeve 'O' ring.

.2 The sleeve nut will have a knurled surface to allow a positive handgrip for tightening. The sleeve nut will not require any tools for removal.

2.6 UV LAMP SLEEVES

.1 Quartz sleeves to be Type 214 clear fused quartz circular tubing as manufactured by General Electric or equal.

.2 The nominal wall thickness will be 1.0 to 2.0 mm to maximize UV transmission.

.3 The UV dose will be adjusted using a quartz sleeve fouling factor when sizing the UV system in order to compensate for attenuation of the minimum dose due to sleeve fouling during operation. Independent validation of sleeve fouling factor is required.

2.7 SUPPORT RACKS

.1 Each UV bank to be provided with support racks to support the UV modules within the effluent channel.

.2 Materials of construction: Type 304 stainless steel.

.3 Support racks to be installed with anchors per manufacturer's specifications.

2.8 LEVEL CONTROLLER

.1 Provide level controller device to maintain and control the effluent water level, to an accuracy that allows for continuous uninterrupted operation of the UV disinfection system.

.2 Level controller to be Level Control Weir installed in the effluent water channel downstream of the UV Banks.

.3 Level Control Weir to be constructed of Type 304 stainless steel.

2.9 WATER LEVEL SENSOR

.1 Manufacturer to provide low water level sensor for each UV channel. During system operation, the water level sensor will ensure UV lamps extinguish automatically if the water level in the channel drops below an acceptable level.

.2 Enclosure Rating: Type 4X

2.10 MONITORING SYSTEM

.1 A submersible UV sensor will continuously monitor the UV intensity produced in the bank of UV lamp modules. The sensor will measure the germicidal portion of the light emitted by the UV lamps.

.2 Monitoring system will be enclosed in a fibreglass Type 4X wall mounted panel and is to be located less than 12 feet (3.66 m) from the LED end of the UV module.

.3 UV intensity will be indicated on a 3-character display in MW/cm^2.

.4 Elapsed time in hours (lamp age) will be indicated on a 5-character display.

.5 Both displays will utilize LEDs and will be visible through the panel door.

.6 A dry contact will be provided for remote indication of low UV intensity alarm.

2.11 CLEANING SYSTEM

.1 An automatic cleaning system will be provided to clean the quartz sleeves using both mechanical and chemical methods. Wiping sequence will be automatically initiated with capability for manual override. Cleaning cycle intervals to be field adjustable.

.2 Cleaning system components to be housed in Hydraulic System Center.

.3 Cleaning system to be provided with the required solutions necessary for initial equipment testing and for equipment start-up.

2.12 POWER DISTRIBUTION CENTERS

.1 Each UV Bank to be provided with a separate Power Distribution Centre. Power distribution will be through environmentally sealed receptacles on the Power Distribution Centre(s) to allow for local connection of UV modules.

.2 Materials of construction: Type 304 stainless steel, type 4X (IP66).

.3 Enclosure rating: Type 4X.

.4 All Power Distribution Centers to be cUL listed to Canadian safety standards.

2.13 HYDRAULIC SYSTEM CENTER

.1 Materials of construction: Type 304 stainless steel, type 4X (IP66).

.2 Enclosure rating: Type 4X.

2.14 SYSTEM CONTROL CENTER:

.1 Materials of construction: Type 304 stainless steel, type 4X (IP66).

.2 Enclosure rating: Type 4X.

.3 Alarms to be provided to indicate to plant operators than maintenance is required or operating conditions which may impact UV treatment performance. Alarms to include:

- .1 Lamp Failure.
- .2 Multiple Lamp Failure.
- .3 Low UV Intensity.
- .4 Module Communication Alarm.

2.15 ISOLATION TRANSFORMER

.1 UV supplier to provide a standalone dry-type isolation transformer to step down from 600 Volt, 3 Phase to 480 Volt, 3 Phase power with 4 Wire + Ground.

.2 Transformer Rating: 27 kVA, K4

.3 Enclosure Rating: NEMA 3R (Indoor), painted mild steel.

.4 Transformer to be cUL listed to Canadian safety standards.

2.16 ELECTRICAL

.1 Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with the requirements of Division 16 - Electrical.

2.17 SPECIFIED PRODUCT

.1 Trojan UV3000Plus™.

2.18 ALTERNATIVE EQUIPMENT

.1 Approved Equal.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 UV disinfection system to be installed in accordance with Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheet.

3.2 TESTING

.1 Microbiological Performance Testing shall be conducted after the installation of the UV disinfection system and all related appurtenances are complete.

.2 Disinfection Equipment Supplier, in coordination with the Contractor will provide all temporary measures required for the Microbiological Performance Testing. Written test procedures shall be submitted to the Consultant for review and approval a minimum of 60 days prior to testing.

.3 Refer to Division 1 and sections 15010 Mechanical General provisions and 15030 – Testing, for additional testing requirements.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This Section covers the supply, delivery, installation, testing and commissioning of the surface aspirators as specified herein.

.2 The General Contractor is to provide surface aspirators in compliance with these specifications and as shown on the Drawings.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.
- .1 American Society for Testing and Materials (ASTM):
- .2 American Bearing Manufacturers Association (ABMA).
- .3 American National Standards Institute (ANSI).
- .4 American Society of Mechanical Engineers (ASME):
- .5 Electrical Safety Authority (ESA).
- .6 Canadian Standards Association (CSA).
- .7 National Electrical Code (NEC).
- .8 Electric and electronic Manufacturers Association of Canada (EEMAC).
- .9 Ontario Electrical Safety Code (OESC).
- .10 National Electric Manufacturers Association (NEMA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15 requirements.

.2 Informational submittals required for all Part 2 – Products specified herein. In addition to the requirements noted in clause .1 above provide the following:
- .1 Product Data:
  - .1 Relevant information to confirm that the specifications have been met.
  - .2 Identify construction materials for all components.
  - .3 Relevant data illustrating full range of operation including speed curves, if applicable.
  - .4 Electrical motor information and specification.
  - .5 Loadings imparted to each piece of equipment.
  - .6 Permissible range of vibration.
  - .7 Factory finishing details.
  - .8 Anchoring requirements.
  - .9 Noise characteristics of equipment.
- .2 Operation and Maintenance Data:
  - .1 Refer to Division 1 and Division 15 for requirements.

.3 Quality Control Data:
.1 Manufacturer's certified testing results.
.2 Manufacturer's certificate confirming proper installation.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Refer to Division 1 for delivery, storage and handling requirements.

.2 All equipment shall be completely factory assembled to the extent possible, practical, and safe for transport and on-site handling.

.3 All equipment delivered to the site shall be stored in accordance with the manufacturer's instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Close Out requirements.

1.6 MAINTENANCE AND SPARE PARTS

.1 Refer to Division 1 for additional Maintenance and Spare Parts Requirements.

.2 Contractor shall verify and demonstrate that proper maintenance can be performed on installed surface aspirators.

.3 Provide spare parts in accordance with procedures outlined in Division 1.

.4 Provide any specialty tools required for maintenance.

1.7 QUALITY ASSURANCE

.1 Manufacturer to provide a written certification stating that the floating aspirators have been installed to their standards.

.2 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier's cost if proper supporting evidence cannot be provided.

.3 Guarding to meet OSHA and CSA Z432 requirements.

.4 All electrical installation and components shall comply with CSA and local electrical authority.

.5 Electrical Equipment not bearing a CSA label requires an ESA field approval.

.6 Where required by Authority having jurisdiction, equipment shall bear a ULC or UL label.

.7 Each surface aspirator shall be tested at the factory for correct operation, lubrication, operating temperature, lack of vibration, and dry amp draw. A test sheet certifying suitable operation shall be provided to Consultant Engineers for review prior to shipment.

.8 Manufacturer to have a minimum of five (5) years experience in the design, manufacture, supply and commissioning of surface aspirators under similar operating conditions.

1.8 COMMISSIONING

.1 Refer to Division 1 and Division 15 section 15010 for commissioning requirements.

1.9 TRAINING

.1 Refer to Division 1 and Division 15 for training requirements.

1.10 WARRANTY

.1 Refer to Division 1 for warranty requirements.

.2 Manufacturer's warranty shall be for a minimum period of one year from Substantial Completion. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts.

PART 2 – PRODUCTS

2.1 GENERAL

.1 Surface aspirators to be horizontally mixing aspirating type aerators, each provided with a multi-pontoon float system, including support brackets and mounting cradle, for installation on the surface of a lagoon cell.

.2 Each surface aspirator to consist of an electric motor flexibly coupled to a solid rotating shaft with an impeller affixed to the lower end. The shaft shall be supported at the top and bottom by two sealed tapered roller bearings. A stationary draft tube shall be provided to facilitate the passage of atmospheric air through the unit and into the wastewater.

.3 Unless otherwise noted, all surface aspirator equipment to be designed to operate in an outdoor location with a Zone 2, Group D electrical classification.

.4 Refer to the Drawings for configuration.

2.2 PERFORMANCE REQUIREMENTS

.1 Surface Aspirators MX-7201, MX-7202, MX-7203, MX-7204, MX-7205 and MX-7206:

.1	Lagoon Surface Area:	0.68 ha
.2	Number of Units:	6
.3	Rated Motor Power (per unit):	18.6 kW (25 HP)
.4	Total Installed Motor Power:	111.9 kW (150 HP)
.5	Minimum Oxygen Transfer Rate (per unit):	40 lbs O_2/hr at standard conditions

2.3 SURFACE ASPIRATORS

.1 Aerator Shaft

.1 Aeartor shaft shall be a minimum of 25.4 mm in diameter, and fabricated as one-piece, solid, 304 stainless steel. Thin walled hollow shafts will not be accepted.

.2 Shaft length to be a minimum of 1219 mm such that the motor is at least 254 mm above the water level and the impeller blades are a minimum of 254 mm below the water surface.

.3 Shaft shall be precision machined with threads and keyways on the propeller end and on the motor end.

.4 Shaft run out shall not exceed 0.2 mm along its entire length to assure straightness and vibration free operation. Balancing the shaft to reduce vibration will not be an accepted measure of shaft straightness.

.5 Shaft shall be shielded from the environment, suitable for cold weather operation.

.2 Aerator Shaft Bearings

.1 Tapered roller bearings shall be installed near the top and bottom of the aerator shaft, designed to stabilize the shaft and support propeller trust loads. Under no circumstances shall the thrust load generated by the propeller be transferred to the aerator shaft/motor shaft coupling or motor bearings.

.2 Shaft bearing design life (L10) shall be at least 100,000 hours as documented by an independent registered Professional Engineer. Supporting documentation to be provided with equipment submittals.

.3 All aerator shaft bearings shall operate within a grease lubricated environment, and be seal protected. The grease lubricated bearings shall allow the units to be able to run dry for a minimum of 30 minutes and shall be dry tested.

.4 Grease fittings shall be used to allow the addition of grease to each bearing. All aerator grease fittings shall be located above the liquid surface.

.5 Bearing seals shall be contained in seal modules and located on each end of a 304 stainless steel bearing support tube. The seal modules shall be removable so all bearings can be easily inspected and to ease seal replacement.

.6 A splash guard cone constructed of 304 stainless steel shall be provided to protect the lower end of the bearing support tube.

.7 Bearings shall be self-heating, suitable to develop sufficient temperature to facilitate cold weather operation.

.3 Draft Tube

.1 The draft tube shall be constructed of stainless steel and designed with an inlet of sufficient size and shape to minimize aerodynamic drag and maximize air flow. Rotating hollow shafts or rotating air inlets shall not be accepted.

.2 The air passageway provided shall be at least 2710 mm^2 in cross-sectional area along its length.

.4 Propeller
- .1 Propeller shall be fabricated of cast stainless steel and be a non-fouling, high efficiency, low vortexing, hollow hub type impeller.
- .2 Impeller assembly shall include a key or spine to prevent the propeller from becoming loose regardless of direction of shaft rotation.
- .3 The propeller must be serviceable without a need for special tooling.
- .4 The air flow outlet shall be at least 3839 mm^2 to maximize oxygen transfer.

.5 Aerator Motor Coupling
- .1 A flexible coupling shall be used between the motor and aerator shaft to compensate for parallel and/or angular misalignment in between the rotating components.
- .2 The coupling shall be flange and sleeve type, manufactured by Woods, Lovejoy, or an equivalent brand.

.6 Motor Mount
- .1 Each surface aspirator shall be provided with a stainless steel motor mount allowing the aerator to be easily rotated from a nearly vertical to nearly horizontal orientation.
- .2 The motor mount shall be designed to allow for the aerator to be secured a various angles and indexed to display the angle of operation.
- .3 The motor mount design will allow for either the motor or aerator section to be removed for service without dismantling the entire aerator from the mounting system.

2.4 FLOAT ATION SYSTEM

.1 Materials
- .1 All materials for the brackets, mounting cradles and fasteners shall be 304 stainless steel.
- .2 The pontoons shall be fabricated of 304 grade stainless steel.
- .3 No galvanized plastic, fiberglass or aluminum components shall be used.

.2 Pontoons
- .1 Marine grade closed cell polymer foam shall be injected into each pontoon to fill the interior, close the ends and close all seals. All foam fill ports shall then be plugged.
- .2 Each pontoon shall be provided with stainless steel supports on which brackets can be bolted. No brackets or plates shall be welded to the pontoon skin.

.3 Support Brackets
- .1 Thick wall pipe shall be provided to span between the pontoons and provide a support for the aerator mounting cradles and optional work grates.
- .2 Mounting cradle pieces shall have a minimum thickness of 8mm and incorporate either a curved slot or bolt hole circle to firmly support the aerator at various angles.
- .3 The cradle shall allow the aerator to be rotated from nearly vertical to nearly horizontal.

.4 Flotation Capacity
- .1 A safety factor of at least two times the total assembly weight, including aerator and motor, shall be used to design the float system.
- .2 The floatation system shall be designed to withstand normal wave action, wind velocities and aerator thrust without capsizing.

.3 The complete aerator float system shall not be more than ¾ submerged when a 91 kg person is standing on it.

.5 Anchoring

.1 Each float system shall be capable of being four-point moored in position as shown in the Contract Drawings.

.2 Stainless steel mooring plates, stainless steel eye bolts or stainless steel cable clamps shall be provided for anchoring each float assembly in place.

2.5 MOTOR

.1 Motor shall be premium efficiency TEFC, NEMA Design B with 1.15 service factor or greater and Class F insulation.

.2 Motor must be suitable for an electrically rated Zone 2, Group G environment.

.3 Motor size 18.6 kW (25 HP), 1800 rpm, 575 V/3ph/60 hz.

.4 Motor to meet the requirements of Section 15053.

2.6 ELECTRICAL

.1 Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with the requirements of Division 16, Electrical.

2.7 CONTROLS

.1 Refer to the Contract Drawings and Process Control Narrative for the proposed control methodology.

.2 The surface aspirators will be controlled through a Programmable Logic Controller (PLC). The PLC will be provided as part of Division 16.

.3 A motor soft start will be provided as part of Division 16.

2.8 SPECIFIED PRODUCT

.1 Fluence Tornado® series as provided by H2Flow Equipment Inc.

2.9 ALTERNATE MANUFACTURERS

.1 Approved Equal.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Surface aspirators complete with multi-pontoon float system are to be installed in accordance with Manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

.1 General:
- .1 Surface aspirator supplier shall complete Manufacturer's Certificate of Proper Installation upon satisfactory installation of the equipment.
- .2 Refer to Division 1 for additional testing requirements.
- .3 Surface aspirator supplier shall calibrate instruments, sensors, and meters supplied for testing.

.2 Functional Testing:
- .1 Functional testing shall be conducted after the installation of the surface aspirators and all related appurtenances are complete, to verify proper operation of all the equipment and controls under wet-run conditions.
- .2 The Equipment Supplier, in coordination with the Contractor, will provide all temporary measures required for the functional tests. Written test procedures shall be submitted to the Consultant for approval a minimum of 60 days prior to testing.
- .3 The functional tests shall determine the characteristics of each unit and demonstrate the units:
  - .1 Have not been damaged by transportation or installation.
  - .2 Have been properly installed.
  - .3 Have no mechanical defects.
  - .4 Are in proper alignment.
  - .5 Have been properly connected.
  - .6 Are free of overheating of any parts.
  - .7 Are free of objectionable vibration and noise as specified.
  - .8 Are free of overloading of any parts.
  - .9 Are properly lubricated.
  - .10 Respond properly to all start-up and shutdown sequences.

.3 Vibration Test: Vibration testing shall be conducted during field functional testing. The Equipment Supplier shall verify operations are within tolerances and the vibration signature recorded over the frequency domain.
- .1 Provide vibration signature test data for each surface aspirator for comparison to factory testing data.
- .2 Provide testing plan with applicable standards being used prior to performing field testing.

.4 Test each unit to ensure surface aspirator delivers rated capacity in Consultant's presence.

.5 Test electrical loading to ensure surface aspirators operate efficiently without electrical overload.

.6 Noise Test: Perform noise testing in the field with equipment installed and operating at peak capacity to verify noise produced by the equipment. Noise from equipment to be less than or equal to those listed by the manufacturer.

3.3 IDENTIFICATION

.1 Surface aspirators are to be tagged consistent with the Contract Drawings and the requirements of Section 15020.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Contractor to supply and install all materials, equipment, and services for the fine bubble aeration system required for each of the two (2) aeration tanks as indicated on the drawings and within these specifications. Scope to include diffusers, distribution, air purging system, supports and supply piping.

.2 Unit Responsibility: The Work requires that the fine bubble air diffuser system, air purging system with all accessories and appurtenances be the end product of one responsible system manufacturer or responsible system supplier. Unless otherwise indicated, the Contractor shall obtain each system from the responsible supplier(s) of the equipment, which supplier(s) shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Contractor's responsibilities under the Contract Documents. The Contractor is responsible to the Owner for providing the equipment system as specified.

.3 Supplier to design aeration system to meet performance requirements specified herein, and complete testing to prove performance.

.4 The aeration system generally consists of two positive displacement blowers feeding an air distribution network that provides air to two (2) aeration tanks in addition to providing site wide channel aeration. Each aeration tank will have two droplegs. A DO sensor will control a modulating valve to vary the air flow in accordance with the demand. Only the fine bubble aeration system and its direct appurtenances forms part of this specification (excluding the blowers, distribution network to the tanks, DO sensors and the modulating valves).

.5 Commission and prove performance of new aeration system.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.5 - Pipe Flanges and Flanged Fittings.
- .2 American Society of Civil Engineers (ASCE): 2, Measurement of Oxygen Transfer in Clean Water.
- .3 Canadian Standards Association (CSA): B137.3, Rigid PVC Pipe for Pressure Applications.
- .4 American Society for Testing and Materials (ASTM):
  - .1 A182 - Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service.
  - .2 A240 - Standard Specification for Heat Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
  - .3 A276 - Standard Specification for Stainless Steel Bars and Shapes.
  - .4 A380 - Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
  - .5 A774 - As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
  - .6 A778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products.
  - .7 D395 - Standard Test Methods for Rubber Property – Compression Set.

.8 D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
.9 D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
.10 D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
.11 D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
.12 D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
.13 D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
.14 D3915 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Pressure Applications.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15 requirements.

.2 Informational submittal required for all Part 2 – Products specified herein. In addition to the requirements noted in clause .1 above, submit the following:
  .1 Product Data:
    .1 Factory finishing details.
    .2 Anchoring requirements.
    .3 List of components and materials to be shipped pre-assembled and parts list of other components and materials.
    .4 A detailed drawing of proposed aeration equipment layout for each aeration tank showing air line sizes and lengths, distances between air distribution headers, and location of diffusers, supports, and expansion joints. Respect the dropleg locations shown on the drawings.
    .5 Diffuser, diffuser connector, balancing orifices, and system head loss curves covering range of airflow rates specified.
    .6 Calculations establishing the maximum air flow to each cell, based on the specified maximum oxygen requirements for each tank, the required diffuser depth and the manufacturer's anticipated oxygen transfer efficiency for each of the two (2) tanks. Calculations to be signed and sealed by a registered Professional Engineer.
    .7 Calculations establishing the number of diffusers proposed for each cell based on the maximum air flow per cell established above, and the proposed maximum air flow per diffuser and/or any other factors. Cleary state any other factors considered which impact the number of diffusers. Calculations to be signed and sealed by a registered Professional Engineer.
    .8 Calculations establishing the complete air headloss for the aeration equipment from the top of the dropleg to the farthest diffuser bubble release point. Calculations to be signed and sealed by a registered Professional Engineer.
    .9 Calculations demonstrating the flow control orifices and piping design will achieve an air flow per diffuser that does not vary by more than 10 percent within a grid at the specified air flow rates. Calculations to be signed and sealed by a registered Professional Engineer.
    .10 Oxygen transfer performance data from a minimum of three previous testing programs to demonstrate conformance with the specification and design oxygen transfer efficiency. Provide information consisting of factory test data and analysis from previous non-steady state clean water oxygen transfer tests. The test to have been conducted according to the procedures outlined in the ASCE standards (Measurement of Oxygen Transfer in Clean Water). The test information to include a complete description of the test procedure and conditions, tank and diffuser configuration, submergence and air flow rate. For each test, the total dissolved solids concentration should be noted.

.11 Calculations demonstrating that support design complies with requirements of this section. Calculations to be signed and sealed by a registered Professional Engineer.

.2 Quality Control Data to include:

.1 A certificate of proper installation submitted on OEM letterhead, signed by the Manufacturer or their representative and certifying that the equipment has been installed in accordance with their installation instructions.

.2 Factory test results, reports, and certifications. Include oxygen transfer performance test. Factory test report to be prepared in accordance with reporting requirements stated in ASCE Standard for Measurement of Oxygen Transfer in Clean Water, including standard oxygen transfer efficiency (SOTE) and demonstration of equal flow distribution within each grid, for all specified air flow conditions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Refer to Division 1 for delivery, storage and handling requirements.

.2 All equipment delivered to the site shall be stored in accordance with the manufacturer's instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.6 MAINTENANCE AND SPARE PARTS

.1 Refer to Division 1 for additional Maintenance and Spare Parts Requirements.

.2 Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

.3 Provide the following spare parts:

.1 Twenty (20) spare membrane disc diffusers.

.4 Forty (40) spare membrane disc diffuser retaining rings. Provide a list of recommended spare parts for the first five years of operation, including a price list and location of the nearest facility from which all spare parts can be obtained.

.5 Provide any specialty tools required for installation or maintenance.

1.7 QUALITY ASSURANCE

.1 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier's cost if proper supporting evidence cannot be provided.

.2 Provide a written performance guarantee indicating the minimum SOTE that will be achieved by the aeration system for each aeration tank.

.3 Provide all equipment from Single Manufacturer where applicable.

.4 Manufacturer to have a minimum of ten (10) years experience in the design, manufacture, supply and commissioning of fine bubble air diffuser systems.

1.8 COMMISSIONING

.1 Refer to Division 1 and to Division 15 for additional commissioning requirements.

.2 .2 Equipment manufacturer's factory trained representative to visit site for a minimum of one day to initially supervise the installation of the diffusers and distribution grid and to train the Contractor's installation crew.

.3 .3 Equipment manufacturer's factory trained representative to inspect the installation of the first tank installation following completion of the installation and connection of the air supply, but prior to adding water to the tank.

.4 .4 Following correction of any deficiencies the tank is to be filled with clean water and the factory trained technician is to witness and monitor the initial start-up.

1.9 TRAINING

.1 Refer to Division 1 and to Division 15 for additional training requirements.

.2 Only following commissioning and acceptance of installation by Consultant, the factory technician is to provide training in the operation and maintenance of the equipment using the maintenance manual provided.

.3 Training required for the aeration system.

1.10 WARRANTY

.1 Refer to Division 1 and to Division 15 for additional training requirements.

.2 The Manufacturer shall provide a warranty for a minimum period of 1 year after the date of Substantial Completion, all aeration system equipment supplied by the Manufacturer shall:

.1 Be free from defects in design, materials, and workmanship.

.2 Maintain the minimum performance requirements as specified herein.

PART 2 – PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Furnish fixed header, fine bubble, diffused air aeration equipment system as a complete package including, but not necessarily limited to, dropleg; air manifold; distribution headers; circular flexible membrane diffuser assemblies; moisture removal system; and supports including header joints; accessories; and miscellaneous appurtenances.

.2 Furnish complete, engineered systems. The Drawings indicate air manifold, headers, diffuser orientations, and general locations only. Details such as air manifold sizes, air header sizes and spacing, air manifold and header supports and spacing, diffuser spacing, etc., shall be defined by and be the responsibility of Manufacturer and shall be consistent with requirements in this Section.

.3 Size and design the aeration grid fit the pre-established tank footprint. Refer to the drawings for tank construction details. Design the manifold and diffusers layout to ensure no dead zones within the aeration tank.

.4 Design aeration equipment so that upon completion of installation, arrangement allows for access between manifolds.

.5 Design aeration equipment so that upon completion of installation, diffusers are level to within plus or minus 10 mm.

2.2 PERFORMANCE REQUIREMENTS

.1 The biological treatment process is an extended aeration process and will be designed with a recycle flow of activated sludge from downstream settling tanks to feed microorganisms for the removal of BOS5 and TKN. Ferric chloride is used as a coagulant in the secondary clarifiers.

.2 The biological treatment plant is designed for an annual average day flow of 4,600 m^3/d and a peak hourly flow of 17,813 m^3/day. Projected loadings to the plant are:

Parameter	**Design Value**
Average Day Flow	4,600 m^3/d
Peak Hour Flow	17,813 m^3/d
Temperature Range:	10 – 20°C
BOD5 Loading Average Maximum Month	 207 mg/L (950 kg/d) 1,354 kg/d
TSS Loading Average Maximum Month	 253 mg/L (1,163 kg/d) 1,653 kg/d
TP Loading Average Maximum Month	 6.0 mg/L (27 kg/d) 37 kg/d
TKN Loading Average Maximum	 48 mg/L (222 kg/d) 284 kg/d
TAN Loading Average Maximum Month	 38 mg/L (174 kg/d) 228 kg/d

.3 Air rates will be controlled based on the measured dissolved oxygen concentration.

.4 System Aeration Requirements:
- .1 Guaranteed minimum Standard Oxygen Transfer Efficiency (SOTE) of 28 percent at peak day aeration demands in each tank.
- .2 Available Minimum Pressure at Top of Dropleg: 44.77kPa(g).
- .3 Aeration Tank Sidewater Depth: 4.5 metres.

2.3 EQUIPMENT CONSTRUCITON

.1 General:
- .1 Shop fabricate welded metal parts and assemblies from Type 304L stainless steel with a 2D finish conforming to ASTM A240.
- .2 Shop fabricate non-welded parts and pieces from sheets and plates of Type 304 stainless steel conforming to ASTM A240, unless specified otherwise.
- .3 After fabrication, pickle and passivate stainless steel assemblies and parts in accordance with ASTM A380/A380M.
- .4 Fasteners and anchorage components shall be 18-8 series stainless steel.
- .5 Perform all solvent welding in the manufacturer's shop. Field welding will not be permitted.
- .6 Header and Header Support System: Allow for expansion and contraction over a temperature range of 70 degrees C when installed.

.2 Dropleg:
- .1 Locate elbow from air supply main connection at top of the aeration tank. Top connection and dropleg connection to air manifold shall be loose follower flanges.
- .2 Furnish the dropleg with supports to prevent movement.
  - .1 Support from its upper connection, with additional support at lower elbow. Connection between dropleg and air manifold shall be a slip joint.
  - .2 Provide at least one intermediate support between top and bottom connection. Design supports so that no vertical load is imposed on the top connection.
- .3 Dropleg to transition from stainless steel to PVC 1 m above the tank floor elevation. Provide stainless Straub type clamp coupling to connect the two dropleg piping materials. Support stainless steel piping to prevent stress on diffuser piping.
- .4 Stainless steel pipe and fittings shall be Type 304L Schedule 10S conforming to ASTM A778/A778M and ASTM A774/A774M.
- .5 PVC pipe and fittings shall be Schedule 40 conforming to ASTM D1784 Class 12454-B, ASTM D1785 and/or CSA B137.3, and ASTM D2466. Joints shall conform to ASTM D2564 and ASTM D2855.
- .6 Provide a 12 mm PT test plug at each dropleg. The test plug will be capable of receiving a probe 3 mm nominal outside diameter and rated for zero leakage at a pressure to 200 kPa.
- .7 Provide a 25 mm capped connection for a portable air flowmeter at each dropleg.

.3 PVC Air Manifold:
- .1 Perpendicular to air distribution headers, same nominal pipe size as dropleg, and located above distribution headers.
- .2 Connect air manifold to distribution headers at common pipe centerline.
- .3 Fabricate with minimum 100 mm diameter fixed joint connections to each air distribution header. Fabricate Manifolds in sections up to 6 metres in length.

.4 Construct from Schedule 40 PVC if stub to distribution header is reinforced with a solvent welded saddle tee, and Schedule 80 if stub is unreinforced. Manifolds shall be provided for long-term exposure to 54 degrees C near-wall temperature.

.5 PVC pipe and fittings shall conform to ASTM D1784 Class 12454-B, ASTM D1785 and/or CSA B137.3, and ASTM D2466. Joints shall conform to ASTM D2564 and ASTM D2855.

.4 Distribution Headers:

.1 SDR 33.5 PVC conforming to ASTM D3915 Class 124524 and ASTM D3034, with 2 parts by weight of titanium dioxide per 100 parts of resin.

.2 Fabricate in sections up to a maximum of 6 metres in length with fixed joints or expansion joints as required.

.3 Attach diffuser elements to distribution headers to resist 200 N-m applied torque about polar axis of holder and 136 N-m about longitudinal axis. Equivalent alternate designs will be considered by Consultant.

.5 Flexible Membrane Diffuser Assemblies:

.1 Diffuser assembly shall include flexible membrane, threaded retainer ring, disc holder with mounting saddle, Click lock wedge and O-ring seal.

.2 Assembly shall be fully supported over the full diameter with a 20% glass-filled polypropylene backer plate capable of withstanding a minimum of 890 N without structural failure.

.3 After 1 year of continuous operation without aeration tank dewatering or diffuser cleaning, pressure drop through diffuser at specified flow rates shall not increase more than 7 kPa.

.4 Backflow preventer assembly to prevent liquid from passing into aeration header. Diffusers shall require no special tools for attaching diffusers to diffuser connectors.

.5 Membrane: Ethylene propylene diene monomer (EPDM) material, molded in a single piece and suitable for application to continuous aeration of activated sludge mixed liquor without significant increase in head loss.

.1 Minimum 2 mm thick after moulding and finishing.

.2 Maximum 15 percent extractible plasticizer content. Manufacturer must have minimum five (5) years experience with fabrication of diffuser membranes with specified content of extractable plasticizer.

.3 Provide EPDM membrane material having the following properties:

.1 Minimum tensile strength of 7,000 kPa.

.2 Minimum elongation of 300 percent.

.3 Testing in accordance with ASTM D412

.1 Maximum durometer, Shore A, change allowed: 10 points.

.2 Maximum loss of tensile strength: 25 percent

.3 Maximum loss of elongation: 25 percent

.4 Testing in accordance with ASTM D395

.1 Maximum compression set: 50 percent

.4 Replaceable without use of any special tools.

.5 Exterior surface shall be smooth to restrict biological film growth.

.6 Inflate during aeration and deflate when airflow is discontinued, further restricting biological film growth.

.7 Cleanable in-place with water from a hose. Acid or other chemical cleaning methods shall not be required to restore diffuser to like-new performance conditions.

.8 Membrane shall employ a non-perforated section that is aligned and seals against the air distribution orifices on the diffuser support structure.

.9 Membrane shall contract and shall seat on backer plate.

.6 PVC Diffuser Element Holders:
- .1 Air plenum chamber below diffuser element.
- .2 Mechanism to attach diffuser element to element holder.
- .3 Provide complete peripheral edge support for diffuser element.

.7 Supports:
- .1 Fabricate from 6.4 mm minimum Type 304 stainless steel plate, ASTM A240/A240M. Use Type 304L stainless steel for welded parts, ASTM A240/A240M. Fabricate threaded rods from Type 304 stainless steel, ASTM A276/A276M.
- .2 Provide plus or minus 1 mm lateral and plus or minus 50 mm vertical adjustment of header. Adjustment shall be continuous and possible without removing air piping from support. Each air piping section shall have a minimum of two supports and additional supports as necessary to maintain level. Support height shall be sufficient to provide diffuser elevation shown on the Drawings. Each support shall provide a bearing surface contoured to fit 360 degrees of air piping. Bearing surface shall be a minimum of 50 mm wide for manifolds and 38 mm wide for distribution headers.
- .3 Air Manifold Piping Supports:
  - .1 Maximum spacing between supports of 2.4 m.
  - .2 Resist thrust generated by expansion or contraction of air distribution headers.
  - .3 Include manifold holddown, guide straps, anchor bolts and supporting structure. Guide straps shall resist not less than 250 kgs uplift force per support without exceeding 165 MPa design stress.
- .4 Support: Fixed, consisting of a hold down mechanism and self-limiting clamp device. Clamping shall positively grip air distribution header when tight and be self-limiting to prevent overstressing header if clamp is overtightened.

.8 Where piping crosses tank expansion joints the piping shall be equipped with flexible connections to allow up to 25mm differential movement.

.9 Moisture Removal Assembly:
- .1 To drain moisture from the entire submerged aeration piping system, each grid shall have an integral purge located in the horizontal PVC piping at the base of the dropleg.
- .2 Purge shall consist of an ejector tube, removal hose and terminates at the top of the aeration tank with a manual valve. Purge line diameter will be a minimum of 75 mm.

.10 Header Joints:
- .1 Special Flanged Joints or Slip Joints Between Sections of Air Distribution Header:
  - .1 Individual header sections shall rotate independently of adjacent header sections for alignment.
  - .2 Flanged Joints for Stainless Steel Piping: Face ring-follower flange type with through-bolts, capable of transmitting longitudinal forces caused by expansion and contraction in air distribution header.
  - .3 Slip joints shall allow for expansion and contraction of air distribution header.
- .2 Fixed Joints for PVC Piping: Spigot section solvent welded to one end of Distribution Header, threaded socket section welded to mating distribution header, and O-ring gasket and threaded screw-on retainer ring.

.11 Appurtenances:
- .1 Stainless Steel Pipe Couplings: Van Stone type flanges ASTM A182 stainless steel drilled ASME B16.5 Class 150 Standard.
- .2 Face Rings: Stainless steel, ASTM A240, Type 304L, inside diameter (ID) drilled 1.6 mm larger than pipe outside diameter (OD).

.3 Gaskets: Neoprene, 45 to 55 durometer; locate at expansion joints and couplings to form an airtight connection at 140 kPa minimum.

.4 For each anchor, provide double stainless steel nuts. Each anchor is to be double nutted to ensure that the connection does not loosen due to stretching caused by dynamic forces through its life.

.5 Miscellaneous: Nuts, bolts, washers, and other non-welded parts: Type 316 stainless steel, ASTM A240. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

.6 Lifting Lugs: Suitably attached for equipment assemblies and components weighing over 45 kg.

2.4 SPECIFIED PRODUCT

.1 FlexAir Pro ISM Disc Aeration, Environmental Dynamics International (EDI) as provided by Nexom

2.5 ALTERNATE MANUFACTURERS

.1 Xylem Water Solutions

.2 Stamford Scientific International

.3 Acquarius Technologies.

PART 3– EXECUTION

3.1 INSTALLATION

.1 Fine bubble diffuser system to be installed in accordance with Manufacturer’s written instructions.

.2 Prior to equipment installation:

.1 Manufacturer is to inspect tank and certify that it is ready for installation.

.2 Manufacturer is to certify that installation staff has been trained and are capable of installation.

3.2 TESTING

.1 Refer to Division 1 for additional testing requirements.

.2 Leakage and Leveling Tests:

.1 Provide leakage and level testing of equipment per Manufacturer’s requirements.

.3 Performance Test:

.1 Conduct on each aeration system.

.2 Perform under actual or approved simulated operating conditions. Airflow shall be as measured by plant instrumentation. Calibrate airflow instrumentation as part of testing procedure.

.3 Test for a continuous 6-hour period without malfunction.

.4 Adjust, realign, or modify units and retest if necessary.

.5 Pressure Test: Measure air pressure immediately upstream of elbow located at top of each dropleg, and at maximum airflows and submergences.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section includes the supply, installation, testing and commissioning longitudinal and cross collector chain and flights collectors as well tipping trough scum collectors for clarifiers.

.2 The Contractor is to provide the sludge and scum collectors and associated components in compliance with these specifications and as shown on the Drawings.

.3 Contract Drawings show only functional features and do not necessarily show all required components and exact dimensions. The Contractor shall supply all equipment, parts and accessories necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments that may be particular to the equipment being supplied. Any and all costs associated with necessary changes shall be considered as being included in the bid price for the work specified.

.4 All like items of equipment shall be the end product of one equipment manufacturer, who shall assume complete responsibility for conformance with these Specifications including design, testing, delivery and performance verification of the clarifier mechanism described in this section. Such manufacturer shall be referred to herein as the Clarifier Equipment Manufacturer.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.
- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM D638: Standard Test Method for Tensile Properties of Plastics.
- .2 American Gear Manufacturers Association (AGMA).
- .3 Canadian Standards Association: (CSA):
  - .1 CSA Z432: Safeguarding of Machinery.
- .4 Electrical Safety Authority (ESA).
- .5 National Electrical Manufacturers Association (NEMA).
- .6 Occupational Safety and Health Administration (OSHA).
- .7 Society for Protective Coatings (SSPC).
- .8 Underwriters Laboratories of Canada (ULC).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15 requirements.

.2 Informational submittal required for all Part 2 – Products specified herein.

.3 In addition to the requirements noted in Division 1 and Division 15 provide the following:
- .1 Product Data
  - .1 Identify construction materials for all components.
  - .2 Relevant data illustrating full range of operation including speed curves, if applicable.
  - .3 Electrical motor information and specification.

.4 Loadings imparted to each piece of equipment.
.5 Permissible range of vibration.
.6 Factory finishing details.
.7 Anchoring requirements.
.8 A motor performance chart exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. Chart to also include date on motor starter and no-load characteristics.
.9 Provide Instrumentation and Control Systems submittals including, but not limited to the following:
  .1 Process Control Narrative.
  .2 Control Panel layouts complete with component bill of materials.
  .3 Control Panel schematics and wiring diagrams, including field loop diagrams and network schematics
  .4 Panel product shop drawings for utilized PLC controllers, power supplies, controller cards, touch screen interface, intrinsically safe relays, terminal block, surge protective devices, starters and drives.
  .5 Field instrumentation product shop drawings and data sheets.
  .6 All HMI screens.
  .7 PLC program.
  .8 Field instrument classification ratings as well as specific installation details.
.10 Operation and Maintenance Data:
  .1 Operation and Maintenance Manuals in accordance with Division 1.
  .2 Installation requirements.
  .3 The Supplier is to submit all operating constraints and design requirements related to the successful commissioning and operation of the clarifier equipment.
.11 Quality Control Data:
  .1 A certificate of proper installation submitted on OEM letterhead, signed by the Manufacturer or their representative and certifying that the equipment has been installed in accordance with their installation instructions.
  .2 Suppliers reference list.
  .3 Factory acceptance test results.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Close Out requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Maintenance and spare parts to be in accordance with Division 1 requirements.

.2 Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

.3 Provide the following spare parts for the clarifier mechanism:

Drive chain	1 x 4.6 m (15 ft.)
Carrying chain with flight attachment	2 x 3.0 m (20 ft.)
Shear pins per shear pin sprocket	four (4)
Tube of Manufacturer’s recommended bearing grease	six (6)
Wear strips	2 x 3.0 m (10 ft.)

.4 Provide any specialty tools required for maintenance.

1.6 QUALITY ASSURANCE

.1 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier's cost if proper supporting evidence cannot be provided.

.2 Provide all equipment from Single Manufacturer where applicable.

.3 Guarding to meet OSHA and CSA Z432 requirements.

.4 All electrical installation and components shall comply with CSA and local electrical authority.

.5 Electrical Equipment not bearing a CSA label requires an ESA field approval.

.6 Where required by Authority having jurisdiction, equipment shall bear a ULC or UL label.

.7 Contractor to verify all relevant dimensions prior to ordering any equipment.

1.7 COMMISSIONING

.1 Refer to Division 1 and Division 15 for commissioning requirements.

.2 Following installation and initial checkout by the installation Contractor, the manufacturer is to provide a factory trained technician to commission the system.

.3 Manufacturer to provide a checklist of items to be completed by the General Contractor prior to beginning commissioning.

1.8 TRAINING

.1 Refer to Division 1 and Division 15 for training requirements.

.2 Training required for all collectors and their controls.

1.9 WARRANTY

.1 Refer to Division 1 and Division 15 for warranty requirements.

.2 The Manufacturer shall provide a warranty for a minimum period of 1 year from Substantial Completion. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts.

PART 2– PRODUCTS

2.1 GENERAL

.1 Each sludge collecting system shall transport settled sludge uniformly along a rectangular concrete tank floor to receiving hopper(s) by scraper flights carried by two endless collector chains, driven by rotating, shaft-mounted collector sprockets. Flights, equipped with replaceable wear shoes, shall be guided by wall-mounted return tracks and replaceable floor-mounted wear strips. The collector head shaft shall be driven through a chain and sprocket connection to a close-coupled gearmotor located above the tank top.

.2 Each scum collector shall manually operated and shall be designed to transport floating scum to the scum pit. A dedicated scum trough is required for each new clarifier and each shall be equipped with it's own dedicated operator.

.3 Non-stainless and non-galvanized steel components shall be cleaned and prepared according to SSPC-SP6, shop primed and finish painted at the factory. Drive system components shall be provided with the Manufacturer's standard outdoor duty finish. Field applied touch-up painting shall be provided by the Contractor as required.

.4 Provide each collector with a noncorrosive identification plate. Refer to section 15020 for additional identification requirements.

.5 Electrical equipment to be suitably rated for the electrical classification associated with the equipment location. Refer to the drawings for site classification requirements.

2.2 QUANTITY

.1 Refer to the drawings for additional requirements.

.2 Clarifiers
- .1 Three (3) longitudinal collectors and associated appurtenances
- .2 Three (3) cross collectors and associated appurtenances
- .3 Three (3) tipping scum collectors and associated appurtenances.

2.3 DESIGN DATA

COLLECTOR TYPE		LONG.	CROSS
No. Collector mechanisms	Qty	3	3
No. Drive units	Qty	3	3
Collector bay nominal length (full tank)	m	40	5
Collector bay nominal width	m	5	1.5
Tank SWD	5	4.5	-
Sewage Peak Hour Flow per clarifier	m^3/day	5938	5938
Flight speed	m/min.	0.3	0.6
Flight spacing	m	3	1.5
No. Shafts / collector	Qty	4	3
Head shaft diameter	mm	102	64
Idler shaft diameter	mm	89	64

COLLECTOR TYPE		LONG.	CROSS
Scum trough included		YES	NO
Scum trough nominal length	m	5	-
Scum trough diameter	mm	350	-

DATA TABLE 2 – GENERAL REQUIREMENTS	
Collector chain: material	Non-metallic, unfilled acetal resin and reinforced nylon resin pins
Collector chain rated working load	13.8 kN (3100lb.)
Collector sprockets: material	High-strength polyurethane, double life tooth profile
Head shaft sprockets: no. teeth; pitch diameter	23-tooth; 565 mm (22.24") P.D.
Idler shaft sprockets: no. teeth; pitch diameter	17-tooth; 422 mm (16.61") P.D.
Head sprocket self-aligning bearings: material	A216 cast steel, split construction, polyurethane hub ball sleeve, water lubricated
Idler sprocket sleeve bearings: material	Virgin Black UHMW-PE, split construction, 316SS band clamps
Drive chain: material	Unfilled acetal resin, SS pin
Drive chain rated working load, minimum	7.78 kN (1750 lb.)
Drive sprockets: material	High-performance polyurethane
Drive cover: material	316 stainless steel, 12 gauge
Return track: material	316 stainless, 12 gauge
Flights: material	Fiberglass
Flights: nominal width x height	3" (75 mm) x 8" (200 mm)
Pedestals & brackets, non-submerged: material	6 mm thick. 304 stainless steel
Pedestals & brackets, submerged: material	6 mm thick. 304 stainless steel
Assembly hardware: material	316 stainless steel
Anchor bolts: material	316 stainless steel
Motor: voltage & minimum nameplate size	575VAC / 3 ph / 60 Hz, 0.37 kW (0.5 HP)
Motors & local switches: hazardous rating	Class 1, Zone 2

2.4 CONSTRUCTION REQUIREMENTS

.1 Sludge Collector Drive System

.1 Each collector shall be independently driven by a gearmotor, mounted on a fabricated support pedestal, consisting of an AGMA II class helical reducer, minimum 1.25 SF based on design loading.

.2 Drive motor to be close-coupled, TEFC, NEMA design B, minimum 1.15 SF, class F insulation, IP44 duty meeting the requirements of 15053. Motors to be 575/3ph/60Hz.

.3 Contractor to coordinate with Clarifier Equipment Manufacturer to confirm the exact size of slab opening size to accommodate drive chain operation.

.4 Provide a drive guard to completely enclose the gearmotor and drive chain assembly above the operating floor. Design guards to be either made of aluminum or 304 stainless steel, hinged and easily rotated for inspection of the drive unit. Guards to meet the requirements of CSA Z-432 and OSHA. Each drive cover to be insulated with hard moisture resistant foam insulation and c/w one (1) 120VAC/1/60, suitably sized heater to prevent the drive mechanism from freezing in -30°C conditions. Heater to be approved for Class 1, Division 2, Groups C & D hazardous location and shall be c/w integral thermostat and integral conduit box. Heater to be installed by the Contractor and is to be located inside the drive cover.

.5 Each mechanism to have safety shear pin or other safety drive device to limit torque on drive shaft. Each system is to include a torque limit switch to annunciate an overload condition and shut-off drive power.

.2 Drive Chain and Sprockets

.1 Drive chain shall be self-lubricating constructed of unfilled acetal resin or reinforced nylon resin c/w 304 stainless steel precision snap-in connecting pins to eliminate internal stresses caused by interference fits.

.2 Drive sprockets shall be non-metallic polyurethane or nylon construction, keyed and set-screwed. Each collector shall include: one (1) minimum 11 tooth, driving sprocket; one (1) minimum 40 tooth, (for longitudinal collectors) or 30 tooth, (for cross collectors) driven sprocket with offset-hub and one (1) minimum 7 tooth, chain take-up or idler sprocket complete with mounting bracket.

.3 Headshaft sprockets shall be split c/w stainless steel hardware for ease of installation.

.4 Where collector drives are shown to be side by side on the drawings a headshaft support plate shall be provided by the Clarification Equipment Manufacturer. Plate to be fabricated of 304 stainless steel and of suitable thickness to provide the rigidity as required by the Manufacturer.

.3 Collector Chain and Sprockets

.1 Collector chain shall be 150 mm pitch non-metallic chain having integrally molded flight attachments. Collector chain shall be manufactured of unfilled acetal resin for superior wear capability and to minimize water absorption and deformation; be designed specifically to exclude grit trapping between the pin and sidebar openings; have a shrouded link opening to shield rivets from catching suspended material; have ribbed sidebars for maximum design strength; solid, self-lubricating, one-piece reinforced nylon resin connecting pins connecting to the link without the use of clips, cotters or washers.

.2 Flight attachments shall be of similar construction to the chain links, with the flight pusher plate extending the full depth of the flight and molded integrally with the link sidebars. The attachment mounting hole spacing shall conform to ASME B29.21. The attachment link shall be capable of twisting a minimum of 7 degrees across the face of the attachment without failure.

.3 Collector sprockets shall be split, non-metallic, molded high-strength polyurethane with double life tooth profile. Each collector shall be supplied with two (2) keyed head shaft sprockets; two (2) free-rotating idler sprockets per idler shaft, each with sleeve bearing. Sleeve bearings shall be split, of thru-bolt design and incorporating two (2) integral shaft collars

.4 Final clarifiers to include a chain tensioner as diagrammatically indicated on the drawings. Tensioner to allow operations to periodically adjust the longitudinal collector chain. All submerged components to be of 304 stainless steel.

.4 Head Shaft Assembly

.1 Head shafts shall be solid cold rolled steel, shall extend the full tank width and shall be supported by two (2) peak cap, split, babbitted, self-cleaning, self-aligning bearings and secured by non-metallic collars.

.2 Bearings shall be provided with non-metallic lubrication extension tubing to the tank top. Shafts shall be fitted with keyways as required.

.5 Collector Fights

.1 All flights shall span the clarifier width with minimum 25 mm side wall clearances, each including reversible non-metallic UHME-PE13 mm (1/2") return track and floor non-metallic wear shoes as required, an integral floor scraper lip, non-metallic filler blocks and pre-drilled flight mounting holes.

.6 .2 Flights shall be fabricated of nominally 75mmx200mm fiberglass. Provide flights with minimum 60% glass fiber content and flexural strength 310 MPa in accordance with ASTM D638. Idler shaft Assembly

.1 Collector idler shafts shall be solid cold rolled steel extending the full tank width and supported by two (2) wall-mounted brackets having position adjustable u-clamps of the same material.

.7 Return Tracks

.1 Return tracks shall be rolled 316 stainless steel, with 2B polished finish to allow for smooth travel of the flight wear shoe without the need for additional wearing strips. Each section is 6.1 m (20 ft) long and supplied with pre-drilled non-metallic wall brackets on maximum 3 m centres. Two brackets required per connection, one anchored at the wall and on attached to the return track.

.2 Provide stainless steel hardware.

.8 Deflector Track Angles

.1 75 mm x 75 mm x 10 mm 316 stainless steel deflector track angles to be supplied with pre-drilled wall brackets where recommended by the Clarifier Equipment Manufacturer to prevent flights from contacting other components within the tank. Minimum 2 anchor bolts per bracket.

.2 Provide stainless steel hardware and UHMW-PE wear strips.

.9 Wear Strip

.1 Minimum 10mm thick UHMW-PE replaceable wear strip shall be supplied in 3m sections pre-drilled for floor and track angles and to comprise two (2) full tank-length floor wear strips.

.2 Provide countersunk stainless steel hardware.

2.5 ELECTRICAL

.1 Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with the requirements of Division 16 - Electrical.

2.6 CONTROLS

.1 Each clarifier to have its own dedicated control panel with controls for its longitudinal and cross collectors.

.2 Control panel shall interface with SCADA and provide a coordinated shutdown of equipment on fault.

.3 Provide each longitudinal collector with two (2) NEMA 7, 120VAC/1/60 momentary limit switches, located on both sides of the collector tank, to sense flight misalignment and no-motion conditions during operation.

.4 Control Panel, to be a NEMA 4X stainless steel enclosure, 120VAC/1/60, c/w: NEMA 4X operators. Panel to service a single clarifier tank, i.e., one (1) cross and longitudinal collector Panel to include the following:

.1 Switches:

.1 Panel heater “Off-On” selector switch.

.2 Operators for each collector:

.1 Start push button.
.2 Stop push button
.3 E Stop push button
.4 Overtorque reset button.
.5 HOA switch pilot.

.3 Indicator Lights for each collector:
.1 Fault indicator light.
.2 Running indicator light.
.3 Stopped indicator light

.4 5A/120V dry contacts for monitoring for each collector:
.1 Collector running (input).
.2 Collector In-Auto mode (input).
.3 Collector fault (input).
.4 Collector overtorque alarm (input).
.5 Collector no motion alarm (input).
.6 Collector in Position A.
.7 Collector in Position B.

.5 5A/120V dry contacts for monitoring specific to a single collector:
.1 Longitudinal collector misalignment.

2.7 SCUM COLLECTORS

.1 Provide one (1) manually operated scum trough per longitudinal collector, each including: circular trough, diameter as per the Data Table, of minimum 6 mm thick. 304 stainless steel construction spanning the collector tank width; two (2) 304 stainless steel, position-adjustable end bearings capable of being mutually aligned and provided with neoprene bearing-wall seals; 304 stainless steel anchor bolts. Machine the outside ends of each scum trough over a minimum 200 mm length and the insides of each end bearing to ensure a tight trough-bearing fit and to avoid seizing during operation. Troughs in separate tanks shall be independently operable in both rotation directions. Contractor shall install and level each trough with bearings aligned and grout between bearings and tank walls and shall install trough operator.

.2 Provide: one (1) end bearing with horizontal adjustment capability; one (1) end bearing with vertical adjustment capability; lubrication extensions from tank top to four (4) lubrication fittings per bearing; bearing internal water seal.

.3 Provide each trough with longitudinal 60O slots, maximum 710 mm length, separated by 50 mm uncut bands, into which water will flow when the pipe is rotated in either direction

.4 Manual operator shall consist of an aluminum hand-wheel mounted on a gear reducer and 304 stainless steel floor stand located at the tank top. Hand-wheel and trough shall be connected through a stainless steel cable and sprocket mechanism or through a geared shaft mechanism. Contractor to coordinate required slab opening to allow proper functioning of the operator.

2.8 SPECIFIED PRODUCT

.1 Evoqua Water Technologies.

2.9 ALTERNATE MANUFACTURERS

.1 WTP Equipment Corp. represented by ENV Treatment Systems Inc.

.2 Polychem Systems, a Division of Brentwood Industries Inc.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Install clarification equipment in strict accordance with manufacturer's instructions.

.2 Provide anchor bolts, fasteners, washers, and templates required for installation of clarification equipment.

.3 Clarifier Equipment Manufacturer shall assist with the work of the Installation Contractor including but not limited to installation of the following equipment components:

- .1 All interconnecting control/power wiring.
- .2 Verify all field wiring and PLC I/O connections made by Installation Contractor to their respective termination points.
- .3 Inspect, test, and verify communications links from respective control panels, drives and equipment to plant SCADA.

3.2 TESTING

.1 Refer to Division 1 for additional testing requirements.

.2 Drive units shall be assembled and fully shop tested prior to shipping to the jobsite.

.3 Following installation and inspection, equipment function tests shall be performed as required to verify satisfactory operation.

.4 A qualified representative of the equipment supplier shall be present at the jobsite for a minimum of four (4) 8-hour days to inspection, commissioning, starting-up and training on the specified equipment.

.5 After installation, the equipment supplier shall provide a certificate stating that the installed equipment has been satisfactorily installed and tested and is ready for duty operation.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section provides details for the fabrication, supply and installation of slide gates and hand gates.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.
  .1 American Society for Testing and Materials (ASTM):
    .1 ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
    .2 ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
    .3 ASTM A380 – Standard Practice for Cleaning, Descalling & Passivation of Stainless Steel Parts
    .4 ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
    .5 ASTM B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
    .6 ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
  .2 American Water Works Association (AWWA):
    .1 AWWA C561 – Fabricated Stainless Steel Slide Gates.
    .2 AWWA C542 – Electric Motor Actuators for Valves and Slide Gates.
    .3 AWWA C513-: AWWA Standard for Open-Channel, Fabricated-Metal Slide Gates
  .3 American Bearing Manufacturers Association (AFBMA).
  .4 American Iron and Steel Institute (AISI).
  .5 American Gear Manufacturers Association: (AGMA).
  .6 American National Standard Institute: (ANSI).
  .7 Canadian Standards Association: (CSA).
  .8 Canadian Electrical Manufacturers Association: (CEMA).
  .9 National Electrical Manufacturers Association: (NEMA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15 requirements

.2 Informational submittal required for all Part 2 – Products specified herein.
  .1 Product Data to be provided in addition to the requirements noted above:
    .1 Make, model and identification tag consistent with the project P&ID for slidegate or handgate.
    .2 Detailed installation instructions including any block-out requirements.
    .3 Provide coating details.
  .2 Operation and Maintenance Data:
    .1 Operation and Maintenance Manuals. Refer to Division 1 for requirements.
    .2 Manufacturer’s installation requirements.
  .3 Quality Control Data to include:
    .1 Certified documentation from the manufacturer indicating compliance with the specified standards.

.2 Calculations stamped by an engineer licensed in the province of Ontario confirming that gates and their installation meet the requirements of the OBC Part 4.
.3 Installation certificate from the manufacturer or its representative confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Maintenance and spare parts to be in accordance with Division 1 requirements.

.2 Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

.3 Provide any specialty tools required for maintenance.

1.6 QUALITY ASSURANCE

.1 Ensure supplied gates conform to the referenced standards specified herein.

.2 Provide all equipment from Single Manufacturer where applicable

.3 All electrical installation and components shall comply with CSA and local electrical authority.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 Mechanical General Provisions.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 Mechanical General Provisions.

PART 2– PRODUCTS

2.1 GENERAL

.1 Refer to drawings and slide gate schedule for sizing and other requirements for individual gates.

.2 All gates to be tagged per the P&ID drawings and per the requirements of Section 15020.

.3 Slide gates to be in accordance with AWWA C561 unless otherwise modified herein.

.4 Gates shall be rising stem unless otherwise noted.

.5 Provide lifting lugs on all gates.

.6 Performance:
- .1 Design seating/unseating heads as scheduled.
- .2 Leakage rate for general service slide gates:
  - .1 Under seating head conditions to be a maximum of 0.60 L/min. per metre of seal periphery.
  - .2 Under unseating head conditions less than 6 m to be a maximum of 1.25 L/min. per metre of seal periphery.
  - .3 Under unseating head conditions greater than 6 m to be defined as follows:
    - .1 1.25 + 0.1025 x (head-6.1).
- .3 Leakage rates for high performance slide gates to be true zero leakage.
- .4 Leakage rates for stop loop to be 1.25 L/min. under design seating head.

.7 All gates shall be complete with any guides, frames, floor stands, brackets, wall thimbles (where specified), stems, actuators, and any other appurtenances for a complete and functioning installation.

.8 All stainless steel gates to be pickled and passivated in accordance with ASTM A380.

2.2 SLIDE GATE MOUNTING

.1 Slide gate mounting configuration as scheduled. Refer also to the drawings for additional mounting requirements.
- .1 Type 1: Self-contained configuration to be embedded into channel walls complete with a flush mount embedded invert.
- .2 Type 2: Self-contained configuration to be surface mounted onto channel walls.
- .3 Type 3: Non-self-contained wall mounted directly to concrete surface, standard invert.
- .4 Type 4: Non-self-contained wall mounted directly to concrete surface with embedded invert
- .5 Type 5: Non-self-contained wall thimble mounted
- .6 Type 6: Other configuration.

2.3 GENERAL SERVICE SLIDE GATES

.1 Gates to be general service where indicated in schedule and assumed where information service information is missing.

.2 Gates to be either self-contained or non-self-contained, arranged to open in an upward or downward fashion and provided with actuation as scheduled. All general service gates to be equipped with the same gear box.

.3 Frame/Guide:
- .1 Fabricated of ASTM A240 Type 304 stainless steel.
- .2 Frame components to have a minimum 6 mm material thickness.
- .3 Frame to be fabricated of structural members or formed plate welded to form a rigid monolithic frame.

.4 Frame to be of the flange back design suitable for mounting on concrete wall.
.5 Guides to be integral with the frame and fabricated of UHMWPE (ultra-high molecular weight polyethylene).
.6 Guides to be one piece construction with a length so as to retain and support the full vertical height of the slide in its fully open position.
.7 Yokes on self-contained gates to have a maximum deflection of 1/360 of the gate's span.
.8 A rigid stainless-steel member shall be provided across the invert of the opening on downward opening gates.

.4 Slide:
.1 Slide to be fabricated of ASTM A240 Type 304 stainless steel.
.2 Slide to consist of flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gates span under design head conditions.
.3 Stress on the slide shall not exceed 40% of the material's yield strength or 25% of its ultimate strength.

.5 Seals:
.1 Top and side seals to be self-adjusting and made of UHMWPE guide and compression cord. Bottom seal to be ASTM D2000 resilient neoprene and set into the bottom member of the frame and shall form a flush bottom.
.2 An ASTM D2000 compliant nitrile compression cord shall provide contact between the guide and the slide in all positions.
.3 Sealing system to remain effective in any gate position and let liquid flow only through the open part of the gate.
.4 All downward opening gates shall be provided with self-adjusting type seals, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord. The cup shaped seal with twin contact surfaces shall be designed with outer seal acting as a wipe to remove debris from the slide when raising the gate thereby protecting the primary seal.

.6 Stems:
.1 Fabricate to ASTM A276 Type 304 stainless steel with a minimum diameter of 30 mm.
.2 Stem to have a slenderness ratio (length/radius) of less than 200.
.3 Provide ASTM A-240 Type 304L stainless steel stem guides equipped with UHMWPE bushing at intervals to ensure a maximum slenderness ratio as noted above.
.4 Stem threads to be machine cut or rolled full depth polished ACME type.
.5 Stem to transmit in compression at least twice the rated output of the manual operation with a 178N effort on the crank or handwheel.
.6 Stems on electrically actuated gates to have a design force not less than 1.25 times the output thrust of the electric motor in the stalled condition.
.7 Provide solid bronze couplings where required to join stems 45 mm in diameter and larger. For smaller diameter stems, pinned extension tube couplings to be used.
.8 Couplings to be grooved and keyed.
.9 Gates having a width greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.
.10 All rising stems to be equipped with a clear polycarbonate stem cover.
.11 Stem cover to have a cap and condensation vent and be equipped with field applied mylar tape to indicate gate position.

.7 Specified Products:
  .1 Standard gates: Fontaine Series 20 and 25.
  .2 Downward Opening Weir Gates: Fontaine Series 40.

.8 Alternate Manufacturers:
  .1 BNW.
  .2 Orbinox.
  .3 Hydrogate Corporation.

2.4 HIGH PERFORMANCE SLIDE GATES

.1 Gates to be high performance where indicated in the schedule.

.2 Gates to be either self-contained or non-self-contained arranged to open in an upward fashion and provided with actuation as scheduled. All high-performance gates to be equipped with the same gear box.

.3 Frame/Guide:
  .1 Fabricated of ASTM A276 Type 304 stainless steel.
  .2 Frame components to be heavy duty construction with a minimum material thickness of 10 mm.
  .3 Frame to be flange back design suitable for mounting on thimble or concrete wall.
  .4 For self-contained gates, the actuator support yoke shall be attached to the vertical extensions of the guide frames. Maximum deflection of the yoke assembly not to exceed 6 mm under actuator applied loading.

.4 Slide:
  .1 Fabricated of ASTM A240 Type 304 stainless steel.
  .2 Slide components to be of heavyduty construction with material thickness of 10 mm.

.5 Seating:
  .1 Seating and de-seating system including gate guides fixed wedges to ensure that gate engages the seal only when seating to provide tight shutoff with zero leakage. Sufficient number of wedges to be provided at top, bottom and sides of gates to eliminate any deflection of the gate when seated.
  .2 ASTM D2000 Hypalon resilient seat to be replaceable and to be securely fastened to the gate frame to prevent pullout due to high velocities during gate closing. Seat material and configuration to be suitable for use in wastewater containing abrasive material.

.6 Stems:
  .1 Fabricated of ASTM A276 Type 304 stainless steel with a minimum diameter of 30 mm.
  .2 Stem to have a slenderness ratio (length/radius) of less than 200.
  .3 Provide ASTM A240 Type 304L stainless steel adjustable stem guides at regular intervals to ensure maximum slenderness ratio is not exceeded.
  .4 Stem threads to be machine cut or rolled full depth ACME type.
  .5 Items to be capable of transmitting in compression at least twice the maximum rated output of the actuator unit at stalling torque.
  .6 Provide solid bronze grooved and keyed couplings where required to join stems with diameters 45 mm and larger. Pinned couplings for smaller diameters.

.7 Lifting stems for self-contained gates to be one piece and of ample cross-section to prevent distortion. Threaded portion of stem at actuator end shall extend 50 mm past the actuator nut when gate is at the bottom of its travel.

.8 Gate having a width greater than two times its height shall be provided with two lifting mechanisms connected by a tandem shaft.

.9 All rising stems to be equipped with a clear polycarbonate stem cover.

.10 Stem covers to be vented and capped with “open” and “closed” position markings.

.7 Wall Thimbles:

.1 Wall thimbles required on all gates installed in new concrete.

.2 Where thimbles are not practical in existing concrete for example, Contractor to measure tolerances and advise manufacturer before installing gate. Manufacturer to advise regarding need for modification of concrete surface to achieve a tight shutoff.

.3 Wall thimble to be fabricated of ASTM A276 304L stainless steel.

.4 Wall sleeve to be fabricated monolithically with integral threaded bolt and waterstop.

.5 Thimbles to suit concrete wall size and provide an area equal to the gate size.

.8 Specified Product: BNW Series 77.

.9 Alternate Manufacturers:

.1 Approved Alternate.

2.5 HANDGATES

.1 Handgates to conform to AWWA C513.

.2 Leakage rate is not to exceed 1.25 L/min. per metre of seal periphery in either seating or unseating head condition.

.3 Refer to handgate schedule and/or drawing for quantity and sizing requirements.

.4 Frame:

.1 Fabricated of ASTM A-240 Type 304L stainless steel or ASTM B308 6061-T6 aluminum.

.2 Frame to be constructed of structural members or formed plate.

.3 Frame to be suitable for mounting on a concrete wall at the end of the channel, embedded inside a channel or surface-mounted inside a channel.

.5 Slide:

.1 Fabricated of ASTM B209 5083 or ASTM B308 6061-T6 aluminum.

.2 Minimum slide thickness to be 6 mm.

.3 Slide to be constructed of a flat plate reinforced to limit deflection to 1/720 of the gate’s span under design head conditions.

.4 Provide plate with one or two handles or hand holes. Handle edges to be rounded.

.6 Seal:

.1 Fabricated of ASTM D2000 EPDM or neoprene rubber.

.2 Side seals to be retained using UHMWPE guide bars and screws.

.3 Sealing system to remain efficient at sealing in any position of the slide and let the liquid flow in only the opened part of the gate.

.7 Specified Product: VAG Series 92.

.8 Alternate Manufacturer:
- .1 Orbinox.
- .2 Hydrogate Corporation.
- .3 Aquanox.
- .4 Dynamic.

2.6 GATE OPERATORS

.1 Gate operators to be provided as an integral component to the gates and to be furnished by the gate supplier.

.2 Operator type as indicated in the gate schedule.

.3 Fitting to be provided to enable all bearings and gears to be lubricated as required.

.4 Manual Operators:
- .1 Minimum manual crank effort to be limited to 178N to unseat gate.
- .2 Provide single or double gear reduction actuator when activation loads exceed 178N. Gears to be totally enclosed and suitable for exterior installations with a rated temperature of -40°C.
- .3 Gate operations to be installed either on a pedestal or on the yoke of a self-contained gate.
- .4 Actuators to be complete with removable 50 mm square nut with either a removable aluminum crank arm or an aluminum handwheel.
- .5 Actuators are to be suited for both hand operation and by means of a portable electric operator.
- .6 Handwheels to be in the vertical position.
- .7 Gates with the slide width larger than double their height to be provided with a dual stem, dual gearbox complete with a stainless steel cross-shaft and vertical crank or handwheel.
- .8 Embedded stainless steel floor boxes and covers to be used with 50 mm square nut actuator when the stem cannot protrude above the finished floor.
- .9 Pedestals to be fabricated from aluminum or galvanized steel with mounting surface to suit the manual or electric actuators required.
- .10 Actuators mounted on pedestals at the grating level to be supported by stainless steel wall brackets. Wall brackets to be fastened to the concrete using stainless steel anchor bolts and to be oversized with regard to the pedestal baseplate by 50 mm to allow for grating support.
- .11 Where pedestals are mounted to the concrete floor or curb a bottom plate flange shall be provided.

.5 Electric Actuators:
- .1 Electric gate actuators to be AWWA C542-09 complaint.
- .2 Provide electric actuators as indicated on the drawings and in the schedules. Actuators to be selected to suit the application and operating conditions. Actuator to be factory mounted and tested by the valve or actuator supplier. Actuator supplier to provide mounting adaptors, installation supervision, start up and commissioning.
- .3 General: 575/3/60 power supply, or 120/1/60 as indicated on the contract drawings, integral reversing starter, local control facilities and terminals for remote control and indication; connections housed within a self-contained, sealed enclosure.

.4 Actuator sizing: sized for valve closure at the required differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. Operating speed for linear valves approximately 10-12 inches per minute.

.5 Suitable for indoor and outdoor use. Ambient temperature ranging from -30°C to 70°C, up to 95% relative humidity. Refer to schedules and drawings for actuators in hazardous areas and required ratings.

.6 Enclosure: O-ring sealed, watertight to CSA 4, and IP68 with plug and socket watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator. All external fasteners shall be stainless steel. The use of unprotected stainless steel fasteners in aluminum alloy casings is not permitted.

.7 Motor: Class F insulated, with a time rating of at least 15 minutes at 40°C or twice the valve stroking time, whichever is the longer, at an average load of at least 33% of maximum valve torque. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case.

.8 Protection shall be provided for motors as follows:

.1 The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.

.2 Motor temperature shall be sensed by a thermostat de-energizing the motor in case of overheating.

.3 Lost phase protection.

.9 Gearing: A grease filled gear case suitable for operation at any angle; metal construction. For rising spindle valves, the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator and include grease nipple for bearing lubrication. Permit the opening of the gear case for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

.10 Hand Operation: Handwheel to be engaged when the motor is declutched, drive restored to power automatically by starting the motor. The handwheel or selection lever shall not move on restoration of motor drive. The hand/auto selection lever to be lockable in both hand and auto positions. The handwheel drive must be mechanically independent of the motor drive and any handwheel gearing should be such as to permit emergency manual operation in a reasonable time.

.11 Monitoring:

.1 Torque and turns limitation to be adjustable as follows:

.1 Position setting range 2.5 to 100,000 turns, with resolution to 15 degrees of actuator output.

.2 Torque setting: 40% to 100% rated torque.

.2 “Latching” to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads. Include a diagnostic module, which will store and enable download of historical actuator operation and torque data to permit analysis of actuator and valve in-service performance.

.3 Five contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form.

.4 The contacts shall be rated at 5A, 250VAC, 30VDC.

.5 Any of the four above-noted contacts shall be selectable to signal one of the following:

.1 Valve opening, closing or moving.

.2 Thermostat tripped, lost phase.

.3 Motor tripped on torque in mid travel, motor stalled.

.4 Remote selected.

.6 The actuator shall include a position indicator. Red, green and yellow lights corresponding to Open, Closed and Intermediate position shall be included on the indicator. End of travel indication colours shall be reversible. The display shall incorporate valve, actuator and control status indication.

.12 Electrical/Controls:
  .1 Reversing starter, control transformer and local controls shall be integral with the valve actuator suitable for 60 starts per hour and controls supply transformer fed from the incoming three phases and overload protection.
  .2 Local controls for Open, Close and Stop and a Local/ Stop/ Remote mode selector switch lockable in any one of the three positions. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.
  .3 The necessary wiring and terminals shall be provided in the actuator for the following control functions:
    .1 Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.
    .2 Remote controls fed from an internal 24VDC supply and/or from an external supply between 20V and 120VAC or 20V and 60VDC, to be suitable for any one or more of the following methods of control:
      .1 Open, Close and Stop control.
      .2 Open and Close maintained or “push to run” (inching) control.
      .3 Overriding Emergency Shutdown to Close (or Open) valve from a normally closed or open contact.
      .4 Two-wire control, energize to close (or open), de-energize to open (or close). Reversible valve travel without the necessity of stopping the actuator.

.13 Valve and actuator representative to visit site to commission actuators, provide signoff sheets that confirm the start of a two-year warranty, and train staff.

.14 Specified Manufacturer: Auma.

.15 Alternate Manufacturers:
  .1 Valmatic.
  .2 Limitork.

PART 3 – EXECUTION

3.1 APPLICATION

.1 Compliance: comply with Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.2 INSTALLATION

.1 Handle and install slide gate and handgates following manufacturer’s written instructions.

.2 Manufacturer of slide gates to visit site to review required installation methods and tolerances prior to gate installation.

.3 Lubricate gate stems prior to use.

.4 Provide equipment identification tags on all gates and stop logs consistent with the P&IDs and in accordance with Section 15020.

3.3 TESTING

.1 Refer to Division 1 for testing requirements.

3.4 SUPPEMENTS

.1 Gate Schedule.

END OF SECTION

BRIGHTON WWT SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO
JLR No.: 32296-001

GATE SCHEDULES

SECTION: 11382.01

SHEET 1 OF 2

I.D.	DESCRIPTION	MOUNTING TYPE	SIZE	SERVICE	STEM TYPE	DESIGN HEAD		OPERATOR TYPE	ACTUATOR OPERATION	INVERTS		ELECTRICAL			FIELD WORK				COMMENTS
						SEATING	UNSEATING			GATE	OPERATOR	POWER	VOLTS	PHASE	SUPP. BY	INST. BY	WIRED BY	COMM. BY	
			mm			m	m			m	m	HP	V						
HG 2101	MANUAL SCREEN CHANNEL INLET HAND GATE		914 X 2150	RAW SEWAGE	N/A	N/A	82.96	N/A	N/A	2.34	2.34	0	0	0	M	M	N/A	G	
HG 2102	MANUAL SCREEN CHANNEL OUTLET HAND GATE		914 X 1800	RAW SEWAGE	N/A	N/A	82.96	N/A	N/A	2.34	2.34	0	0	0	M	M	N/A	G	
HG 3101	AERATION TANK NO.1 INLET HAND GATE 1		300 X 1000	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3102	AERATION TANK NO.1 INLET HAND GATE 2		300 X 1000	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3103	AERATION TANK NO.1 INLET HAND GATE 3		300 X 1000	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3105	AERATION TANK NO.2 INLET HAND GATE 1		300 X 1000	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3106	AERATION TANK NO.2 INLET HAND GATE 2		300 X 1000	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3107	AERATION TANK NO.2 INLET HAND GATE 3		300 X 1000	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3108	AERATION TANK NO.1 OUTLET HAND GATE 1		300 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3109	AERATION TANK NO.1 OUTLET HAND GATE 2		300 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3110	AERATION TANK NO.1 OUTLET HAND GATE 3		300 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3112	AERATION TANK NO.2 OUTLET HAND GATE 1		300 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3113	AERATION TANK NO.2 OUTLET HAND GATE 2		300 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3114	AERATION TANK NO.2 OUTLET HAND GATE 3		300 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3115	AERATION TANK NO. 3 INLET CHANNEL HAND GATE		1000 X 1800	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3116	AERATION TANK NO. 3 OUTLET CHANNEL HAND GATE		1000 X 1800	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3201	CLARIFIER TANK NO, 1 INLET HAND GATE 1		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3202	CLARIFIER TANK NO. 1 INLET HAND GATE 2		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3203	CLARIFIER TANK NO. 1 INLET HAND GATE 3		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3205	CLARIFIER TANK NO. 2 INLET HAND GATE 1		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3206	CLARIFIER TANK NO. 2 INLET HAND GATE 2		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3207	CLARIFIER TANK NO. 2 INLET HAND GATE 3		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3209	CLARIFIER TANK NO. 3 INLET HAND GATE 1		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3210	CLARIFIER TANK NO. 3 INLET HAND GATE 2		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3211	CLARIFIER TANK NO. 3 INLET HAND GATE 3		400 X 1000	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3212	CLARIFIER TANK NO.4 INLET CHANNEL HAND GATE		1000 X 1800	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 3213	CLARIFIER TANK NO.4 OUTLET CHANNEL HAND GATE		1000 X 1800	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 4001	UV DISINFECTION CHANNEL INLET HAND GATE		711 X 1650	EFFLUENT WATER	N/A	N/A	81.29	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 4002	UV DISINFECTION BYPASS INLET HAND GATE		711 X 1650	EFFLUENT WATER	N/A	N/A	81.29	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HG 4003	UV DISINFECTION CHANNEL OUTLET HAND GATE		711 X 1650	EFFLUENT WATER	N/A	N/A	81.29	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	
HGF 2201	GRIT CHANNEL NO. 1 HAND GATE FRAME		1225 X 2000	RAW SEWAGE	N/A	86.2	82.96	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 2202	GRIT CHANNEL NO. 2 HAND GATE FRAME		1225 X 2000	RAW SEWAGE	N/A	86.2	82.96	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 3101	AERATION INLET CHANNEL HAND GATE FRAME		1000 X 1800	RAW SEWAGE	N/A	N/A	82.49	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 3102	AERATION OUTLET CHANNEL HAND GATE FRAME 1		1000 X 1800	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 3103	AERATION OUTLET CHANNEL HAND GATE FRAME 2		1000 X 1800	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 3201	CLARIFIER INLET CHANNEL HAND GATE FRAME 2		1000 X 1800	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 3202	CLARIFIER INLET CHANNEL HAND GATE FRAME 3		1000 X 1800	MIXED LIQUOR	N/A	N/A	82.49	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 3203	CLARIFIER OUTLET CHANNEL HAND GATE FRAME 1		1000 X 2000	MIXED LIQUOR	N/A	N/A	82.23	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	

FIELD WORK NOTATION

M = MECHANICAL CONTRACTOR
E = ELECTRICAL CONTRACTOR
G = GENERAL CONTRACTOR
EX = EXISTING EQUIPMENT

PLOT DATE: Thursday, April 24, 2025 2:45:17 PM

BRIGHTON WWT SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO
JLR No.: 32296-001

GATE SCHEDULE

SECTION: 11382.01

SHEET 2 OF 2

I.D.	DESCRIPTION	MOUNTING TYPE	SIZE	SERVICE	STEM TYPE	DESIGN HEAD		OPERATOR TYPE	ACTUATOR OPERATION	INVERTS		ELECTRICAL			FIELD WORK				COMMENTS
						SEATING	UNSEATING			GATE	OPERATOR	POWER	VOLTS	PHASE	SUPP. BY	INST. BY	WIRED BY	COMM. BY	
			mm			m	m			m	m	HP	V						
HGF 3204	CLARIFIER OUTLET CHANNEL HAND GATE FRAME 2		1000 X 2000	MIXED LIQUOR	N/A	N/A	82.23	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
HGF 3205	CLARIFIER OUTLET CHANNEL HAND GATE FRAME 3		1000 X 2000	MIXED LIQUOR	N/A	N/A	82.23	N/A	N/A	N/A	N/A	0	0	0	M	M	N/A	G	
SG 2101	AUGER SCREEN CHANNEL INLET SLUICE GATE		914 X 2150	RAW SEWAGE	RISING	86.2	82.96	HAND CRANK	OPEN/CLOSE	2.34	2.34	0	0	0	M	M	N/A	G	GENERAL SERVICE
SG 2102	AUGER SCREEN CHANNEL OUTLET SLUICE GATE		914 X 1800	RAW SEWAGE	RISING	86.2	82.96	HAND CRANK	OPEN/CLOSE	2.34	2.34	0	0	0	M	M	N/A	G	GENERAL SERVICE
SG 2201	GRIT CHANNEL NO.1 INLET SLUICE GATE		1225 X 2000	RAW SEWAGE	RISING	86.2	82.96	HAND CRANK	OPEN/CLOSE	2.34	2.34	0	0	0	M	M	N/A	G	GENERAL SERVICE
SG 2202	GRIT CHANNEL NO. 2 INLET SLUICE GATE		1225 X 2000	RAW SEWAGE	RISING	86.2	82.96	HAND CRANK	OPEN/CLOSE	2.34	2.34	0	0	0	M	M	N/A	G	GENERAL SERVICE
SG 2203	GRIT CHANNEL NO.1 OUTLET SLUICE GATE		1225 X 1100	RAW SEWAGE	RISING	86.2	82.96	HAND CRANK	OPEN/CLOSE	1.34	2.34	0	0	0	M	M	N/A	G	GENERAL SERVICE
SG 2204	GRIT CHANNEL NO.2 OUTLET SLUICE GATE		1225 X 1100	RAW SEWAGE	RISING	86.2	82.96	HAND CRANK	OPEN/CLOSE	1.34	2.34	0	0	0	M	M	N/A	G	GENERAL SERVICE
SG 4004	UV DISINFECTION BYPASS OUTLET SLIDE GATE		711 X 1650	EFFLUENT WATER	N/A	N/A	81.29	N/A	N/A	1.81	1.81	0	0	0	M	M	N/A	G	HIGH PERFORMANCE

FIELD WORK NOTATION

M = MECHANICAL CONTRACTOR
E = ELECTRICAL CONTRACTOR
G = GENERAL CONTRACTOR
EX = EXISTING EQUIPMENT

PLOT DATE: Thursday, April 24, 2025 2:45:15 PM

PART 1- GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the supply, installation, testing and commissioning of a vertical multi-stage variable speed effluent water pumping assembly. The system is to be designed and tested as a variable speed pumping station designed to maintain a consistent delivery pressure.

.2 Refer also to the Pump Schedule and drawings for additional requirements.

1.2 RELATED SECTIONS

.1 Section 01021 - Testing and Commissioning.

.2 Section 01330 - Submittal Procedures.

.3 Section 01340 - Shop Drawings, Product Data.

.4 Section 01730 - Operation and Maintenance Manuals.

.5 Section 09900 - Painting.

.6 Section 15010 - Mechanical General Provisions.

.7 Section 15053 - Electric Equipment, Motors and Drives.

.8 Section 15083 - Cleaning and Flushing of Systems.

.9 Section 15100 - Process Valves and Actuators.

.10 Section 15020 - Identification.

.11 Section 15349 - Process Piping.

.12 Section 15241 - Vibration Isolation and Seismic Control Measures.

.13 Section 17500 - Control Narratives.

1.3 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
  .1 American Society of Mechanical Engineers (ASME):
    .1 ASME B16.5 – Pipe Flanges and Flanged Fittings.
  .2 American Society for Testing and Materials (ASTM):
    .1 ASTM A48: Standard Specification for Gray Iron Castings.
    .2 ASTM A536: Standard Specification for Ductile Iron Castings.
    .3 ASTM D1784: Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

.3 American Iron and Steel Institute (AISI).
.4 Hydraulic Institute Standards:
  .1 HI 11.6: Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Test.
.5 International Organization for Standardization (ISO):
  .1 ISO 9906: Rotodynamic Pumps – Hydraulic Performance Acceptance Test.
.6 National Electrical Manufacturer's Association (NEMA).
.7 Ontario Electrical Safety Code (OESC).
.8 Canadian Standards Association (CSA).
  .1 CSA Z432; Safeguarding of Machinery.
.9 Occupational Health and Safety Administration (OSHA).

1.4 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1, Sections 01330 and 01340 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all PART 2 – PRODUCTS.

.3 Product Data:
  .1 Relevant information to confirm that the specifications have been met. Identify all deviations.
  .2 Identify construction materials for all pump and system components.
  .3 Relevant data illustrating full range of operation (on pump curves) including speed curves, if applicable.
  .4 Electrical motor information and specifications.
  .5 Loadings imparted to the pump base.
  .6 Permissible range of vibration.
  .7 Factory finishing details.
  .8 Anchoring requirements.
  .9 Pump staging information.
  .10 Control panel data.

.4 Operation and Maintenance Data:
  .1 Operation and Maintenance Manuals in accordance with Division 1. Manufacturer's installation requirements.

.5 Quality Control Data:
  .1 Manufacturer's certified testing results.
  .2 A certificate of proper installation submitted on OEM letterhead, signed by the Manufacturer or their representative and certifying that the equipment has been installed in accordance with their installation instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.6 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed pumps.

.2 For each pump provide the following spare parts:
- .1 One (1) set of bearings.
- .2 One (1) set of mechanical seals.
- .3 One (1) set of gaskets.

.3 For the automatic strainer provide the following spare parts:
- .1 One (1) set of bearings.
- .2 One (1) set of gaskets.
- .3 One (1) cover seal.

.4 Provide any specialty tools required to maintain the pump.

1.7 QUALITY ASSURANCE

.1 Pump manufacturer to provide a written certification stating that the pumps have been installed to their standards.

.2 Pumps and associated equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to the Electrical Safety Code.

.3 Manufacturer is defined as a company specializing in the design and manufacture of the products specified in this Section with a minimum five (5) years experience and five (5) installations of the same type of equipment as specified herein with documented successful operation.

.4 Pump manufacturer to have proven established network of service centres in Eastern Ontario. Service centres to be specialized in manufacturer’s line of pumps and stock spare parts.

1.8 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

.2 In addition to the requirements noted in the section above, the following factory tests are required:
- .1 Development of the entire head/capacity pump curve.
- .2 Development of the entire NPSHR curve.
- .3 Development of the pump efficiency curve and overall efficiency curve.

.3 Carry out the tests using calibrated instruments in accordance with Hydraulic Institute Pump 14.6 Standard. The Owner reserves the right to reject the equipment if the guaranteed pump performance does not meet the requirements of the Acceptance Grade 2U classification.

1.9 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.10 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

.2 The Manufacturer shall provide a warranty for a minimum period of 1 year from Substantial Completion. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide a skid mounted variable speed pumping assembly to distribute effluent water throughout the plant.

.2 Assembly to be located indoors.

.3 Assembly to include as a minimum:
- .1 Three (3) variable speed vertical multi-stage centrifugal pumps.
- .2 Three (3) variable frequency drives.
- .3 A single pressure tank.
- .4 A single duplex manual strainer assemblies.
- .5 A single automatic strainer assembly.
- .6 Valving and interconnecting piping to provide equipment isolation and required flow control.
- .7 All necessary instrumentation and controls for a complete and functional system. Pressure transmitters on the suction and discharge headers will be supplied by Division 17.

.4 All guarding to be to CSA Z432 and to OSHA standards.

.5 Coordinate with Contractor's designer for seismic support systems and provide all necessary attachments and reinforcing for equipment.

.6 Nuts, bolts and other fasteners to be Type 316 stainless steel.

.7 Refer to Section 17508 – Effluent Water System.

2.2 PERFORMANCE

.1 The pumping/filtration system is to be designed for continuous or intermittent operation.

.2 Pumping performance requirements as scheduled.

.3 Expected effluent water characteristics:

Total Suspended Solids:	<25 mg/L
Total Chlorine Residual:	<0.04 mg/L
Total Phosphorous:	<1 mg/L
pH:	6.5 – 9.0
Temperature:	0 - 30°C

2.3 PUMPS

.1 Pumps to be base mounted in-line vertical multi-stage type.

.2 Head-capacity curve to have a steady rise in head from maximum to minimum flow within the preferred operating region. Shut-off head to be a minimum of 20% higher than the head at the best efficiency point.

.3 Pump Fabrication:
- .1 Pump suction and discharge to be fabricated of ASTM A536 ductile iron complete with flange connection to ASME B16.5 Class 250.
- .2 Pump Head: ASTM A48 Class 30 grey cast iron.
- .3 Impeller and Impeller Wear Rings: AISI Type 304 stainless steel.
- .4 Pump Shaft: AISI Type 431 stainless steel.
- .5 Motor Stool: ASTM A48 Class 30 grey cast iron.
- .6 Intermediate Bearing Journals: Tungsten carbide.
- .7 Intermediate Chamber Bearings: Lead-free tin bronze.
- .8 Chamber Bushings: Graphite filled tungsten carbide.
- .9 O-ring Seals: EPDM.

.4 Shaft seal to be a single balanced metal bellows cartridge type.

.5 Shaft seal replacement to be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one piece component. Pumps to have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

.6 Interconnecting Process Piping
- .1 Interconnecting piping to be stainless steel (Type 304 or 316) to the standards of Section 15349.
- .2 Provide pump suction and discharge headers.

.7 Pump Motor:
- .1 Motors to be provided in accordance with Section 15053.
- .2 Designed for continuous duty operation, NEMA Design B with a 1.15 service factor.
- .3 Totally enclosed and fan cooled (TEFC) with Class F insulation.
- .4 Nameplate to have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.
- .5 Motors to have a NEMA C-flange for vertical mounting.
- .6 Drive end bearings to be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

.8 Specified Product: Grundfos model Hydro MPC-EC (CUE) 3CR 20-3.

.9 Alternate Manufacturer:
- .1 Armstrong.
- .2 Bell & Gossett.

2.4 DRIVES

.1 Each pump to be provided with a dedicated variable frequency drive (VFD). Provide a NEMA 4X stainless steel control panel to be located in close proximity to the pumps. Control panel to house the drives and control circuitry.

.2

.3 VFD to be of the PWM (Pulse Width Modulation) design using current IGBT Insulated Gate Bipolar Transistor) technology.

.4 VFD to convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. Motor current to closely approximate a sine wave. Motor voltage to be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

.5 VFD to have a minimum of two skip frequency bands that can be field adjusted.

.6 VFD to have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.

.7 VFD to include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature and motor over-temperature (when PTC thermistors are used).

.8 VFD to have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors to provide a minimum 3% impedance line reactor.

.9 Protect VFD from sustained low voltage. VFD to provide full rated output with an input voltage as low as 90% of the nominal.

.10 VFD to catch a rotating motor operating forward or reverse up to full speed.

.11 VFD to have, as a minimum, the following input/output capabilities:
- .1 Speed Reference Signal: 0-10 VDC, 4-20mA.
- .2 Digital remote ON/OFF.
- .3 Fault Signal Relay (NC or NO).

.12 Specified Product: Grundfos CUE series.

.13 Alternate Manufacturers:
- .1 Approved equal.

2.5 PRESSURE TANK

.1 Tank to be sized for 1,400 L total volume, with overall height of 2,794 mm and diameter of 914 mm.

.2 Provide a vertical steel pressurized bladder type expansion tank compatible with operating fluid and integral base. Tank to be ASME Section VIII certified for 860 kPa working pressure.

.3 Bladder to be fabricated of heavy duty butyl rubber.

.4 Provide pressure and temperature gauges, air loading valve with stop and drain connection.

.5 Specified Manufacturer: Amtrol WELL-X-TROL Series.

.6 Alternate Manufacturers:
.1 Expandflex.
.2 Canbraco.

2.6 MANUAL STRAINER

.1 Inlet to pump assembly to be equipped with a manual duplex basket strainer. Strainer capacity to match assembly requirements.

.2 Strainer assembly to allow for basket cleaning without the need for a system shutdown.

.3 Strainer assembly to be designed with a flat mounted base and ergonomic hand removable covers.

.4 All fabrication materials to be compatible with plant effluent water.

.5 Assembly to be constructed of ASTM D1784 Class 23447 CPVC.

.6 Provide an AISI Type 304 strainer basket with a 4 mm (80 mesh equivalent) perforation size.

.7 Strainer CV value to be minimum 63 l/s (1,000 GPM).

.8 Pressure Rating: 1034 kPa @ 21°C.

.9 Specified Product:
.1 Hayward DB Series.

.10 Alternate Manufacturer:
.1 Approved Equal.

2.7 AUTOMATIC STRAINER

.1 Pump assembly discharge to be provided with an automatic strainer.

.2 Strainer to be motorized self-cleaning and fully automatic to provide continuous debris removal from the effluent water system.

.3 Strainer capacity and associated pressure drop to match pump assembly requirements.

.4 Body and cover to be fabricated of ASTM A126, Grade B cast iron designed, manufactured and tested generally to ASME Section VIII standards, using qualified ASME Section IX welders.

.5 Housing to be suitable for a design pressure of 1035 kPa. Inlet and outlet connections to be flanged and conform to ASME B16.5 standards.

.6 Strainer to have a single 25 mm backwash connection and a 19 mm drain connection located in vessel bottom.

.7 Unit to be complete with factory supplied steel support legs for bolting to concrete or steel base.

.8 Straining element to be manufactured of AISI Type 316 stainless steel with reverse rolled slotted wedge wire screen with a 3175 micron (60 mesh equivalent) spacing.

.9 Wide or flat cross-section of wedge wire to face the direction of flow providing for a continuous smooth flat surface to trap debris. Straining media to be free of pockets, tubes, collector bars, etc. that accumulate and trap debris permanently.

.10 All internal parts to be fabricated of AISI Type 316 stainless steel. Strainer to be provided with drive shaft and hollow port assembly with all necessary bearings and seals.

.11 Port assembly to be factory and field adjustable for positive effective cleaning and shear capacity.

.12 Gear reducer motor to be driven by a TEFC motor meeting the requirements of Section 15053.

.13 Automatic backwash accessories include an electrically actuated ball valve, differential pressure switch and pressure gauges mounted on the strainer.

.14 Backwashing cycle to be triggered on a timed cycle, with a differential pressure override. When initiated, the backwash actuated valve is opened to cause a pressure change in the backwash arm. The resulting flow into the arm dislodges accumulated debris and cleans the strainer.

.15 Controls:
- .1 Strainer to be equipped with a dedicated stainless steel NEMA 4X control panel.
- .2 Control panel to include the following:
  - .1 HOA switch pilot.
  - .2 Cycle timer.
  - .3 Backwash ON pilot light.
  - .4 Backwash OFF pilot light.
  - .5 Differential high pressure pilot light.
  - .6 Alarm status pilot light.
- .3 Provide discrete signals to plant PLC via Form C dry contacts. Each contact to be rated for 5A @ 120 VAC.
- .4 The following signals are required:
  - .1 Run status (output).
  - .2 In Auto (output).
  - .3 Differential pressure high.
  - .4 Differential pressure high -high
  - .5 Motor overload.

.16 Electrical:
- .1 Power Requirements: ¼ hp, 120 V, 1 ph, 60 hz.
- .2 Provide combination-type, full-voltage, non-reversing starter for strainer motor with manual-reset overload protection in all three phases. Provide fused control power transformer to supply 120 VAC, single-phase control power for all functions. All external interfaces to be provided via numbered terminal block.

.3 Electrical components to be provided in accordance with the requirements of Division 16, Electrical. All internal wiring to be pre-wired to a terminal block.

.17 Specified Product:
.1 Eaton Model 2596.

.18 Alternate Manufacturer:
.1 Approved Equal.

2.8 VALVES

.1 Valves to be to the standards of Section 15100.

2.9 COATINGS

.1 Any ferrous material other than stainless steel will require coatings meeting the requirements of Section 15020 and Division 9.

.2 Pumps standard factory finish and colour to be provided.

2.10 CONTROLS

.1 Provide a local control panel with a NEMA 4X rating to contain the controls circuitry and VFDs. Control panel to include the control circuit and control relays for alarm functions. Control panel to include:
.1 Pump Run Lights.
.2 System Fault Light.
.3 Surge Arrestor.
.4 Emergency/Normal Operation Switches.
.5 Pump Alarm Lights.
.6 Audible Alarm (80 dbA).
.7 Control Panel Internal Illumination.
.8 Service Disconnect Switches.

.2 Controller to provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

.3 Controller to be microprocessor-based, capable of having software changes and updates via personal computer (notebook). Controller user interface to have a VGA display with a minimum screen size of 10” diagonal for easy viewing of system status parameters and for field programming. Display to have a backlight with contrast adjustment. Password protection of system settings to be standard.

.4 Controller to display the following status readings from a single display on the controller:
.1 External flow rate.
.2 Current value of the control parameter (typically discharges pressure).
.3 Most recent existing alarm (if any).
.4 System status with current operating mode.
.5 Status of each pump with current operating mode and rotational speed as a percentage (%).

.5 Controller to have as a minimum the following hardware inputs and outputs:
- .1 Three analog inputs (4-20mA).
- .2 Three digital inputs.
- .3 Two digital outputs.
- .4 Ethernet connection.
- .5 Field service connection to PC for advanced programming and data logging.
- .6 Any additional hardware required to meet the intent of the control narratives. Refer to Section 17500 - Control Narratives.

.6 Controller to have built-in data logging with the following parameters available for logging:
- .1 Estimated flow rate.
- .2 Speed of pumps.
- .3 Inlet pressure.
- .4 Discharge pressure.
- .5 Power consumption.
- .6 Controlling parameter (discharge pressure).

.7 Pump system programming (field adjustable) to include as a minimum the following:
- .1 Water shortage protection.
- .2 Transducer settings (suction and discharge analogue supply/range).
- .3 PI controller (proportional gain and integral time) settings.
- .4 High system pressure indication and shutdown.
- .5 Low system pressure indication and shutdown.
- .6 Low suction pressure/level shutdown (via digital contact).

.8 Controller to have continuous water shortage protection. System restart after shutdown to be manual or automatic (user selectable).

.9 System pressure setpoint to be capable of being automatically adjusted by using an external setpoint influence. Setpoint influence functions enables user to adjust the control parameter (typically pressure) by measuring an additional parameter.

.10 Controller to be capable of receiving a remote analog setpoint (4-20mA) as well as a remote system ON/OFF (digital) signal.

.11 Pump system controller to store up to 24 warning and alarms in memory. The time, date and duration of each alarm will be recorded. A potential-free relay will be provided for alarm notification to the building management system. Controller to display the following alarm conditions:
- .1 High system pressure.
- .2 Low function pressure (warning and/or alarm).
- .3 VFD trip/failure.
- .4 Loss of remote setpoint signal (4-20mA).
- .5 Low system pressure.
- .6 Individual pump failure.
- .7 Loss of sensor signal (4-20mA).
- .8 System power loss.

.12 Controller to be capable of providing instantaneous power consumption (watts or kilowatts) and cumulative energy consumption (kilowatt hours). Control panel to accept an external 120 VAC (UPS) power source for the controls circuitry.

.13 Supplier to provide the Owner with a copy of the control logic and the ability to access and read all elements of the control system for the purposes of troubleshooting.

.14 Refer to Section 17500 – Control Narratives for the control intent of the effluent water system.

2.11 ELECTRICAL

.1 Electrical components to be provided in accordance with the requirements of Division 16 Electrical. All internal wiring to be prewired to a terminal block.

.2 All external wiring between pump motors, instrumentation and panel to be provided by the Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Packaged pumping system to be installed in accordance with the manufacturer's written instructions.

3.2 IDENTIFICATION

.1 Equipment to be tagged consistent with the Contract Drawings and with the requirements of Section 15020.

3.3 SUPPLEMENTS

.1 Pump Schedule included at the end of this section.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This Section covers the supply, delivery, supervision of installation and commissioning of rotary positive displacement blowers and appurtenances, as specified herein.

.2 The General Contractor is to provide rotary positive displacement blowers in compliance with these specifications and as shown on the Drawings.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.
- .1 American Society for Testing and Materials (ASTM):
- .2 ASTM A105 – Standard Specification for Carbon Steel Forgings for Piping Applications
- .3 ASTM A48 – Standard Specification for Gray Iron Castings

.2 American Bearing Manufacturers Association (ABMA).
.3 American National Standards Institute (ANSI).
.4 American Society of Mechanical Engineers (ASME):
- .1 ASME PTC9 – Displacement Compressors, Vacuum Pumps and Blowers.

.5 Electrical Safety Authority (ESA).
.6 Canadian Standards Association (CSA).
.7 National Electrical Code (NEC).
.8 Electric and electronic Manufacturers Association of Canada (EEMAC).
.9 Ontario Electrical Safety Code (OESC).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15.

.2 Informational submittals required for all Part 2 – Products specified herein. In addition to the requirements noted in clause .1 above provide the following:
- .1 Product Data to be provided in addition to the requirements noted above:
  - .1 Identify construction materials for all components.
  - .2 Relevant data illustrating full range of operation including speed curves, if applicable.
  - .3 Electrical motor information and specification.
  - .4 Loadings imparted to each piece of equipment.
  - .5 Permissible range of vibration.
  - .6 Factory finishing details.
  - .7 Anchoring requirements.
  - .8 A motor performance chart exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. Chart to also include date on motor starter and no-load characteristics.
  - .9 Noise characteristics of equipment.
- .2 Operation and Maintenance Data to include:
  - .1 Refer to Division 1 and Division 15 for requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Refer to Division 1 for delivery, storage and handling requirements.

.2 All equipment shall be completely factory assembled to the extent possible, practical, and safe for transport and on-site handling.

.3 All equipment delivered to the site shall be stored in accordance with the manufacturer's instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Close Out requirements.

1.6 MAINTENANCE AND SPARE PARTS

.1 Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

.2 Provide Spare Parts in accordance with procedures outlined in Division 1.

.3 For each blower model and size, provide the following spare parts:
- .1 One (1) spare set of V-belts, as required for each blower.
- .2 One (1) spare set of filter elements for each air inlet filter on each blower.
- .3 First change of oil.

.4 One (1) year maintenance kit required.

.5 Provide any specialty tools required for maintenance.

1.7 QUALITY ASSURANCE

.1 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier's cost if proper supporting evidence cannot be provided.

.2 Performance Test, replace the unit with a suitable blower at no additional cost to the Region.

.3 Guarding to meet OSHA and CSA Z432 requirements.

.4 All electrical installation and components shall comply with CSA and local electrical authority.

.5 Electrical Equipment not bearing a CSA label requires an ESA field approval.

.6 Where required by Authority having jurisdiction, equipment shall bear a ULC or UL label.

.7 The equipment specified herein shall be factory assembled as far as practical to verify that all mating parts can be field assembled. All mating parts shall be trial fit and match marked. The manufacturer shall submit certification of shop trial assembly and photographs of assembly before shipment. The Owner and the Contractor shall be given the opportunity to witness the shop assembly.

.8 Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented and all deficiencies noted, corrected, re-inspected, and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Inspection records and evidence of inspector qualification shall be submitted to Owner upon request.

1.8 COMMISSIONING

.1 Refer to Division 1 and Division 15 section 15010 for commissioning requirements.

1.9 TRAINING

.1 Refer to Division 1 and Division 15 for training requirements.
.2 Training required for all Part 2 equipment.

1.10 WARRANTY

.1 Refer to Division 1 for warranty requirements.
.2 In addition, provide a written manufacturer's warranty for the equipment specified in this Section. The warranty shall be for a minimum period of 1 year from Substantial Completion. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts.

PART 2 – PRODUCTS

2.1 GENERAL

.1 Blowers to be positive displacement type with three (3) lobe rotors and internal pulsation cancellation, rated for variable speed operation.

.2 The blower and drive motor shall be factory mounted on a common base of cast iron or steel fabrication, suitably constructed to support the weight of the equipment.

.3 No special foundations shall be required. The blower package will be installed directly on a concrete slab without grouting the base frame. There shall be only four (4) easily accessible anchor points.

.4 Refer to the Drawings for configuration.

.5 Blowers are to be provided with provisions to allow the use of a variable frequency drive, furnished by others.

.6 Blowers to be able to be placed side by side as indicated on the layout drawings without adversely affecting operation.

.7 Blowers are to be able to fit into the new blower room as a single unit without disassembly through the double doors provided.

2.2 PERFORMANCE REQUIREMENTS

Blowers BL-3301 and BL-3302:

.1	Discharge Flow Rate:	108 m^3/min (3,800 cfm) at inlet conditions. 6114 m^3/hr at 20 degrees C, 1 bar, 36%RH
	Discharge Pressure:	600 mbar(g) (8.7 psig).
.2	Inlet Temperature:	Minus 30 degrees C to 35 degrees C.
.3	Maximum Discharge Temperature:	95°C.
.4	Inlet Size:	300 mm (12 in).
.5	Discharge Size:	300 mm (12 in).
.6	Electrical Requirements:	575V/3P/60Hz.
.7	Motor Rating:	186 kW (250 HP).
.8	Blower Maximum Speed:	1800 rpm.
.9	Maximum Feed Field Noise Level at 1m:	83 dB(A).

2.3 EQUIPMENT CONSTRUCITON

.1 Cylinder, End Plates, and Covers:

- .1 Cast iron according to ASTM A48/A48M, with pre-inlet channels to reduce sound emissions through pulsation cancellation.
- .2 Cylinder to be sealed from gear case and front cover to prevent oil from entering the air stream.

.2 Rotors:

- .1 Three (3) lobe rotors from one (1) piece drop forged steel according to C45N (AISI 1043 equivalent).
- .2 Rotors to be statically and dynamically balanced.
- .3 Each impeller/shaft shall be supported by anti friction bearings and fixed to control the axial location of the impeller/shaft in the unit.
- .4 A double sealing arrangement shall be provided to prevent lubricant from contaminating the air stream but may not utilize any type of lip type seal.
- .5 The rotors shall be timed by a pair of single helical AGMA 12 quality gears with hardened and ground teeth minimum AGMA service factor of 1.70. Gears shall be mounted on the shafts with a tapered interference fit and secured by a locknut.

.3 Bearings: Conform to the standards of AFBMA, with a minimum L10 rating of one-hundred thousand (100,000) hours (at duty point). Regardless of theoretical bearing life calculations, the bearings shall be sized for an expected 5 years between overhauls.

.4 Lubrication: Bearings and timing gears are to be splash lubricated. Grease lubrication shall be not acceptable.

.5 Drive: Heavy duty narrow V belt type, self tensioning, with suitable guard.

- .1 V Belt: High-capacity type, oil and heat resistant, sized for a minimum of 150 percent of the maximum full load horsepower of the motor.

.2 Guard: Sheet metal construction and totally enclosed, meeting OHSA specifications, complete with openings for ventilation. Provide adequate rigidity to prevent vibration during blower operation.

.6 Intake System:

.1 Intake silencer and air intake filter contained in a combined housing directly mounted to blower.

.2 Cleanable and exchangeable dry type filter element, 99 percent efficiency.

.3 Pressure drop not to exceed 50 mm WC at rated capacity.

.4 Provide dirty filter indicator gauge.

.7 Discharge System:

.1 Combination base frame and discharge silencer of welded steel construction, complete with machine mounts designed to maintain alignment of both, the blower internal components and the drive during operation.

.2 Blower discharge flange, designed for piped air discharge with ANSI 150 flanged connection. The silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the pressure setting of the pressure safety valve.

.8 Connection Housing: Cast steel connection housing for connection to discharge piping and mounting of pressure relief valve, check valve, and pressure switch.

.9 Pressure Relief Valve: For mounting in the blower discharge, weighted type with spare weights for field adjustment to the design head, bottom flanged, capable of discharging the full blower capacity. Size and setting as recommended by manufacturer.

.10 Check Valve: Flap type non-return valve, supplied integral to the blower package, or external to suit application.

.11 The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall not exceed 1/2 inch/second RMS when operating at the specified maximum operating pressure and speed in the actual blower package.

.12 Each blower shall be factory tested according to DIN EN 10204, in accordance with ISO 1217 performance test, to verify flow, BHP, and slip at design conditions as well as blower maximum conditions. Slip test only shall not be acceptable. The acceptance criteria are plus or minus 5 percent tolerance on power and minus 5 percent tolerance on flow regardless of the size of the machine. The performance test can be performed in accordance with other internationally recognized standards, such as ISO or DIN.

.13 A recessed oil sight glass must be provided on each oil sump. Protruding sight glasses are not acceptable.

.14 Each blower shall be supplied with vibration isolating feet with a minimum efficiency of 80 percent. Blower manufacture shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations form the blower package being transmitted to the base or the piping.

.15 Painting shall be Supplier's standard. Aluminum, stainless steel, and brass shall not be painted. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint colour. Painted cast iron and carbon steel shall be alkyd resin primer and final coat with a total dry film thickness of 70 μm. Surface preparation SSPC 10 or better. Sound enclosure shall be powder coated polyester base total dry film thickness 80 μm. Galvanized components may only be painted with appropriate surface preparation.

2.4 BLOWER ACCESSORIES

.1 The package layout must minimize the space requirement including the space required for accessing all accessories of the package (including but not limited to), belt drive, pressure safety valve, check valve, flexible connectors, and lubrication points on motor and blower) for regular maintenance and periodic checking. The sound enclosure shall not interfere with this requirement and shall not require disassembly of the piping or the use of tools to meet the aforementioned requirements. Operator shall not be required to reach over any component of the blower package to perform oil filling and draining.

.2 Each blower package shall be connected to the plant piping via flexible connector(s) located downstream of the discharge silencer (and upstream of the inlet silencer if the Specifications require the inlet air to be piped to the blower package). The flexible connectors shall be sized for a standard, Schedule 40 pipe diameter and shall prevent the transmission of noise and vibrations from the blower package into the piping. The flexible connectors shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream.

.3 Each blower shall be supplied with a V-belt drive that shall be of the high-capacity type, oil and heat resistant. Belt tensioning shall be automatic without the use of any devices or interaction on the part of the operator. Neither slide rails nor load adjusting springs shall be used. Sheaves shall be dynamically balanced regardless of the operating speed.

.4 The belt drive shall be guarded in compliance with OSHA regulations. Portions of the guard shall be easily removable allowing for belt inspection and replacement. Guard material shall be perforated carbon steel. Expanded metal shall be limited to small surfaces not to exceed 0.1 m^3.

.5 Each blower shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve. The safety valve shall be set to protect the blower from exceeding its maximum pressure rating. The materials selected for the valve internals shall enable safe and reliable operation at the site conditions. The single valve shall be sized to pass 100 percent of the design flow. The valve shall be field adjustable, spring loaded and have a proportional operating characteristic with respect to the pressure set point. If the blower package is supplied with a sound enclosure, the pressure relief valve shall also be housed by the sound enclosure and shall relieve into a segmented section of the sound enclosure.

.6 Each blower shall be supplied with one (1) factory assembled check valve that shall be installed on the discharge line. The check valve shall be of the full-bore low pressure drop, flapper type design with a steel body, and steel flap embedded in EPDM with full contact seal. The valve shall be removable without disturbing the piping. The vendor shall include the pressure losses produced by the check valve in the blower performance calculation.

.7 Each blower shall be supplied with the following instrumentation: one pressure gauge that shall be supplied to measure the discharge pressure, with an isolation ball valve. The scale shall be appropriately selected for the application pressure range. The pressure gauge shall have a stainless steel case and be glycerin-filled for pulsation dampening. Minimum dial diameters shall be 63mm. A filter maintenance indicator shall be provided. Minimum dial diameters shall be 63mm. The scale shall be appropriately selected for the filter vacuum range.

.8 Each blower shall receive an initial oil filling at the factory. Oil requirements shall be such that the oil shall be available from a local source.

.9 Each blower shall be supplied with a sound enclosure covering the entire blower package including the drive motor, the inlet silencer, and the discharge silencer. The sound enclosure must be designed for easy inspection and maintenance of all blower package components. The enclosure shall be designed so as to be able to install the blower packages side by side so that all maintenance is done from the front or rear of the package. Oil level must also be able to be monitored from the outside of the enclosure without shutting down the blower or opening the enclosure. The enclosure shall provide suitable protection for indoor installation. Details are as follows:

.1 Panels shall be made of galvanized steel sheet, powder coated.

.2 The enclosure and the blower package must be both mounted on a skid/oil drip pan designed for meeting environment protection standards and for easy transportation and installation.

.3 A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts.

.4 Quick release panels, each less than 23 kg (50 pounds) (as mandated by OSHA) must provide easy and quick access for routine maintenance of the blower and the package components. Should the panels be heavier than 23 kg (50 pounds), hinged doors must be supplied, with the appropriate frame, reinforcements, and supporting elements.

.5 A mechanical, shaft driven ventilation fan shall provide ventilation and cooling integral to the sound enclosure. Motor driven ventilation fans shall be permitted as long as the blower manufacturer provides a factory installed and prewired system which includes the fan motor, motor starter, wiring and NEMA 4X stainless steel, fan control panel. Fan shall operate off the power feed for the drive motor of 575 V, 3 phase, 60 Hz power. Fan control panel shall only allow the main blower motor to run after ventilation fan operation is confirmed. The Contractor shall only make electrical connections for the ventilation system in the provided control panel. Cooling fan shall be sized for sufficient heat removal from the sound enclosure.

.6 Electrical components, instrumentation and instrument connections shall be accessible without removing panels of the sound enclosure.

2.5 MOTOR

.1 TEFC, premium efficiency inverter duty motor, suitable for variable speed drives and selected in accordance with Section 15053.

.2 All motors shall be TEFC and meet all applicable requirements of NEMA MG 1, Section IV, Part 31.

.3 Motors connected to VFDs shall be inverter duty rated motors to NEMA MG 1, Section IV, Part 30.

.4 One (1) thermistor per phase required for each blower.

2.6 ELECTRICAL

.1 Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with the requirements of Division 16, Electrical.

.2 Blower to be provided with pre-wired electrical to a junction box located on the rear of the unit.

2.7 CONTROLS

.1 Variable frequency drives where required to be provided by others.

.2 Blower controls by Division 17.

2.8 SPECIFIED PRODUCT

.1 Delta GM Series Rotary Positive Displacement blower as manufactured by Aerzen Canada Inc.

2.9 ALTERNATE MANUFACTURERS

.1 Gardner Denver

PART 3– EXECUTION

3.1 APPLICATION

.1 Compliance: comply with Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheet.

3.2 INSTALLATION

.1 Blowers to be installed in accordance with Manufacturer’s written instructions.

.2 Prior to connecting each blower unit, support complete piping assembly and anchor in alignment with pumping assembly so as not to impart any undue strain on the blower. Correct any misalignment.

3.3 FIELD QUALITY CONTROL

.1 General:
- .1 Blower supplier shall complete Manufacturer’s Certificate of Proper Installation upon satisfactory installation of the equipment.
- .2 Refer to Division 1 for additional testing requirements.
- .3 Blower supplier shall calibrate instruments, sensors, and meters supplied for testing.

.2 Functional Testing:
  .1 Functional testing shall be conducted after the installation of the blower(s) and all related appurtenances are complete.
  .2 The Equipment Supplier, in coordination with the Contractor, will provide all temporary measures required for the functional tests. Written test procedures shall be submitted to the Consultant for approval a minimum of 60 days prior to testing.
  .3 The functional tests shall determine the characteristics of each unit and demonstrate the units:
    .1 Have not been damaged by transportation or installation.
    .2 Have been properly installed.
    .3 Have no mechanical defects.
    .4 Are in proper alignment.
    .5 Have been properly connected.
    .6 Are free of overheating of any parts.
    .7 Are free of objectionable vibration and noise as specified.
    .8 Are free of overloading of any parts.
    .9 Are properly lubricated.
    .10 Respond properly to all start-up and shutdown sequences.

.3 Vibration Test: Vibration testing shall be conducted during field functional testing. The Equipment Supplier shall verify operations are within tolerances and the vibration signature recorded over the frequency domain.
  .1 Provide vibration signature test data for each blower and drive assembly for comparison to factory testing data.
  .2 Provide testing plan with applicable standards being used prior to performing field testing.

.4 Test each unit to ensure blower delivers rated capacity in Consultant's presence.

.5 Test electrical loading to ensure blower (s) operate efficiently without electrical overload.

.6 Noise Test: Perform noise testing in the field with equipment installed and operating at peak capacity to verify noise produced by the equipment. Noise from equipment to be less than or equal to those listed by the manufacturer.

3.4 IDENTIFICATION

.1 Blowers are to be tagged consistent with the Contract Drawings and the requirements of Section 15020.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 15010: Mechanical General Provisions

.2 Section 15030: Testing

.3 Section 15055: Equipment Supports

.4 Section 15061: Steel Pipe Welding Procedures

.5 Section 15241: Vibration Isolation and Seismic Control Measures

.6 Section 15349: Process Piping

.7 Wiring for Equipment: conform to Division 16

1.2 SECTION INCLUDES

.1 This section consists of furnishing a complete odor control system consisting of a dry scrubber vessel, dry scrubber media, exhaust fan, grease filter, instrumentation, and control panel as specified to properly operate and monitor the odor control system.

.2 This Section covers the requirements for the design, supply, delivery, installation, performance testing, startup, and commissioning of packaged, engineered carbon filter odour control units, including all related appurtenances, systems and equipment required to provide a fully operational odour control system.

.3 These Specifications are intended to give a general description of what is required, but do not cover all details that will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing and delivery of all materials, equipment and appurtenances for the complete odour control system herein specified, whether specifically mentioned in these Specifications or not.

1.3 DEFINITIONS

.1 Person-Day: One person for 8 hours within regular Contractor working hours.

.2 CH4: Methane Gas

.3 H2S: Hydrogen Sulfide Gas

.4 D/T: Detection to threshold as per the specified air odor determination method.

.5 OU: Odor Unit.

1.4 REFERENCES

.1 ASHRAE 52.2-2012: Method of Testing General Ventilation Air – Cleaning Devices for Removal Efficiency by Particle Size.

.2 American Society for Testing and Materials (ASTM).

.1 ASTM C582 – Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.

.2 ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulation Materials.

.3 ASTM D883 – Definition of terms relating to plastics.

.4 ASTM D2563 – Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.

.5 ASTM D2583 – Test for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

.6 ASTM D3299 – Standard Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks

.7 ASTM D4097 – Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks.

.8 ASTM D4167 - Standard Specification for Fiber-Reinforced Plastic Fans and Blowers

.3 AMCA 211-13: Certified Ratings Program – Product Rating Manual for Fan Air Performance.

.4 AMCA 99-0401-86: Classification for Spark Resistant Construction

.5 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.6 CSA Approval for complete electrical installation.

.7 National Electrical Manufacturers Association (NEMA).

.8 Guarding: CSA Z-432.

.9 The Society for Protective Coatings (SSPC).

.10 American National Standard Institute (ANSI).

.11 Underwriters Laboratories (UL).

.12 National Fire Protection Association (NFPA).

.13 When reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Section 01330.

.2 Shop Drawings

.1 Dimensional layouts, materials, details of appurtenances and anchoring. Fabrication and installation shall be in accordance with approved Drawings.

.2 Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other Work, and weights of associated equipment. All such submissions shall be stamped by a registered professional engineer licensed in the Province of Ontario.

.3 Power and control wiring diagrams, including equipment layout and sizing, bill of materials, and wiring diagrams, including terminals and numbers.

.4 Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.

.5 Control panel component manufacturer's data sheets.

.6 Cable schedule indicating all power and controls connections to equipment and interconnection wiring between electrical control panels and devices.

.3 Product Data:

.1 Manufacturer’s catalog information, descriptive literature, specifications, dimensional layouts, and identification of materials of construction.

.2 Control panel component manufacturer’s data sheets.

.1 Control narrative

.2 Control panel layout and wiring diagrams

.3 Control panel bill of materials

.3 Special shipping, storage and protection, and handling instructions.

.4 External utility requirements such as power and water for each component.

.4 Maintenance Data: Include manufacturer’s literature, cleaning procedures, filter media replacement procedures, replacement parts lists, and repair data.

.5 Manufacturer’s Certificates: Certify that Products meet or exceed requirements specified in this Section.

.6 Manufacturer's Instructions: Indicate rigging, lifting, installation anchoring procedures and detailed performance testing, startup and commissioning plans.

.7 Manufacturer’s Field Reports: Report startup, field inspection and testing results.

.8 Operational and Maintenance Manuals. The manual shall include the Supplier’s direction and assembly recommendations, power draw curves, efficiency curves and a complete list of recommended spare parts.

.1 Operator safety including hazards and warnings

.2 Description of systems, components, and technical data.

.3 Operating instructions.

.4 Preventative maintenance recommendations

.5 Troubleshooting guide

.6 System drawings

.7 Brochures and datasheets for all components provided

.9 Warranties.

.10 Performance Testing Protocol

.1 Overview of Protocol

.2 Test conditions including the minimum time after system start up before performance testing can be completed.

.3 Test duration

.4 Required measurements and samples

.5 Performance requirement statement

1.6 QUALITY ASSURANCE

.1 The odour control unit manufacturer shall have full responsibility for the design and fabrication of the odour control system described herein The odor control manufacturer shall have at least 15 years' experience in design and fabrication of odor control systems as demonstrated by a list of at least 5 successful installations of comparable size and configuration in the Canadian market..

.2 The components and equipment covered by these Specifications shall be standard equipment of proven field operation of at least 5 years, as assembled by manufacturers having a minimum of 5 years experience in the production of such equipment and systems.

.3 All equipment furnished under this Specification shall be new and unused.

.4 Consideration of alternate media shall be submitted to the Engineer at least 14 days prior to the bid date. No alternate media will be considered unless it has been pre-approved by the Engineer.

.5 The odor control manufacturer shall provide the Owner with training and monitoring support service during the first year of operation.

.6 The odor control manufacturer shall perform laboratory analysis for nutrient and microbial analysis of the biofilter media after 1 year of operation.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 All equipment items shall be properly protected so that no damage or deterioration will occur from the time of shipment until installation is completed and the units and equipment are ready for operation. In the case of an incomplete shipment or damage has occurred, the BIOREM® Logistics Department must be contacted.

.2 Finished surfaces of all exposed blower and equipment openings shall be protected.

.3 Proper care shall be taken to protect mechanical parts from moisture during shipment, storage, and handling.

.4 Accept components on the site and haul and unload with appropriate procedures and precautions protecting against damage.

.5 Inspect and correct for damage.

.6 Parts are not to be delivered to site until Contractor is ready for installation. Parts are not to be exposed to adverse weather and/or storage conditions while waiting for installation.

.7 Product delivery, storage, and handling shall comply with Manufacturer's instructions and as follows.

.8 Dry scrubber media shall be delivered in bags or bulk sacks, and bags should be stored together to minimize contamination prior to installation. The media shall be stored between 5 - 30 °C (40 - 85 °F), avoiding heat, radiation, and static electricity. The containers shall be kept tightly sealed and protected from open air and humidity.

.9 All electrical and ancillary equipment shall be stored in a climate controlled building greater than 50 degrees F.

1.8 WARRANTY

.1 The odour control units shall be warranted for a period of 24 months from the date of Substantial Performance of the Work.

.2 The odour control unit manufacturer shall warranty the chemical media to not require replacement for a period of 2 years from the date of Substantial Performance of the Work based on 5 ppm by volume average H2S concentration in the influent air supplied to the units provided that the systems are operated and maintained in accordance with the manufacturer's instructions for operation and maintenance.

PART 2 - PRODUCTS

2.1 SPECIFIED MANUFACTURER

.1 BIOREM.

.2 Approved Alternates:
- .1 ECS Environmental Solutions
- .2 Pure Air Filtration.
- .3 Circul-Aire Canada.
- .4 Continental Carbon Group Inc.

2.2 DESIGN CRITERIA

.1 The manufacturer shall furnish a complete, pre-engineered odour control system complete with pretreatment equipment, such as mist/grease eliminator. The manufacturer of the odour control system shall be responsible for the design and fabrication of the complete system within the limits specified herein

.2 The system shall be designed to suit treatment of air exposed to raw sewage.

.3 The following minimum design parameters shall be incorporated into the manufacturer's design system performance.
- .1 Influent Concentration:
  - .1 Average 1 ppm H2S.
  - .2 Peak 10 ppm H2S.
  - .3 Foul Air Source: Headworks

.2 Airflow Rate:
  .1 471.6 L/s, continuous operation.
.3 Removal Efficiency:
  .1 H_2S Removal Efficiency: >99 percent or H_2S outlet <0.5 ppm, whichever is higher.
  .2 Odour: 90% or a maximum outlet of 100 D/T, whichever is higher.
.4 Chemical Media:
  .1 Headworks:
    .1 Number of Media Sections: One (1)
    .2 Total Media Volume: 1.5 cu m.
    .3 Vessel Dimensions: 5ft diameter: 6.5ft height
    .4 Media EBRT: 3.7 seconds
    .5 Media Bed Inside Dimensions: 5ft diameter, 2.54 ft height
    .6 Media Type: Activated carbon.
  .2 Exhaust Fan Quantity: 1
  .3 Exhaust Fan Capacity: 1000 CFM @ 1.0 in WC e.s.p. Vendor to account for all internal static pressure drops through the components within the scope of supply including the mist eliminator, carbon media vessel, interconnecting ductwork, discharge stackhead, etc.
  .4 Exhaust Fan Motor Size: 5 HP

.4 Operating Conditions: Equipment associated with the odour control units shall be suitable for long-term operation under the following operating conditions:
.1 Duty: Continuous.
.2 Location: Outdoors, Kingston, Ontario.
.3 Ambient Air Temperature: Minus 40 to plus 40 degrees C.
.4 Process Air Temperature: 10 to 35 degrees C.

2.3 SYSTEM PERFORMANCE REQUIREMENTS

.1 It is the full responsibility of the odour control unit manufacturer to verify that the design for the odour control unit will meet the specified performance requirements when operating at the service conditions described herein. Manufacturer to account for operation during cold weather operation and design and account for condensation removal and freezing prevention.

2.4 GENERAL

.1 The odour control unit manufacturer shall design or select all system components and services listed below. All components shall meet the requirements of this Specification.

.2 Materials used in the manufacture of equipment which come into direct contact with a corrosive dry chemical, gas, liquid or solution shall be entirely suitable for complete corrosion resistant service.

.3 All equipment furnished shall be new and suitable for the conditions of service to which they will be subject. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen. All parts shall be protected so that no damage occurs during shipment and storage on site.

.4 Interconnecting ducts and duct connections to be flanged and designed to SMACNA Industrial Duct Standards.

.5 All tappings and connections for instrumentation to be flanged or threaded.

.6 Provide PVC full port ball valves for all drain connections.

.7 Provide FRP or SS low loss stack head to ensure a vertical discharge of air designed to prevent any rain entrainment into the carbon media vessel.

.8 All instrumentation to be provided with a means of isolation for service and maintenance.

.9 The odour control unit and all connections and parts exposed to the air supply shall be constructed of materials compatible with compounds in the exhaust air stream and compounds generated in the destruction of odours in the air stream. Acceptable duct materials include 316 stainless steel or FRP.

2.5 CARBON MEDIA VESSELS

.1 To be of 316 stainless steel or FRP construction. FRP construction be as follows:

.1 The corrosion barrier shall consist of one layer of surfacing veil (C or Nexus depending on the operating conditions) plus two layers of random mat for a total thickness of 100 mils.

.2 The structural layers to be an isophthalic polyester resin.

.3 Reinforcing material shall be commercial grade e-glass fiber containing a coupling agent to produce a suitable bond with the resin used.

.4 Ultraviolet absorbers shall be added to the exterior surface for improved weather resistance. Insulated tanks, where applicable, shall have a light gray pigmented exterior gelcoat layer.

.5 All surfaces shall be finished so as to obtain complete cure of the resin without air inhibition. The finished laminate shall be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes and pimples in accordance with ASME RTP-1 Level 2 specifications. The vessels shall conform to the resin manufacturer’s minimum standard for Barcol hardness.

.6 The vessel walls and roof shall have 2 inches thick of thermal insulation, covered with an FRP skin.

.2 Include flanged access panels to permit removal and replacement of the media.

.3 Vessel to be factory tested to no less that 1.5 times maximum working pressure.

.4 Media support beds to be design with safety margin to provide rigid support under all foreseeable conditions, such as saturated media, seismic requirements. Manufacturer shall include with the shop drawings, detailed calculations illustrating the seismic characteristics of the proposed vessel. Calculations shall be signed and stamped by a professional Engineer licensed in the province of Ontario.

.5 Tie down and lifting lugs to be 316 stainless steel.

.6 Carbon media bed shall be grounded with a 316 stainless steel rod to prevent static electricity from accumulating.

.7 All bolts and fasteners shall be minimum Type 316 stainless steel hardware and EPDM strapping.

.8 All gaskets shall be EPDM.

2.6 FAN

.1 Fan shall be industrial belt driven centrifugal type fan meeting AMCA requirements.

.2 All parts of the fan that are exposed to the airstream are to be constructed to ensure corrosion resistant and spark-proof operation. Fans shall be spark resistant FRP or 304 stainless steel.

.3 Fan shall be equipped with flanged inlet/outlet.

.1 Motor: 575V, 3 ph, 60 Hz, TEFC, inverter duty, three phase induction type, premium efficiency. 1750 RPM motor.

.4 Fan sound attenuating enclosure shall be provided to limit fan noise to 75 dB at a distance of 1.5 m.

.5 Fans shall have a 316 stainless steel shaft.

.6 The fans shall be manufactured by Universal Fan and Blower, Hartzell Air Movement or approved equal.

2.7 GREASE / MIST ELIMINATOR

.1 To be of 316 stainless steel or FRP construction.

.2 Provide grease / mist elimination pre-filter designed with a particle removal efficiency of 99% of particles 10 microns or larger.

.3 End connections shall be designed for maximum air velocity of 12.7 m/s.

.4 Maximum air velocity across pre-filter to be 2 m/s.

.5 Section to be provided complete with condensate drain connection and drip pan.

.6 The grease filter shall consist of an FRP housing with a combination plastic/stainless steel mesh pad.

.7 The pad shall be removable for cleaning and the door shall have an access hatch sealed with quick release snap acting pressure latches to allow removal and replacement of the filter pad.

.8 The grease filter shall include an NPT or flanged drain connection.

.9 The mesh pad shall consist of 2 inches thick 316 stainless steel mesh followed by 4 inches thick polypropylene mesh with 316 stainless steel grid support structure.

.10 The mesh pad shall be divided into multiple sections as needed such that the weight of each section is a maximum of 50 lbs.

2.8 CONTROL SYSTEM

.1 Provide complete factory tested and verified control system.

.2 Control system to permit both manual operation and automatic operation. Automatic operation to initiate, regulate and stop all control steps without operator intervention.

.3 Provide monitoring instrumentation and shutdown capability for key operating parameters.

.4 Provide emergency stop button to be functional in manual or automatic mode.

.5 Provide differential pressure gauge to monitor differential pressure across the grease / mist eliminator section.

.6 Provide independent pressure switch across grease / mist eliminator to be used to alarm high differential pressure to the plant SCADA system.

.7 Provide dry contact to remotely annunciate general fault.

.8 Controls to be packaged in a single NEMA 4X enclosure, 304 stainless steel.

.9 The control panel shall have a single point of connection to 600 VAC 3 phase power and shall be furnished with a fused main disconnect. The main disconnect shall be interlocked with the panel door mechanism to prevent opening of the panel door when the panel is energized.

.10 CSA/UL certified.

.11 Panel shall be mounted a minimum of 3 feet from any potential leak point to comply with NFPA 820.

2.9 ELECTRICAL GENERAL REQUIREMENTS

.1 Electrical and control system must comply with the requirements of Division 16, and those included in the current edition of applicable electrical safety regulations of the Ontario Electrical Safety Authority (ESA).

.2 All equipment and material to be CSA, ULC, or cUL certified. Refer to www.esafe.com electrical product safety for complete list of recognized certification marks.

.3 Manufacturer is responsible for obtaining ESA certification for complete packaged system including all electrical components, control panels, etc. Permanently attached certification marks shall be attached to each assembly and all equipment supplied.

.4 Products must meet applicable EEMAC standards. Permanently attached certification marks shall be attached to each assembly and all equipment supplied. Manufacturers and approval labels must be accessible after equipment is installed.

2.10 INSTRUMENTATION

.1 Instrumentation as indicated on the P&ID. Instrumentation shall meet the following specifications:

.2 Static pressure indicators (air)
- .1 Type: Low pressure capsule
- .2 Accuracy: 1.6% of span
- .3 Wetted materials: 316 stainless steel
- .4 Display: 304 stainless steel case, glass window.

.3 Differential pressure indicators (air).
- .1 Type: Diaphragm
- .2 Accuracy: 2.5% of span
- .3 Wetted materials: Aluminum and EPDM
- .4 Display: 304 stainless steel case, glass window

.4 Temperature indicators
- .1 Type: bimetallic coil
- .2 Accuracy: 1.0% of span
- .3 Wetted materials: 316 stainless steel sheath
- .4 Display: Hermetically sealed glass window.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Installation of equipment shall be in strict accordance with the respective manufacturer's written instructions and recommendations in the manufacturer's layout and shop drawings and in accordance with any other information as may be provided by the manufacturer.

.2 The Contractor shall follow all manufacturer's recommendations for loading of media.

.3 All wiring shall be in accordance with the requirements of Division 16 of this Specification, the Ontario Electrical Safety Code (latest revision), and current bulletins, and all other related local electrical and fire codes requirements.

.4 The odor control system shall be installed by the Contractor in accordance with the Contract Documents following the instructions of the Manufacturer.

.5 The Contractor shall give the Manufacturer 5 full working days' notice prior to media placement.

.6 All equipment shall be assembled and shipped so that field assembly will be minimized.

3.2 FIELD QUALITY CONTROL AND PERFORMANCE TESTING

.1 The manufacturer shall submit a detailed description of the testing approach and methodology to be used 3 weeks in advance of the performance test

.2 Performance testing of the odor control system shall be performed by the Manufacturer and shall commence as soon as possible after the acclimation period: a minimum of six (6) weeks after start up, as determined by the biological odor manufacturer.

.3 After all equipment has been installed according to instructions, and to the satisfaction of the manufacturer, tests shall be performed to, confirm that the system operates correctly, meeting all design criteria set forth herein. The manufacturer shall supply all personnel, instrumentation and hardware required for the commissioning and performance testing.

.4 The test period shall be continuous over a minimum 6-hour period. The equipment manufacturer shall be allowed to adjust the system for up to an hour before testing is initiated.

.5 The Manufacturer shall furnish the following equipment for testing:
- .1 Portable manometer with a range of 0 to 10 inWC
- .2 Portable anemometer with a range of 0 to 4000 fpm.
- .3 Portable H2S gas data logger with a range of 0 to 1,000 ppm range for inlet measurements
- .4 Portable H2S gas data logger with a range of 0 to 50 ppm range for outlet measurements.
- .5 Tedlar or Nalophan bags for collecting odor samples.
- .6 Vacuum chamber or stack diluting sampler for odor sample collection.

.6 The performance testing procedure shall be as follows:
- .1 Prior to testing ensure the air flow rate is set as designed.
- .2 Inlet and outlet H2S concentrations shall be logged for a six-hour period.
- .3 Record air flow, air temperature, media differential pressure at the beginning at end of the test.
- .4 Two sets of inlet and outlet odor samples shall be collected for odor panel analysis of the detection threshold.

.7 After the initial adjustment period the manufacturer shall not make any system adjustments unless directed by the Consultant. The test shall be determined successful if the outlet H2S concentration is less than the maximum specified in this Section. If the test cannot be completed due to equipment failure by items not furnished, the Contractor shall correct the failure and the performance test shall be re-run. If the odour control unit fails to meet the required performance, the system equipment shall be altered, modified, or the necessary components replaced by the manufacturer at its sole expense until the required performance is met.

.8 The odour control units shall operate reliably and without system interruption as provided and shall meet the Performance Criteria specified herein.

.9 The Contractor shall provide, to the satisfaction of the Consultant, written documentation of any field testing, commissioning reports and certification of proper installation.

.10 The manufacturer shall list, recommend, and complete corrective actions for any deficiencies found.

3.3 VENDOR'S SERVICES DURING CONSTRUCTION

.1 Provide manufacturer's service technician during construction for coordination and verification, and for start-up, field testing, operator training and final adjustment. Include two (2) full 8-hour days at site.

.2 Provide one (1) full four-hour training sessions to the Owner Operating Staff for new equipment.

.3 Demonstrate tear down procedures for water pumps, fans, inspection of media and possible faults and solutions, and trouble-shooting procedures for system.

.4 A written report covering the technician's findings and approval of installation shall be submitted to the Consultant covering all inspections and outlining, in detail, any deficiencies noted.

3.4 VENDOR'S SERVICE CONTRACT – POST-CONSTRUCTION

.1 The manufacturer shall provide services as follows:

- .1 Site visit shall be conducted after the first 6 months of operation, and no later than 12 months after commissioning.
- .2 Site visit is to be conducted by a Certified Field Representative of the manufacturer. Site visit is to be coordinated by manufacturer with the Owner, the Contractor, and the Consultant.
- .3 The manufacturer's Field Representative shall provide a complete system inspection, additional Operator training, if required, and system performance testing.
- .4 Media samples shall be retrieved during the visit and analyzed for the following:
  - .1 H2S capacity testing per ASTM D6646
  - .2 Butane capacity testing per ASTM
- .5 A summary report shall be completed and submitted to the Consultant and the Owner that will summarize the collected data, list system deficiencies and recommend improvements and corrective actions.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

.1 Extent of Work:
- .1 Work consists of furnishing one (1) laboratory fume hood complete with base cabinets to support hood.
- .2 Include minor materials not specifically mentioned, but which may be found necessary to provide a complete installation, unless indicated otherwise.
- .3 Cooperate with mechanical and electrical trades for installation and connection of service fittings, outlet boxes, sinks, duct stubs for fume hoods, and exhaust equipment.
- .4 Drill holes and provide cut-outs for installation of services.

1.2 RELATED REQUIREMENTS

.1 Section 07920 - Joint Sealants.

.2 Section 08800 - Glazing.

.3 Division 15 - Plumbing fixtures and trim, exhaust ductwork.

.4 Division 16 - Electrical Outlets and Wiring.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)
- .1 ANSI A208.1-2009, Particleboard.

.2 ANSI/AIHA 295.

.3 ASHRAE 110.

.4 ASTM International
- .1 ASTM A 167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM A 240/A 240M-15, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .3 ASTM A 653/A 653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM B 117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
- .5 ASTM B 456-11e1, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- .6 ASTM E 478-08, Standard Test Methods for Chemical Analysis of Copper Alloys.

.5 CSA International
- .1 CSA O112.10-08 (R2013), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).

.6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.7 National Electrical Manufacturers Association (NEMA)
.1 NEMA LD 3-2005, High-Pressure Decorative Laminates (HPDL).

1.4 SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for steel laboratory casework and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
.1 Indicate on drawings:
.1 Details of laboratory casework construction and related and dimensional position, with sections.
.2 Location of each casework unit.
.3 Location for roughing-in of plumbing, including sinks, faucets, strainers and cocks and electrical services.

.4 Samples:
.1 Submit duplicate samples of:
.1 Countertop material, 300 x 300 mm including external corner.
.2 Standard colour of cabinet finish on 300 x 300 mm steel sheet.
.3 Cabinet hardware.
.4 Plumbing brass and electrical outlets.
.2 Submit one base cabinet complete with cupboard and drawers minimum 1200 mm long, including specified bench top, splashback, end return and curb shelf.
.3 Submit wall case minimum 600 mm long. If sliding doors used on project 875 mm minimum long.

.5 Test Reports:
.1 Include test reports by independent testing laboratories indicating results of furniture finish tests.

1.5 QUALITY ASSURANCE

.1 Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

.2 Fume hoods shall be designed and constructed in accordance with S.E.F.A. standards for laboratory fume hoods.

.3 Hoods shall function as ventilated, enclosed workspaces, designed to capture, confine and exhaust fumes, vapours and particulate matter produced or generated within the enclosure.

.4 Designed to meet or exceed ANSI/A1HA Z95 verified by an independent agency in accordance with ASHRAE 110.

.5 Manufacturer to submit test results for a similar hood.

.6 All electrical devices to be CSA approved.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect fume hood from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.7 SITE CONDITIONS AND PROTECTION

.1 Verify that field measurements are as indicated on shop drawings.

.2 Hoods and base cabinet not to be installed until major architectural and structural work is complete.

1.8 SEQUENCING AND SCHEDULING

.1 Schedule work to not deliver fume hood to site until destination space is ready to receive it.

1.9 WARRANTY

.1 Provide written warranty that work performed under this section shall remain free from defects as to materials and workmanship for a period of two (2) years from date substantial performance. Replace defects in materials and workmanship that may develop within this time without any cost or expense to the Owner.

.2 Defects include, but are not limited to:

.1 Ruptured, cracked, or stained coating.

.2 Discoloration or lack of finish integrity.

.3 Weld or structural failure.

.4 Warping or unloaded deflection of components.

.5 Failure of hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

.1 Products from the following manufacturers are acceptable for use on this project:
- .1 Mott Lab Inc.
- .2 Bedcolab Systems.
- .3 Versa Lab.
- .4 Sigma.

2.2 CONSTANT VOLUME HEAD

.1 Application: Containment of exhaust from process water analysis in BAF Building.

.2 Lining: 304 stainless steel with black epoxy resin base.

.3 Standard air type where air volume is reduced by closing sash.

.4 1200 mm width x 750 mm deep.

2.3 BASIC MATERIALS

.1 Sheet Steel:
- .1 Mild steel, cold rolled furniture grade to requirements of ASTM A1008/A1008M, Grade C or higher, with smooth surfaces to furniture quality.

.2 Galvanized Sheet Steel:
- .1 Commercial quality galvanized sheet steel to ASTM 653, Designation Z275.

.3 Stainless Steel:
- .1 Sheet: ASTM A240, type 304 or 316 alloy.
- .2 Finish: Unless otherwise indicated, AISI No. 4 brushed Finish.

.4 Glass:
- .1 6mm / 1’4” thick clear float Type 1 tempered in accordance with Section 08800 – Glazing.

.5 Sealant:
- .1 One component, RTV (room temperature vulcanization) silicone sealant in accordance with Section 07920 – Joint Sealants.

.6 Resilient Base and Adhesive:
- .1 Base:
  - .1 Top set coved, 3mm / 1/8” thick, 100mm (4”) high for base units, color as later selected by Consultant from base manufacturer’s complete colour range.
- .2 Adhesive:
  - .1 As recommended by the base manufacturer, trowelled applied with 100% coverage, compatible with both surfaces.

2.4 FUME HOOD CONSTRUCTION

.1 All exterior panels and framing members shall be high quality cold rolled and levelled mild steel and shall conform to A.S.T.M. specification A366, finished as in Section H.4.

.2 Screws used to attach exterior structural members shall be sheet metal type, zinc plated. Interior fastening devices shall be truss head stainless steel screws. Exterior panel members shall be fastened by means of concealed devices. Exposed screws are not acceptable.

.3 Where required, bypass grilles shall be low resistance type, 1.22 mm (18 gauge) mild steel directionally louvered upward, finished same as exterior panels.

.4 Safety glass shall be laminated type, 6 mm thick.

.5 Sash guides on track shall be corrosion resistant black polyvinyl chloride.

.6 Sash cables shall be 4 mm stranded stainless steel.

.7 Sash pull shall be type 316, 1.22 mm (18 gauge) stainless steel with a #4 satin finish.

.8 Pulley assembly for sash cable shall be 38 mm diameter nylon tired, ball bearing type, with cable retaining device.

.9 Interior access panels shall be provided on both interior sides and shall be secured using a special molded black P.V.C. gasket designed to be removed and reinstalled without the use of special tools.

.10 Baffle support and control brackets shall be type 316, 1.5 mm (16 gauge) stainless steel.

.11 Duct stubs shall be bell shaped type 316, 1.2 mm (18 gauge) stainless steel.

2.5 FUME HOOD

.1 Fume hood superstructure shall be wide, double wall construction consisting of an outer shell of sheet steel and an inner liner of 304 stainless steel. Double wall shall house and conceal steel framing members, attaching brackets and optional remote operating service fixture mechanisms. Wall thickness shall be approximately 120 mm. Access to optional fixture valves concealed between walls shall be provided by removable panels on hood exterior and access panels on both inside liner walls. Frame, inner and outer shell shall be assembled, fastened and connected into a rigid self-supporting entity.

.2 A fluorescent light fixture shall be installed on exterior of roof. Hood roof shall have a safety glass panel sealed to isolate the light fixture from fumes and vapours. Single two tube fixtures shall be rapid start type, C.S.A. listed. Ballast shall be sound rated to limit noise level. Fixture interior shall be finished with white baked enamel. Lamps shall be included. Average interior illumination levels of the work area shall be 80-foot candles minimum. Provide 15 amp switch to turn on the light as well as enable the remote exhaust fan.

.3 Provide one 120V/15A duplex receptacle inside the fume hood wired to a common junction box.

.4 Fume hood sash shall be full view type providing a clear and unobstructed side to side view of fume hood interior. Sash shall be laminated safety glass set into extruded P.V.C. guide. Top and bottom sash rails shall be 1.22 mm (18 gauge) stainless steel. Glass shall be set into rails with polyvinyl chloride glazing channel. Bottom rail shall be an integral, formed, full width, flush pull. Top rail shall be formed to accept lead weights for fine tuning of sash for exact and positive operation. A single weight, pulley, cable, counterbalance system shall be used to prevent sash jamming and permit one finger operation at any point along full width sash pull and to hold sash at any position without creep. Sash system shall be designed to prevent sash drop in the event of malfunction or failure of a cable. All models shall have a single sash and counterbalance system. Sash shall open and close against rubber bumper stops. Provide contact switch for signal to fume hood exhaust fan to start when sash is open. Exhaust fan by others. Wiring from switch to fan by Division 16.

.5 Baffles shall provide controlled air vectors into and through the fume hood and be fabricated of 316 stainless steel. Exhaust slots shall be provided on the full perimeter of the baffle with top, middle, and bottom slots adjustable. A fixed, permanently open horizontal slot located at 762 mm above the work surface shall be provided.

.1 Baffle adjustment shall permit setting for:

.1 High thermal loading.

.2 Normal operation.

.3 Heavier than air gases or fumes generated near work surface

.2 Adjustment shall be instantaneous, one handed, with a single point control, operable while hood is in use without disturbing apparatus. Changes in average face velocity and exhaust volume as a result of baffle adjustment shall not exceed 5% for any baffle position at the specified face velocity. Baffle designs which require insertion of the operators' head and shoulders into the hood are not acceptable.

.6 Fume hoods shall be designed to minimize static pressure loss with adequate slot area around the baffle and the bell-shaped exhaust collar configuration. Measured average static pressure loss reading taken three diameters above the hood outlet from four points, 90° apart, shall not exceed the following maximums:

Face Velocity	Measured S.P.L. (W.G.)
0.51 m/s	124.2 Pa

.7 Perimeter of sash opening shall have an air foil or streamlined shape with all right angle corners radiused or angled toward hood. Bottom horizontal foil shall provide a nominal 25 mm bypass when the sash is in the closed position. Bottom foil shall be removable without the use of special tools. Sash shall close on air foil. Bottom air foil shall be constructed of type 316 stainless steel.

.8 Unit to be complete with stainless steel cup sink. Gooseneck faucet with aerator, strainer, waste fittings, including p-trap by fume hood manufacturer. Provide lab faucet vacuum breaker for backflow prevention.

.9 Provide fume hood face velocity monitor and alarm if velocity is insufficient when the unit is in operation. Provide all controls and relays required for indicated operation.

2.6 COLOURS

.1 Provide laboratory furniture paint finish in manufacturer's standard colours. Submit colour samples.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for fume hood installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.3 CABINET INSTALLATION

.1 Coordinate installation with size, location and installation of service utilities.

.2 Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

.3 Use anchoring devices to suit conditions and substrate materials.

.4 Install laboratory fume hood plumb with countertops level to 1.5 mm / 1/16" in 3 m / 10', securely anchored to building structure with no distortion. Use concealed shims as required.

.5 Ensure fume hood is level.

.6 Support fume hood on continuous galvanized steel hanging brackets by bolting directly to wall.

.7 Connect mechanical and electrical.

.8 On completion, touch up marred or abraded finished surfaces.

.9 Wipe down surfaces, leave in clean condition.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by laboratory fume hood installation.

END OF SECTION

PART 1 - GENERAL

1.1 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

.1 Gas, air and vacuum cocks, faucets, tail pieces, strainers, traps, electrical outlets, non-integral sinks and drains.

1.2 REFERENCES

.1 ASTM International
- .1 ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).

1.3 COORDINATION OF BUILDING COMPONENTS

.1 Coordinate with appropriate trades, design, fabrication and installation of mechanical, electrical and other components as indicated into steel laboratory casework.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed Product literature and data sheets for steel laboratory casework and include Product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Indicate on Shop Drawings:
  - .1 Details of laboratory casework construction and related and dimensional position, with sections.
  - .2 Location of each casework unit.
  - .3 Location for roughing-in of plumbing, including sinks, faucets, strainers and cocks and electrical services.

.4 Samples:
- .1 Submit duplicate samples of:
  - .1 Countertop material, 300 mm x 300 mm / 12” x 12” including external corner.
  - .2 Standard colour of cabinet finish on 300 mm x 300 mm / 12” x 12” steel sheet.
  - .3 Cabinet hardware.
  - .4 Plumbing brass and electrical outlets.

.2 Submit one (1) base cabinet complete with cupboard and drawers minimum 1200 mm / 48” long, including specified bench top, backsplash, end return and curb shelf.

.3 Submit wall case minimum 600 mm / 2’ long.

.5 Test Reports:

.1 Include test reports by independent testing laboratories indicating results of furniture finish tests.

1.5 QUALITY ASSURANCE

.1 Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum five (5) years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect steel laboratory casework from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.7 SITE CONDITIONS

.1 Verify that field measurements are as indicated on Shop Drawings.

1.8 SEQUENCING AND SCHEDULING

.1 Schedule work to not deliver casework to site until destination space is ready to receive it.

1.9 EXTENDED WARRANTY

.1 Submit an extended warranty for work of this Section in accordance with General Conditions, except that warranty period is extended to two (2) years from the date of Ready-for-Takeover.

.1 Warrant against defects in materials and workmanship, and against failure to meet the design criteria and specified requirements, including but not limited to:

.1 Ruptured, cracked, or stained coating.

.2 Discoloration or lack of finish integrity.

.3 Weld or structural failure.

.4 Warping or unloaded deflection of components.

.5 Failure of hardware.

.2 Coverage: Labour and materials to repair or replace work of this Section as required to correct deficient work and meet specified requirements including affected adjacent work.

PART 2- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Products from the following manufacturers are acceptable for use on this project:
- .1 Mott Lab Inc.
- .2 Bedcolab Systems.
- .3 CiF Lab Solutions.

2.2 CASEWORK MATERIALS

.1 Sheet Steel:
- .1 Mild steel cold rolled furniture grade to requirements of ASTM A1008/A1008M, Grade C or higher, with smooth surfaces to furniture quality.

.2 Galvanized Sheet Steel:
- .1 Commercial quality galvanized sheet steel to ASTM A653, Designation Z275.

.3 Stainless Steel:
- .1 Sheet: ASTM A240, type 304 or 316 alloy.
- .2 Finish: Unless otherwise indicated, AISI No. 4 brushed finish.

.4 Glass:
- .1 6 mm / 1/4” thick clear float Type 1 tempered in accordance with Section 08800 – Glazing.

.5 Sealant:
- .1 One component, RTV (room temperature vulcanization) silicone sealant in accordance with Section 07920 – Joint Sealants.

.6 Resilient Base and Adhesive:
- .1 Base:
  - .1 Top set coved, 3 mm / 1/8” thick, 100 mm / 4” high for base units, colour as later selected by Consultant from base manufacturer’s complete colour range.
- .2 Adhesive:
  - .1 As recommended by the base manufacturer, trowel-applied with 100% coverage, compatible with both surfaces.

2.3 EPOXY RESIN COUTERTOPS

.1 Counter tops:
- .1 Mould epoxy resin tops form a modified epoxy resin, specially compounded and oven cured to give optimum physical and chemical resistance properties as well as high resistance to mechanical and thermal shock.
- .2 Thickness: 32 mm / 1-1/4” thickness
- .3 Colour: Satin black.
- .4 Provide drip groove on underside of exposed edges.

.2 Backsplash and Sidesplash:

.1 19 mm / 3/4" thick of same material and colour as countertop secured to back edge of countertop.

2.4 COUNTERTOP FABRICATION

.1 Fabricate laboratory countertops and backsplashes as indicated.

.2 Fabricate countertop and backsplash sections in as long a length as practicable.

.3 Cut holes for fittings, accessories, and equipment.

.4 Round or chamfer exposed edges and corners of cutouts.

.5 Finish exposed edges and surfaces in same manner as specified for working surface of countertop material.

.6 Make allowances around periphery and where fixed objects pass through or project into countertop material to permit normal movement without restriction.

.7 Joints: Make joints watertight.

2.5 LABORATORY SERVICE FITTINGS

.1 Mechanical:
- .1 Refer to Division 15 for the supply of following service fittings:
  - .1 Sinks, including cup sinks, complete with tailpieces, cross strainer, plug and overflow.
  - .2 Other fittings as indicated.
- .2 Refer to Section 11601 for the supply of the fume hood.
- .3 Coordinate and accommodate mechanical work, plumbing lines and waste outlets where indicated.

.2 Identify fittings as to type of service with coloured plastic removable type buttons with engraved lettering and following colour coding.

SERVICE	LETTERING		COLOUR CODING
	ENGLISH	FRENCH	
Cold Water	CW	EF	Green
Hot Water	HW	EC	Red
Distilled Water	DIW	ED	White
Demineralized Water	DEW	EDEM	White
Vacuum	VAC	VIDE	Yellow
Air	AIR	AIR	Orange
Gas	GAS	GAZ	Yellow-Orange
Oxygen	OXY	OXY	Green
Nitrogen	N	N	Blue
Argon	A	A	White
Steam	ST	VAP	Black

.3 Electrical:
- .1 Refer to Division 16 for the supply of following service fittings:
  - .1 Electrical receptacles and cover plates.
  - .2 Other fittings as indicated.

.2 Coordinate and accommodate electrical work, electrical wiring and other components where indicated.

.4 Coordinate locations and installation requirements for mechanical and electrical fittings with Division 15 and 16 including, but not limited to:
.1 Obtain templates, manufacturer's instructions and other information necessary to incorporate fittings into steel laboratory casework.

.5 Coordinate locations and installation requirements for mechanical and electrical fittings with Division 15 and 16 including, but not limited to:
.1 Obtain templates, manufacturer's instructions and other information necessary to incorporate fittings into steel laboratory casework.

2.6 CABINET HARDWARE

.1 Pulls:
.1 Provide recessed handles for drawers and hinged doors in 100 mm / 4" satin finish aluminum.

.2 Door Hinges:
.1 Provide soft close five knuckle-type barrel door hinges of 1.9 mm / 14 ga. steel screwed into door and fastened to cabinet side stile with two counter sunk #8-32 zinc plated machine screws and captive serrated tooth washer nuts.
.2 Standard hinge finish: Bright chrome.

.3 Drawer Slides:
.1 Provide soft close full extension drawer slides, 1.9 mm / 14 gauge slides and slide suspension channels, load capacity 45 kg / 100 lbs minimum.

2.7 FABRICATION

.1 Fabricate steel laboratory casework to details.

.2 Align end panels, top rails, bottoms and vertical posts, at intersections in same plane, without overlap.

.3 Grind exposed welds flush and smooth, burnish to match adjacent surfaces.

.4 Use the following minimum steel thicknesses for furniture manufacturing:
.1 3 mm / 11 gauge thick levelling bolt gusset plates.
.2 2 mm / 0.08" thick metal for tapping strips, gussets, drawer runners and hinge reinforcements.
.3 1.5 mm / 1/16" thick metal for tubular rails, legs for tables, gusset plates, cabinet top and intermediate horizontal rails, cabinet top rails, hanging brackets, frame and base.
.4 1.2 mm / 0.05" thick metal for cabinet floor, cabinet sides, vertical front members, cabinet fronts, cabinet toe kick, service cover panels, table and kneehole frames, front rails, gable legs and dust caps, false panels, furring and filler panels, cabinet door outer pan and slide support, cross rails, scribe strips and fillers.
.5 0.9 mm / 0.04" thick metal for shelves, drawer and door inner panels, drawer bodies and back panels to cabinets, drawer bodies, drawer dividers, bin bodies, and pull-out shelves.

2.8 CABINETS

.1 Construct cabinet bodies of sheet metal, flanged and returned at exposed gables to receive flush mounted drawer fronts and doors.

.2 Flange and set back top rails and bottom panels.

.3 At base cabinets include 38 mm / 1/2" long levelling screw for adjusting to floor variations, in gussets and accessible through plugged openings in bottom.

.4 Include removable backs, knee space panels or access doors where piping or wiring occur.

2.9 DOORS

.1 Fabricate doors of double pan construction, 19 mm / 3/4" thick, telescoped inner pan into outer pan with exposed vertical edge formed into channel shape having return lip over inner pan, offset to receive lip.

.2 Provide reinforcement for hardware attachment to inner pan and conceal. Install hardware.

.3 Bevel inside edge of cutout in front panel of glass door.

.4 Set glass in continuous rubber gasket between panels.

2.10 DRAWERS

.1 Fabricate drawer fronts of double pan construction, 19 mm / 3/4" thick, telescoped inner pan into outer pan with exposed vertical edge formed into channel shape having return lip over inner pan, offset to receive lip.

.2 Weld drawer bodies to front through flanges on sides and bottom, and back through flanges at rear.

.3 Extend flanges outward or downward, top of side and back rolled. Cove corners to 12 mm / 1/2" radius.

.4 Include reinforcements for hardware and install finish hardware.

2.11 SHELVES

.1 Provide adjustable shelves.

.2 Form shelves of steel sheet with front and rear edges flanged down 19 mm / 3/4" and hemmed back at 30 degrees to underside of shelf.

.3 Support adjustable shelves with shelf clips inserted in slots in front stile and in formed channel in back.

2.12 DUST COVER TOPS

.1 Provide sloped dust cover tops to wall cabinets where indicated. Return ends where ends are exposed.

.2 Slope dust covers upward 30 degrees from front to back of cabinet.

.3 Attach covers from inside of cabinet.

2.13 FINISHING

.1 Grind and polish spot weld marks from exposed surfaces.

.2 Immerse in hot alkaline to remove grease, oil, dirt and foreign matter.

.3 Neutralize, wash, and apply metal pretreatment coating.

.4 Stainless steel: No. 4 finish.

.5 Shop finish components.

.6 Coat metal surfaces in contact with cementitious materials with bituminous paint.

.7 Steel furniture:
- .1 Provide electrically applied epoxy/urethane powder coat finish.
- .2 Apply primer and bake at 175°C, to minimum dry film thickness of 0.02 mm / 0.8 mils.
- .3 Apply enamel and bake at 212°C to minimum dry film thickness conforming to following requirements:
- .4 Colour: Not more than two (2) colours as later selected by Consultant from manufacturer’s complete colour range.

PART 3- EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written data, including Product technical bulletins, Product catalogue installation instructions, Product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for steel laboratory casework installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.3 CABINET INSTALLATION

.1 Coordinate casework installation with size, location and installation of service utilities.

.2 Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

.3 Use anchoring devices to suit conditions and substrate materials.

.4 Install laboratory casework plumb with countertops level to 1.5 mm / 1/16” in 3 m / 10’, securely anchored to building structure with no distortion. Use concealed shims as required.

.5 Level base cabinets by adjusting levelling screws.

.6 Bolt cabinets together in continuous runs with joints flush, uniform and tight with misalignment of adjacent units not to exceed 1.0 mm / 0.04”.

.7 Insulate to prevent electrolysis between dissimilar metals.

.8 Fit closure strips and scribe to irregularities of adjacent surfaces, maximum gap opening 0.5 mm / 0.02”. Apply matching filler pieces where casework abuts dissimilar construction.

.9 Support wall cabinets on continuous galvanized steel hanging brackets.

.10 Field weld joints in stainless steel work, without open seams.

.11 Close ends of units, splash aprons, shelves and bases with sealant.

.12 After installation, adjust operating hardware.

3.4 COUNTERTOP INSTALLATION

.1 Fabricate countertops in lengths as indicated, with ends abutting tightly and sealed with corrosion resistant sealant.

.2 Anchor tops to base casework in a single true plane with ends abutting at hairline joints with no raised edges at joints.

.3 Factory prepare joints for no need for in-field processing of top and edge surfaces.

.4 Dress joints smoothly.

.5 Remove surface scratches.

3.5 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01741 – Cleaning.

.1 Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01741 – Cleaning.

.1 Touch up marred or abraded finished surfaces.

.2 Wipe down surfaces to remove fingerprints and markings.

.3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01355 – Construction/Demolition Waste Management and Disposal.

3.6 PROTECTION

.1 Protect installed Products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel laboratory casework installation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This Section covers the design, supply, installation, commissioning, placement into service, and testing of:
- .1 Kito ER2 Heavy Duty Electric Chain Hoist
- .2 Kito MR2 Three Phase Motorized Trolley

.2 Provide two (2) hoist and trolley systems as defined above, one for each monorail beam located in the UV Building.

.3 Provide all electrical work associated with the equipment.

1.2 REFERENCES

.1 American National Standards Institute/ American Society of Mechanical Engineers:
- .1 ANSI/ ASME HST-4, Performance Standard for Overhead Electric Wire Rope Hoists.
- .2 ANSI/ ASME B30.16, Overhead Hoists (Underhung).
- .3 ANSI/ ASME B30.11, Monorails and Underhung Cranes (Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings).
- .4 ASME B30.16, Overhead Underhung and Stationary Hoists.

.2 Canadian Standards Association:
- .1 CSA B167, Overhead Travelling Cranes – Design, Inspection, Testing, Maintenance, and Safe Operation.
- .2 CSA C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
- .3 CSA C22.2 No. 33, Construction and Test of Electric Cranes and Hoists.
- .4 CSA G40.20-13/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .5 CSA S16, Limit States Design of Steel Structures.
- .6 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.3 Canadian Institute of Steel Construction:
- .1 Crane-Supporting Steel Structures: Design Guide, 4th Edition.
- .2 CISC Code of Standard Practice for Structural Steel, 9th Edition.
- .3 CISC Handbook of Steel Construction – 12th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit Shop Drawings and erection drawings. Shop Drawings to include details of:
- .1 General arrangement of each crane and hoist, including engineering details and complete list of materials and components. Indicate all key dimensions and clearances.
- .2 Suspension fittings, safety stops and bumpers.
- .3 Trolleys.
- .4 Hoists, cable(s) and hooks.
- .5 Details of electrical conductors and collectors.
- .6 Control details, control panel layout, schematic and wiring diagrams.

.7 List of accessories provided.

.2 Shop Drawings shall be reviewed and accepted in accordance with the Contractor's Quality Plan prior to forwarding to the Consultant.

.3 Reproduction of Contract Documents will not be acceptable as Shop Drawings.

.4 Submit Shop Drawings in a single, complete digital submission in order that all details may be read in conjunction with plans, elevations, and other dependent details.

.5 Where Shop Drawings are re-submitted, clearly illustrate all revisions from previous submissions using revision marks and "bubbles".

.6 Submit certified test results of load tests for all hoists.

.7 Submit mill test reports, including mechanical properties, for material used in fabrication.

.8 Submit Operations and Maintenance Manual as described herein.

1.4 CLOSEOUT SUBMITTALS

.1 Operations and Maintenance Manual to include, as a minimum:
- .1 Equipment function, normal operating characteristics, and limiting conditions.
- .2 Assembly, installation, alignment, and maintenance instructions.
- .3 Lubrication and regular maintenance instructions and schedule.
- .4 Guide to 'Troubleshooting'.
- .5 Parts list.
- .6 As-Built Drawings.
- .7 Load test results.
- .8 Warranty Certificate.

1.5 QUALITY ASSURANCE

.1 Qualifications:
- .1 Manufacturer's Qualifications:
- .2 Installer's Qualifications:
  - .1 The crane installer shall be certified by the manufacturer in the installation of the type of crane being installed.

.2 Quality Plan:
- .1 Develop and implement a Quality Plan that verifies the fabrication and installation of the hoists specified herein is in general conformance with this Section.
- .2 The Quality Plan shall describe, as a minimum, the following plans and procedures:
  - .1 Identify the personnel responsible for implementation and oversight of the quality control plan for this Section in an organization chart. Describe the roles and responsibilities of each person listed.
  - .2 Provide samples of Crane Manufacturer's and Installer's quality control inspection forms to be used on the project. The quality forms shall, as a minimum, include the following:
    - .1 Shop Drawing review and sign off.
    - .2 Fabrication inspection.

.3 Installation inspection.
.4 Load test documentation.
.5 Deficiency sign-off.

.3 Describe quality control procedures steps related to:
.1 Shop fabrication.
.2 Installation.
.3 Testing.
.4 Defective work, including: identification, documentation, submission of proposed remedial details, and follow-up inspection.

.3 Risk Management: List and describe any anticipated project specific risks associated with the work of this Section or related Sections and outline proposed means of mitigation.

.4 The Quality Plan shall be prepared taking into account the specific requirements of this project. Generic quality plans that, in the Consultant's reasonable opinion, fail to address the specific requirements of this project will be returned 'Revise and Resubmit'.

.5 The Quality Plan shall be submitted to the Consultant for review and acceptance. Acceptance of the Quality Plan by the Consultant shall be considered a prerequisite for review of other submittals listed herein. Failure of the Contractor to coordinate the timely submission of a complete Quality Plan, which ultimately results in the detail of the review of other submissions, shall not be at the risk of the Owner or Consultant for back charge.

1.6 EXAMINATION

.1 Prior to fabrication, review all dimensions and performance requirements with all Contract Documents. Report any conflicts or uncertainties to the Consultant for clarification.

.2 Prior to installation, examine all site conditions and dimensions that affect this work. Report any conflicts or uncertainties to the Consultant for clarification.

1.7 COORDINATION

.1 Review all Contract Documents and Shop Drawings related to all other trades which may affect this work. Report any discrepancies to Consultant for direction.

1.8 STORAGE AND HANDLING

.1 Store and handle hoist components in accordance with the Contractor's Quality Plan and manufacturer's instructions to prevent damage.

.2 All components damaged during shipping, handling, or installation shall be repaired or replaced to the satisfaction of the Consultant no cost to the Owner.

1.9 WARRANTY & MAINTENANCE SERVICE

.1 Provide complete service and maintenance of hoists during building contract and 24month warranty period at no additional cost to Owner.

.2 Maintenance to include systematic examination, adjustment of hoist equipment and repair or replacement of parts whenever required as per planned maintenance tasks and frequencies. Use genuine parts produced by the manufacturer of specific equipment.

.3 Provide two (2) annual inspections, one at 12 months after acceptance and one month prior to expiration of warranty.

.4 Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Consultant.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

.1 Refer to Schedule of Hoisting Equipment and contract drawings for requirements of hoists.

.2 Hoists and Trolleys to be electrically powered unless noted otherwise.

.3 Hoisting equipment to meet specified hook-to-hook wall approaches and hook heights.

2.2 HOIST AND TROLLEY

.1 The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110% of the rated load.

.2 Hoist shall be equipped with two means of braking (holding brake and control brake) per CMAA Standards 70 and 74. The holding brake shall be a DC disc brake which will be electrically opened and spring applied. The control means of braking will be Regenerative Braking which will allow the load to be lowered safely to the ground in the event of a power failure.

.3 Hoist motor shall be two-speed reversing, totally enclosed, fan cooled squirrel cage type motors complete with Class F insulation rated for hoist duty. Hoist motor to be mounted outside of the drum to ensure proper heat dissipation and for ease of maintenance.

.4 Hoist speeds to have a 6:1 speed ratio to allow for fast lifting speeds and very slow creep speeds for fine placement of loads.

.5 Hoist gearing to be totally enclosed with oil-bath type lubrication.

.6 Supply upper and lower hoist travel limit switches.

.7 Supply secondary upper limit switch as a back-up safety feature to prevent the hook from contacting the drum in case the main upper limit fails.

.8 Hoist to be single reeved type to provide virtual true lift with minimal hook drift.

.9 Wire rope to be galvanized for corrosion resistance.

.10 Hoist to be equipped with an adjustable rope guide.

.11 Hook to be Standard C-Type hook complete with safety latch, mounted on anti-friction bearing to allow 360-degree rotation.

.12 Trolley motors to be two speed reversing TEFC squirrel cage type

.13 Trolley to be equipped with energy absorbing rubber bumpers.

.14 Trolley drives to be direct drive rotating axle type with no open gears.

.15 Trolley gearing to be totally enclosed with oil-bath type lubrication.

.16 Supply trolley drop stops in case of axle failure.

.17 Supply trolley travel slow down limit switches to prevent trolley from contacting bridge end-stops at full speed.

.18 Trolley frame to be of welded construction.

2.3 MOTORS

.1 In addition to motor requirements specified elsewhere in this Section:
- .1 Provide all motors suitable for 575 volt, 3 phase, 60 Hz power.
- .2 Ground all motors, controls, and auxiliary apparatus to crane structure.

2.4 POWER SUPPLY, CONDUCTOR AND COLLECTORS

.1 Power supply for the hoist(s) shall be 575 volt, 3 phase, 60 Hz. All power required for the operation of the hoist, trolley, and end trucks shall be developed from this source.

.2 A padlockable wall mounted disconnect switch and power to runway conductors to be provided by Electrical Contractor.

.3 Provide enclosed type electrical conductor system for bridge cranes.

.4 Provide conductor systems suitable for a 3 phase power supply with stainless steel contact surface and insulating covers and end covers.

.5 Support sections from structure at maximum 1.5 m centres with insulated hanger clamps assemblies with insulator and stainless steel assemblies.

.6 Provide sliding shoe type collectors with adjustable spring-loaded arms capable of horizontal or vertical movement to adapt to conductor irregularities.

.7 Set shoe in moulded plastic head to prevent external contact with the shoe when it is running on the conductor.

.8 Provide collectors with no exposed bare current-carrying surfaces or wires when the shoe is in contact with the conductor.

2.5 CONTROLS

.1 Crane to be controlled via a six-way pushbutton pendant mounted on an independent festoon track and remote radio control transmitter. Pendant shall include a strain relief cable.

.2 Pushbutton pendant and remote radio control transmitter shall have two-step, spring return type buttons which will automatically return to the OFF position when pressure is released.

.3 Pendant to be equipped with multi-pin plug style connection to allow for replacement of pendant.

.4 Arrange pendant control and remote radio control transmitter to permit simultaneous operation in all directions of the hoist and bridge crane.

.5 Pushbuttons to be clearly marked with hoist, trolley and bridge travel directions. Text to be in English.

.6 Control enclosures to be NEMA 4 type.

.7 Provide transformers to reduce voltage for controls as required.

.8 Supply a warning horn on the crane, controlled from the pendant and radio remote transmitter.
Supply a rotating beacon light on the crane bridge to indicate power to the crane.

2.6 LABELING

.1 Hoist and monorail beam to be labeled with load rating.

.2 Corrosion-resistant nameplate to be fixed to bridge with the following information:
- .1 Name of manufacturer.
- .2 Manufacturer's model number and serial number.
- .3 Capacity.
- .4 Date of manufacture (month and year).

2.7 SURFACE PROTECTION AND FINISH

.1 Hoist and trolley to be factory painted per manufacturer's standard.

.2 The following items shall not be painted:
- .1 Rail surfaces in contact with wheels.
- .2 Wheel running surfaces.
- .3 Hoist wire rope.
- .4 Conductor bar, festoon cables and supports.

.3 Crane capacity to be painted on both sides of monorail beam in suitably tall letters and colour to view from ground.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verify that conditions of substrate previously installed under other Sections are acceptable for installation in accordance with the manufacturer's written instructions. Inform Consultant of unacceptable conditions immediately upon discovery.

.2 Do not proceed with installation until after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install hoists, trolleys, and conductor assemblies in accordance with manufacturer's instructions.

.2 Provide all necessary accessories to make hoists complete, usable, and capable of meeting the operating requirements specified herein.

.3 Adjust limit controls and pendant control height to suit Owner's requirements as directed by Consultant.

.4 Touch-up all paint damaged or marred during installation to the satisfaction of the Consultant.

3.3 TESTING

.1 All hoist equipment to be operated through a complete lift and lowering cycle and through a complete travel of the monorail and trolley to determine the equipment performs smoothly and safely.

.2 Upon completion of installation make complete test of hoist in accordance with manufacturer's testing procedures.

.1 Manufacturer's Technical Representative is to be present during all tests.

.2 Document test results and submit to Consultant for review and acceptance.

.3 All tests shall be carried out in accordance with CSA requirements.

.1 Perform load testing with actual solid weights. Use of water bags for load testing will not be permitted.

.2 Contractor shall supply the test weight loads. Provide suitable means for connection the test weight loads to the hoist hooks.

3.4 USE BY CONTRACTOR

.1 If crane is used by the Contractor, it shall be repaired, repainted, and otherwise refurbished to "like new" condition prior to its acceptance. Contractor assumes all responsibility for operation and maintenance until the crane has been accepted by the Owner.

3.5 TURNOVER

.1 A training session shall be provided for the crane operating personnel and maintenance department. The training shall outline crane care, operation, troubleshooting, and provide an overview of manuals. Allow for a minimum of eight (8) hours of instruction time to be carried out on site.

3.6 SCHEDULE OF HOISTING EQUIPMENT

.1 All equipment furnished under this section shall be in accordance with the following equipment schedule.

.1 Electrically Operated Monorail Hoists

Location	Tag	Capacity (Tonnes)	CMAA Duty Class	Hook Height	Hoist Speed	Trolley Speed	Power Supply	Reference Drawings	Remarks
UV Building		1	A	30ft.	14ft/4min	80ft/20min	575V	S503	Refer to structural drawings for hoist span and travel distance.

END OF SECTION

PART 1– GENERAL

1.1 GENERAL

.1 Contractors, supervisors, and tradesmen performing work in this Division must be experienced and qualified to undertake the works. Experience in the municipal water/wastewater treatment or industrial sector is necessary.

.2 Mechanical Contractor's foreman to have several years of experience in similar municipal water or wastewater or industrial plant construction work of a similar scope.

.3 Unless otherwise noted, all requirements of Division 15 apply to Division 11.

1.2 CONTRACTOR QUALITY ASSURANCE PROGRAM

.1 The Contractor is solely responsible for the quality control as specified in Division 1.

1.3 DOCUMENT REFERENCES

.1 These specifications are an integral part of the Contract Documents. Refer to other Sections to ensure a completed operational product and fully coordinated standard of work.

.2 Review specifically Division 1 for requirements that may pertain to the work in this Section.

.3 "Provide" in Divisions 11 and Division 15 means to "supply and install".

.4 Conform to Canadian Metric Practice Guide CSA CAN3-Z234.1-00.

.5 Provide all required adaptors between "metric" and "Imperial" installations.

.6 Metric descriptions in this Division are nominal equivalents of Imperial values. .

1.4 COMMISSIONING

.1 Refer to Division 1. Division 1 could include clauses that have significant financial impact. Review carefully and advise all subcontractors and suppliers.

.2 Supply complete instruction and information relating to the operation and maintenance of all equipment and systems.

.3 Deliver a system which performs in accordance with the contract documents and equipment manufacturer's requirements.

1.5 PROJECT SCHEDULE

.1 Refer to Division 1 for additional scheduling requirements.

.2 Refer to Division 1 for additional project phasing and sequencing requirements

1.6 PROGRESS PAYMENTS

.1 Refer to Division 1.

1.7 DRAWINGS AND MEASUREMENTS

.1 Drawings do not indicate exact architectural, structural or electrical features. Examine drawings prior to laying out, fabricating and installing work to ensure no interference exists. Report conflict with work to Consultant before proceeding.

.2 Drawings show general design and arrangement of mechanical system installation and are diagrammatic in some details. Coordinate all drawings and with all trades for complete operational system. Make modifications to mechanical layouts where minor interferences occur at no cost to Owner. Be prepared to make minor relocations to position and orientation of equipment at no cost to Owner.

.3 Do not scale drawings to order material. Take field measurements before ordering materials and make material conform to site conditions.

.4 Routing and elevations of small diameter piping is somewhat diagrammatic. Contractor to plan final installation and review with Consultant prior to installation. Consideration to be given to following building and piping lines, maximize available headroom, avoid interference with equipment and other piping, avoiding unnecessary offsets and fittings.

.5 Prior to fabrication, prepare dimensioned interference drawings for piping in all process areas including, but not limited to:

.1 Headworks Building
.2 UV Building
.3 Process Building
.4 Tunnel

.6 Provide additional field drawings with position of various services when required by Consultant.

.7 Indicate distance from column lines and pipe elevations. Show all interference drawings to piping, lights, cable trays and electrical wiring runs. Consultant will provide AutoCAD format drawings if requested.

.8 Where drawings and/or specifications conflict, advise and cooperate with Consultant to resolve issues.

.9 Submit sketches clearly indicating proposed rerouting of piping and/or relocation of equipment for approval prior to installation.

.10 All costs incurred as a result of interferences not identified prior to installation are to be borne by Contractor.

1.8 AS-CONSTRUCTED DRAWINGS

.1 After award of Contract, the Consultant will provide Contractor with a set of white prints for the purpose of maintaining As-Constructed Drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and change orders. Record changes in same scale and quality of original drawings.

.2 Identify all revisions made to contract drawings and reference fabrication drawings included.

.3 Changes to be performed by qualified drafting personnel.

.4 Record locations of concealed components of mechanical and electrical services. Photograph concealed locations and submit As-Constructed Drawings.

.5 Record elevation of major piping and dimensions from nearest column line or reference point.

.6 Update schedules with equipment and equipment models supplied.

.7 Identify drawings as "Project Record Copy". Maintain in new condition and update regularly.

.8 On completion of work and prior to final inspection, submit record documents to Consultant.

.9 Refer to Division 1 for additional requirements.

1.9 INTERRUPTION OF EXISTING SERVICES

.1 Refer to Division 1 for additional requirements.

.2 Plan work in order that unknown or hidden services are identified several days in advance of the related project work.

.3 Immediately advise Consultant when unknown services are encountered and await instructions. Proceed with any emergency measures if required.

1.10 REMOVAL AND REUSE OF EXISTING MATERIALS

.1 Identify to Owner at least 72 hours in advance existing material and equipment to be removed from work but not identified for re-use on-site to Owner/Others. Acceptance of removed material and equipment is at discretion of Owner. Where deemed unsuitable, remove such items from site. Otherwise move to location on-site designated by Owner.

.2 Equipment to be relocated is to be removed and relocated by Contractor in an as found condition. Contractor is responsible for temporary storage of equipment. Document as found conditions prior to removal.

.3 All demolished piping is to be removed from the site and disposed of in accordance with Division 1 and Division 15 requirements.

.4 Materials to be salvaged are itemized in Division 1.

1.11 RELATED WORK

.1 Assume full responsibility for laying out work and for any damage caused to Owner's or other trade property by improper methods or location of equipment.

.2 Concrete bases for mechanical work: Division 3.

.1 Locate and size bases, supply and set equipment anchor bolts in place: Division 15.

.3 Cutting, patching and reinforcing openings cut for mechanical work: Divisions 3 & 5.
.1 Co-ordinate location and size for mechanical openings: Division 15.

.4 Repairing walls and floors following mechanical demolition: Division 3.

.5 Sealant installation (except Link-Seal) for mechanical pipe and duct sleeves through walls and floors: Divisions 1 & 7.

.6 Painting mechanical equipment, ductwork, piping: (except specified with a factory finish), unless indicated otherwise: Division 9.
.1 Standards for mechanical identification painting: Division 15.
.2 Standards for paint and application Division 9.

.7 Installation of instrumentation requiring insertion or direct connection to piping, tanks or equipment: Division 15.

.8 Isolation of piping, flushing, and cleaning to permit tie-ins: Division 15.

.9 Installation of tubing to connect analyzers and instruments: Division 15.

.10 Installation requirements for Instrumentation: Division 17.

.11 Request details for installation of Instrumentation and Analyzers: Division 15.

.12 Wiring of instrumentation: Division 17.

.13 Coordinate all wiring requirements with Division 16.

.14 Installation and alignment of electric motors and equipment: Division 15.

.15 Wiring and testing of electric motors: Division 16.

.16 Installation and Commissioning of HVAC control components and wiring: Division 16.

.17 Supply of HVAC control components, specified in individual sections. Division 15.

.18 Installation of underground piping between buildings. Division 2.

.19 Trenching and backfill for underground pipe piping between buildings. Division 2.

1.12 COOPERATION WITH OTHER TRADES

.1 Review all contract documents and coordinate with work of other Divisions.

.2 Co-operate fully with Division 16 to lay out location of ducts, piping and lighting fixtures in areas where in close proximity to each other.

.3 Report areas of conflict immediately to Consultant in writing for comment. Do not continue work until corrective measures are prescribed. Site reports to be issued on a standard form and be numbered sequentially and dated.

1.13 PROTECTION OF WORK

.1 Protect all finished and unfinished work from damage. Protect bearings, seals, glands, shafts of rotating equipment. Cover floors and other work with tarpaulins where required.

.2 Cap all equipment connections until piping connections are made. Cover all equipment in construction areas with tarps and protect from damage.

.3 Repair damage caused to surfaces of building without cost to the Owner and to satisfaction of Consultant.

.4 Be responsible for condition of all materials and equipment supplied and/or installed. Provide protection prior to, during and after installation until takeover by Owner.

.5 Store all equipment indoors at all times. Provide temporary storage as required.

.6 Replace all damaged materials without cost to Owner and to satisfaction of Consultant. Repairs to damaged equipment or components will not be accepted.

1.14 TEMPORARY AND TRIAL USE

.1 Obtain written permission from Consultant to use and test permanent equipment and systems prior to Substantial Performance.

.2 Consultant may use equipment and systems for test purposes prior to acceptance. Provide labour, material and instruments required for testing. Rectify incomplete work immediately to satisfaction of Consultant.

.3 Protect equipment and system openings from dirt, dust and other foreign materials during temporary usage. Cover all pipe and equipment openings.

.4 Clean and renew equipment and system used prior to acceptance.

1.15 PRE-COMMISSIONING COMPONENT AND SYSTEM TESTS

.1 Refer to Division 1 for additional commissioning details.

.2 Original equipment manufacturer to submit equipment start-up procedures and requirements prior to start-up.

.3 Perform systematic check, test components in all systems, ensure that each system functions correctly before commencing balancing work.

.4 Provide all primary elements, test wells, tappings, valves, etc. required for testing.

.5 Provide isolation valves on all instrumentation and vents and all devices which require isolation during testing due to high pressures.

.6 Check motors for smooth operation throughout their entire range.

.7 Check seals on pumps and packing on valves.

.8 System Check List (if applicable):

.1 Complete lubrication of equipment. Following initial start-up, drain lubricants and replace.

.2 Complete system start-up.

.3 Adjust stuffing boxes and packing glands on pumps and valves.

.4 Verify rotation of electric motors and ratings of overload heaters.

.5 Adjust rotating equipment alignment and belt drive tension.

.6 Check safety and operating control set points and automatic control sequences with design requirements. Verification to be functional by instituting actual operating conditions or simulating the same. Jumpering of contacts to simulate an alarm, for example, will not be accepted.

.7 Clean up installation and temporary coverings, remove stickers and tags.

.8 Touch up painted finishes where damaged.

.9 Complete equipment and piping identification work with valve tags, schedules and piping identification system.

.10 Check list of Startup Procedure (each system).

.1 Pre-startup Inspection:

.1 Verify proper equipment mounting and setting.

.2 Verify that control, interlock and power wiring are correct.

.3 Verify alignment of motors and drives.

.4 Verify proper piping connections and accessories.

.5 Verify that lubrication is complete.

.2 First Run Observation:

.1 Verify direction of rotation.

.2 Verify setting of safety controls.

.3 Monitor heat build-up in bearings.

.4 Check motor loads against nameplate.

.3 Equipment Check List:

.1 Verify proper overload heater sizes.

.2 Verify function of safety and operating controls.

.3 Verify proper operation of equipment.

.4 Report on inspection, observation and checking procedures.

1.16 ALIGNMENT AND VIBRATION

.1 As part of the pre-commissioning process, following start-up and acceptance of installation by manufacturer`s representative, field check alignment of all drives and drives and clearance on couplings. Complete laser alignment. Measure vibration through full range of frequencies using independent millwright or testing agency. Record measured alignment tolerances and vibration measurements. Submit report and complete recommendations for the following equipment:

.1 Blowers.

.2 Raw Sewage Pumps.

.3 Sludge Pumps.

.4 Effluent Water Pumps

.2 Verify alignment of drives and belt tension for all belt driven equipment.

.3 Verify bearing temperatures after four (4) continuous hours of operation.

.4 Alignment and vibration analysis, in addition to other verification items above, to be completed by experienced millwright firm regularly involved in this work. One firm is to be used for all equipment on site unless otherwise approved. Analysis to be performed in cooperation/consultation with the equipment manufacturer’s representative.

.5 Acceptable companies:
- .1 Nesbitt Engineering.
- .2 Hewitt (Brockville).
- .3 Alternates approved by Consultant during Tender period.

1.17 LUBRICATION

.1 Coordinate with equipment suppliers to:
- .1 Provide initial lubrication of equipment.
- .2 Provide initial fill of lubricating and transmission oils.
- .3 Replace all lubricating and transmission oils used at start-up within 14 days of substantial performance.

1.18 OPERATING AND INSTRUCTION MANUALS

.1 Furnish Consultant with operation and maintenance manuals in accordance Division 1 and section 15014 requirements.

.2 Operation and Maintenance Manuals are considered necessary for the operation of the equipment and must be submitted prior to substantial performance.

1.19 TRAINING

.1 Refer to Division 1 and individual specification sections for additional Training requirements

.2 Instruct operating staff in maintenance, adjustment and operation of mechanical equipment. Training provided before equipment and related system has been successfully proven will not be acceptable.

.3 Provide instruction during regular work hours.

.4 Notify Consultant of instruction period and await written notice to proceed.

.5 Use operation and maintenance data manual and updated As-Constructed Drawings for instruction purposes. All information provided at training session is to be documented and included in manuals.

.6 Review teardown and overhaul requirements using information included in manuals.

.7 Instruct staff on changes made under terms of warranty or modification of equipment.

.8 Document training dates and have each person in attendance sign off on training record sheet.

1.20 PERFORMANCE DOCUMENTATION

.1 Competent representative of manufacturer to thoroughly inspect equipment before submitting same for Substantial Performance and certify in writing as complete, installed in accordance with installation instructions and operating correctly.

1.21 WARRANTY:

.1 Refer to Division 1 and individual specification sections for additional warranty requirements.

1.22 CLEANING

.1 Do not operate equipment until systems are clean.

.2 Remove all debris from inside mechanical equipment, ductwork and piping systems.

.3 Vacuum clean inside duct systems.

.4 Flush piping system thoroughly with water to remove sediment and debris in accordance with Section 15083.

.5 Prior to connecting to on-line potable water systems directly or isolated by a valve, systems must be disinfected in accordance with Division 1.

PART 2 – PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 – EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

.1 Refer to Division 1 for additional demolition requirements.

.2 Clearly identify materials and equipment to be removed, retained or to remain in place prior to commencement of work. Complete walkthrough with Consultant and Owner. Physically mark items for, and extent of, demolition and document scheduling and constraints.

.3 Dispose of demolished material except where specifically noted otherwise on the drawings and as listed in Division 1.

.4 Where existing materials are to be turned over to the Owner, be responsible for removal and delivery to Owner on site. Load on pallets for transportation by Owner. Clean equipment for storage.

.5 Where existing materials are to be reused be responsible for removal, storage, cleaning and reinstallation.

.6 Where portions of existing systems are to be demolished, coordinate work to maintain operation of remainder of system.

1.2 EXISTING CONDITIONS

.1 Take over structures and equipment to be demolished and removed based on their condition at the time of examination during tender period.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3- EXECUTION

3.1 DEMOLITION

.1 Prior to undertaking any demolition or other work, Contractor to review the Designated Substances Survey and complete any required abatement.

.2 Complete demolition of systems and equipment as indicated on the drawings.

.3 Demolish complete or partial mechanical systems to accommodate construction and remedial work as indicated.

.4 Temporarily remove existing equipment, services, and obstacles where required to complete the new work and replace same as work progresses.

.5 Maintain adequate structural support during removal of equipment and material.

.6 Cap existing systems at point of disconnection except where detailed. Cut back pipe into wall and grout per detail on drawing.

.7 Dispose of demolished materials and equipment identified for removal unless indicated otherwise.

3.2 PIPING DEMOLITION

.1 Recognize that most process piping systems subject to removal have not been decommissioned.

.2 Include for flushing chemical piping to a sanitary drain and at a rate acceptable to plant operators.

.3 Include for flushing and/or pigging of sludge lines to permit removal from site and disposal. Flush contents and pump to a location acceptable to operators.

3.3 PREPARATION

.1 Disconnect and cap mechanical services to be abandoned or services to abandoned equipment as indicated on drawings. Identify all services prior to abandonment or removal. Services to be capped to standards of new piping and/or ductwork specifications in this Division.

.2 Do not disrupt active services for other facilities.

.3 At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling. Protect interior of parts not to be demolished from exterior elements at all times.

.4 Demolish in a manner to minimize dusting. Keep dusty materials wetted.

.5 Remove contaminated or dangerous materials from site and dispose of in safe manner to minimize danger at site or at any time during disposal.

3.4 RESTORATION

.1 Restore existing work damaged due to this work to a condition equal to that before work began and to satisfaction of Consultant.

3.5 EQUIPMENT SALVAGE

.1 Refer to Section 15010 and Division 1.

END OF SECTION

PART 1- GENERAL

1.1 BINDER DETAIL

.1 Refer to Division 1 and individual equipment specifications for additional requirements.

.2 Binders must be clearly and permanently identified on spine and front with project name and number and specific binder contents. Any material larger than 8½ x 11 (i.e., folded prints) will be inserted into appropriate size and properly reinforced plastic pouches with flap to top of binder. Fit into the binder rings and contents clearly identified on front and back. Drawings not to be punched for rings.

.3 Manual to be submitted prior to requesting initial start-up.

1.2 ORGANIZATION

.1 Prepare a binder for each major process building/facility. Include only equipment related to that building in binder. Prepare a separate binder(s) for general equipment such as piping, valves, etc. that are used in multiple areas. HVAC systems are to be organized into one separate binder and separated by tabs that clearly indicate the building or facility where the equipment is installed.

.2 Organize binder by specification section. Provide tabs for each section and subsections.

.3 Prepare detailed index referencing tabbed section numbers.

.4 Include list of suppliers and contacts at front of section.

1.3 INFORMATION DETAIL

.1 Only pertinent detail is acceptable. Full pages taken from suppliers' catalogues pertaining to a full range of equipment is not acceptable. Only totally legible photocopies may be used. All chapters must be identified by tabs.

.2 Information should be divided into the following categories described in more detail in1.4 below.

Operation	-	Concept of operation
Equipment	-	Detail of components used
Maintenance	-	Troubleshooting techniques
	-	Lubrication requirements
Spare Parts	-	On-Site stocking requirements
Start-up Reports	-	Detailed start-up reports and measured start-up parameters
Warranties	-	Outline of coverage dates

1.4 CATEGORY DETAIL

.1 Outline of system function giving:
- .1 Step-by-step start-up procedures.
- .2 Step-by-step shutdown procedures.

.3 Emergency shutdown procedure.
.4 Adjustment sequencing.
.5 Start-up set points.
.6 Valve charts.

.2 Equipment
.1 All pertinent detail preferably in chart form.
.2 Tag number indicated in Contract documents.
.3 Review drawing number.
.4 Model, part number and serial number.
.5 Contract and specification number.
.6 Wiring diagrams reduced to 280 x 430 format.
.7 Reviewed drawings - as-builts, including applicable specification number.
.1 All wiring and loop diagrams to be reduced to 250 x 430 format.
.8 Exact motor nameplate data summarized on a single sheet for each piece of equipment and verified in the field.
.9 Complete parts diagram and assembly drawing listing all part numbers.
.10 Complete information to complete teardown maintenance including assembly and torquing requirements.

.3 Maintenance
.1 Lubrication (acceptable products and schedules).
.2 Troubleshooting procedures.
.3 Adjustment techniques.
.4 Operational checks.
.5 Provide one (1) page summary of daily/weekly/ monthly/yearly maintenance for each piece of equipment.

.4 Spare Parts
.1 List of recommended spares to be maintained on-site to ensure optimum efficiency.
.2 List all special tools and appropriate unique application.
.3 Detail manufacturer and supplier names and addresses.
.4 All equipment is to be listed as to types.

1.5 ELECTRONIC FORMAT DATA

.1 Each manufacturer is to provide maintenance information in hardcopy for the binders and as PDF format files.

1.6 WARRANTIES

.1 List contacts for warranty rectification.

.2 Copies with seal and signature of Contractor of all registration certificates, specifically pressure vessels; permits, approvals, etc.

.3 Detail all warranty periods.

1.7 MECHANICAL ROOM

.1 Frame and hang one copy in each respective area of the following (copies to be included in manual):
.1 Valve Tag List and copy of Process Flow Diagram.

.2 Mounting in framing to be suitable for long term exposure to a high humidity environment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Includes, but is not limited to:
- .1 Painting of mechanical equipment, piping, supports, etc.: Division 9, Section 09900.
- .2 Coordination of painting requirements, colour requirements, etc. for mechanical piping and equipment: Divisions 11 and Division 15.
- .3 Manufactured secondary colour marking bands, arrows, lettering: Division 15.

.2 Refer to individual specification sections for additional coating and tagging requirements.

1.2 SYSTEM DESCRIPTION

.1 Provide identification system for piping, valves and equipment.

.2 Identification to consist of colour codes, valve tags, equipment and system nameplates, lettered identification, schedules.

1.3 QUALITY ASSURANCE

.1 Piping Systems: CGSB 24-GP-3a.

1.4 SUBMITTALS

.1 Submit following for review by Consultant, at least two weeks prior to ordering material:
- .1 Legend and colour classification for material not listed in table or changed from table.
- .2 List of equipment nameplates.
- .3 Submit type of markers to be used and corresponding material upon which marker is to be applied to, including sample installations.

PART 2 - PRODUCTS

2.1 VALVE SCHEDULE

.1 Provide 1 valve list (in plastic covers) for each Operation and Maintenance Manual.

.2 List tag schedule designating number, service, function, and location of each tagged item. Identify normal operating position of valves.

2.2 EQUIPMENT MANUFACTURER'S IDENTIFICATION

.1 Equip each piece of equipment with stainless steel manufacturer's nameplate. Submit nameplate data to Consultant. Use raised or recessed letters. Fasten mechanically. Identification to include the following (as applicable):
- .1 - Model number

.2 - Serial number
.3 - Capacity
.4 - Head
.5 - Impeller diameter
.6 - Efficiency
.7 - Performance rating
.8 - Year of manufacture
.9 - Other information required to uniquely identify the equipment
.10 - Performance data in S.I. metric units
.11 - CSA approval

Record exact nameplate data and include on a separate sheet for each piece of equipment in maintenance manual. Insert sheet in O&M Manual.

.2 Provide registration plates (pressure vessel, UL, ULC, CSA approval) as required by respective agency. Indicate equipment model, size, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.3 PIPE MARKERS

.1 Standard of Acceptance: Brady Type B-946.

PART 3 - EXECUTION

3.1 PIPING AND VALVES

.1 All new exposed ferrous piping, other than stainless steel, to be primed and painted in accordance with Division 9 standards and as listed herein. Exposed piping is considered to be uninsulated or unenclosed piping.

.2 Pipe 40 mm and larger: provide Brady Type B-946 vinyl coated pressure sensitive tape as listed below. Provide alphabetic identification and directional arrows where applicable. Use Type B.946 vinyl tape for outdoor piping. Use Type B-500 vinyl coated cloth tape where surfaces are not smooth (i.e., uninsulated ductile iron pipe). Each marker to be one continuous piece and include entire label name.

Paper Size	Character Height	Character Line Width	Symbol Line Width
75 mm and larger	40 mm	12 mm	40 mm
40 to 65 mm	25 mm	8 mm	20 mm
ducts	64 mm	12 mm	40 mm

.3 Pipes smaller than 40 mm: provide Brady Type B-946 pressure sensitive vinyl tape. Identification to have minimum 10 mm high letters.

.4 Provide manufacturer's banding tape at each end of pipe marker. Band to be applied to go around pipe a minimum of two passes. Use directional arrow banding tape where applicable. Adhesives on all markers and bands to be suitable for use on respective mounting surfaces and environments. Use double headed arrows where flow is reversible.

.5 Provide rectangular polished aluminum tags on pipe and tubing smaller than 12 mm in diameter. Tags to be 1.5 mm thick and 19 mm wide. Provide 6 mm clear of characters at both ends of tags. Black characters to be minimum 12 mm high with 2 mm character line width.

.6 Piping markers to be in accordance with Identification Colours Table.

.7 Locate markers and classifying colours on piping so they can be seen and identified from normally accessible locations on floor or platform.

.8 Do not exceed 6.0 m between identification.

.9 Identify piping on both sides of equipment.

.10 Identify both sides where piping passes through walls, partitions and floors or is concealed in pipe chase, gallery or other confined space.

.11 Identify piping at all valves immediately upstream of valves.

.12 Identify services in full except in cases of limited space. Avoid single letter abbreviations.

.13 Check colour classification in table with respect to environment, location and service.

.14 Identify piping at branch fittings.

.15 Identify piping at end of every run.

.16 Paint entire length of exposed ferrous piping. Paint in accordance with colours listed in Identification Colours Table.

.17 Paint all new and existing valves in service areas. Paint valve handles yellow.

.18 Provide tags for valves connected by a chain to the valve handle. Attach one tag to the valve and one tag to the chain operator in a location readily visible to the operator.

.1 Indoor tags to be engraved 2 ply plastic laminate.

.2 Outdoor tags to be engraved brass tag, minimum 50 mm.

.19 Tag all new valves and existing process valves per the P&ID and MID drawings.

.20 Review list of system nameplates, tags and duct identification with Consultant prior to engraving.

3.2 VALVE SCHEDULE

.1 Number system valves as indicated on drawings. Provide individual schedule for each building and area.

3.3 EQUIPMENT

.1 Locate nameplates for easy identification.

.2 Do not insulate or paint over plates.

.3 In addition to metal manufacturers nameplates provide laminated plastic plates with black surface and white centre, 90 mm x 40 mm x 2.5 mm nominal thickness. Engrave with 12 mm high lettering. Identify major equipment and tankage with 25 mm high letters. Fix to equipment mechanically. Where not practical to fix to equipment, fix to adjacent surface

3.4 MANUFACTURED MARKERS

.1 Use pre-manufactured mechanical snap-on bands in primary colour only when proper pipe surface quality cannot be obtained for secondary band and lettering identification application.

3.5 IDENTIFICATION SIGNAGE

.1 Provide signs at all separated and effluent water connection points indicating water is not potable including hose bibbs, wall hydrants and yard hydrants.

.2 All signage to be of fibreglass construction of 100 mil thickness minimum 250 mm x 350 mm.

.3 Standard of Acceptance: Brady 69407.

3.6 WARRANTY

.1 Replace or repair all identification markers in disrepair 12 months after substantial performance.

3.7 SPARES

.1 Provide the following:
- .1 Twelve (12) spare pipe markers for each piping service.
- .2 Allow for 24 valve tags and marking as directed by the Consultant.

3.8 SUPPLEMENTS

.1 Identification schedule included at the end of this section.

END OF SECTION

Table: Identification Colours

"Note: This list is generic, not all services or systems may be included in this project."

SYSTEM IDENTIFIER		PIPE MARKERS		PIPE PAINTING		
		Colour of Background	Colour of Legend/Arrow	Pipe Colour	CGSB Colour Code	ICI Paint Code
EFF1	PRIMARY EFFLUENT	Yellow	BLACK	MID GREY	501-103	30 B6 12/027 30
DR	DRAIN (PROCESS)	Y	B	LIGHT BROWN	504-107	00 YY 43/304
PA	PROCESS AIR	B	W	LIGHT BLUE	502-106	30 B6 38/170
EW	EFFLUENT WATER	Y	B	YELLOW ORANGE	508-103	DC 9200 Safety Orange
FCL	FERRIC CHLORIDE	Y	B	FANTASIA	511-104	DC 9600 Safety Purple
SL	PRIMARY SLUDGE	Y	B	MID BROWN	504-107	00 YY 43/304
RAW	RETURN ACTIVATED SLUDGE	Y	B	MID BROWN	504-107	00 YY 43/304
WAS	WASTE ACTIVATED SLUDGE	Y	B	MID BROWN	504-107	00 YY 43/304
RSE	RAW SEWAGE	Y	B	MID GREY	501-103	30 B6 12/027
RSP	RAW SEPTAGE	Y	B	MID GREY	501-103	30 B6 12/027
SCM	SCUM	Y	B	DARK BROWN	504-102	60 YR 07/093
CA	COMPRESSED AIR	Y	B	YELLOW	505-110	DC 9400 Safety Yellow
MW	MUNICIPAL WATER	G	WHITE	LIGHT BLUE	502-106	30 B6 28/170
MHW	MUNICIPAL HOT WATER	G	W	DARK BLUE	502-103	10 B8 09/250
MTW	MUNICIPAL TEMPERED WATER	G	W	MID BLUE	502-208	60 B6 13/164
MHWR	MUNICIPAL HOT WATER RETURN	G	W	DARK BLUE	502-103	10 B8 09/250
CND	CONDENSATE	G	W	BLACK		DC 9990 Black
DWV	DRAIN/WASTE/VENT	Y / VENT: BLUE	B / VENT: WHITE	BLACK / TBD	512-101	DC 9990 Black
OF	OVERFLOW	PER RELATED MEDIA		PER RELATED MEDIA		
RL	REFRIGERANT LIQUID	Y	B	YELLOW ORANGE	508-103	DC 9200 Safety Orange
RS	REFRIGERANT SUCTION	Y	B	YELLOW ORANGE	508-103	DC 9200 Safety Orange
SAN	SANITARY DRAIN	Y	B	MID GREY	501-103	30 B6 12/027
STM	STORM DRAIN	G	W	BLACK		DC 9990 Black
SW	SEPARATED WATER (MUNICIPAL WATER DOWNSTREAM OF A BFP)	G	W	MID BLUE	502-208	60 B6 13/164
VENT	VENT	G	W	TBD		
ODR	ODOUR CONTROL	Y	B	TBD		

END OF SECTION

PART 1- GENERAL

1.1 GENERAL

.1 Test systems after installation but prior to concealment and final placing of equipment.

.2 Conduct tests in presence of authority having jurisdiction, Commissioning Team and Consultant.

.3 Isolate all instrumentation, vents and other devices from system which may be subject to damage due to high test pressures.

.4 Where new work connects to an existing piping system, isolate and test new work. Make final connection and use alternative procedure to verify integrity of final connection, i.e., X-ray or approved alternative procedure.

1.2 SUBMITTALS

.1 Submit notice of tests to Consultant a minimum of 48 hours prior to test being performed.

.2 Submit report, listing all mechanical tests performed, to Commissioning Team and Consultant for review prior to Substantial Performance. Report to include single line schematic type sketch indicating extent of test section, test pressure, duration, etc.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Provide equipment, pumps, compressors, accessories to conduct tests using non-potable water.

.2 Provide gauges calibrated by independent agency normally performing this service. Submit gauge calibration certificate.

PART 3 – EXECUTION

3.1 TESTING

.1 Testing requirements noted in table below:

SYSTEM IDENTIFIER		DESIGN PRESSURE (kPa)	TEST PRESSURE (kPa)	TEST DURATION (hours)	TEST TYPE (H) (P) (O)	NOTES
PROCESS						
EFF1	Primary Effluent	300	450	2	H	
EW	Effluent Water	900	1035	2	H	
RSE	Raw Sewage	160	450	2	H	
RSP	Raw Septage	160	450	2	H	
SL	Sludge	600	900	2	H	2
RAS	Return Activated Sludge	600	900	2	H	2
WAS	Waste Activated Sludge	600	900	2	H	2
SCM	Scum	350	600	2	H	2
PA	Process Air	240	450	2	P	4
ODR	Odour Control	5	30	2	P	
OF	Overflow		70	2	H	
DR	Drain		70	2	P	
CHEMICALS						
FCL	Ferric Chloride	400	600	2	H	
BUILDING MECHANICAL						
CA	Compressed Air	620	1035	1	P	6
MW	Municipal Water	586	1035	2	H	3
MHW	Municipal Hot Water	586	1035	2	H	3
MTW	Municipal Tempered Water	586	1035	2	H	3
MHWR	Municipal Hot Water Return	586	1035	2	H	3
CND	Condensate		70	2	H	
DWV	Drain/ Waste/ Vent		70	2	H	
RL	Refrigerant Liquid	2880	3100	2	O	5
RS	Refrigerant Suction	895	1600	2	O	5
SAN	Sanitary Drain		70	2	H	
STM	Storm Drain		70	2	H	
SW	Separated Water	586	1035	2	H	3

NOTES:
General:

- For yard piping refer to Division 2 requirements.
- All testing procedures to comply with ASME B31.3 (Process and Chemical) or ASME B31.9 (Building Mechanical). The more stringent requirement between the standards and this specification shall be met.
- For ductwork testing requirements refer to Section 15800.
- Provide additional temporary restraints where required due to pipe joints, expansion joints, etc.

SYSTEM IDENTIFIER	DESIGN PRESSURE (kPa)	TEST PRESSURE (kPa)	TEST DURATION (hours)	TEST TYPE (H) (P) (O)	NOTES
• All testing to be witnessed. Pretest systems prior to witnessed test. Record all testing on a from similar to that attached as Appendix 'A', Section 15030. • All lines to be flushed prior to testing. Final cleaning, disinfection and/or chemical cleaning to follow testing. *Specific* (1) Test in accordance with CSA B149.1. (2) Cap lines at pump connections and test to last closed discharge valve in line. If valve is not rated for tight shut-off at test pressure, blind line to facilitate test. (3) Clean and disinfect municipal and separated water systems. Owner to take samples and submit for bacteriological testing. Do not open system until test results are received (48 hours). (4) Test all air systems for headworks aeration system. Flush process air piping and blow-dry. Isolate and test line at bottom of drop to air diffusion headers in tank(s) or channels. (5) Working pressures identified in the table are approximated. Test with refrigerant and/or nitrogen.					
LEGEND: (H) Hydraulic (P) Pneumatic (O) Other					

END OF SECTION

LOCATION _____ DATE _____
Service: _____ Line Number: _____
Approximate Total Pipe Length: _____

CLEANING
Date: _____ Time: _____ Specification: _____

CIRCULATION PUMP
Flow Rate: _____ Duration: _____ Branch Circulation: ☐ yes ☐ no

WITNESS
Contractor's Name: _____ Signature: _____
Owner Rep. Name: _____ Signature: _____

FLUSHING
Date: _____ Time: _____ Specification: _____
Medium: _____
Flow Rate: _____ Duration: _____

WITNESS:
Contractor's Name: _____ Signature: _____
Owner Rep. Name: _____ Signature: _____

TESTING:
Date: _____ Time: _____

Types of Joints: _____
Types of Test: ☐ Hydrostatic ☐ Pneumatic
Final Test Pressure: _____ Duration: _____
Calibrated Gauge: ☐ yes ☐ no Gauge Range: _____
Test: Medium Temperature Begin: _____ End: _____
Ambient Temperature Begin: _____ End: _____
Visual Inspection: ☐ yes ☐ no

WITNESS
Contractor's Name: _____ Signature: _____
Owner Rep. Name: _____ Signature: _____

PIPING SYSTEM COMMISSIONING (Section 15030)

Notes:
1. Complete all sections of the form.
2. Attach schematic sketch of system or section of piping being tested.
3. Attach copy of laboratory report for disinfection testing where applicable.

PROJECT

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Balance the following systems and coordinate with Commissioning Activities:
- .1 Ventilating including Air Conditioning and Ventilation, Make-up and Exhaust System(s).

.2 Perform individual equipment tests to verify unit capacity and general performance.

.3 Coordinate with work in other sections to ensure that all field installed devices, primary elements, test wells and holes are provided.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineer (ASHRAE):
  - .1 ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building, Heating, HVAC Systems.
- .2 Associated Air Balance Council (AABC)
- .3 National Environmental Balancing Bureau (NEBB)
- .4 National Building Comfort Testing Association (NBCTA)
- .5 Ontario Building Code.
- .6 Ontario Electrical Safety Code.

1.3 SUBMITTALS

.1 Prior to fabrication of piping and ductwork, submit preliminary plan indicating locations for primary elements, tappings, etc., necessary to complete the balancing.

.2 Submit certified reports for review listing system and equipment data to Part 3 requirements.

.3 Final reports to generally be in accordance with the AABC published National Standards for total system balance, current edition.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Close Out requirements

1.5 MAINTENANCE AND SPARE PARTS

.1 N/A

1.6 QUALITY ASSURANCE

.1 Carry out balancing in accordance with ANSI, ASHRAE Standard 111, Measurement, Testing, Adjusting, and Balancing of Building, Heating, HVAC Systems.

1.7 COMMISSIONING

.1 N/A

1.8 TRAINING

.1 N/A

1.9 WARRANTY

.1 Provide joint guarantee for one year from AABC., N.E.B.B. or N.B.C.T.A. and Testing Company stipulating quality of work performed in accordance with Codes and Standards.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Provide calibrated measurement equipment to measure air and water flows.

.2 Provide non-intrusive flow meter to measure liquid flows.

.3 All test equipment to be independently calibrated by a firm normally providing this service.

.4 Include calibration reports and equipment specifications in final balancing report.

PART 3 - EXECUTION

3.1 GENERAL REPORTING REQUIREMENTS

.1 Review specifications and drawings, make site visits, prepare reports and ensure all systems operate to specified requirements.

.2 Conduct site inspection during course of construction and make recommendations to ensure proper provisions are made for testing and balancing.

.3 Carry out startup balancing after startup/operation reports are completed. Submit startup report of equipment and system performance including actions required to conform with contract documents.

.4 Carry out final balancing after final verification of controls is completed. Submit final balancing report of system and controls performance including actions required to conform to contract documents. Identify and schedule seasonal balancing work required.

.5 Carry out seasonal balancing and report on system performance as required. Verify heating system performance at or near winter design conditions.

3.2 BALANCING

.1 Balance all air outlets and water flow terminals to -5% to +10% of design flows.

.2 Total energy balance to be within +10% of design.

.3 Adjust fan speeds and modify pumps or controls as required to produce design flow.

.4 Allow all costs to change sheaves on at least four (4) pieces of belt driven equipment. Owner will supply sheaves and belts as advised by balancing Contractor.

.5 Adjust system for design outside air quantity.

.6 Adjust system for design exhaust air quantity.

.7 Multi speed supply and exhaust systems driven by variable speed drives require that balancing contractor work with VSD supplier to establish and fix set VSD speeds.

.8 Test and record heating and cooling apparatus entering and leaving air, water, and refrigerant temperatures.

.9 In consultation with the Owner, following complete finishing of the spaces, adjust flow patterns from air distribution devices to minimize drafts.

.10 Verify that all controls are functioning as intended.

.11 Document verification process.

3.3 PERFORMANCE TESTS, GENERAL

.1 Conduct capacity tests on all HVAC equipment. Tests to be made during a period of stable operation and minimum load fluctuation. Submit performance report for each item tested which includes a comparison of installed capacity and design capacity.

.2 Provide manufacturers data, design data and recorded data in test reports.

.3 Provide nameplate data, tested electrical data and heater size and rates for all motors.

.4 Provide schematics for each test report identifying all components with system and position of controlling devices.

.5 Carry out final balancing under peak load conditions to suit system and outdoor conditions. Where loads cannot be simulated final tests to be carried out at time of peak condition.

.6 Verify variable volume systems/equipment performance under minimum and maximum conditions. Final tests to be carried out with controls operating.

.7 Measure pressure differential between areas connected to the odour control system. Balance to provide positive pressure in areas where air is made up and negative pressure in areas where odour control inlet is located and/or hazardous areas.

3.4 DUCT SYSTEM BALANCING

.1 Duct System Balancing report to include:

.1 Duct Air Quantities:

.1 Mains, Branches, Fresh Air and Exhaust Identification.

.2 Duct Sizes.

.3 Number of Pressure Readings.
.4 Sum of Velocity Measurements.
.5 Average Velocity.
.6 Duct Recorded L/s.
.7 Duct Design L/s.

.2 Air Inlets and Outlets:
.1 Supply or Exhaust Outlet Identification (Location and number designation).
.2 Manufacturers Catalogue Identification and type.

.3 Application Factors re: Velocity, Area, etc. and designated area.
.4 Design and Recorded Velocities - m/s.
.5 Design and Recorded Quantities - L/s.
.6 Deflector Vane or Diffusion Cone Settings.

3.5 FANS, AIR HANDLING EQUIPMENT

.1 Air Handling Equipment report to include:
.1 Equipment:
.1 Manufacturer and model.
.2 Size.
.3 Arrangement discharge and class.
.4 Motor type, kW, volt, phase, cycles and F.L.A.

.2 Design Data:
.1 L/s.
.2 Static pressure.
.3 Motor kW, rpm and amps.
.4 Fan rpm.
.5 Motor amperage rating, volts, phase.
.6 Motor kW.

.3 Fan Recorded Data:
.1 L/s.
.2 Static pressure (suction, discharge, total).
.3 Fan rpm.
.4 Motor operating amps, volts, phase.
.5 Motor operating kW.
.6 Pulley sizes.
.7 VFD frequency if applicable
.8 Belt size and quantity.

.2 Include pressure drop data for all accessories and equipment in system.

.3 Verify and report on performance minimum and maximum volume condition under variable volume control and at minimum and maximum outside air condition under economizer control.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Section includes gauges and thermometers for all process and building mechanical applications alike.

.2 Refer to Process Controls and Instrumentation sections as well as project detail drawings, P&ID and MID drawings to determine extent of in-line instruments. Install in accordance with manufacturer's and supplying contractor's written instructions.

.3 Refer also to Table of Devices in Division 17 for list of instruments.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B40.100-2013 – Pressure Gauges and Gauge Attachments

.2 Ontario Building Code.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010 PART 2 – PRODUCTS including accessories.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Contractor shall verify and demonstrate that proper access and maintenance can be performed on the thermometers/gauges installed.

.2 Provide Spare Parts in accordance with procedures outlined in Division 1.

.3 Provide one (1) spare gauge for each pressure range.

.4 Provide two (2) spare diaphragm seal assemblies, including gauges.

1.6 QUALITY ASSURANCE

.1 Provide thermometers of same make and style throughout.

.2 Pressure gauges to be of the same make and style throughout. Conform to ASME B40.100-2013.

.3 In cooperation with Process Controls and Instrumentation Supply Contractor, submit sketches of instrumentation installation, locations and requirements as part of the shop drawing review process.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

.1 Gauge: Liquid filled gauge minimum 100 mm face, solid front, blowout back, stainless steel case, full gasket bayonet lock ring. Bourdon tube: phosphor bronze, soldered to 6 mm brass socket. Movement: stainless steel and mounted independent of case. All wetted parts to be stainless steel or monel.

.2 Adjustment: equip gauge with dial face zero reset screw.

.3 Accuracy: 1% over full scale range, ASME B40.100 Grade 1A.

.4 Indication: select range for mid-point indication during normal operating conditions.

.5 Scale graduations: kPa. Figures to be black embossed on white surface.

.6 Specified Product: Trerice 750 Series (liquid filled).

.7 Acceptable Alternates for Gauges and Accessories:
- .1 Ashcroft
- .2 Winters
- .3 Wika.

2.2 GAUGE ACCESSORIES

.1 Snubbers
- .1 Gauges installed on water piping to be equipped with 6 mm 316 stainless steel snubber.
- .2 Specified Manufacturer:
  - .1 Trerice D368 (air and gases)
  - .2 Trerice D370 (water).

.2 Gauge Cock

.1 Ball valve: 316 stainless steel body and seat, Teflon packing, chrome plated brass handle.
.1 Maximum operating pressure: 20,670 kPa
.2 Maximum operating temperature: 204°C
.2 Specified Manufacturer: Trerice 735-8 Type FFG.

.3 Diaphragm Seals
.1 Provide Standard diaphragm seal as listed to include:
.1 filling screw connection to be leaktight
.2 type 316L stainless steel construction
.3 flushing connection with shutoff valve; clean-out design
.4 stainless steel diaphragm capsule
.5 Viton diaphragm
.6 glycerin filled.

.4 Diaphragm seals to be factory mounted to gauges.

.5 Provide diaphragm seals for the following services:
.1 all sludge lines
.2 scum lines
.3 wastewater
.4 chemicals.

.6 Specified Product: Trerice 516.

.7 Alternate Manufacturers:
.1 Ashcroft
.2 Winters
.3 Wika.

2.3 THERMOMETERS

.1 Thermometers: industrial type, adjustable angle, with 175 mm aluminum case and brass stem, mercury filled with red indication. Accuracy ±1 scale division.

.2 Provide air-dust stem where required.

.3 Scale range: black embossed figures on white background indicating Celsius temperature.

.4 Specified Product: Trerice Industrial, AX Series.

.5 Acceptable Manufacturers:
.1 Winters.
.2 Ashcroft.
.3 Wika.

2.4 DIAL THERMOMETER

.1 150 mm face universal angle dial thermometer.

.2 Cast aluminum face, glass window, stainless steel ring, aluminum white background face with black gradations.

.3 Red spirit filled. Accuracy ±1 scale division.

.4 Application: Boiler vents and engine exhausts.

.5 Specified Manufacturer: Trerice 80762.

.6 Alternate Manufacturers:
- .1 Winters.
- .2 Ashcroft.
- .3 Wika.

PART 3 - EXECUTION

3.1 PRESSURE GAUGE INSTALLATION

.1 Provide gauges as indicated on the Drawings and in the following Table.

.2 Gauges are indicated on Drawings and details by ISA “PI” symbol. Provide tappings as indicated in Table and on Drawings.

Table: Pressure Gauges

Equipment	Note	Range	Units	Equipment Inlet	Equipment Outlet	Diaphragm Seal
Suction Strainer	Effluent Water System	0-210	kPa	No	Yes	No
Pump	Effluent Water System	0-210	kPa	Yes	No	No
Header	Effluent Water System	0-690	kPa	No	Yes	No
Expansion Tank	Effluent Water System	0-690	kPa	Yes	No	No
Pump	Raw Sewage	0-415	kPa	No	Yes	Yes
Suction Strainer Differential Pressure	Effluent Water System	0-105	kPa	Yes	Yes	No
Discharge Strainer Differential Pressure	Effluent Water System	0-105	kPa	Yes	Yes	No
Pumps	Water	0-1100	kPa	No	Yes	No
Odour Control	Air	0-12	in w.c.	Yes	Yes	No
Pressure Regulating Valves	Water	0-690	kPa	Yes	Yes	No

.3 A tapping is to include a connection to the main, a valve and fittings per drawing details. Install a plug where gauge is not installed. Gauge is not required.

.4 Diaphragm seals and gauges to be factory assembled.

3.2 THERMOMETER / THERMOWELLS INSTALLATION

.1 Provide thermometers as indicated in the following table.

.2 Thermometers are indicated on the Drawings by a “TI” symbol.

.3 All thermometers require thermowells.

.4 Provide thermowells as indicated. Refer to details.

.5 Install thermowells for all intrusive temperature devices indicated in Division 17 Table of Contents

Table: Thermometers

Equipment	Note	Range	Units	Equipment Inlet	Equipment Outlet
Make-up Air Units, Air Handling Units, ERVs, HRVS	Air Side Ductmount	0-55	°C	Yes	Yes
	Coils	0-82	°C	See MID/Details	See MID/Details
Water Heater					
	Water	0-82	°C	See MID/Details	See MID/Details
	Tempered Water – mount at tank outlet	0-55	°C	No	Tank outlet

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Unless specified otherwise, this section defines the requirements of all motors and drives associated with motor drive equipment noted in Division 11 and Division 15.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of the project tender date.

- .1 Canadian Standards Association (CSA):
  - .1 CSA C22.2 No. 100 - Motors and Generators.
  - .2 CSA C22.2 No. 145 – Motor and Generators for Use in Hazardous Locations.
  - .3 CSA C390 – Energy Efficiency Test Methods for Three Phase Induction Motors.
  - .4 CSA Z-432 – Safeguarding of Machinery.
- .2 American Bearing Manufacturers Association (ABMA):
  - .1 ABMA 9, Load Ratings and Fatigue Life for Ball Bearings.
  - .2 ABMA 11, Load Ratings and Fatigue Life for Roller Bearings.
- .3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - .1 IEEE 85, Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery.
  - .2 IEEE 112, Standard Test Procedures for Polyphase Induction Motors and Generators.
  - .3 IEEE 114, Standard Test Procedures for Single-Phase Induction Motors.
  - .4 IEEE 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Motors.
  - .5 IEEE 841, Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors.
- .4 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA MG1, Motors and Generators.
  - .2 NEMA MG13, Frame Assignments for Alternating Current Integral Horsepower Induction Motors.
  - .3 NEMA 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
  - .4 NEMA MG 1Part 31, Definite-Purpose Inverter Fed Polyphase Motors.
- .5 Electrical Equipment Manufacturers Association of Canada (EEMAC):
  - .1 Standard MG2, Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.
- .6 National Fire Protection Association (NFPA):
  - .1 NFPA 70, National Electrical Code (NEC).
- .7 Underwriters Laboratories (UL):
  - .1 UL1, Flexible Metal Conduit.
  - .2 UL 674, Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
  - .3 UL 2111, Overheating Protection for Motors.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1, and Division 15, Section 15010. All submittals to be submitted under cover of associated Division 11 or Division 15 equipment.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS.

- .1 Product Data:
  - .1 Nameplate data in accordance with NEMA MG 1.
  - .2 Rating Information:
    - .1 Service factor.
    - .2 Locked rotor current.
    - .3 No load current.
    - .4 Adjustable frequency drive motor load classification (e.g., variable torque); maximum torque and allowable motor speed range.
    - .5 Guaranteed minimum full load efficiency and power factor.
    - .6 Insulation rated thermal class.
    - .7 Operational thermal rise classification at nameplate load at 40 Deg. C ambient.
    - .8 Motor NEMA Design Type.
  - .3 Enclosure type and mounting (e.g., horizontal, vertical).
  - .4 Conduit box dimensions and usable volume as defined in NEMA MG 1.
  - .5 Bearing type.
  - .6 Bearing lubrication.
  - .7 Bearing life.
  - .8 Space heater voltage and watts.
  - .9 Description, ratings and wiring diagram of motor thermal protection. Motor sound power level in accordance with NEMA MG 1.
  - .10 Maximum brake horsepower required by the equipment driven by the motor.
  - .11 Stamped drawings by a licensed professional engineer in the Province of Ontario of equipment guards indicating compliance with OHSA and CSA requirements and applicable safety standards.
- .2 Operation and Maintenance Data:
  - .1 Operation and Maintenance Manuals – to be in accordance with Division 1 requirements.
  - .2 Installation requirements and/or recommendations.
  - .3 Certificate of proper installation.
- .3 Quality Control Data:
  - .1 NEMA M61, Part 31 – Certification for Inverter Duty Motors.
  - .2 Factory Test Reports.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment.

.2 Provide spare parts in accordance with procedures listed in Division 1.

.3 Refer also to individual specification sections of Division 11 and Division 15 for additional motor requirements.

1.6 QUALITY ASSURANCE

.1 The motor manufacturer or its factory trained representative shall provide a written certification on OEM letterhead stating that the motor has been installed to their standards.

.2 When referenced by a motor-driven equipment specification outside of this section, any deviations or discrepancies shall be clearly identified as a deviation from this Section within shop drawing submissions.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Use manuals to review routine maintenance and teardown. Provide photographs in manual illustrating each step of a typical teardown.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

.2 Individual specification sections within Division 11 and Division 15 may have additional warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.

.2 In order to obtain single source responsibility, utilize a single supplier to provide a drive motor, its driven equipment, and specified motor accessories.

.3 Meet requirements of NEMA MG 1.

.4 Frame assignments in accordance with NEMA MG 13.

.5 Provide motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

.6 Motors shall be specifically designed for the use and conditions intended, with a NEMA B Design Letter Classification to fit the application.

.7 Lifting lugs on all motors weighing 45 kg or more.

.8 Operating Conditions:
- .1 Maximum ambient temperature not greater than 40 degrees C.
- .2 Class B (80 Degrees C) rise in winding temperature when operating at rated nameplate conditions.
- .3 General Purpose and Inverter Duty Motors shall be suitable for the intended operating conditions without any reduction being required in the nameplate rated horsepower, operational speed range, or exceeding the rated temperature rise of the machine.
- .4 Overspeed in either direction in accordance with NEMA MG 1.

.9 TEFC: Totally enclosed, fan-cooled enclosure.

.10 Motor Nameplate Horsepower: The rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

.11 Inverter Duty Motor: Motor meeting all applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.

2.2 HORSEPOWER RATING

.1 As designated in motor-driven equipment specifications or drawings.

.2 Constant Speed Applications: Brake horsepower of the driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding any service factor.

.3 Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any operating condition not to exceed motor nameplate horsepower rating, excluding any service factor.

2.3 SERVICE FACTOR

.1 At least 1.15 SF at maximum rated ambient temperature for General Purpose motors.

.2 A 1.00 SF at maximum rated ambient temperature for only Inverter Duty Rated motors.

2.4 MOTOR POLES

.1 Unless indicated otherwise in separate motor-driven equipment specifications or drawings, squirrel cage induction motors shall be typically of 4 Pole Design.

.2 A 1.00 SF at maximum rated ambient temperature for only Inverter Duty Rated motors.

2.5 VOLTAGE AND FREQUENCY RATING

.1 System Frequency: 60 Hz.

.2 Voltage Rating: Unless indicated otherwise in separate motor-driven equipment specifications or drawings, three phase motors shall typically be 575 VAC, 3 Phase machines.

.3 Suitable for full voltage starting.

.4 Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 80 percent of motor rated voltage.

2.6 EFFICIENCY POWER FACTOR

.1 For all motors except single-phase, under 1 horsepower, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists.

.2 Efficiency:
- .1 Only NEMA Premium® efficiency motors are acceptable as per NEMA MG 1 Tables 12-12 and 12-13.
- .2 Tested in accordance with CSA C390, paragraph 12.59.
- .3 Guaranteed minimum at full load in accordance with NEMA MG 1 Table 12-10, or as indicated in motor-driven equipment specifications.

.3 Power Factor: Guaranteed minimum at full load in accordance with Section 15053.01 “Electric Equipment Motors and Drives - Table 1”, or as indicated in motor-driven equipment specifications or drawings.

2.7 LOCKED ROTOR RATINGS

.1 Locked Rotor kVA Code G or lower, if motor horsepower not covered by NEMA MG 1 tables.

.2 Safe stall time 12 seconds or greater

2.8 INSULATION SYSTEMS

.1 Motors Rated: Sealed windings in accordance with NEMA MG 1 and IEEE 841.

.2 Inverter Duty motors to have NEMA MG1 Part 31 Certified insulation systems.

.3 Unless otherwise indicated in motor-driven equipment specifications, Class F Winding Insulation shall be provided.

2.9 ENCLOSURES

.1 Enclosures to conform to NEMA MG 1.

.2 Unless noted otherwise in motor driven equipment specifications or drawings, TEFC motor enclosures shall be typically provided. Furnish TEFC motors with a drain hole with porous drain/weather plug.

2.10 EQUIPMENT GUARDS

.1 Provide protective galvanized metal guards of solid metal over all revolving parts of couplings and shafts, in accordance with the requirements of the Ministry of Labour, and to the approval of the Engineer. The guards shall be firmly held in place, and easily removable. Openings shall be provided as necessary to permit lubrication of grease nipples or oil cups, insertion of test instruments without removal of the guards.

.2 Provide guards to totally enclose all exposed belt driven assemblies and rotating components in general conformance with CSA Z-432 or OSHA Standard guidelines. Provide:

.1 Expanded metal screen welded to 25 mm steel angle frame.

.2 1.2 mm thick (No. 18 USSG) galvanized sheet metal tops and bottoms.

.3 Removable side(s) for servicing.

.4 28 mm diameter branded hole on shaft center to insert tachometer.

.5 Allowance for motor movement during belt tension adjustment.

2.11 TERMINAL (CONDUIT) BOXES

.1 Oversize main terminal boxes for all motors.

.2 Diagonally split, rotatable to each of four 90 degree positions. Threaded hubs for conduit attachment. Furnish gaskets between box halves and between box and motor frame.

.3 Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19 and NFPA 70, Article 430:

Terminal Box Usable Values		
Voltage	**Horsepower**	**Percentage**
600 and below	15 through 125	500
600 and below	150 through 300	275

.4 Terminal for connection of equipment grounding wire in each terminal box.

2.12 BEARINGS AND LUBRICATION

.1 Horizontal Motors:

.1 Through 400 Horsepower: Re-greaseable ball bearings in labyrinth sealed end bells with removable grease relief plugs.

.2 Minimum 100,000 hours L 10 bearing life for ball and roller bearings as defined in ABMA 9 and 11.

.2 Oil Lubrication Systems (where required for large motors):

.1 Oil reservoirs with sight level gauge.

.2 Oil fill and drain openings with opening plugs.

.3 Provisions for necessary oil circulation and cooling.

.3 Bearing Isolation: Inverter Duty Motors shall have an electrically isolated bearing on non-drive end and common mode shaft grounding brush protecting the drive end bearing.

2.13 NOISE

.1 Measured in accordance with IEEE 85 and NEMA MG 1.

.2 Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

2.14 BALANCE AND VIBRATION CONTROLS

.1 In accordance with NEMA MG 1, Part 7.

2.15 EQUIPMENT FINISH

.1 Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.16 SPECIAL FEATURES AND ACCESSORIES

.1 Winding Thermal Protection:
- .1 Resistance Temperature Detectors:
  - .1 To be provided with motors 37 kW (50 horsepower) and larger.
  - .2 100 ohm precision resistors with calibrated resistance-temperature characteristics.
  - .3 Six (two for each phase) positioned to detect highest winding temperature and located between coil sides in stator slots.
  - .4 Compatible with monitoring instrumentation.
  - .5 Leads brought to separate motor terminal box.
  - .6 Provide separate stainless steel RTD connection nameplate.

.2 Vibration detection sensors as required in other motor driven specification requirements.

.3 Nameplates:
- .1 Raised or stamped letters on stainless steel or aluminum.
- .2 Display motor data required by NEMA MG 1, paragraphs 10.39 and 10.40 in addition to bearing numbers for both bearings.
- .3 Premium efficiency motor nameplates to also display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

.4 Anchor Bolts: Provide anchor bolts meeting manufacturer’s recommendations and of sufficient size and number for the specified seismic conditions.

2.17 SPECIAL MOTORS

.1 Requirements in this article take precedence over conflicting features specified elsewhere in this Section.

.2 Inverter Duty Motor:

.1 Motor supplied power by adjustable voltage and adjustable frequency drives shall be Inverter Duty Rated.

.2 Motor shall be suitable for operation over entire speed range indicated without reduction in available torque or exceeding maximum rise in operating temperatures.

.3 Provide forced ventilation where speed ratio is greater than published range for motor being installed.

.4 Motor shall be capable of 10:1 VFD turn down ratio.

2.18 V-BELT DRIVE ASSEMBLIES

.1 Fit reinforced belts in sheave grooves matched to drive. Multiple belts on unit to be matched set.

.2 Use cast iron sheaves. Secure to shaft with removable key.

.3 Use sheave with split tapered bushing and keyway with fixed pitch for motors unless specific exceptions required for item concerned.

.4 Use minimum drive rating of 1.5 times motor nameplate rating, including service factor. Keep overhung loads within manufacturer's design requirements on all prime mover shafts.

.5 Allow for 150 mm minimum center line adjustment for belt drive units with motor slide rail adjustment plates.

.6 Select drives and belts for blowers and pumps for intermittent start/stop duty at hourly intervals.

2.19 FACTORY TESTING

.1 Manufacturer's Tests:

.1 In accordance with CSA C390 for polyphase motors and for single-phase motors.

.2 Routine (production) tests on all motors in accordance with NEMA MG 1, plus no load power at rated voltage and polyphase, rated voltage measurement of locked rotor current. Test multispeed motors at all speeds.

.3 For energy efficient motors, test efficiency at 50, 75, and 100 percent of rated horsepower:

.1 In accordance with CSA C390 or IEEE 112, Test Method B, and NEMA MG 1, paragraphs 12.59, and 12.60.

.2 For motors 500 horsepower and larger where facilities are not available to test by dynamometer (Test Method B), determine efficiency by CSA C390 or IEEE 112, Test Method F.

.4 Power Factor:

.1 Speed.

.2 Current at rated horsepower.

.3 kW input at rated horsepower.

.4 On motors of 75 kW (100 horsepower) and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.

.5 Temperature rise at rated kW (horsepower) for motors.

.2 Test Report Forms:

.1 Efficiency and power factor by CSA C390.

.2 Temperature Test: CSA C390 or IEEE 112, Form A-2.

2.20 SITE TESTING

.1 Contractor to perform the following motor electrical tests after installation but before startup and commissioning activities of the motor driven equipment:

.1 For all applicable Inverter Duty process motors as per Section 16031 “Inspection and Testing”.

2.21 SPECIFIED MANUFACTURERES

.1 GE Canada.

.2 Leeson Canada.

.3 Reliance Electric.

.4 MagneTek.

.5 Baldor.

.6 U.S. Electrical Motors.

.7 TECO Westinghouse Motor Co.

.8 Toshiba International Corp., Industrial Division.

.9 WEG Electric Motors Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 In accordance with manufacturer’s instructions and recommendations.

.2 Align motor carefully and properly with driven equipment.

.3 Secure equipment to mounting surface with anchor bolts.

3.2 SUPPLEMENTS

.1 Motor Performance Requirement Table included at the end of this section.

END OF SECTION

TABLE 1
MOTOR PERFORMANCE REQUIREMENTS

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
1	1,800	82.5	82.5			Mfr.'s Std.	Mfr.'s Std.		
	1,200	80.0	80.0			Mfr.'s Std.	Mfr.'s Std.		
1.5	3,600	82.5	82.5			Mfr.'s Std.	Mfr.'s Std.		
	1,800	84.0	84.0			Mfr.'s Std.	Mfr.'s Std.		
	1,200	84.0	85.5		82.0	Mfr.'s Std.	Mfr.'s Std.		Mfr.'s Std.
2	3,600	84.0	84.0			Mfr.'s Std.	Mfr.'s Std.		
	1,800	84.0	84.0			Mfr.'s Std.	Mfr.'s Std.		
	1,200	85.5	86.5	83.7	83.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	82.9	82.5	82.9	81.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
3	3,600	84.0	85.5	82.0	82.0	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	86.5	87.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	86.5	87.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	84.1	83.0	84.1	82.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
5	3,600	85.5	87.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	87.5	87.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	87.5	87.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	85.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
7.5	3,600	87.5	88.5	84.8	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	88.5	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.

TABLE 1
MOTOR PERFORMANCE REQUIREMENTS

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
7.5	1,200	88.5	89.5	88.4	87.5	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	85.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
10	3,600	88.5	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	89.5	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
15	3,600	89.5	90.2	88.4	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	91.0	91.0	90.9	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	90.2	90.2	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
20	3,600	90.2	90.2	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	91.0	91.0	91.7	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	91.0	90.2	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
25	3,600	91.0	91.0	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	91.7	92.4	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	91.7	91.7	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.

TABLE 1
MOTOR PERFORMANCE REQUIREMENTS

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
30	3,600	91.0	91.0	89.5	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	92.4	92.4	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	92.4	91.7	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	91.7	91.0	90.9	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
40	3,600	91.7	91.7	90.2	89.3	86.6	86.1	87.0	89.0
	1,800	93.0	93.0	92.8	91.7	78.2	78.2	83.0	84.5
	1,200	93.0	93.0	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.0	90.9	90.2	70.0	70.5	70.0	70.5
50	3,600	92.4	92.4	90.2	89.3	85.1	86.7	89.0	89.0
	1,800	93.0	93.0	92.8	91.7	79.5	79.4	82.5	82.5
	1,200	93.0	93.0	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.7	90.9	90.9	78.5	72.9	78.5	80.0
60	3,600	93.0	93.0	91.7	90.9	85.8	88.3	87.5	89.0
	1,800	93.6	93.6	93.5	92.8	80.5	79.9	80.5	80.5
	1,200	93.6	93.6	92.8	91.7	81.5	81.5	81.5	81.5
	900	92.4	91.7	91.7	90.9	79.5	73.2	79.5	79.5
75	3,600	93.0	93.0	91.7	91.7	87.1	88.5	88.5	88.5
	1,800	94.1	94.1	93.5	93.5	81.0	81.5	81.0	81.5
	1,200	93.6	93.6	93.5	92.8	82.0	82.0	82.0	82.0

TABLE 1
MOTOR PERFORMANCE REQUIREMENTS

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
75	900	92.8	92.4	92.8	91.7	80.5	74.5	80.5	81.0
100	3,600	93.0	93.6	91.7	91.7	87.0	88.2	87.0	88.5
	1,800	94.1	94.5	94.0	93.5	81.0	81.0	81.0	81.0
	1,200	94.1	94.1	92.8	92.8	82.1	81.7	85.5	85.5
	900	93.5	92.4	92.8	91.7	77.0	77.3	77.0	80.0
125	3,600	93.6	94.5	91.7	91.7	86.4	89.1	87.0	90.5
	1,800	94.5	94.5	93.5	92.8	85.4	85.5	87.5	86.0
	1,200	94.1	94.1	93.5	92.8	82.7	82.3	85.5	85.5
	900	93.5	93.0	92.8	92.4	78.5	78.5	78.5	78.5
150	3,600	93.6	94.5	92.4	91.7	86.5	90.0	86.5	90.5
	1,800	95.0	95.0	94.5	94.0	82.5	85.0	84.5	85.0
	1,200	94.5	95.0	93.5	94.0	81.5	81.5	81.5	81.5
	900	93.5	93.0	92.8	92.4	78.0	78.5	78.0	78.5
200	3,600	94.5	95.0	92.4	93.0	87.8	89.4	91.0	91.0
	1,800	95.0	95.0	94.0	94.0	85.2	86.5	87.0	87.0
	1,200	94.5	95.0	93.5	93.5	79.0	82.5	79.0	82.5
250	3,600	95.0	95.0	91.7	92.4	85.0	86.5	85.0	86.5
	1,800	96.0	96.0	94.5	94.5	79.0	79.0	79.0	79.0
	1,200	95.0	95.0	94.5	93.5	82.0	82.0	82.0	82.0

TABLE 1
MOTOR PERFORMANCE REQUIREMENTS

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
300	3,600	95.0	95.0			89.8	89.9		
	1,800	95.4	95.2	94.5	94.0	80.0	80.0	80.0	80.0
	1,200	95.0	95.0			84.5	90.1		
350	3,600	95.0	95.0			89.4	85.9		
	1,800	95.0	95.0			85.9	85.9		
400	3,600	95.0	95.0			88.4			
	1,800	95.0	95.0			86.8			
450	3,600	95.0	95.0			89.1			
500	3,600	95.0	95.0			88.3			
650	892	95.0	95.0			86.0	86.0		

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY:

.1 Includes, but is not limited to, the support of Division 11 and Division 15 equipment.

.2 Unless detailed otherwise, this Division is to be responsible to provide all required equipment supports to the standards of Division 5.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

.1 Canadian Standards Association (CSA):

.1 CSA W59-18: Welded Steel Construction.

.2 CSA G40.20-13: General Requirements for Rolled or Welded Structural Quality Steel

.2 Ontario Building Code.

1.3 INFORMATIONAL SUBMITTALS

.1 Submit detail shop drawings of all supports for review by Consultant before fabrication or construction.

.2 Submit intended grout mix.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 N/A

1.6 QUALITY ASSURANCE

.1 Construct supporting structures to safely withstand operating stresses.

.2 Distribute load and impact over building areas. Refer to Section 15241 and coordinate with Contractor’s Seismic Support Design Engineer for attachments to equipment and building structure.

.3 Conform to codes and regulations of agencies having jurisdiction.

.4 Weld steel standards to CSA W59-18.

1.7 COMMISSIONING

.1 N/A

1.8 TRAINING

.1 N/A

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Provide all special steel (angle iron, plate, pipe, etc.) supports required for support of tanks, pumps, motors, air handling units and other equipment supplied by this Section.

.2 Unless indicated otherwise, all supports to be hot dip galvanized.

.3 Supports to be submerged in liquid retaining tankage are to be 304 stainless steel.

.4 Material to CSA G40.20-13.

2.2 ANCHOR BOLTS

.1 Provide all anchor bolts not supplied by equipment manufacturers.

.2 Anchor bolts to be 304 stainless steel.

PART 3 - EXECUTION

3.1 EQUIPMENT FOUNDATIONS

.1 Co-operate with work of other trades in locating foundations and provide anchor bolts for concrete foundations, pedestals.

.2 Confirm all housekeeping pad dimensions prior to pouring of concrete.

.3 Confirm with manufacturer of equipment where foundation design is not indicated and provide foundation dimensions, size of foundation bolts, method of setting, aligning and anchoring of equipment.

.4 Allow minimum 25 mm grout space between machinery baseplate and concrete foundation, fill space complete. Do not remove leveling wedges before grout reaches final set. Fill voids left by removal of wedges with grout, finish exposed surface of grout to make neat appearance.

.5 Fill base plates with grout or concrete.

3.2 TANKS

.1 Locate supports for tanks to avoid undue strain on shell and interference with pipe connections.

.2 Locate supports for tanks containing tubes to allow tube removal.

.3 Use cast iron or welded steel (hot dip galvanized) saddles of curvature to fit tank where saddles are indicated.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Provide pipe sleeves for pipes passing through concrete walls or floors, unless detailed otherwise.
- .1 Provide waterproofing flanges for all pipe sleeves.
- .2 Provide smooth core through existing walls and floors as required and where detailed.
- .3 Seal all openings through sleeves.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B31.3-20 – Process Piping.
- .2 Canadian Standards Association (CSA):
  - .1 CSA W59-18: Welded Steel Construction.

1.3 INFORMATIONAL SUBMITTALS

.1 Submit shop drawings of modular sleeve seals.

.2 Submit Interference/Coordination drawings per Section 15010 prior to fabricating and installing sleeves. Submit sleeve drawing in conjunction with interference drawings.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENT

.1 N/A

1.6 QUALITY ASSURANCE

.1 Sleeve construction and welding in accordance with CSA W59-18 and ASME B31.3

1.7 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 For pipe diameter 750 mm and less, sleeves are to be constructed of carbon or stainless steel schedule pipe with a minimum Schedule 10 wall thickness. Sleeves for pipes larger than 750 mm are to be as detailed on drawings.

.2 Pipe sleeves to be constructed with an annular fin (waterstop) continuously welded to the midpoint of the sleeve.

.3 Sleeves required as follows:

.1 Through foundation walls and water retaining walls.

.2 As detailed on drawings.

.3 As required in Division 1.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Unless detailed otherwise terminate sleeves flush with vertical surfaces of concrete.

.2 Coordinate with Division 3 to core drill in existing floors, roofs and walls to accommodate mechanical work. Existing concrete reinforcing to be identified and marked by Contractor, for review by Consultant, prior to core drilling.

END OF SECTION

PART 1- GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section describes the requirements associated with the erection of Process and Building Services Piping.

.2 The Contractor is required to retain the services of a third-party pipe support engineer to design the pipe supports in accordance with the requirements noted herein. In addition, the third party engineer is to review the pipe support installation and provide a sealed letter confirming that the support installation is in accordance with their design intent.

.3 Contractor to coordinate with the Seismic requirements noted in Division 1 and in Division 15, Section 15241.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of the project tender date.

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B31.1 – Power Piping.
  - .2 ASME B31.3 – Process Piping.
  - .3 ASME B31.9 – Building Services Piping.
- .2 Manufacturers Standardization Society:
  - .1 MSS SP-69 – Pipe Hangers and Supports – Selection and Application.
  - .2 MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices.
  - .3 MSS SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture.
- .3 Ontario Building Code.
- .4 National Plumbing Code.
- .5 ASHRAE.
- .6 Ontario Regulation 815.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following:

- .1 For each piping system and method of support:
  - .1 General arrangement and coordination drawings for piping supporting elements and methods.
  - .2 Support elements: hangers, trapeze, restraints, anchors, guides and attachments. Submit load rating for each type of hanger, support and attachment to the building structure.
  - .3 Submittals to be stamped by a qualified Professional Engineer licensed in the Province of Ontario and regularly designing piping support systems.
  - .4 Using the contract drawings as a basis, mark-up to include piping supports location and type, generally in accordance with MSS SP-89.
  - .5 Submit copy of Cover Page and Table of Contents for each applicable MSS Standard (www.mss-hq.com).

.2 Submit manufacturer's recommended support spacing for plastic piping.

.3 Submit pipe support element inspection report in accordance with MSS SP-89, certified by a qualified Professional Engineer licensed in the Province of Ontario.

.4 Provide certification of the design and installation of the pipe support system by the Professional Engineer responsible for the design and stamping of submittal drawings.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 N/A.

1.6 QUALITY ASSURANCE

.1 Manufacturing facilities shall be registered to ISO 9001.

.2 Conform to the latest edition of the following standards and codes in addition to these specifications.

.1 Pipe hangers and supports:

.1 Load ratings to ASME B31.1 or MSS SP-58.

.2 Fabrication and Installation Practices – MSS SP-89.

.3 Selection and Application – MSS SP-69.

.4 Materials, Design and Manufacture – MSS SP-58.

.2 Building Services Piping: ASME/ANSI B31.9.

.3 Process Piping: ASME/ANSI B31.3.

.4 Potable Hot and Cold Water: Ontario Building Code, National Plumbing Code.

.5 Sanitary and Storm Drainage Piping: Ontario Building Code, National Plumbing Code.

.6 Seismic Support: Ontario Building Code, ASHRAE. Facility to be considered a post-disaster facility.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 N/A.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

.2 Contractor to return to site eleven (11) months after Substantial Completion to verify and adjust hangers as required.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Specific support products are not included herein as it is the responsibility of the Contractor's Pipe Support Engineer.

.2 Acceptable support system manufacturers include:

.1 Anvil International.

.2 E. Myatt and Co. Inc.

.3 Process Pipe Support Systems Inc.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install pipes parallel and close to the building structure.

.2 Locate groups of pipes parallel to each other and spaced at a distance to permit service access for valves or other equipment located above.

.3 Pipe routing, connections and take-offs to follow building lines.

.4 Provide swing joints, offsets and prefabricated expansion joints to accommodate pipe expansion or contraction due to temperature change. Coordinate piping and piping supporting elements with the building architecture, structure, electrical systems and other mechanical systems to ensure proper installation and access for maintenance and service.

.5 Coordinate pipe supporting elements with other systems, with provisions for vibration and seismic control.

.6 Provide all pipe supporting elements as necessary to ensure proper support under all operating conditions and in accordance with relevant standards and the constraints and requirements of the piping system manufacturer (pipe, fittings, valves, equipment, etc.).

.7 Representative pipe support details are indicated on the Drawings and are intended to provide a minimum standard of pipe support systems. The Contractor's piping support designer is to review these details and provide the equivalent, if suitable for the application, or better, as required.

.8 Details on Drawings may not be all-inclusive for all installation or possible situations.

.9 Do not conceal piping and pipe supporting elements before the completion of the Contractor's quality assurance inspection and testing and approval of local authorities having jurisdiction.

3.2 PIPE SUPPORT

.1 The design of pipe supporting elements is dependent on Contractor controlled methods of installation

and the physical characteristics, limitations and operating characteristics of the piping system.

.2 Methods of installation include the physical location of the pipe relative to the support structure, method of support (hanger, trapeze, etc.), attachment location (roof structure, column, interior wall, etc.), attachment method (cast-in-place, expansion inserts, structural bridging, clamping, etc.,) and piping systems being supported (single, multiple, etc.).

.3 Provide pipe supporting elements to properly support piping system (pipe, fittings, valves, equipment, etc.) such that the piping system and pipe supporting elements are protected from excessive stress and distortion.

.4 Pipe supporting elements consist of: hangers, which support from above; supports, which bear load from below; restraints, anchors and guides which limit or direct movement, as well as support loads and attachments between support elements and the structure.

.5 Design the pipe supporting elements to carry the sum of all concurrently acting static and dynamic loads including the following:

.1 Dead weight of pipe, fittings, valves, insulation, inline equipment, hanger system, contents and other pipes (if supported from the line under consideration).

.2 Live weight of contents.

.3 Weight of test fluid, when greater than normal fluid (not considered concurrent with occasional loads).

.4 Occasional loads such as ice, wind and earthquake loads.

.5 Forces imposed by thermal expansion and contraction of pipe bends and loops.

.6 Frictional, spring, and pressure thrust forces imposed by expansion joints in the system.

.7 Frictional forces of guides and supports.

.8 Forces due to internal pressure including test pressures.

.9 Forces due to flow changes in direction at bends and elbows.

.10 Forces due to operation of safety, relief and stop valves.

.6 Each pipe support to be field adjustable under full load conditions.

.7 Readjust all pipe support elements after initial installation as required to suit final operating conditions.

.8 Prior to connecting pumping units or other equipment to pipe sections, support complete piping assembly and anchor in perfect alignment with pumping units and sleeves to prevent movement of piping assembly and strain on pumping units or equipment. Disconnect piping and demonstrate to Engineer that no strain is placed on equipment connections.

.9 Support all valves and risers so that weight of valve or valve assembly is not carried by adjacent horizontal pipe sections.

.10 Provide additional support and/or bracing to prevent equipment rotation in the pipe where components are connected to piping by grooved end couplings.

.11 Clean all surfaces to be encased by concrete to bare metal immediately before placing concrete.

.12 Ensure that position of pipe on supporting blocks is not disturbed when placing concrete.

.13 Concrete type supports to provide for not more than 120° contact area.

.14 Space pipe supports in accordance with manufacturer's instructions or to prevent undue strain or sag.

.15 Provide custom-made supports where indicted or where directed by Consultant.

.16 Provide additional anchoring if pipe movements or vibrations are observed, resulting from fluid motions.

3.3 HANGERS

.1 Hangers to be capable of field adjustment while supporting the load.

.2 Turnbuckles and adjusting nuts are to have full thread engagement and suitable locking devices.

.3 Where piping moves horizontally due to thermal expansion/ contraction, hanger components to allow for swing and traveling devices (rolling or slip supports) and restraints are to be provided as required to limit hanger swing angle to less than 4°.

.4 Where piping moves vertically (thermal expansion) provide variable supports (spring cushion, variable spring and/or constant support hangers) as required to prevent the transfer of excessive loads to adjacent hangers, supports or connected equipment.

.5 Where the structure that pipe support element is attached to moves vertically (load changes, snow load on roof, etc.), provide variable supports (spring cushion, variable spring and/or constant support hangers) as required to prevent transfer of excessive loads to adjacent hangers, support or connected equipment.

.6 Provide variable supports with means to limit misalignment, buckling, eccentric loading and overstressing of the spring.

.7 Where trapeze supports are provided to reduce hanger attachments to the structure, individual hangers or base supports are to be provided for each pipe attached to the trapeze to allow for individual adjustment and support to suit requirements for sloping, horizontal movement and vertical movement.

3.4 MATERIALS

.1 Hangers for copper piping to be copper plated wrought steel.

.2 All supports, hangers, hanger rods, anchors, anchor guide braces, etc., located inside process tankage and channels or where submerged, to be fabricated of 316 stainless steel. Fasteners and associated hardware to be 316 stainless steel.

.3 Hot dip galvanize (ASTM A123) all supports, hangers, hanger rods, anchor guides, braces, etc., not specifically noted in Articles 3.4.1 and 3.4.2. Fasteners and associated hardware to be cadmium plated.

.4 Hot dip galvanize all supports, hangers, anchor guides, braces, etc., after fabrication and before installation. Electrogalvanized components will not be accepted.

.5 Except as noted in Articles 3.4.1 and 3.4.2, all bolts, washers, nuts, etc., cadmium plated or electrogalvanized.

3.5 SUPPORT SPACING

.1 Provide support spacing in accordance with MSS SP-69, ASME B31.1 and piping/fitting manufacturer's standards.

.2 Use ASME B31.1 Standard for minimum rod diameter and spacing for pipe supports, with the following exceptions:

.1 Minimum rod diameter: 12 mm.
.2 Support plumbing piping in accordance with more stringent requirements of either Ontario Regulation 815 or as specified.
.3 Support 12 mm nominal copper pipe every 1.5 m.
.4 Support plastic piping in accordance with manufacturer's recommendations.

.3 Smallest pipe size to govern spacing between pipe rack supports.

.4 For ductile iron, cast iron, steel, copper and stainless steel pipe, do not exceed the following spans between hangers and supports on straight runs having no valves or fittings. Maximum support spacing not to exceed values indicated in table below.

PIPE SIZE	**MAXIMUM SPACING**	
(mm)	Sewage or Water Service	Air or Gas Service
Up to 25 mm*	1.8 m	2.1 m
30 mm to 50 mm	2.4 m	3.0 m
65 mm to 100 mm	3.0 m	4.2 m
150 mm to 200 mm	3.6 m	5.1 m
300 mm and larger	7.0 m	9.1 m
** For 12 mm copper pipe support spacing not to exceed 1.5 m.*		

.5 Support spacing to limit the stresses in the piping to less than the allowable stress when determined on the basis of a support span twice that of the actual span.

.6 Support spacing to limit the deflection to less than the smaller of 5 mm or 10% of the nominal diameter of the pipe, based on the weight of the empty pipe, insulation and other dead loads.

.7 Support spacing varies with pipe material (steel, cast iron, glass, plastic, etc.), type of fitting (screwed, welded, flanged, soldered. Brazed, thermoplastic welded, mechanical and proprietary joints, etc.), media contained (fluid, gas), ambient temperature and temperature of media contained.

3.6 ANCHORS, GUIDES AND RESTRAINTS

.1 Provide anchors, guides, pivots and other restraints required to secure piping (fittings, expansion joints, elbows, etc.) while withstanding thrusts, moments and other imposed loads.

.2 Where Z-bends, U-bends or pipe loop expansion arrangements are used, provide anchors and

guides to direct movement along axis of joint. Guide spacing to take into consideration the column buckling strength of the pipe.

.3 Provide supplemental anchors, guides and restraints for joints that do not have a self-restraining design (mechanical and proprietary joints) in accordance with the manufacturer's requirements.

.4 Provide rolling or slip support or restraints necessary to ensure that the hanger attachment to the structure does not move out of a safe vertical position from pipe movement due to thermal expansion/contraction.

.5 Provide sway restraints or shock absorbing devices to ensure that the hanger attachment to the structure does not move out of safe vertical position due to shock loads (thrusts due to rapid flow or pressure changes).

3.7 PIPE ATTACHMENTS

.1 Provide non-integral type pipe attachments including clamps, slings, cradles, saddles, straps, clevises and rollers for support of horizontal piping.

.2 Non-integral pipe attachments (clamps) for vertical pipes are to incorporate shear lugs or be welded to the pipe to prevent slippage.

.3 Attachments for piping systems that require movement due to thermal expansion are to include rolling or sliding supports. The support is to include for free movement of the pipe or the imposed loads and friction forces of the supports

.4 Provide protective surfaces (pads, cushions, shields, etc.) on supports for piping that requires protection against contact damage in accordance with the pipe manufacturer's requirements.

.5 Pipe attachment material to be compatible with the pipe material or be suitably isolated to prevent contact of dissimilar metals to prevent corrosion.

.6 Pipe attachments for insulated pipe not to pierce insulation and to be provided with shields and/or insulated saddles to prevent insulation damage from the loads transmitted to the pipe support.

.7 Where welded integral type attachments are required (ears, shoes, lugs, cylindrical attachments, rings and skirts, etc.) for multi-axial type loading, materials to be compatible with piping and strength to be adequate for all expected loads.

.8 Coordinate with Division 9 to permit pipe to be continuously painted at hanger.

3.8 INSULATION SHIELDS

.1 Refer to representative drawing details for saddles to be installed with insulated piping.

.2 Provide saddles for insulated piping as detailed; to fit tight to circumference of cladding. Exposed edges are not acceptable.

.3 Provide high density insulation blocks at each pipe saddle to avoid compressing pipe insulation at support.

3.9 ATTACHMENT TO BUILDING STRUCTURE

.1 Spacing, location and loading of individual attachments and all piping system attachments not to exceed capacity of structure. Contractor's pipe support designer to review design load of structure with respect to load induced by pipe support systems.

.2 Attachments to concrete floor to be at least 400 mm from edge of slab.

.3 Attachments to concrete floor to be cast-in-place inserts or expansion studs and anchors. Explosive actuated fasteners not permitted.

.4 Attachments to composite metal roof deck not to interfere with composite behaviour of roof deck structure.

.5 Attachments to metal roof deck not permitted.

.6 Locate connections to open web steel joists at panel points.

.7 Attachments to steel structure to be bolted type connections.

.8 Attachments to open web steel joists to be at panel points.

.9 Beam attachments to provide concentric support on both sides of beam (C-clamp type supports are not permitted).

.10 Maximum loads on attachments to concrete not to exceed one-fifth of the ultimate strength of the attachment as determined by manufacturer's tests. Install attachments in accordance with manufacturer's requirements.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the installation procedures, material specifications, worker qualifications and testing/inspection requirements for the welding of all steel piping.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of the project tender date.'

- .1 American National Standards Institute (ANSI):
  - .1 ANSI B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.
  - .2 ANSI B16.11 – Forged Fittings, Socket Welding and Threaded.
  - .3 ANSI B16.25 – Butt Welding Ends.
- .2 American Society of Mechanical Engineers (ASME):
  - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Rules for Construction of Pressure Vessels.
  - .2 ASME BPVC Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators.
  - .3 ASME BPVC Section V, Non-destructive Examination.
  - .4 ASME B31.3, Process Piping.
- .3 American Society of Non-destructive Testing (ASNT):
  - .1 SNT-TC-14 Personnel Qualification and Certification in Non-destructive Testing.
- .4 American Welding Society (AWS):
  - .1 AWS QC1 Standard for AWS Certification of Welding Inspectors.
- .5 Canadian Standards Association (CSA):
  - .1 CSA W178.1 Welding Inspection Organizations Company Certification.
  - .2 CSA W178.2 Welding Inspector Certification.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15.

.2 Quality Control Submittals:

- .1 Submit certified welding procedures to be used for specified welds. Procedures to be certified in accordance with ASME B31.3 and BPVC Section IX.
- .2 Provide manufacturer's record of certification for all materials to be used for welding.
- .3 Provide records of certification and qualifications for the following:
  - .1 Welders and Welding Operators.
  - .2 Weld Inspectors.
  - .3 Weld Inspection and Testing Agency.
- .4 Provide approved non-destructive inspection and testing procedures to be in accordance with ASME B31.3 and BPVC Section V.
- .5 Submit certified inspection and test reports to Consultant for review.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Not applicable.

1.6 QUALITY ASSURANCE

.1 Welding installations to ASME B31.3.

.2 Welder to mark each weld with personal steel pencil for individual work identification. Mark each joint with stencil before radiographs are taken.

.3 Provide services of independent inspection and testing agency for welding operations.

.4 Welder and welding operator qualifications:

- .1 Welders to be qualified in accordance with ASME B31.3 and BPVC Section IX, Article III. Welder's certification of qualification not to be older than six (6) months and to be on file at work site.
- .2 Welders to be certified for position and materials required.
- .3 Welders to be certified for a minimum of twelve (12) months prior to work being completed on site.

.5 Inspection qualifications:

- .1 Welding inspector to be certified by one of the following governing bodies:
  - .1 AWS Certified, AWS QC 1 Qualified.
  - .2 CSA Certified to CSA W178.2.
- .2 Welding inspector to have prior inspection experience of specified welds.

.6 Independent inspection and Testing Agency qualifications:

- .1 Inspection and Testing Agency to be certified in accordance with:
  - .1 CSA W178.1.
  - .2 ASNT SNT-TC-14.
- .2 All testing and inspection personnel to be qualified and all equipment to be used is to be calibrated and in good working order.
- .3 Inspection and Testing Agency to have a minimum of the (10) years experience in the field of pipe welding.

1.7 COMMISSIONING

.1 Not applicable.

1.8 TRAINING

.1 Not applicable.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 PIPE FITTINGS

.1 Steel butt weld fittings: to ANSI B16.9.

.2 Steel socket weld fittings: to ANSI B16.11.

2.2 ELECTRODES

.1 Weld electrodes: in accordance with ASME B31.3 and BPVC Section II, Part C.

PART 3 - EXECUTION

3.1 WELDING REQUIREMENTS

.1 Provide welding by machine or manual shielded metallic arc process. Use direct current exclusively with base material on negative side of the line. Provide all position rod type electrodes suitable for the application.

.2 Details of welding technique and procedures, such as number of beads and passes, angle of surfaces to be welded, weld gap at base, electrode diameter, and average current values, are subject to review by Consultant or other representative.

.3 Equip welders working close to flammable materials with fire extinguishers. Observe necessary fire prevention precautions such as shields to avoid fire hazards.

.4 Welding to be performed in accordance with ASME B31.3.

3.2 PREPARATION FOR WELDING

.1 Use only piping with machine beveled ends to ANSI B16.25 for welded runs. If machining is impractical, prepare ends by grinding or flame cutting and by subsequent grinding back 3 mm prior to welding. Clean each joint internally and ensure ends are free from scale, surface cracks, oil, grease, oxides or other foreign matter before connecting to system. Ensure stainless steel wire brushes or stainless steel wool is used for cleaning of stainless steel joints.

.2 Fit backing rings accurately and weld to upstream interior of pipe. Remove weld slag and splatter prior to assembling pipe. Provide backing rings of suitable material for pipe, split or solid type.

.3 Align ends of pipe-to-pipe, pipe-to-fittings, expansion joint or valve, and fitting-to-valve joints as accurately as is practical within existing commercial tolerance on pipe diameters, wall thickness and out-of-roundness. Alignment to provide most favourable condition for deposition of root bead. Ensure root gap is as per the qualified welding procedure. Preserve alignment during welding.

.4 After ends are properly spaced and aligned, hold in position by us of a temporary bar or clamp. Tack welds to be of same quality and same procedure as completed weld, performed by a qualified welder.

.5 Make welds full penetration, continuous and without defects, as per the qualified welding procedure. Clean each layer of weld to remove slag and scale, using appropriate materials for the joint. Chip where necessary to prepare for proper deposition of next layer.

3.3 WELDING INSPECTION

.1 Make work available at any time for inspection by Consultant. Cover or insulate welds only after inspection is carried out to the satisfaction of the Consultant and the Testing Agency.

.2 The extent and methodology of weld examination is to be as per ASME B31.3, which requires the following at a minimum:

- .1 Visual examination of sufficient materials and components, selected at random, to satisfy the examiner that they conform to specifications and are free from defects.
- .2 Visual examination of at least 5% of fabrication. For welds, each welder's and welding operator's work to be represented.
- .3 Not less than 5% of all welds to be fully examined by random radiographic testing or ultrasonic examination. Welds to be selected to ensure that work product of each welder or welding operator is included

.3 Visual inspection and non-destructive testing results to be interpreted in accordance with AWS and ASME B31.3. Weld acceptance criteria as per ASME B31.3. Any of the following could cause rejection of the weld:

- .1 Failure to meet radiographic requirements or other code tests.
- .2 Welding performed by unqualified personnel.
- .3 Welds not reasonably uniform in appearance.
- .4 Evidence of peening.
- .5 Cracks.
- .6 Oxidation around welds.
- .7 Lack of fusion.
- .8 Presence of porosity, slag, inclusion of overlaps.
- .9 Undercutting adjacent to completed welds or evidence of undercutting by grinding.

.4 Cut out and replace welds of poor or doubtful quality with satisfactory welds. Re-examination or testing will be at the Contractor's cost.

.5 Refer to Section 15030 for hydrostatic testing requirements.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESRIPTION SUMMARY

.1 All new and/or modified piping systems to be cleaned and flushed in accordance with this section.

.2 In addition, all potable water systems to be disinfected to the requirements herein.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 Ontario Provincial Standard Specifications. (OPSS).
- .2 American Water Works Association (AWWA):
  - .1 AWWA Standard C651 – Disinfection of Water Mains
  - .2 AWWA Standard C652 – Disinfection of Water Storage Facilities.
  - .3 AWWA Standard C653 – Disinfection of Water Treatment Plants.
- .3 Ontario Building Code (OBC).
- .4 Chlorine Institute (CI):
  - .1 Chlorine Institute: Pamphlet 6, Piping Systems for Dry Chlorine.

1.3 INFORMATION SUBMITTALS

.1 Submit all disinfection procedures.

.2 Submit documented results of disinfection and chemical cleaning.

.3 Record flushing and cleaning procedure and data in a form similar to that in Appendix “A”, Section 15030.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 Not Applicable

1.6 QUALITY ASSURANCE

.1 The disinfection of potable water systems to be in accordance with OPSS and AWWA guidelines.

PART 2 - PRODUCTS

2.1 FLUSHING WATER

.1 In addition to municipal water, two water systems are available at the plant including Effluent (plant) water and separated water. Effluent water is treated plant flow taken from downstream of disinfection; this water is used for flushing and initial washdown and may contain contaminants such as E-coli. Separated water is municipal water downstream of a backflow preventer. Although generally clean, there is some risk that it may be contaminated by a process connection for example.

2.2 WATER SYSTEMS

.1 Potable Water: clean and flush with potable water per OBC. Disinfect in accordance with documented OPS and/or AWWA C651 for potable water. Submit procedures.

.2 Separated Water: clean and flush with separated water. Disinfect in accordance with documented OPSS and/or AWWA C651. Submit procedures.

.3 Effluent Water: clean and flush with separated water.

2.3 PROCESS AIR

.1 Flush with separated water. Blow dry with air prior to connection to diffusers and blower.

2.4 GAS LINES

.1 Blow clean with air.

2.5 CHEMICAL LINES

.1 Flush with separated water. Blow dry with air and confirm system is dry prior to adding chemical.

2.6 SLUDGE LINES

.1 Flush with Plant Effluent Water.

PART 3 - EXECUTION

3.1 CLEANING AND FLUSHING OPERATION

.1 General:

.1 Unless indicated otherwise, systematically clean and flush piping by isolating branches and forcing high velocity flow (greater than 2.0 m/s) through a limited number of branches at any one time.

.2 Flushing of piping at high velocity may be replaced with pigging and then flushing at a velocity greater than 1.0 m/s.

.3 For cleaning requirements, the Contractor is to assume that all pipes to be flushed and cleaned are full of debris, sediment and/or sludge/scum. It is the Contractor's responsibility to ensure that pipes and tanks are cleaned and that the solids flushed are disposed of appropriately.

.2 Separated Water Systems:

.1 After completing tests, replacement and repairs, flush each branch in water systems thoroughly with separated water for 15 minutes to remove sediment.

.2 Systematically flush individual branches from main to discharge point.

.3 Clean any strainers and reinstall in piping system. Replace any "construction" strainers with specified strainers.

.4 Disinfect "non-potable" water system in accordance with AWWA and OBC requirements for potable water.

.5 Refill system immediately after flushing operation.

.3 Process Lines:

.1 Following successful testing, pass a foam pig through each line and then flush systems with effluent water at a rate of 2.0 m/s.

.2 Pig and flush piping prior to connecting pumps and accessories.

.4 Water lines

.1 Supply all materials, equipment and labour required to carry out the disinfection.

.2 Give the Consultant at least one week notice of the date of chlorination of the pipes.

.3 After completing tests, replacement and repairs prior to disinfection of the work, thoroughly clean all pipelines by means of hose streams, brushes and other means as may be required for the successful removal of all the foreign material using municipal water for a minimum of 15 minutes to remove sediment. Clean all oil, grease and other such material not removed with water. Use appropriate solvents in such a manner as not to injure the concrete or other materials. Use materials that will not impart taste and odour to potable water.

.4 Systematically flush individual branches from main to discharge point. Flush pipelines with potable water until a turbidity free water is obtained at all ends.

.5 Clean any strainers and reinstall in piping system. Replace any "construction" strainers with specified strainers.

.6 The continuous feed method shall be used, in accordance with AWWA Standard-C651, with the following exceptions:

.1 The chlorine concentration in the water throughout the length of the pipe is maintained at a minimum strength of 50 mg/L. The chlorine solution to be used shall be Javex or a similar concentrated solution of known strength.

.2 All surfaces shall be in contact for a period of at least 24 hours with a chlorine solution having a starting strength of 50 mg/L available chlorine. Following the 24-hour period, no less than 25 mg/L shall remain in the pipe.

.7 The taking of samples and testing for chlorine residual will be carried out by the General Contractor.

.8 Contractor to safely dispose of all chlorinated water used for testing, flushing, or disinfection. The acceptable chlorine residual of water discharged to water courses shall not be greater than 0.02 mg/L.

.9 Following final flushing, fill the pipelines with potable water from the system supply and allow to stand for 24 hours. Samples will be forwarded to a Ministry of Health laboratory for bacteriological tests. Water line may only be placed in service once acceptable test results are returned from the Ministry of Health laboratory.

.5 Water Tanks

.1 Disinfection: Disinfect by chlorination in accordance with AWWA-C652 and AWWA-C653. Procedure to be submitted to Consultant for approval prior to commencement.

.2 Water used for disinfection shall be fully de-chlorinated prior to disposal.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Provide, test, and commission process valves complete with all noted accessories and actuators. The following specification is to be read in conjunction with the Valve Schedule, Valve Data Sheets and the Contract Drawings.

.2 Valves, operators and accessories shall be installed as shown on the Drawings and Specifications.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of the tender date.

.1 American Water Works Association (AWWA):

.1 AWWA C500, Metal Seated Gate Valves for Water Supply Service.
.2 AWWA C504, Rubber Seated Butterfly Valves.
.3 AWWA C508, Swing Check Valves for Waterworks Service 2” through 24” NPS.
.4 AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
.5 AWWA C512, Air-Release, Air/Vacuum and Combination Air Valves for Waterworks Services.
.6 AWWA C517, Resilient-Seated Cast-Iron Eccentric Plug Valves.
.7 AWWA C540, Power Acting Devices for Valves and Sluice Gates.
.8 AWWA C550, Protective Interior Coatings for Valves and Hydrants.
.9 AWWA C606, Grooved and Shouldered Joints.

.2 American Society of Mechanical Engineers (ASME):

.1 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
.2 ASME B16.5 - Pipe Flanges and Flanged Fittings.
.3 ASME B16.104 - Control Valve Seat Leaking.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A48 - Standard Specification for Gray Iron Castings.
.2 ASTM A126 - Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
.3 ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
.4 ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.
.5 ASTM B124/B124M - Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.
.6 ASTM A536 - Standard Specification for Ductile Iron Castings.
.7 ASTM A582/A582M-12e1 - Standard Specification for Free-Machining Stainless Steel Bars.
.8 ASTM A743/A743M-13ae1 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
.9 ASTM B16/B16M - Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
.10 ASTM B127 - Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet and Strip.
.11 ASTM B283/B283-14a - Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).

.12 ASTM B584-14 - Standard Specification for Copper Alloy Sand Castings for General Applications.
.13 ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride (PVC) Compounds and Chlorinated Ploy (Vinyl Chloride) (CPVC) Compounds.
.14 ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
.15 ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

.4 Canadian Gas Advisory Council (CGA):
.1 CGA 311-M88 (R2014) - Lever Operated Pressure Lubricated Plug Type Gas Shut-Off Valves.

.5 Canadian Standards Association (CSA):
.1 CSA B149.6 - Code for Digester Gas, Landfill Gas, and Biogas Generation and Utilization.

.6 Manufacturer's Standardization Society (MSS):
.1 MSS SP 61, Pressure Testing of Valves.
.2 MSS SP 81, Stainless Steel or Stainless Steel Lined, Bonnetless Knife Gate Valves with Flanged Ends.
.3 MSS SP 110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

.7 National Sanitation Foundation (NSF) International:
.1 NSF/ANSI 61 - Drinking Water System Components – Health Effects.
.2 NSF/ANSI 61-372 - Drinking Water System Components – Lead Content.

.8 Occupational Health and Safety Act (OSHA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS, including Valve Accessories.
.1 Product Data:
.1 Material of construction for all valve components illustrating compliance with the Valve Data Sheet, the Specification and relevant reference standards.
.2 Include information demonstrating that the valve and all its wetted components are chemically compatible with the proposed service fluid.
.3 Valve head loss and CV values.
.4 Factory and field test results where required. Provide certified hydrostatic test results in accordance with manufacturer's standard procedures or MSS SP-61.
.5 AWWA Certification Documentation where applicable.
.2 Operations and Maintenance Data:
.1 Operation and Maintenance Manuals – refer to Division 1 for requirements. Provide one Operation and Maintenance Manual for each type of valve and operation supplied.
.2 Installation Requirements/Recommendations.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed valves.

1.6 QUALITY ASSURANCE

.1 Ensure that the supplied valves comply with the referenced standards noted in the Specifications and the Valve Data Sheets.

.2 All valves of the same type shall be from a single manufacturer.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Provide training for each type of actuator.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

.2 Electric actuators to carry a two-year warranty.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Include all valves indicated in the process valve schedule, process and instrumentation drawings (P&ID's), flow diagrams, or as noted in the contract drawings. A valve indicated on any one drawing is to be considered part of the Contract whether indicated on a corresponding plan, elevation, flow diagram or not. Generally, unless indicated otherwise, valves shown on the Mechanical Instrumentation Drawings (MID's) and the mechanical M drawings are not covered under this section.

.2 Generally, manual valves 50 mm in diameter and smaller are not scheduled.

.3 Alternate valves may be considered if demonstrated to be technically equal and there is a cost

savings to the Owner. Alternates must be approved by Consultant prior to fabrication or ordering materials. Refer to Division 1.

.4 Unless otherwise indicated, all valves to have a 1035 kPa pressure rating.

.5 Unless specifically noted otherwise, valves to have the same nominal diameter and joining strategy as the connecting pipes and/or equipment.

.6 Provide all required appurtenances to ensure compatibility with valve and adjoining pipe and/or equipment.

.7 Factory mount operator, actuator and accessories. Coordinate actuator, operator and accessory orientation with site conditions, ensuring all controls and operators are accessed to the satisfaction of the Engineer. This includes but is not limited to on-site adjustments and modifications to the actuator, operator and accessory orientation to suit access to controls.

.8 Unless otherwise indicated, valves to have clockwise opening operation.

2.2 MANUAL ACTUATORS

.1 General:
- .1 Refer to the Valve Schedule and Valve Data Sheets for additional requirements.
- .2 Operator rim pull is not to exceed 36 kg (356 N) on handwheel and chain wheels. Maximum input of 17 nm on square nut.
- .3 Provide valve position indications on the actuator.
- .4 Provide actuators with combination 50 mm square nut and hand wheel for socket operation.
- .5 Actuators shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. All actuators will be designed to fully close the disc for full seating.
- .6 The manufacturer shall factory mount and test all actuators. Valve and actuator to be supplied as a single unit.
- .7 Unless otherwise noted, valves to open in the counterclockwise direction.

.2 Lever Type Actuator:
- .1 Lever actuator to be used on quarter turn valves, as noted in the Valve Schedule and Valve Data Sheets.
- .2 Lever actuators not to be used on valves over 150 mm.
- .3 Lever actuator to be infinitely adjustable and lockable.
- .4 Lever actuator shall be fabricated of ASTM A536 Ductile Iron.

.3 Gear Type Actuators:
- .1 Gear type actuators complete with handwheel to be used on quarter turn valves not meeting the lever actuator requirements.
- .2 Fully enclosed scotch yoke type and worm gear type mechanisms permitted.
- .3 Scotch yoke type actuator (travelling nut):
  - .1 Actuator housing to be fully sealed and enclosed and constructed of ASTM A126 Cast Iron.
  - .2 Provide hardened steel gears with bronze pinion shaft operating in bronze bearings. Gear ratios shall not be less than AWWA C500, Table 7.

.4 Worm gear type actuator:
- .1 Actuator housing to be fully sealed and constructed of ASTM A536 Ductile Iron.
- .2 Ductile iron or bronze worm gear.

.5 Actuator to be painted to match associated valve.

.6 Actuator to have adjustable travel stop.

2.3 ELECTRIC ACTUATORS

.1 Linear Valves:
- .1 Provide electric actuators as indicated on the drawings and in the schedules. Actuators to be selected to suit the application and operating conditions. Actuator to be factory mounted and tested by the valve or actuator supplier. Actuators for existing valves to be selected by actuator supplier and mounted on site. Actuator supplier to provide mounting adaptors, installation supervision, start up and commissioning.
- .2 General: 575/3/60 power supply, or 120/1/60 as indicated on the contract drawings, integral reversing starter, local control facilities and terminals for remote control and indication; connections housed within a self-contained, sealed enclosure.
- .3 Actuator sizing: sized for valve closure at the required differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. Operating speed for linear valves approximately 10-12 inches per minute.
- .4 Suitable for indoor and outdoor use. Ambient temperature ranging from -30°C to 70°C, up to 95% relative humidity. Refer to schedules and drawings for actuators in hazardous areas and required ratings.
- .5 Enclosure: O-ring sealed, watertight to CSA 4, and IP68 with plug and socket watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator. All external fasteners shall be stainless steel. The use of unprotected stainless steel fasteners in aluminum alloy casings is not permitted.
- .6 Motor: Class F insulated, with a time rating of at least 15 minutes at 40°C or twice the valve stroking time, whichever is the longer, at an average load of at least 33% of maximum valve torque. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case.
- .7 Protection shall be provided for motors as follows:
  - .1 The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.
  - .2 Motor temperature shall be sensed by a thermostat de-energizing the motor in case of overheating.
  - .3 Lost phase protection.
- .8 Gearing: A grease filled gear case suitable for operation at any angle; metal construction. For rising spindle valves, the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator, and include grease nipple for bearing lubrication. Permit the opening of the gear case for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

.9 Hand Operation: Handwheel to be engaged when the motor is declutched, drive restored to power automatically by starting the motor. The handwheel or selection lever shall not move on restoration of motor drive. The hand/auto selection lever to be lockable in both hand and auto positions. The handwheel drive must be mechanically independent of the motor drive and any handwheel gearing should be such as to permit emergency manual operation in a reasonable time.

.10 Monitoring: Torque and turns limitation to be adjustable as follows:

.1 Position setting range 2.5 to 100,000 turns, with resolution to 15 degrees of actuator output.

.2 Torque setting: 40% to 100% rated torque.

"Latching" to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads. Include a diagnostic module, which will store and enable download of historical actuator operation and torque data to permit analysis of actuator and valve in-service performance.

Five contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form.

The contacts shall be rated at 5A, 250VAC, 30VDC.

Any of the five above-noted contacts shall be selectable to signal one of the following:

.1 Valve opening, closing or moving.

.2 Thermostat tripped, lost phase.

.3 Motor tripped on torque in mid travel, motor stalled.

.4 Remote selected.

.5 Actuator being operated manually

The actuator shall include a position indicator. Red, green and yellow lights corresponding to Open, Closed and Intermediate position shall be included on the indicator. End of travel indication colours shall be reversible. The display shall incorporate valve, actuator and control status indication.

.11 .Electrical/Controls:

.1 Reversing starter, control transformer and local controls shall be integral with the valve actuator suitable for 60 starts per hour and controls supply transformer fed from the incoming three phases and overload protection.

.2 Local controls for Open, Close and Stop and a Local/ Stop/ Remote mode selector switch lockable in any one of the three positions. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

.3 The necessary wiring and terminals shall be provided in the actuator for the following control functions:

.1 Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.

.2 Remote controls fed from an internal 24VDC supply and/or from an external supply between 20V and 120VAC or 20V and 60VDC, to be suitable for any one or more of the following methods of control:

.1 Open, Close and Stop control.

.2 Open and Close maintained or "push to run" (inching) control.

.3 Overriding Emergency Shutdown to Close (or Open) valve from a normally closed or open contact.

.4 Two-wire control, energize to close (or open), de-energize to open (or close). Reversible valve travel without the necessity of stopping the actuator.

.12 DeviceNet: Actuator to be DeviceNet compatible without the use of adaptors, converters or gateways and capable of operating DeviceNet at 500kbs or better. Provide DeviceNet EDS files for each type of valve. Within 90 days of contract award provide a sample of each type of actuator for use by Systems Integrator. Sample will be returned following successful testing and set-up.

.13 Valve and actuator representative to visit site to commission actuators, provide signoff sheets that confirm the start of two year warranty and train staff.

.14 Specified Manufacturer: Auma.

.15 Alternate Manufacturers:

.1 Rotork.

.2 Limitorque.

.2 Quarter Turn Valves:

.1 Provide electric actuators as indicated on the drawings and in the schedules. Actuators to be selected by valve manufacturer to suit the application and operating conditions. Actuator to be factory mounted and tested by the valve or actuator manufacturer.

.2 Suitable for single-phase or three-phase as indicated on electrical drawings. Incorporate motor, integral reversing starter, local control facilities, and terminals for remote control and indication connections.

.3 Sized for valve closure at the required differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure that the torque switch trips at a maximum valve torque with the supply voltage 10% below nominal. Operating time to be selected to prevent hammer blow.

.4 Suitable for indoor or outdoor use. The actuator shall be capable of functioning in an ambient temperature of -30°C to 70°C. CSA 4 and 6P, with plug and socket terminal connections.

.5 Motor shall be Class “F” insulated and will be of a suitable time rating to ensure three successive open/close/open cycles; provide thermal protection device.

.6 Primary drive through spur gears. Main actuator output drive to be steel wormshaft driving an aluminum/ bronze wormwheel grease lubricated. Gear ratio shall ensure “self-locking” characteristics and inhibit “backdriving”.

.7 Handwheel for manual operation.

.8 Disconnect the motor starter at a predetermined torque. The torque setting shall have a minimum turndown ratio of 3:1. Provide one travel limit switch per direction of travel and two additional limit or intermediate position switches.

.9 Mechanical dial position indicator to provide remote position indicator.

.10 The actuator starter, control transformer, and all control devices shall be integral with the valve actuator. Jammed valve motor protection to prevent the motor from overheating in the event of stalling against a jammed valve.

.11 Provide open/stop/close control and remote/local control of the actuator at the valve.

.12 DeviceNet: Actuator to be DeviceNet compatible without the use of adaptors, converters or gateways and capable of operating DeviceNet at 500kbs or better. Provide DeviceNet EDS files for each type of valve. Within 90 days of contract award provide a sample of each type of actuator for use by Systems Integrator. Sample will be returned following successful testing and set-up.

.13 Provide:

.1 Phase correction device capable of automatically correcting the phase relationship of a three-phase supply.

.2 Two interposing relays suitable for remote control.

.3 A monitor relay having volt-free contacts available (one normally open and one normally closed).

.14 Wiring and Terminals:
- .1 Valve opening; and
- .2 Valve closing.
- .3 Compartment shall be separated from the inner electrical compartment of the actuator by means of a watertight seal. The terminal compartment of the actuator by means of a plug and socket watertight seal, Plan of terminals shall be provided and attached to the inside of the terminal box cover.

.15 Actuators shall be ‘o’ ring sealed, watertight, and dustproof to IP68/NEMA 6 minimum standard. Inner watertight and dustproof ‘o’ ring seal via plug and socket between the terminal compartment and the internal electrical elements of the actuator.

.16 Specified Manufacturers: Auma.

.17 Alternate Manufacturers:
- .1 Rotork.
- .2 Limitorque.

.3 Plastic Ball Valve Actuators:
- .1 Provide where indicated on drawings and in the Valve Schedule.
- .2 Electric 120 V NEMA 4x actuator with permanently lubricated gear train.
- .3 Actuator to have a manual override with fail safe option and integral motor protection to de-energize motor when travel limits have been reached.
- .4 Discrete position feedback for open/close position.
- .5 For discrete application, accept open and closed commands.
- .6 For modulating applications, provide 4-20 mA input and output signals.
- .7 Specified Product: Chemline V Series.
- .8 Alternate Manufacturers:
  - .1 Georg Fisher.

2.4 VALVE ACCESSORIES

.1 Chain Wheels:
- .1 Provide guided chain with galvanized or stainless steel coil proof chain. Chain to be selected by valve manufacturer.
- .2 Chain wheels to be adjustable and detachable.
- .3 Chains to be complete with hooks and tie back anchors. Install chains so as not to impeded path of egress.
- .4 Standard of Acceptance: Dezurik CW

.2 Floor Box:
- .1 For use with non rising 50mm square nut style actuators and provided with a cover.
- .2 Body: Stainless Steel or cast iron.
- .3 Cover: Stainless Steel or cast iron.
- .4 Specified Product: Clow F-5695-T.
- .5 Alternate Manufacturers:
  - .1 Approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

.1 Install valves in accordance with:
- .1 The valve manufacturer's written instructions.
- .2 The connecting pipe manufacturer's written instructions.

.2 All valves to be located such that they are accessible.

.3 Valves/pipes to be supported such that there are no pipe loads transferred to the valve.

.4 Provide chainwheel actuators on all valves located at least 2 m above the finished floor. Refer also to valve data sheets. Provide 304 or 316 stainless steel tie backs where chain would otherwise interfere with normal operator travel.

.5 Pressure testing of valves to be performed in conjunction with Pressure Testing Requirements of the adjoining process pipe. Refer to Section 15030 for additional requirements.

3.2 SUPPLEMENTS

.1 The Valve Schedule is included as part of this section. It is intended to serve as a guide to the type and size of valve required. Where a valve is indicated on the drawings, but not listed herein, select a valve to match a similar service listed herein. Not all small valves such as drains or instrument isolation are listed, valves not listed must be provided as specified elsewhere. Valves clearly indicated on the drawings are not listed here or specified elsewhere to be assumed as new and similar to a valve with a similar function.

The following Data Sheets are included as part of this section.

.1 Plug Valves:
- .1 Eccentric Plug Valves: Data Sheet 15100-A.
- .2 Three-way Plug Valves: Data Sheet 15100-A1.

.2 Gate Valves:
- .1 Wedge Gate Valve: Data Sheet 15100-B3.

.3 Butterfly Valves:
- .1 AWWA Butterfly Valves: Data Sheet 15100-C.
- .2 Non-AWWA Butterfly Valves: Data Sheet 15100-C2.

.4 Ball Valves:
- .1 Regular Service Ball Valves: Data Sheet 15100-D.
- .2 Plastic PVC Ball Valves: Data Sheet 15100-D3.
- .3 Characteristic Ball Valve: Data Sheet 15100-D4.
- .4 PVC Double Containment Ball Valve 15100-D5

.5 Check Valves:
- .1 Swing Check Valves: Data Sheet 15100-E.
- .2 Ball Check Valves: Data Sheet 15100-E1.
- .3 PVC Check Valves: Data Sheet 15100-E3.

.6 Air Release Valves:

.1 Air Release Valve (Sewage): Data Sheet 15100-G1.

.7 Solenoid Valves:

.1 Slow Closing Solenoid Valves: Data Sheet 15100-I.

.2 Fast Closing Solenoid Valves: Data Sheet 15100-I1.

.8 Relief Valves:

.1 PVC Pressure Relief Valves: Data Sheet 15100-J1.

END OF SECTION

BRIGHTON WASTEWATER TREATMENT
SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO
JLR No.: 32296-001

PROCESS MANUAL VALVE SCHEDULE

SECTION: 15100A

SHEET 1 OF 2

I.D.	DESCRIPTION	TYPE	FLOW	OPERATION					Kv	COMMENTS
			L/s	OPERATOR	SIZE mm	LINE SIZE mm	FLUID	NORMAL POSITION		
VAR 7301	DECANT PUMP STATION AIR RELEASE VALVE	G1		N/A	25	25	RAW SEWAGE	N/A		
VC 1101	RAW SEWAGE PUMP NO.1 DISCHARGE CHECK VALVE	E1		SWING ARM	300	300	RAW SEWAGE	N/A		
VC 1102	RAW SEWAGE PUMP NO.2 DISCHARGE CHECK VALVE	E1		SWING ARM	300	300	RAW SEWAGE	N/A		
VC 1103	RAW SEWAGE PUMP NO.3 DISCHARGE CHECK VALVE	E1		SWING ARM	350	350	RAW SEWAGE	N/A		
VC 1104	RAW SEWAGE PUMP NO.4 DISCHARGE CHECK VALVE	E1		SWING ARM	350	350	RAW SEWAGE	N/A		
VC 5101	SLUDGE PUMP NO.1 DISCHARGE CHECK VALVE	E1		BALL CHECK	150	150	SLUDGE	N/A		
VC 5102	SLUDGE PUMP NO.2 DISCHARGE CHECK VALVE	E1		BALL CHECK	150	150	SLUDGE	N/A		
VC 5103	SLUDGE PUMP NO.3 DISCHARGE CHECK VALVE	E1		BALL CHECK	150	150	SLUDGE	N/A		
VC 5104	SLUDGE PUMP NO.4 DISCHARGE CHECK VALVE	E1		BALL CHECK	150	150	SLUDGE	N/A		
VC 7101	FERRIC CHLORIDE FILL CHECK VALVE	E3		BALL CHECK	75	75	FERRIC CHLORIDE	N/A		
VC 7301	DECANT PUMP NO.1 DISCHARGE CHECK VALVE	E1		SWING ARM	100	100	RAW SEWAGE	N/A		
VC 7302	DECANT PUMP NO2 DISCHARGE CHECK VALVE	E1		SWING ARM	100	100	RAW SEWAGE	N/A		
VF 1101	RAW SEWAGE PUMP NO.1 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	300	300	RAW SEWAGE	OPEN		
VF 1102	RAW SEWAGE PUMP NO.2 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	300	300	RAW SEWAGE	OPEN		
VF 1103	RAW SEWAGE PUMP NO.3 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	350	350	RAW SEWAGE	OPEN		
VF 1104	RAW SEWAGE PUMP NO.4 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	350	350	RAW SEWAGE	OPEN		
VF 1105	RAW SEWAGE FLOW METER ISOLATION VALVE 1	A		HANDWHEEL	400	400	RAW SEWAGE	OPEN		
VF 1106	RAW SEWAGE FLOW METER ISOLATION VALVE 2	A		HANDWHEEL	400	400	RAW SEWAGE	OPEN		
VF 1107	RAW SEWAGE FLOW METER ISOLATION VALVE 1	A		HANDWHEEL	450	450	RAW SEWAGE	OPEN		
VF 1108	RAW SEWAGE FLOW METER ISOLATION VALVE 2	A		HANDWHEEL	450	450	RAW SEWAGE	OPEN		
VF 3301	ROTARY AERATION BLOWER NO.1 INLET ISOLATION VALVE	C2		HANDWHEEL	300	300	PROCESS AIR	OPEN		
VF 3302	ROTARY AERATION BLOWER NO.2 INLET ISOLATION VALVE	C2		HANDWHEEL	300	300	PROCESS AIR	OPEN		
VF 3303	ROTARY AERATION BLOWER NO.1 DISCHARGE ISOLATION VALVE	C2		HANDWHEEL	300	300	PROCESS AIR	OPEN		
VF 3304	ROTARY AERATION BLOWER NO.2 DISCHARGE ISOLATION VALVE	C2		HANDWHEEL	300	300	PROCESS AIR	OPEN		
VF 3305	PROCESS AIR TO HEADWORKS CHANNEL ISOLATION VALVE	C2		LEVER	75	75	PROCESS AIR	OPEN		
VF 3306	PROCESS AIR TO INLET AERATION CHANNEL ISOLATION VALVE	C2		HANDWHEEL	350	350	PROCESS AIR	OPEN		
VF 3308	PROCESS AIR TO MIXED LIQUOR CHANNEL ISOLATION VALVE	C2		HANDWHEEL	100	100	PROCESS AIR	OPEN		
VF 3309	AERATION TANK NO.1 PROCESS AIR ISOLATION VALVE 1	C2		HANDWHEEL	200	200	PROCESS AIR	OPEN		
VF 3310	AERATION TANK NO.1 PROCESS AIR ISOLATION VALVE 2	C2		HANDWHEEL	200	200	PROCESS AIR	OPEN		
VF 3311	AERATION TANK NO.2 PROCESS AIR ISOLATION VALVE 1	C2		HANDWHEEL	200	200	PROCESS AIR	OPEN		
VF 3312	AERATION TANK NO.2 PROCESS AIR ISOLATION VALVE 2	C2		HANDWHEEL	200	200	PROCESS AIR	OPEN		
VF 4001	UV DISINFECTION CHANNEL NO.1 EFFLUENT WATER ISOLATION VALVE	B3		HANDWHEEL	200	200	EFFLUENT WATER	OPEN		EPOXY COATED, SUITABLE FOR DIRECT BURY APPLICATION.
VF 4002	UV DISINFECTION CHANNEL NO.2 EFFLUENT WATER ISOLATION VALVE	B3		HANDWHEEL	200	200	EFFLUENT WATER	CLOSED		EPOXY COATED, SUITABLE FOR DIRECT BURY APPLICATION.
VF 5101	CLARIFIER TANK NO.1 SLUDGE ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5102	CLARIFIER TANK NO.2 SLUDGE ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5103	CLARIFIER TANK NO.3 SLUDGE ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		

FIELD WORK NOTATION

M = MECHANICAL CONTRACTOR
E = ELECTRICAL CONTRACTOR
G = GENERAL CONTRACTOR

PLOT DATE: Tuesday, April 29, 2025 12:24:54 PM

BRIGHTON WASTEWATER TREATMENT
SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO
JLR No.: 32296-001

PROCESS MANUAL VALVE SCHEDULE

SECTION: 15100A

SHEET 2 OF 2

I.D.	DESCRIPTION	TYPE	FLOW	OPERATION					Kv	COMMENTS
				OPERATOR	SIZE	LINE SIZE	FLUID	NORMAL POSITION		
			L/s		mm	mm				
VF 5104	SLUDGE PUMP NO.1 TO SLUDGE PUMP NO.4 (SPARE) ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	CLOSED		
VF 5105	SLUDGE PUMP NO.2 TO SLUDGE PUMP NO.4 (SPARE) ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	CLOSED		
VF 5106	SLUDGE PUMP NO.3 TO SLUDGE PUMP NO.4 (SPARE) ISOLATION VAVLE	A		HANDWHEEL	150	150	SLUDGE	CLOSED		
VF 5107	SLUDGE PUMP NO.1 SUCTION ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5108	SLUDGE PUMP NO.2 SUCTION ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5109	SLUDGE PUMP NO.3 SUCTION ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5110	SLUDGE PUMP NO.4 SUCTION ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5111	SLUDGE PUMP NO.1 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5112	SLUDGE PUMP NO.2 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5113	SLUDGE PUMP NO.3 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5114	SLUDGE PUMP NO.4 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5115	SLUDGE PUMP NO.1 DISCHARGE ISOLATION VALVE 2	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5116	SLUDGE PUMP NO.2 DISCHARGE ISOLATION VALVE 2	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5117	SLUDGE PUMP NO.3 DISCHARGE ISOLATION VALVE 2	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5118	SLUDGE PUMP NO.4 DISCHARGE ISOLATION VALVE 2	A		HANDWHEEL	150	150	SLUDGE	OPEN		
VF 5123	AERATION TANK NO.1 RAS ISOALTION VALVE	A		SQUARE NUT	200	200	RAW SEWAGE	OPEN		PROVIDE STEM EXTENSION AND FLOOR BOX FOR 2" SQUARE NUT ACTUATOR.
VF 5124	AERATION TANK NO.2 RAS ISOLATION VALVE	A		SQUARE NUT	200	200	RAW SEWAGE	OPEN		PROVIDE STEM EXTENSION AND FLOOR BOX FOR 2" SQUARE NUT ACTUATOR.
VF 7101	FERRIC CHLORIDE FILL ISOLATION VALVE	D3		LEVER	75	75	FERRIC CHLORIDE	CLOSED		
VF 7102	FERRIC CHLORIDE STORAGE TANK NO.1 INLET ISOLATION VALVE	D3		LEVER	75	75	FERRIC CHLORIDE	OPEN		
VF 7103	FERRIC CHLORIDE STORAGE TANK NO.2 INLET ISOLATION VALVE	D3		LEVER	75	75	FERRIC CHLORIDE	OPEN		
VF 7104	DRAINAGE SUMP ISOLATION VALVE	B3		HANDWHEEL	100	100	FERRIC CHLORIDE	CLOSED		PROVIDE EPOXY COATING
VF 7301	DECANT PUMP NO.1 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	100	100	RAW SEWAGE	OPEN		
VF 7302	DECANT PUMP NO.2 DISCHARGE ISOLATION VALVE	A		HANDWHEEL	100	100	RAW SEWAGE	OPEN		
VF 7303	AERATED SOLIDS STABILIZATION CELL DECANT ISOLATION VALVE	A		HANDWHEEL	300	300	SUPERNATANT	CLOSED		
VPC 7101	FERRIC CHLORIDE PUMP NO.1 PRESSURE REGULATING VALVE	J1		N/A	15	15	FERRIC CHLORIDE	N/A		SEE DATASHEET
VPC 7102	FERRIC CHLORIDE PUMP NO.2 PRESSURE REGULATING VALVE	J1		N/A	15	15	FERRIC CHLORIDE	N/A		SEE DATASHEET
VPR 1101	RAW SEWAGE HEADER AIR RELEASE VALVE 1	G1		N/A	25	400	RAW SEWAGE	N/A		SEE DATASHEET
VPR 1102	RAW SEWAGE HEADER AIR RELEASE VALVE 2	G1		N/A	25	450	RAW SEWAGE	N/A		SEE DATASHEET
VPR 1103	RAW SEWAGE HEADER AIR RELEASE VALVE 3	G1		N/A	25	400	RAW SEWAGE	N/A		SEE DATASHEET
VPR 1104	RAW SEWAGE HEADER AIR RELEASE VALVE 4	G1		N/A	25	450	RAW SEWAGE	N/A		SEE DATASHEET
VPR 7101	FERRIC CHLORIDE PUMP NO.1 PRESSURE RELIEF VALVE	J1		N/A	15	15	FERRIC CHLORIDE	N/A		SEE DATASHEET
VPR 7102	FERRIC CHLORIDE PUMP NO.2 PRESSURE RELIEF VALVE	J1		N/A	15	15	FERRIC CHLORIDE	N/A		SEE DATASHEET
VTS 7301	WAS LAGOON TELESCOPING VALVE	L		HANDWHEEL	300	300	SUPERNATANT	CLOSED		TRAVEL DISTANCE 1500 MM

FIELD WORK NOTATION

M = MECHANICAL CONTRACTOR
E = ELECTRICAL CONTRACTOR
G = GENERAL CONTRACTOR

PLOT DATE: Tuesday, April 29, 2025 12:24:54 PM

General	Non-lubricated bubble tight bi-directional valve. Valve sizes per drawings and valve schedule. End Connections: Flanges: ASMEB16.1 Class 125 or Grooved in accordance with AWWA C606.
Code/Standard Compliance	AWWA C517 (latest edition)
Pressure/Temperature Rating	1210kPa for valves up to 300mm and 1035kPa for valves larger than 300mm. Temperature rating:-29-82 ºC
Body	ASTM A126 Class B Cast Iron or A536 Ductile Iron. All exposed bolts, washers, springs, and nuts to be stainless steel.
Plug	Full round or 100% rectangular port plug to be fabricated monolithically of cast or ductile iron. Plug facing to be chloroprene or Buna-N to AWWA C517 Standard.
Seat	Raised welded nickel plug seat.
Packing	Adjustable Buna-N chevron packing ring or “U” cup type. Packing to be easily accessible for inspection, adjustment, and/or replacement without removing the bonnet or removing the valve from service. Packing gland to be ASTM A126 Class B Cast Iron with stainless steel bolting hardware. Provide PTFE or Buna-N journal grit seals.
Bearings	Journal bearings shall be provided at each end of the plug. Fabricated of wetted oil impregnated ASTM A-743 stainless steel or ASTM B-127 bronze, to AWWA C517 standard
Coating	Exposed valves to be coated to Division 09900 and 15020 standards Epoxy coating required where indicated in the valve schedule External epoxy coating required for buried and/or submerged service. Epoxy coating to be two part epoxy spray, 8 mil thick, conforming to AWWA C550.
Manual Operator	Refer to valve schedule and specifications for additional requirements Valves less then 100mm to have infinitely adjustable lockable ASTM A536 ductile iron lever actuator. Valves 100mm and over to have totally enclosed worm gear actuator c/w hand wheel. Grease fittings required for each actuator bearing. Fully grease packed actuator bearings are acceptable.
Power Operators	Refer to valve schedule and specifications for requirements
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Dezurik PEF Plug Valve**
Approved Alternates	**Henry-Pratt Ballcentric Plug Valve** **Valmatic Series 5800R**
Application	Raw sewage, municipal wastewater sludge Where indicated on drawings and in the valve schedule.
Execution: • Install valve to manufacturer’s recommendations. • Plug valves to be installed with stem horizontal.	

General	Non-lubricated drip tight resilient seated tapered plug valve for changeover of services. Valve sizes per drawings and valve schedule. Flanges: ANSI/ASME B16.1 Class 150
Code/ Standard Compliance	AWWA C504
Pressure/Temperature Rating	Pressure (CWP): 1210kPa Temperature rating: -29 to 121 ºC
Body	ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron. All exposed bolts, washers, and nuts to be stainless steel.
Plug	Single style plug to allow straight through and 90º flow combinations. Plug to be fabricated monolithically of stainless steel or shall be ASTM A-536 Grade Ductile Iron. Plug facing to be Buna-N. Plug valve position indicator required.
Seat	Raised welded nickel or epoxy coated plug seats.
Packing	Adjustable Buna-N chevron packing ring or “U” cup type shaft seals. Packing to be easily accessible for inspection, adjustment, and/or replacement without removing the bonnet or removing the valve from service.
Bearings	Synthetic rubber bearings.
Coating	Exposed valves to be coated to Division 09900 and 15020 standards. Epoxy coating required where indicated in the valve schedule
Manual Operator	Refer to valve schedule and specifications for additional requirements . Single or double hand wheel actuation.
Power Operators	Refer to valve schedule and specifications for requirements
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Dezurik PTW Plug Valve**
Approved Alternates	**Henry-Pratt Multi-Port Plug Valve** **Valmatic 5500**
Application	Raw sewage, Municipal wastewater sludges, water. Where indicated on drawings and in the valve schedule.
Execution: • Install valve to manufacturer’s recommendations. • Plug valves to be installed with stems horizontal.	

END OF SECTION

General	Resilient wedge bi-directional valve. Valve sizes per drawings and valve schedule. Valve to be NSF 61 for potable water applications. Flanges: To ASME B16.1 Class 125
Code/Standard Compliance	AWWA C509 (latest edition) AWWA C515 (latest edition) NSF 61 for potable water.
Pressure/Temperature Rating	Pressure rating (CWP): 1725kPa Temperature rating: -29°C to 51°C
Body	ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron.
Bonnet	ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron.
Wedge	Synthetic rubber encapsulated ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron. Valve to be c/w visual disk position indicator.
Stem	Non rising stem design unless otherwise noted. ASTM B138 bronze construction.
Seals	Multiple stem rings of Buna-N rubber. Bonnet seal: Buna-N rubber. ASTM D2000 compliant.
Bearings	Guide Cap bearings.
Coating	Exposed valves to be painted to Division 09900 and 15020 standards. Epoxy coating/lining to be heat activated fusion bonded, 9 mil thick, conforming to AWWA C550.
Manual Operator	Refer to valve schedule and specifications for additional requirements. Provide 50mm square nut hand wheel and wrench. Valve actuators shall comply with AWWA C509.
Power Operators	Refer to valve schedule and specifications for requirements.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product(s)	**Mueller 2360 Series** **American Series 2500** **M&H C509**
Application	Water, Wastewater (liquid train), Unwatering. Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturer’s recommendations.
- Valves to be installed with stem oriented in the vertical upwards for raw sewage or high sediment liquids.

General	Bubble tight bi-directional resilient seated AWWA C504 compliant class 150B butterfly valve. Valve sizes per drawings and valve schedule. Flanges: Class 125 to ANSI B16.1.
Code/Standard Compliance	AWWA C504 (latest edition). NSF 61 and NSF 372 compliant for potable water applications.
Pressure/Temperature Rating	Pressure rating (CWP): 1050kPa. Temperature rating:-29 ºC to 100 ºC.
Body	ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron.
Disk	ASTM A48 Class 40C Cast Iron or ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron or ASTM A351 Stainless Steel. Disk seating edge to be constructed of ASTM A743 316 stainless steel. Valve to be c/w visual disk position indicator. Disk to be fastened to the shaft with torque screws or pins.
Shaft	Turned, ground, and polished type 304 or 316 stainless steel. 2 piece construction for valve sizes 450 mm and larger.
Seat	In body style seat of synthetic rubber seat. Seats may not be located on the disc or be retained by segments and/or screws. Compatible with chlorinated water.
Seals	Multiple self-compensating, Buna-N, chevron type packing rings. Packing to be independently secured to allow the removal of the operator under full line pressure.
Bearings	Permanently lubricated nylon or Teflon upper and lower journal shaft bearings.
Coating	Exposed valves to be painted to Division 09900 and 15020 standards. Epoxy coating required where indicated in the valve schedule. External epoxy coating required for buried and/or submerged service. Epoxy coating to be two part epoxy spray, 8 mil thick, conforming to AWWA C550.
Manual Operator	Refer to valve schedule and specifications for additional requirements. Gas Service: valves less than or equal to 150 mm to have infinitely adjustable lockable ASTM A536 ductile iron level actuator. Valves larger than 150 mm to have manual gear operator. Liquid Service: valves less than 150 mm to have infinitely adjustable lockable ASTM A536 ductile iron lever actuator. Valves larger than or equal to 150 mm to have manual gear operator. Valve actuators shall comply with AWWA C504.
Power Operators	Refer to valve schedule and specifications for requirements.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID Drawings and Specification Section 15020 requirements.
Specified Product	Dezurik BAW Series Butterfly Valve
Approved Alternates	Henry-Pratt Model 2FII Crispin F47 – 474 L2
Application	Water, wastewater applications downstream of grit removal process. Where indicated on drawings and in the valve schedule.
Execution: • Install valve to manufacturer's recommendations. • Orient valves in piping to allow access to seat adjustment screws.	

General	Bubble tight to ASME 16.104 Class VI bi-directional resilient seated butterfly valve. Valve to be designed for both on/off and throttling control. Valve sizes per drawings and valve schedule. End connections: Grooved or Lugged to match ASME B16.5 Class 150 bolt pattern.
Code/Standard Compliance	NSF61 for potable water applications.
Pressure/Temperature Rating	Pressure rating: Valves 300 mm and under: 1210 kPa. Pressure rating: Valves 350 mm and larger: 1030 kPa. Temperature rating:-29ºC to 122ºC.
Body	ASTM A536 Ductile Iron or ASTM A126 Class B Cast Iron.
Disk	ASTM A536 nylon coated Ductile Iron. Valve to be complete with visual disk position indicator.
Shaft	Type 420 stainless steel. One piece shaft for sizes less than 350 mm. Through shaft or two piece construction for valve sizes 350 mm and larger.
Seat	EPDM seat.
Seals	Dual EPDM O-ring seals or Double U cup seal design.
Bearings	Permanently lubricated nylon or brass shaft bearings or acetal bushing.
Coating	Exposed valves to be coated to Division 09900 and 15020 standards. Epoxy coating required where indicated in the valve schedule. External epoxy coating required for buried and/or submerged service. Epoxy coating to be two part epoxy spray, 8 mil thick, conforming to AWWA C550. Interior and exterior polyester coating is acceptable.
Manual Operator	Refer to valve schedule and specifications for additional requirements. Gas Service: valves less than or equal to 150 mm to have infinitely adjustable lockable ASTM A536 ductile iron lever actuator. Valves larger than 150 mm to have manual gear actuator. Liquid Service: valves less than or equal to 150 mm to have infinitely adjustable lockable ASTM A536 ductile iron lever actuator. Valves larger than 150 mm to have manual gear actuator.
Power Operators	Refer to valve schedule and specifications for requirements.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID Drawings and Specification Section 15020 requirements.
Specified Product	Dezurik BOS Series.
Approved Alternates	Bray 31-119N.
Application	Interior and exterior process air service. Where indicated on drawings and in the valve schedule.
Execution: • Install valve to manufacturer’s recommendations.	

General	2-way general service, cold non shock bronze or brass ball valve. Valve sizes per drawings and valve schedule. End connections: Threaded NPT or soldered
Code/Standard Compliance	MSS-SP-110
Pressure/Temperature Rating	Pressure (CWP): 2750 kPa Temperature rating: -29 to 100 ºC
Body	2 piece construction. Bronze body to ASTM B584. Brass body to B283, Polytetrafluoroethylene (PTFE) body seal.
Ball	ASTM 276 stainless steel 316 ball or ASTM B16 brass chromium plated.
Seat	Polytetrafluoroethylene.(PTFE).
Stem	Blow out proof ASTM B16 brass stem.
Packing	Modified Polytetrafluoroethylene(MPTFE) c/w adjustable bronze or brass or stainless steel packing gland or double O-ring design NBR/FPM.
Stem Bearing	Reinforced Polytetrafluoroethylene.(RPTFE).
Manual Operator	Stainless steel high rise lever. Latch lock.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements. Provide stem extension were required.
Specified Product	**Apollo 70-10X-04 Series, 77C-10X-04 Series**
Approved Alternates	**Kitz 68AMLL, 69AMLL** **Nibco T-585-66-LF, S-585-66-LF**
Application	General water service. General air service. Where indicated on drawings and in the valve schedule.
Execution: • Install valve to manufacturer’s recommendations.	

General	Full port bi-directional True Union PVC ball valve. Minimum suffix “A” designation for chemical resistance rating to ASTM D-1784. Valve sizes per drawings and valve schedule. End connections: Schedule 80 Socket connection to ASTM D-2467 or Flanged to ASME Class 150 bolt pattern using one piece moulded fabrication.
Pressure/Temperature Rating	Pressure : 1585 kPa @ 20 ºC and 1035 kPa @ 50 ºC Temperature range: 0-60 ºC
Body	Single piece PVC construction c/w ISO standard actuator mounting platform.
Ball	PVC construction.
Seat	Polytetrafluoroethylene(PTFE).
Stem	PVC construction, blow out proof design c/w double O-Ring seals.
Manual Operator	PVC lever actuator which doubles as a valve servicing tool. Lockable handle.
Power Operators	Refer to valve schedule and specifications for requirements.
Accessories	Valve to c/w base mounting inserts. NSF 61 compliant for potable water applications. Vented ball required on off gassing chemicals including sodium hypochlorite. Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Chemline Type 21**
Approved Alternates	**Georg Fisher Type 546**
Application	General water service 50mm and larger. Used on the following water/wastewater chemical processes: Alum and Ferric based coagulants. Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturers recommendations
- For solvent welded installations ensure that the solvent used is compatible and recommended by the piping and/or valve manufacturer for use with the specific chemical being transported in the pipe/system.

General	V-port ball valve. Bubble-tight Class VI shut off. Valve sizes per drawings and valve schedule. End connections: Flanged to ANSI B16.10 Class 150.
Pressure/Temperature Rating	Pressure (CWP): 1895kPa Temperature rating: -29 to 100 ºC
Body	316 Stainless Steel body to ASTM A276. Carbon Steel body to (ASTM A36).
Ball	Precision machined, mirror finished, solid Stainless Steel ball.
Seat	Interchangeable Polytetrafluoroethylene.(PTFE).
Stem	Blow out proof stainless steel.
Packing	Multiple V-ring Teflon or graphite.
Stem Bearing	Stainless Steel/Reinforced Polytetrafluoroethylene.(RPTFE).
Manual Operator	Infinite position lever with adjustable memory stop.
Power Operators	Refer to valve schedule and specifications for requirements.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements. Provide stem extension were required.
Specified Product	**Dezurik VPB**
Approved Alternates	**Flowtek – Advanced V-Control Ball Valve**
Application	Effluent water. General air service. Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturer’s recommendations.

General	Full port bi-directional True Union PVC floating ball valve. Minimum suffix "A" designation for chemical resistance rating to ASTM D-1784. Valve sizes per drawings and valve schedule. End connections: Schedule 80 Socket connection to ASTM D-2467 or Flanged to ASME Class 150 bolt pattern using one piece molded fabrication.
Pressure/Temperature Rating	Pressure: 1585 kPa @ 20 ºC and 1035 kPa @ 50 ºC Temperature range: 0-60 ºC Both primary and containment space to be pressure rated.
Body	Single piece PVC construction c/w ISO standard actuator mounting platform.
Ball	PVC construction.
Seat	Polytetrafluoroethylene (PTFE).
Stem	PVC construction, blow out proof design c/w double O-Ring seals.
Manual Operator	PVC lever actuator. Lockable handle.
Power Operators	Refer to valve schedule and specifications for requirements.
Accessories	Valve to be c/w base mounting inserts. NSF 61 compliant for potable water applications. Vented ball required on off gassing chemicals including sodium hypochlorite. Refer to valve schedule and specifications for additional requirements Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Georg Fisher Type Double Contained 546**
Approved Alternates	**Approved Equal.**
Application	General water service 50mm and larger. Used on the following water/wastewater chemical processes: Alum and Ferric based coagulants. Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturers recommendations.
- For solvent welded installations ensure that the solvent used is compatible and recommended by the piping and/or valve manufacturer for use with the specific chemical being transported in the pipe/system.
- Valve to be of same manufacturer of double containment piping system provided as part of 15100.

General	Air cushion swing check valve to AWWA C508. Valve sizes per drawings and valve schedule. Valve to be designed to allow field conversion of the closure device. End connections: Flanges to ASME B16.1 Class 125.
Code/Standard Compliance	AWWA C508 (latest edition) NSF 61 for potable water.
Pressure/Temperature Rating	Pressure rating: 1375kPa Temperature 20°C
Body	ASTM A126 grade B cast iron.
Disk	ASTM A126 grade B cast iron.
Shaft	ASTM A743 Stainless Steel supported at both ends.
Seat	ASTM A743 316 Stainless Steel.
Disk Seat	Buna-N.
Lever	Lever and adjustable weight to be ASTM A536 ductile iron or cast iron and mountable on either side of the valve.
Cylinder	Cast Bronze or aluminum cylinder externally attached to either side of the valve provide adjustability of the valve closure rate.
Coating	Exposed valves to be coated to Division 09900 and 15020 standards. Epoxy coating required where indicated in the valve schedule. Epoxy coating to be 8 mil 2-part epoxy or heat activated fusion bonded epoxy conforming to AWWA C550. When used in potable water applications, epoxy coatings to be NSF-61 certified.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Apco Series CVS-250A**
Approved Alternates	**Henry Pratt Series 9001** **Golden Anderson 250-DS**
Application	Water, Wastewater (liquid train). Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturer's recommendations.
- Ensure that a protective cage, installed to OSHA standards is installed around the lever/weight assembly.

General	Low head, non-clog ball check valve. Valve sizes per drawings and valve schedule. Flanges: faced and drilled per ANSI/ASME B16.1 Class 125.
Pressure/Temperature Rating	Pressure Rating: 1035kPa Temperature rating: 70 ºC
Body	ASTM A126 Class B Cast Iron or A536 Ductile Iron. Provide cleanout port for cleaning and maintenance without the need to remove valve from installation.
Ball	Sinking ball. Aluminum or iron encapsulated with Buna-N rubber compound.
Bonnet	ASTM A126 Class B Cast Iron or A536 Ductile Iron c/w stainless steel or zinc plated steel bolting hardware.
Gasket	Synthetic Rubber.
Coating	Exposed valves to be coated to Division 09900 and 15020 standards. Provide interior/exterior epoxy coating.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**HDL model 5087**
Approved Alternates	**Flomatic model 408** **GA Industries model 240 or 242**
Application	Where indicated on drawings and in the valve schedule. All Process Sludges.

Execution:

- Install valve to manufacturers recommendations.
- Vertical installation only unless specifically indicated otherwise.

General	Full port ball True Union check valve. Single union on valves 65mm and larger. Minimum suffix “A” designation for chemical resistance rating to ASTM D-1784. Valve sizes per drawings and valve schedule. End connections: Schedule 80 Socket connection to ASTM D-2467 or Flanged to ASME Class 150 bolt pattern using one piece moulded fabrication.
Pressure/Temperature Rating	Valves up to 50mm: Pressure rating of 1035 kPa Valves 65mm and larger: Pressure rating of 690 kPa Temperature range: 0-60 ºC
Body	PVC construction.
Ball	PVC construction.
Seat	EPDM.
Accessories	NSF 61 compliant for potable water applications. Vented ball required on off gassing chemicals including sodium hypochlorite. Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Chemline BT/BC**
Approved Alternates	**Georg Fisher 561/562**
Application	General water service 50mm and larger. Used on the following water/wastewater chemical processes: Alum and Ferric based coagulants. Where indicated on drawings and in the valve schedule.
Execution: • Install valve to manufacturer’s recommendations. • For solvent welded installations ensure that the solvent used is compatible and recommended by the piping and/or valve manufacturer for use with the specific chemical being transported in the pipe/system.	

General	Single body, double orifice, low profile combination air/vacuum relief valve. Valve sizes per drawings and valve schedule. End connection: Threaded NPT or flanged to meet ASME B16.1 Class 125.
Code/Standard Compliance	AWWA C-512.
Pressure/Temperature Rating	Pressure rating: 1035 kPa Temperature rating: 100ºC
Body	ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron or ASTM A743 or 316 Stainless Steel.
Float	Concave design constructed of ASTM A240 Stainless Steel.
Needle	Buna-N rubber compound.
Seat	Design for drip tight shut off. Buna-N rubber compound construction.
Internal Linkage	ASTM A126 Class B Cast Iron or Delrin Thermoplastic to ASTM D4181.
Plug	Stainless steel ASTM A240 T304 or ASTM B124 Brass.
Coating	Exposed valves to be coated to Division 09900 and 15020 standards.
Accessories	Inlet shut off valve.
Specified Product	**APCO Valve 440**
Approved Alternates	**Valmatic Series 800** **Crispin X Series, US Series**
Application	Where indicated on drawings and in the valve schedule. Sewage force mains.

Execution:

- Install valve to manufacturer’s recommendations.

General	General service pilot operated solenoid suitable for continuous duty. Valve sizes per drawings and valve schedule. End connections: Threaded NPT.
Pressure/Temperature Rating	Pressure rating: 1550 kPa Temperature rating:0 to 52 ºC
Body	Brass body.
Trim	Stainless Steel. Copper coil around stainless steel tube.
Seals and disk	Buna-N rubber compound.
Electrical	120v AC, class F insulation, CSA Certified. NEMA 4x enclosure for non-rated applications. NEMA 7 enclosure for Zone 1 or Zone 2 rated applications.
Power Operator	Solenoid
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Asco 8210**
Approved Alternates	**-**
Application	General water service. Process air. Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturer's recommendations.
- Ensure valve has correct electrical rating corresponding to the electrical classification of the installation location.

General	Pilot operated slow closing solenoid for transience control. Valve sizes per drawings and valve schedule. End connections: Threaded NPT
Pressure/Temperature Rating	Pressure rating: 1550 kPa Temperature rating:0 to 52 ºC
Body	Brass body.
Trim	Stainless Steel. Copper coil around stainless steel tube.
Seals and disk	Buna-N rubber compound.
Piston	Stainless Steel.
Electrical	120v AC, class F insulation, continuous duty, CSA Certified. NEMA 4x enclosure for non-rated applications. NEMA 7 enclosure for rated Class 1 Zone 2 applications.
Power Operator	Solenoid.
Accessories	Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Asco 8221**
Approved Alternates	**-**
Application	General water service (400kPa pressure or greater). Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturer's recommendations.
- Ensure valve has correct electrical rating corresponding to the electrical classification of the installation location.

General	Dual purpose True Union PVC backpressure and relief valve c/w integral directional flow control. Low hysteresis valve design. Minimum suffix “A” designation for chemical resistance rating to ASTM D-1784. Valve sizes per drawings and valve schedule. End connections: Schedule 80 Socket connection to ASTM D-2467 or Flanged to ASME Class 150 bolt pattern using one piece moulded fabrication.
Pressure/Temperature Rating	Pressure: 1035 kPa @ 20 ºC and 410 kPa @ 40 ºC Temperature range: 0-50 ºC
Set Pressure Range	Valves up to 50mm: 35kPa to 900kPa Valves 50mm to 65mm: 50kPa to 900kPa Valve 100mm: 35kPa to 620kPa
Body	PVC construction.
Bonnet & Piston	PVC construction.
Seat	EPDM.
Seals	EPDM or Viton.
Control Diaphragm	PTFE bonded EPDM.
Spring	Galvanized spring steel.
Manual Operator	Manually operated 304 stainless steel spring tensioning bolt.
Accessories	Valve to be c/w base mounting inserts. Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**Chemline SB 12**
Approved Alternates	**Georg Fisher 586**
Application	Used on the following water/wastewater chemical processes” Alum and Ferric based coagulants Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturer’s recommendations.
- For solvent welded installations ensure that the solvent used is compatible and recommended by the piping and/or valve manufacturer for use with the specific chemical being transported in the pipe/system.

General	Double V-notch inlet, rising-stem, stainless steel telescopic valve with stainless steel slip tube assembly c/w integral seal, stainless steel extension stem and anti-rotation key. Valve sizes per drawings and valve schedule. End connections: Flanged.
Code/Standard Compliance	
Pressure/Temperature Rating	Pressure: 1035 kPa Temperature rating: 0 - 50 ºC.
Body	304 SS construction.
Seals	Stacked neoprene seal, c/w double base flange, stainless steel seal flange.
Stem	Stainless steel ASME thread construction, c/w clear stem cover, square bronze lift nut and lift nut retainer plate.
Manual Operator	Manually operated aluminum handwheel, mounted to pedestal.
Accessories	Valve to c/w galvanized steel pedestal, stainless steel pedestal support bracket and stem guides. Anti-rotation key to be provided pedestal mounted or on stem to prevent valve tube rotation. Refer to valve schedule and specifications for additional requirements. Valve tag denoting specific valve identity number consistent with the project P&ID drawings and Specification Section 15020 requirements.
Specified Product	**BNW Model 44**
Approved Alternates	
Application	Used on the following water/wastewater chemical processes: Primary Effluent Water Secondary Effluent Water Supernatant Decant Where indicated on drawings and in the valve schedule.

Execution:

- Install valve to manufacturer’s recommendations.
- Concrete anchors to be provided by Contractor.

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 The following section covers the vibration control and seismic control measures required to accommodate the installation of all mechanical components.

.2 The Contractor is to retain the services of a third party Structural Engineer licensed in the province of Ontario to provide the vibration control and seismic restrain design and installation review for all the mechanical equipment and appurtenances to the requirements noted herein.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.5 - Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.11- Forged Fittings, Socket Welding and Threaded
- .2 Ontario Building Code.
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- .4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Divisions 1 and Division 15.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS:

- .1 Provide separate shop drawings for each isolated system as well as system shop drawings complete with performance and product data.
- .2 Provide detailed drawings of all seismic control measures for equipment, piping and ductwork.
- .3 Shop drawings to be reviewed, approved, and sealed by the Contractor's Structural Engineer responsible for design of supports, anchors and restraints prior to submission to Consultant. Submit certified test data to Consultant detailing performance of vibration isolation and seismic.

.3 Submit complete report of testing results including sound curves.

1.4 CLOSE OUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment.

1.6 QUALITY ASSURANCE

.1 Vibration control measures to conform to the latest edition of the ASHRAE standards for vibration control and isolation.

.2 Seismic control measures to conform to the latest edition of the following standards:

.1 Ontario Building Code.
.2 ASHRAE and SMACNA Standards for Seismic Restraint.

.3 Supports, anchors and restraints are to conform to and be coordinated with the requirements of the Project Structural Engineer and the Contractor's Structural Engineer responsible for the design of structural support systems for mechanical systems and equipment.

.4 Contractor to provide all necessary information on equipment, pipe support and duct support requirements to the vibration and seismic control manufacturer.

.5 Equipment vibration control devices, seismic control devices and equipment bases are to be from one manufacturer.
.1 Standard of Acceptance: Mason Industries.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

.2 Experienced and competent sound and vibration testing professional engineer to take vibration measurements for HVAC systems after start up and TAB of systems to Section 15030 – Testing and Section 15031 – Balancing Mechanical Systems.

.3 Provide Consultant with notice 48 h in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and, where appropriate, provide remedial recommendations (including sound curves).

.5 Prepare and submit complete report of test results including sound curves.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

1.10 SEISMIC DESIGN PARAMETERS

.1 Seismic Site Class:
.1 Seismic Site Class ‘A or C’. Building Dependent (refer to Structural drawings)
.2 Sa(0.2) = 0.173.
.3 Post-disaster importance category Ie = 1.5.
.4 Cp, Ar and Rp as per OBC Table 4.1.8.17.

PART 2 - PRODUCTS

2.1 RUBBER PAD ISOLATORS

.1 Two (2) layers of 19 mm thick neoprene pad separated horizontally by a 1.5 mm galvanized shim.

.2 Provide load distribution plates as required.

2.2 NEOPRENE ISOLATOR

.1 Neoprene mounting with a minimum static deflection of 50 mm and all directional seismic capability. Neoprene to be bridge-bearing quality.

.2 Ductile iron casting with two separated and opposing molded neoprene elements. Elements to prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.

2.3 SHEET METAL SUPPORT ATTACHMENT ISOLATORS

.1 Neoprene bushing cushioned between two (2) steel sleeves. Neoprene to be bridge bearing quality.

.2 Steel disc and outer sleeve to act as stop so tightening of bolt does not interfere with panel isolation.

2.4 OPEN SPRING ISOLATORS

.1 Free standing and laterally stable (without housing), complete with molded neoprene cup or 6 mm neoprene acoustical friction pad between the baseplate and the support and leveling bolts.

.2 Spring diameters to be no less than 80% of the compressed height of the spring at rated load.

.3 Springs to have minimum additional travel to solid equal to 50% of the rated deflection.

2.5 RESTRAINED SPRING ISOLATOR

.1 Spring isolator with rigid housing that includes vertical limit stops to prevent spring extension when load is removed. Designed to suit seismic loads.

.2 Maintain minimum clearance of 12 mm travel in all directions before contacting resilient snubbing collars.

.3 Provide 6 mm neoprene acoustical friction pad bonded to the baseplate.

.4 Spring diameters to be no less than 80% of the compressed height of the spring at rated load and springs are to have a minimum additional travel to solid equal to 50% of the rated deflection.

2.6 HOUSED SPRING ISOLATORS

.1 Springs to be mounted in a ductile iron or steel housing to provide all directional seismic snubbing.

.2 Provide vertical adjustment, allowing a maximum 6 mm travel in all directions before contacting the resilient snubbing collars.

.3 Spring diameters to be no less than 80% of the compressed height of the spring at rated load and springs are to have a minimum additional travel to solid equal to 50% of the rated deflection.

2.7 SPRING AND NEOPRENE HANGER

.1 Rigid steel frames with minimum 32 mm thick neoprene elements at top and a steel spring seated in a steel washer neoprene cup on the bottom. Neoprene bushings to extend into steel housing.

.2 Spring diameters and hanger box lower hole sizes to permit the hanger rod to swing through a 30° arc before contacting the rod bushing and short circuiting the spring.

.3 Spring diameters to be no less than 80% of the compressed height of the spring at rated load and springs are to have a minimum additional travel to solid equal to 50% of the rated deflection.

2.8 PRE-COMPRESSED SPRING AND NEOPRENE HANGER

.1 Neoprene and spring hanger to be pre-compressed and locked at the rated deflection by a resilient seismic up-stop to maintain a fixed elevation during installation.

.2 Provide deflection scale on housing and release mechanism to free spring.

2.9 HORIZONTAL THRUST RESTRAINT

.1 Provide spring element in series with neoprene molded cup and provisions for factory preset and field adjustment for a maximum 6 mm movement at start and stop.

.2 Provide rod and angle brackets for attachment to equipment and ductwork or structure. Locate at the centre line of thrust and symmetrically on either side of equipment.

2.10 SEISMIC CABLE RESTRAINTS

.1 Galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two (2), arranged to provide all directional restraint.

.2 Cable end connections to be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.

2.11 SEISMIC SOLID BRACE

.1 Steel angles or channels to resist seismic loads with a minimum safety factor of two (2) arranged to provide all directional restraint.

.2 End connectors to be steel assemblies that swivel to the final installation angle and utilize two (2) through bolts to provide proper attachment.

2.12 HANGER SEISMIC RESTRAIN CLAMPS

.1 Steel angles, sized to prevent buckling, to be clamped on support rods.

.2 Utilize a minimum of three (3) ductile iron clamps at each restraint location.

2.13 CLEVIS SEISMIC BRACES

.1 Clevis hanger cross-bolt braces of preformed channels, bolted across the clevis cross bolt.

2.14 SEISMIC SNUBBERS

.1 Interlocking steel members restrained by a shock absorbent rubber material compounded to bridge bearing specifications with a gap of 3 mm to 6 mm between hard and resilient surfaces.

.2 Elastomeric materials to be replaceable and a minimum 19 mm thick.

2.15 ACOUSTICAL PIPE ANCHORS AND GUIDES

.1 Pipe anchors to consist of two sizes of steel tubing separated by a minimum of 12 mm thick, 60 durometer neoprene. Allowable loads not to exceed 3450 kPa.

.2 Pipe guides to consist of a telescoping arrangement of two sizes of steel tubing separated by 12 mm thick 60 durometer neoprene. Provide removable shear pins to preset and adjust height of guide to suit vertical movement due to expansion or contraction.

2.16 MOLDED FLEXIBLE PIPING/PUMP CONNECTORS

.1 Flexible spherical expansion joints of multi-layered polyester (DuPont Kevlar) tire chord fabric reinforcement with peroxide cured EPDM cover, liner and chord frictioning.

.2 Solid steel rings within the raised face rubber flanged ends to prevent pullout. Double sphere connections to be provided with a ductile iron external ring reinforcement between spheres.

.3 Flanges to be split ductile iron or steel with hooked or similar interlocks.

.4 Rated at 1.72 MPa at 77°C with a uniform drop in allowable pressure to 1.48 MPa at 121°C in all sizes to 350 mm diameter. Safety factors for burst and flange pullout to a minimum of 3/1.

.5 Provide control rods at unanchored locations where required.

2.17 METAL HOSE PIPING/PUMP CONNECTORS

.1 Stainless steel, braided outer core, inner core with annular corrugation, rated for 2070 kPa operation.

.2 Provide with carbon steel flanged ends to ANSI B16.5 for piping 60 mm diameter and larger, screwed ends to ANSI B16.11 for piping 50 mm and smaller.

.3 Use minimum end to end dimension of 300 mm for 20 mm service.

2.18 STRUCTURAL BASES

.1 Provide structural bases to maintain alignment of component parts (motors, drives, equipment, isolators) and to support equipment, vibration isolation and seismic restraint devices.

.2 Pump bases to include support for suction and discharge elbows for split case pumps.

.3 Structure to be suitable for all starting and operating forces without misalignment and flexing.

.4 Structure to be suitable for seismic restraint to maintain support and alignment during a seismic event. Perimeter members to be steel beams with a minimum depth equal to 1/10 of the longest base dimension.

.5 Motor slide rails to be integral with base.

.6 Isolator attachments to minimize height and maintain a minimum 25 mm clear space between sub-base and structural base.

2.19 STRUCTURAL RAILS

.1 Provide structural rails to support equipment, vibration isolation and seismic restraint devices where a unitary base is not required for equipment alignment.

.2 Structure to be suitable for all starting and operating forces and to maintain support during a seismic event.

.3 Isolator attachments to minimize height and maintain a minimum 25 mm clear space between sub-base and structural rails.

2.20 REINFORCED CONCRETE INERTIA BASES

.1 Provide reinforced concrete in entire base to maintain alignment of component parts (motors, drives, equipment, isolators) and to support equipment, vibration isolation and seismic control devices.

.2 Bases for split case pumps to be large enough for suction and discharge elbow support.

.3 Structure to be suitable for all starting and operating forces, without misalignment and flexing.

.4 Structure to be suitable for seismic restraint to maintain support and alignment during a seismic event.

.5 Encase reinforced concrete inertia slabs in a steel channel frame with 1.2 mm sheet metal bottom.

.6 Isolator attachments to minimize base height and maintain 25 mm clear space between sub-base and inertia base.

.7 Provide inertia base with concrete of 2400 kg/m³ density for:

5.6 kW and under	150 mm thick
7.5 kW to 18.7 kW	200 mm thick
22.4 kW to 44.8 kW	250 mm thick
56 kW and over	300 mm thick

.8 Reinforce base with 10 mm reinforcing bars for 150 mm and 200 mm bases and 15 mm with 250 mm and 300 mm bases. Space all bars 300 mm o.c. in both directions of the horizontal plane and weld in place.

2.21 SUB-BASES

.1 Install isolation material on 100 mm thick concrete sub-base.

.2 Coordinate operating static deflections with detailed equipment schedule and manufacturer's requirements.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Coordinate vibration isolation and seismic restraint with structural, architectural and electrical building systems. Provide support and restraint as required to suit seismic design.

.4 Inspect complete installation on system start-up and report in writing to Consultant changes necessary to prevent short circuit transmission. Perform changes necessary to eliminate short circuiting or to increase vibration isolation efficiency.

3.2 EQUIPMENT BASE AND VIBRATION ISOLATOR APPLICATION

.1 Centrifugal Fans:
- .1 Structural Base: slab-on-grade installations of equipment below 37 kW only.
- .2 Rubber Floor/Hanger Isolator: slab-on-grade installations of equipment below 37 kW.
- .3 Minimum Isolator Deflection:
  - .1 13 mm: all slab-on-grade installations of fans below 600 mm diameter.
  - .2 19 mm: all installations of fans up to 37 kW.

.2 Propeller Fans
- .1 No base, isolators attached directly to equipment: all installations except for roof mounted equipment.

.2 Structural or Curb Mounted Base: all roof mounted equipment installations.
.3 Rubber Pad Isolator: all installation except for roof mounted equipment.
.4 Restrained Spring Isolators: all roof mounted equipment installations.
.5 Minimum Isolator Deflection:
.1 13 mm: all except roof mounted installations.
.2 45 mm: all roof mounted installations.

.3 Packaged HVAC Equipment
.1 No base, isolators attached directly to equipment; all installations of equipment below 11 kW shaft power and 1000 Pa static pressure only.
.2 Structural Base: slab-on-grade installations of equipment above 11 kW shaft power or 1000 Pa static pressure.
.3 Concrete Inertia Slab: above grade installation of equipment above 11 kW shaft power or 1000 Pa static pressure.
.4 Minimum Isolator Deflection:
.1 19 mm: all slab-on-grade installations and above grade less than 11 kW.
.2 45 mm: all above grade installations.

.4 Packaged Rooftop HVAC Equipment
.1 Curb Mounted Base: below 11 kW shaft power and 1000 Pa static pressure.
.2 Structural Base or Rail: Installations of equipment above 11 kW shaft power or 1000 Pa static pressure.
.3 Open Spring Isolators: all rooftop installations.
.4 Minimum Isolator Deflection:
.1 19 mm: all installations in addition to internal isolation.

.5 Small Ducted Fans, Fan Powered Terminal Units
.1 No base, isolators attached directly to equipment: all equipment.
.2 Open Spring Isolators or Hangers: all equipment.
.3 Minimum Isolator Deflection:
.1 13 mm: up to 285 L/s
.2 19 mm: above 285 L/s

.6 Air Compressors and Vacuum Pumps
.1 No base, isolator attached directly to equipment: tank mounted equipment up to 7.5 kW only, all locations.
.2 Concrete Inertia Base: all other equipment and locations.
.3 Open Spring Isolators: all equipment and locations.
.4 Minimum Isolator Deflection:
.1 19 mm: all slab-on-grade installations.
.2 45 mm: all above grade installations.

.7 Pumps
.1 No base, isolators attached directly to equipment: all inline pump installations.
.2 Structural Base: slab-on-grade installations of close coupled pumps up to 5.6 kW.
.3 Concrete Inertia Base: all other pumps and locations.
.4 Rubber Isolator: slab-on-grade installations of close coupled pumps up to 5.6 kW.
.5 Open Spring Isolator: all other equipment and locations.
.6 Minimum Isolator Deflection:
.1 6 mm: slab-on-grade installations of close coupled pumps up to 5.6 kW.

.2 19 mm: slab-on-grade installation of large inline pumps up to 19 kW and close coupled pumps above 5.6 kW and above grade installations of close coupled pumps up to 5.6 kW.

.3 45 mm slab-on-grade installations of inline pumps above 22 kW and above grade installations of close coupled (above 5.6 kW, inline, end suction and split case pumps.

.8 Boilers - Fire Tube

.1 No base, isolators attached directly to equipment: all installations.

.2 Rubber Pad Isolators: below grade installations only.

.3 Restrained Spring Isolators: all above grade installations.

.4 Minimum Isolator Deflection:

.1 6 mm: all slab-on-grade installations.

.2 19 mm: all above grade installations.

.9 Engine Driven Generators

.1 No base, isolators attached directly to equipment: all installations.

.2 Concrete Inertia Base: all above grade installations.

.3 Open Spring Isolators: all installations.

.4 Minimum Isolator Deflection:

.1 19 mm: all slab-on-grade installations.

3.3 PIPING SYSTEM VIBRATION ISOLATION

.1 Refer to Section 15060.

.2 Provide vibration isolation within 15 m of vibrating equipment.

.3 Suspended Piping: first three (3) hangers to have the same deflection as the equipment isolators with a maximum deflection of 50 mm. The remaining hangers are to be spring or a combination of rubber and spring hangers with a deflection of 20 mm.

.4 Floor Supports: first two (2) floor support isolators to be restrained spring type with a blocking feature to prevent load transfer to equipment as the piping is filled or drained. Provide a slide plate on top of the isolator where pipe is subject to larger thermal movement.

.5 Riser Supports, Anchors and Guides: isolate to standards for piping system.

.6 Piping Penetrations: seal all openings with acoustical barrier such as fibrous material and caulking or fabricated mechanical seal.

.7 Flexible Pipe Connectors: provide flexible pipe connectors to permit isolators to function properly, to protect equipment for strain from misalignment/ expansion/contraction and to attenuate noise and vibration transmission along the piping. Provide restraint to counteract thrust and limit movement.

3.4 DUCT SYSTEM VIBRATION ISOLATION

.1 Flexible Duct Connectors: provide canvas and rubber duct connections at all fan and air handling unit/makeup air unit intakes and discharges. Provide thrust restraints to maintain flexible connection slack condition.

3.5 SEISMIC CONTROL MEASURES

.1 General:

.1 The facility will be considered a “post disaster” facility per the OBC. The following systems must remain in operation post-disaster to maintain minimum treatment:

.1 Emergency generator sets and associates systems.

.2 Emergency Waste Gas Flare and associated systems.

.3 Chlorination systems.

.4 Hot water heating boilers, circulation pumps, piping and ancillaries.

.5 The above does not preclude other requirements of this section and other regulatory requirements.

.6 The following chemical feed systems:

.1 Sodium Aluminate

.2 Sodium Hydroxide (Caustic Soda)

.3 Activated Silica

.4 Polyphosphate

.2 All systems and/or equipment are to remain in position during and after an earthquake so as not to jeopardize occupants or impede safe exiting.

.3 Seismic control systems to work in all directions.

.4 Fasteners and attachment points to resist same maximum load as seismic restraint.

.5 Drilled or power driven anchors and fasteners not permitted.

.6 No equipment, equipment supports or mounts to fail before failure of structure.

.7 Supports fabricated using cast iron or threaded pipe not permitted.

.8 Seismic control measures not to interfere with integrity of fire stopping.

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment:

.1 Use one or more of following methods depending upon site conditions and as indicated:

.1 Install tight to structure.

.2 Cross brace in all directions.

.3 Brace back to structure.

.4 Cable restraint system.

.3 Seismic restraints:

.1 Cushioning action to be gentle and steady.

.2 Shall never reach metal-like stiffness. Vibration isolated equipment:

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.4 Piping systems:

.1 All other piping systems: hangers longer than 300 mm; brace at each hanger.

.2 To be compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:

.1 Approved by Consultant.

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 The following specification pertains to all Division 11 and Division 15 piping.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 Thermal Insulation Association of Canada (TIAC)
- .2 TIAC Best Practices Guide.
- .3 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1 SI Edition, Energy Standard for Buildings except Low-Rise Residential Buildings.
- .4 American Society for Testing and Materials (ASTM):
  - .1 ASTM C177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  - .2 ASTM C 335:Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411: Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C 449/C 449M: Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - .6 ASTM C 534: Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  - .7 ASTM C 547: Standard Specification for Mineral Fiber Pipe Insulation.
  - .8 ASTM C 553: Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .9 ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .10 ASTM C 795: Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .11 ASTM C 921: Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .12 ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials.
- .5 National Fire Protection Association (NFPA):
  - .1 NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Material.
- .6 Canadian General Standards Board (CGSB):
  - .1 CGSB 51.9: Mineral Fibre Thermal Insulation for Piping and Round Ducting.
  - .2 CGSB 51-GP-52MA: Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .3 CGSB 51.53: Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .7 Canada Green Building Council (CaGBC):
  - .1 LEED Canada-NC Version 1.0: LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum).

.2 LEED Canada-CI Version 1.0: LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
.1 Material Safety Data Sheets (MSDS).

.9 Underwriters Laboratories of Canada (ULC):
.1 CAN/ULC-S102: Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
.2 UL-723: Standard for Test for Surface Burning Characteristics of Building Materials

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Divisions 1 and Division 15.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS:
.1 Performance data for each insulation type.
.2 Submit TIAC installation method from published standard clearly listing which service each installation method will apply to. Edit to reflect variances from standard.
.3 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

.3 Submit samples where requested.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Not Applicable.

1.6 QUALITY ASSURANCE

.1 Conform to the latest version of the following:
.1 ASTM C411.
.2 ASTM C533.
.3 ASTM C534.
.4 ASTM C547.
.5 ASTM E96.
.6 ULC requirements.
.7 NBC Part 6.

.2 Provide insulation to NFPA Standard 90A, and 255, Latest edition; as well as UL-723 Latest edition fire hazard ratings.

.3 Unless indicated otherwise all insulation to be installed to published standards of Thermal Insulation Association of Canada (TIAC).

.4 Flameproofing treatment to withstand high humidity conditions without deterioration.

.5 Performance Requirements defined: Catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.

.6 The contractor performing the work of this section shall be a recognized installer of insulation systems and have a minimum of five (5) years experience which can be documented and verified. The contractor shall be a current and listed member of TIAC (Thermal Insulation Association of Canada).

.7 Where applicable products shall bear a ULC or UL label.

.8 Contractor to complete sample installation in the field for Consultant's review prior to proceeding with the work. Sample installation to include straight pipe, one valve, a tee or elbow and a mechanical piping joint.

1.7 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Material not to soften, corrode or otherwise deteriorate in either wet or dry state and be type recommended by manufacturer as suitable for proposed application.

2.2 JACKETS

.1 PVC: 20 mil, glass white installed with nylon rivets and 40 mm wide PVC tape; formed PVC fittings. Cladding to meet all flame spread requirements.
- .1 Fittings to be moulded and preformed to fit pipe fittings and valves.
- .2 Standard of Acceptance: Childers.

.2 Aluminum: embossed alloy, 0.5 mm thick, protective liner factory attached to interior surface.
- .1 Standard of Acceptance: Childers.

.3 Plain: no jacket required, wire and staple insulation at joints.

.4 Vapour barrier: factory applied, all-purpose type, white Kraft paper laminated to aluminum foil and reinforced with glass fibre fabric, white Kraft side.

2.3 GLASS FIBRE INSULATION TYPE IP-1

.1 Material: glass fibre, preformed sectional type, 1 m lengths, to CAN/CGSB-51.9-92. Preformed fittings.

.2 Fittings: preformed to suit fittings and dimensions.

.3 Density: 88 kg/m³.

.4 Temperature rating: to 316°C.

.5 Conductivity: 0.035 W/m°C @ 22°C.

.6 Jacket: factory applied, all-purpose type, white Kraft paper laminated to aluminum foil and reinforced with glass fibre fabric, white Kraft side facing out.

.7 Fastenings: galvanized and flared staples, 75 mm wide adhesive tape of same material as jacket.

.8 Specified Product: Knauf, rigid type.

.9 Alternate Manufacturers:
.1 Manson
.2 Approved equal.

2.4 CALCIUM SILICATE INSULATION TYPE IP-2

.1 Material: hydrous calcium silicate preformed sectional and block type, to CGSB 51-GP-2b.

.2 Density: 208 kg/m³.

.3 Temperature rating: to 815°C.

.4 Conductivity: K factor of 0.055 W/m.°C @ 38°C.

.5 Jacket: aluminum.

.6 Fastenings: aluminum straps.

.7 Specified product: Insulcoustic, Thermo-12.

.8 Alternate Manufacturer:
.1 Approved equal

2.5 FLEXIBLE POLYETHYLENE INSULATION TYPE IP-3

.1 Material: 25 mm thick, flexible, closed cell polyethylene, preformed tubular type, 2 m sections and 15 m continuous lengths, to CGSB 51-GP-40M.

.2 Density: 32 kg/mn.

.3 Temperature rating: to 100°C.

.4 Conductivity: 0.0382 W/m² @ 24°C.

.5 Fastenings: contact adhesive, synthetic rubber base, hydrocarbon and ketone type solvent, wet flash point below -7°C, dry flammability to ASTM E84.

.6 Finish: vinyl lacquer coating, glossy finish compatible only with latex caulking material, wet flash point 18°C, dry flammability to ASTM E84.

.7 Standard of Acceptance:
- .1 Insulation: Insulcoustic.
- .2 Adhesive: Foster.
- .3 Finish: Foster

2.6 GLASS FIBER INSULATION TYPE IP-4

.1 Material: glass fibre, board bonded to facing, flexible, CGSB 51-6P-10M.

.2 Density: 56 kg/mn.

.3 Temperature Rating: 345°C.

.4 Conductivity: .039 W/m°C.

.5 Jacket: all service jacket, foil/Kraft laminate reinforced with open mesh glass fibre.

.6 Alternate Manufacturers:
- .1 Knauf.
- .2 Manson.

2.7 OUTDOOR PIPE INSULATION TYPE IP-5

.1 Preformed foam glass insulation to ASTM C552 and CGSB 51-GP-38.

.2 Compressive strength: 690 kPa .

.3 Density:0.11 kg/m³.

.4 Permeability: zero.

.5 Conductivity: 41 Btu in./hr sf.

.6 Standard of Acceptance: Pittsburgh Corning; Foamglas.

2.8 MINERAL FIBRE INSULATION TYPE IP-6

.1 Pre-molded mineral fibre insulation, sectional type 900 mm lengths to CAN/CGSB-51.9-92.

.2 Fittings: preformed to suit pipe fittings.

.3 Temperature rating: 649°C.

.4 Conductivity: 0.036 W/m°C @ 38°C per ASTM C335.

.5 Fastenings: 18 ga. stainless steel wire on stainless steel banding.

.6 Specified Manufacturer: Fibrex 1200 CorePlus.

.7 Alternate Manufacturers:
- .1 Roxul.
- .2 Knauf.

2.9 GLASS BLOCK INSULATION TYPE IP-7

.1 Glass fibre blocks.

.2 Thermal conductivity: .0075W/m°C at 204°C mean temperature.

.3 Rated to minimum 537°C.

.4 Specified Manufacturer: Knauf.

.5 Alternate Manufacturers:
- .1 Roxul.

2.10 FASTENINGS AND SUPPORTS

.1 Wire
- .1 Vapour barrier insulation: stainless steel wire 1.2 mm, dead soft annealed wire, type 304.
- .2 Non-vapour barrier insulation: galvanized annealed wire 1.8 mm.

.2 Strap
- .1 Stainless steel strap 13 mm x 0.5 mm type 304, dead soft.
- .2 Aluminum strap 13 mm x 0.5 mm.
- .3 Velcro straps with standard buckles.

.3 Staples
- .1 Flare type, galvanized, 14 mm.
- .2 Specified Manufacturer: Bostich CT 850.

2.11 WEATHERPROOF CAULKING

.1 Silicone based heat resistant caulking, set into fabric reinforcing cloth extending 75 mm each side of caulk line, at flashings, weather barrier joints, expansion joints.

.2 Non-setting sealant for sliding insulation surfaces to US Fed. Specification TT-S-00227E.
- .1 Specified Manufacturer: Tremco Dymeric.

.3 White petroleum jelly for exterior of insulated piping between sliding circumferential surfaces made of 150 mm wide 0.4 mm aluminum bands forming top shield and slip shield.
- .1 Specified Manufacturer: Vaseline.

PART 3 - EXECUTION

3.1 INSULATION SCHEDULE

.1 Refer to Pipe Insulation Table.

3.2 PIPE SUPPORTS

.1 Pipe supports are not to penetrate pipe insulation, vapour barrier or cladding. Ensure all pipe supports are selected to be outside the insulation and that appropriate saddles and shields are provided.

3.3 INSTALLATION

.1 Prior to installation ensure that:
- .1 Hydrostatic tests have been completed.
- .2 Surfaces to be covered are clean and dry.
- .3 Insulation is clean and dry.

.2 Application
- .1 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shaped to blend with fitting insulation and adjacent covering; with full length sections and tight to insulated object.
- .2 Apply insulation material, accessories and finish in accordance with manufacturer's recommendations.
- .3 Preformed insulation: sectional up to 300 mm, sectional or curved segmented above 300 mm. With multi-layered, insulation use staggered butt joint construction.
- .4 Apply breeching insulation blocks with edges tightly butted and joints staggered. Spot weld pins on 305 mm centres to breeching on all sides. Impale double layer insulation on pins. Secure with 50 mm o.d. speed washers. Point all joints with insulating cement.
- .5 Breeching and stack insulation to be installed in a minimum of two (2) layers with joints overlapped.
- .6 Pipe hangers and support not to penetrate insulation. Coordinate with Section 15060.

.3 Pack solid around pipes with mineral fibre insulation where they pass through sleeves for depth of penetration. Vapour barrier jacket to be continuous. Pipe sleeves to accommodate full insulation thickness and allow pipe expansion. Provide mastic caulking.

.4 Pack mineral fibre insulation around breeching, whether covered or uncovered where it passes through sleeves, for depth of penetration. For vapour barrier jacket, provide continuous covering. Sleeves to accommodate full thickness of insulation and allow expansion. Provide mastic caulking.

.5 Terminate insulation at each end of unions and flanges and at other points where required, with insulation cement, CGSB 51-GP-6M, trowelled on a bevel.

.6 Allow for radial expansion of pipe and permit pipe to move longitudinally inside insulation and to expand and contract without opening up joints between sections.

.7 Gouge out insulation for proper fit where there is interference between weld bead and insulation.

.8 Bevel insulation away from studs and nuts to permit their removal without damage to insulation. Trim around extending parts of pipe saddles, supports, hangers, clamp guides and seal with insulating cement.

.9 Joints

.1 Adhere and seal laps of vapour barrier cover or vapour barrier strip of 75 mm minimum width furnished with insulation, using vapour seal adhesives.

.10 Install factory fabricated easily disassembled insulation, for valves and fittings requiring periodic maintenance of parts and sub-assemblies.

.11 Fasten PVC jacketing and tape joints and seams with PVC material.

.12 Breeching Jacket

.1 Aluminum (outdoor): apply embossed aluminum sheets flush against insulation and lapped to shed moisture. Fasten with stainless steel bands or self-tapping screws. Provide spacers to prevent compression of insulation at band locations.

.2 Canvas (indoor): tightly stretch 25 mm hexagonal wire mesh over insulation. Secure by wiring to anchors with edges tied together. Apply finish cement in two 13 mm thick coats. Leave first coat rough and allow to dry before applying second coat. Trowel to smooth, hard finish. Paste 200 g/m canvas over cement with suitable lagging adhesive. K factor to be 0.055 @ 38°C or better.

.13 Any exterior vertically insulated pipe insulation to be finished with a suitable leak tight cap/weather flashing to prevent water penetration.

.14 Ensure pipe/breeching insulation is not compressed by cladding or supports.

3.4 INSULATION OF FITTINGS, FLANGES AND BODIES

.1 All fittings, flanges and valve bodies installed in insulated pipe are also to be insulated.

.2 50 mm and smaller: insulating cement to CGSB 51.12-95 with embedded cotton jacket.

.3 60 mm and larger: build up ends of insulation on piping with preformed pipe insulation as adjoining pipe insulation.

.4 Finishes:

.1 For mechanical joints: shape to fit over and provide a minimum 12 mm cover over joint using 50 mm insulation up to 200 mm.

.2 Provide for slip type expansion joints, with metal liner and removable insulation cover.

.3 Vapour seal protruding metal parts: valve stems, sliding parts of mechanical expansion joint insulating covers: provide a 1.6 mm thick rubber or neoprene gasket between pipe support shield and insulation.

3.5 WEATHERPROOF SYSTEM OUTSIDE PIPE

.1 Secure preformed insulation, Type IP-2 to pipe surface with mechanical fasteners.

.2 Seal all breaks and joints with 100 mm wide RFFR adhesive tape.

.3 Apply aluminum cover to insulated piping exterior to building. Caulk and seal all joints to make weatherproof.

3.6 HEAT TRACING

.1 Coordinate insulation application with heat tracing requirements. Refer to Specification Division 16, Section 16857.

3.7 SUPPLEMENTS

.1 Pipe Insulation Table.

END OF SECTION

		INSUL. TYPE	JACKETS	THICKNESS (MM) (See Note 1)	COMMENTS
EFF1	PRIMARY EFFLUENT	IP-5	ALUM	50	INSULATE EXTERIOR ABOVE GRADE PIPING
MW	MUNICIPAL WATER	IP-1	PVC	25 L.T. 25 / 40 G.T. 25	
MHW	MUNICIPAL HOT WATER	IP-1	PVC	25 L.T. 25 / 40 G.T. 25	
MTW	MUNICIPAL TEMPERED WATER	IP-1	PVC	25 L.T. 25 / 40 G.T. 25	
MHWR	MUNICIPAL HOT WATER RETURN	IP-1	PVC	25 L.T. 25 / 40 G.T. 25	
DR	DRAIN (PROCESS)	IP-5	ALUM	50	INSULATE EXTERIOR ABOVE GRADE PIPING
FCL	FERRIC CHLORIDE	IP-5	ALUM	50	INSULATE EXTERIOR ABOVE GRADE PIPING
DWV	DRAIN/WASTE/VENT	N/A	N/A	N/A	
OF	OVERFLOW	N/A	N/A	N/A	
PA	PROCESS AIR	IP-5	PVC	25	NOTE 4
RL	REFRIGERANT LIQUID	IP-3	N/A	25	
RS	REFRIGERANT SUCTION	IP-3	N/A	25	
SAN	SANITARY DRAIN	N/A	N/A	N/A	
EW	EFFLUENT WATER	IP-1	PVC	25 L.T. 25 / 40 G.T. 25	IP-5 INSULATION FOR EXTERIOR PIPING
		IP-5	ALUM	50	
STM	STORM DRAIN	IP-1	PVC	25 L.T. 25 / 40 G.T. 25	NOTE 9
SW	SEPARATED WATER (MUNICIPAL WATER DOWNSTREAM OF A BFP)	IP-1	PVC	25 L.T. 25 / 40 G.T. 25	COMPLETE SYSTEM
VENT	VENT	IP-1	PVC	25	1000MM FROM EXTERIOR WALL PENETRATION
ODR	ODOUR CONTROL	IP-5	ALUM	50	Exterior application, make weatherproof
SL	SLUDGE	N/A	N/A	N/A	
RAS	RETURN ACTIVATED SLUDGE	N/A	N/A	N/A	
WAS	WASTE ACTIVATED SLUDGE	N/A	N/A	N/A	

		INSUL. TYPE	JACKETS	THICKNESS (MM) (See Note 1)	COMMENTS
RSE	RAW SEWAGE	N/A	N/A	N/A	
RSP	RAW SEPTAGE	N/A	N/A	N/A	
SCM	SCUM	IP-5	ALUM	50	NOTE 6

Note 1: - AA L.T. BB indicates insulation thickness (AA) for pipe size less than or equal to size indicated (BB).
- G.T. indicates greater than.

Note 2: - All outdoor aluminum jackets to be weatherproof.

Note 3: - Ceiling space refers to areas with suspended ceilings.

Note 4: - Insulate complete length of new process air piping in Electrical Room, in Headworks Building ground floor and all outdoor exposed process air piping above the Aeration Tank walkways or channels. Piping below the top of tank walls or in channels do not require insulation.

Note 6: - Entire exterior (both buried and exposed) Scum Piping System to be insulated to suit heat tracing.

Note 7: - HWR pipes within the SIT Trenches are not to be insulated.

Note 8: - Insulate drain line from Electrical Service Building, and the Service Building Electrical Room AC Units.

Note 9: - Insulate storm drains at first horizontal branch from the roof drain to next elbow, minimum 1000mm. Insulate storm drain inside building where drain discharges to grade, and to 300mm above the heat trace wye connection.

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 The following specification pertains to all Division 11 and Division 15 ducting that require insulation.

.2 The drawings may contain additional insulation requirements.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
- .1 Thermal Insulation Association of Canada (TIAC)
- .2 TIAC Best Practices Guide.
- .3 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1: SI Edition, Energy Standard for Buildings except Low-Rise Residential Buildings.
- .4 American Society for Testing and Materials (ASTM):
  - .1 ASTM C177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
  - .2 ASTM C 335: Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411: Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
  - .4 ASTM C 449/C 449M: Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - .6 ASTM C 534: Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
  - .7 ASTM C 547: Standard Specification for Mineral Fiber Pipe Insulation.
  - .8 ASTM C 553: Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .9 ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .10 ASTM C 795: Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .11 ASTM C 921: Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .12 ASTM E 84: Standard Test Methods for Surface Burning Characteristics of Building Materials.
  - .13 ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials
- .5 National Fire Protection Association (NFPA)
  - .1 NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems
  - .2 NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Material

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 51.9: Mineral Fibre Thermal Insulation for Piping and Round Ducting
- .2 CGSB 51.10: Thermal Insulation, Mineral Fiber, Block or Board, for Ducting, Machinery and Boilers
- .3 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation
- .4 CGSB 51.53: Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

.4 Underwriters Laboratories of Canada (ULC)
  .1 CAN/ULC-S102: Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  .2 UL-723: Standard for Test for Surface Burning Characteristics of Building Materials

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Divisions 1 and 15.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS.
  .1 Performance data for each insulation type.
  .2 Submit TIAC installation method from published standard clearly listing which service each installation method will apply to. Note variances from published standard.
  .3 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

.3 Submit samples/mock up where requested.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Not Applicable

1.6 QUALITY ASSURANCE

.1 Provide insulation to NFPA Standard 90A, and 255, Latest edition; as well as UL-723 Latest edition fire hazard ratings.

.2 Unless indicated otherwise all insulation to be installed to published standards of Thermal Insulation Association of Canada (TIAC).

.3 Flameproofing treatment to withstand high humidity conditions without deterioration.

.4 Performance Requirements defined: Catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.

.5 The contractor performing the work of this section shall be a recognized installer of insulation systems and have a minimum of five (5) years experience which can be documented and verified. The contractor shall be a current and listed member of TIAC (Thermal Insulation Association of Canada).

.6 Conform to the latest edition of the Ontario Building Code, ASTM 411 and ULC requirements.

.7 Where applicable products shall bear a ULC or UL label.

.8 Contractor to complete sample installation in the field for Consultant's review prior to proceeding with the work. Sample installation to include straight pipe, one valve, a tee or elbow and a mechanical piping joint.

1.7 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Provide adhesives, sealers, vapour coating, mastics, laggings and bedding compounds compatible with materials to which they are applied.

.2 Material not to soften, corrode or otherwise deteriorate in either wet or dry state and be type recommended by manufacturer as suitable for proposed application.

2.2 MATERIAL THICKNESS

.1 Insulation system thickness for the following operating temperatures:

Insulation Thickness	Operating Temperature
50 mm in 2 layers	-40°C to 0°C
25 mm	0°C to 65°C

2.3 GLASS FIBRE INSULATION TYPE ID-1

.1 Material, glass fibre, flexible blanket type, to CGSB 51-GP-11b, Type 1.

.2 Density: 16 kg/m³.

.3 Temperature rating: to 120°C.

.4 Conductivity: 0.036 W/m/°C @ 24°C.

.5 Facing: RFFRK, factory applied facing of reinforced foil-faced flame resistant Kraft paper.

.6 Fastenings:
- .1 Adhesive to ASTM E-84.
- .2 Glass fibre or 1.6 mm annealed wire ties.
- .3 Tape, 100 mm wide, self-adhesive RFFRK.

.7 Standard of Acceptance:
- .1 Knauf.

.2 Manson.
.3 Fibrex.
.4 Adhesive: Flintkote Type 230-04.

2.4 GLASS FIBRE INSULATION TYPE ID-2

.1 Material: glass fibre, rigid board type, to CGSB 51-GP-10M.

.2 Density: 72 kg/m³.

.3 Temperature rating: to 120°C.

.4 Conductivity: 0.032 W/m/°C.

.5 Facing: RFFRK, factory applied facing of reinforced foil-faced flame resistant Kraft paper.

.6 Fastenings:
.1 Mechanical fasteners, welded pins, speed washers or clips.
.2 Tape: 100 mm wide, self-adhesive RFFRK.

.7 Standard of Acceptance:
.1 Knauf.
.2 Manson.
.3 Fibrex.

2.5 COVERING / JACKETS

.1 Aluminum: embossed corrugated aluminum sheet, 0.4 m thick, mechanical fasteners.
.1 Standard of Acceptance: Childers.

2.6 FASTENINGS AND SUPPORTS

.1 Weld pins 3 mm mild steel, length as required to suit insulation, with 32 mm x 32 mm plated clips nylon stops.

2.7 FACING MATERIALS

.1 Vapour barrier jacket and facing material to CGSB 51-GP-52 for duct thermal insulation.

PART 3 - EXECUTION

3.1 GENERAL

.1 Insulate all ducting not at ambient temperature to prevent surface condensation and to keep surface temperature below 70°C.
.1 Insulate all outside air ductwork up to coil or factory insulated air-handling unit (thickness 50 mm).

.2 Insulate exhaust only from outside wall to 300 mm past exhaust damper (i.e., 300 mm on warm side of damper or 900 mm from outside wall), (thickness 50 mm).

.3 Insulate all outside air intakes, not provided with a coil, up to point where air discharges to space (thickness 50 mm).

.2 Provide Type ID-2 for all rectangular duct exposed to outside air and as outlined below unless indicated to a greater extent on drawings.

.3 Provide Type ID-1 for all round cooling duct and Type ID-2 for all rectangular cooling duct and as listed below unless indicated to a greater extent on drawings.

.1 Cooling supply to diffuser (thickness 25 mm)

.2 Cooling return in unconditioned spaces (thickness 25 mm)

3.2 EXTERIOR JACKET

.1 Provide aluminum jacket for insulated ducting in process areas and mechanical rooms.

.2 Provide aluminum jacket for all insulated ductwork in ceiling spaces or concealed in offices or finished areas.

3.3 WEATHERPROOF SYSTEM

.1 Secure 50 mm thick rigid insulation, Type ID-2 to duct surface with mechanical fasteners spaced 5 per m² on sides and bottom, adhesive for top of duct.

.2 Seal all breaks and joints with 100 mm wide RFFRK adhesive tape.

.3 Cover insulation surface with peel and stick roofing membrane.

.4 Apply aluminum cover to insulated ductwork exterior to building.

.5 Silicone based heat resistant caulking: set into glass fabric reinforcing cloth extending 75 mm each side of caulk line, at flashings and where weather barrier joint is required.

3.4 INSTALLATION

.1 Prior to installation ensure that:

.1 Surfaces to be covered are clean and dry.

.2 Insulation is clean and dry.

.2 Application:

.1 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.

.2 Duct insulation with vapour barrier to be continuous.

.3 Joints:

.1 Place joints on top of duct.

.2 Adhere and seal laps of vapour barrier cover, or vapour barrier strip of 75 mm minimum width furnished with insulation, using vapour seal adhesives.

.3 Round ductwork: cover with flexible duct insulation, install without sagging. Apply duct insulation adhesive in 75 mm wide strips at 460 mm centres on sides and bottom of duct. Provide one row of pins on bottom and sides of ducts up to 500 mm wide and two rows of pins on ducts over 500 mm wide. Secure insulation with speed washer or clip. Seal all joints and breaks with 100 mm wide self-adhesive embossed aluminum foil vapour barrier tape

.4 Stagger both longitudinal and horizontal joints, on duct insulation of multi-layered construction.

.5 Rectangular ductwork: cover with rigid glass fibre insulation and at least 50 mm overlapping seams located where least visible. Use adhesive lagging to secure overlapping edges, provide over vapour barrier jacket or coating.

.6 Exterior ductwork: cover insulated ductwork outside building with aluminum sheet material. Attach with mechanical fasteners. Overlap 100 mm at joints

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Supply, install and test all process piping and related appurtenances in accordance with the Contract Documents.

.2 This section covers process piping, both above and below grade which typically extends 1m beyond the outer perimeter of building structures (unless specifically noted otherwise). Beyond this point refer to Division 2 for yard piping details.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of the project tender date.

- .1 American Iron and Steel Institute (AISI).
- .2 American Society of Mechanical Engineers (ASME):
  - .1 ASME-B1.20.1 - Pipe Threads, General Purpose, Inch.
  - .2 ASME-B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - .3 ASME-B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.
  - .4 ASME-B16-11 - Forged Fittings, Socket-Welding and Threaded.
  - .5 ASME-B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  - .6 ASME-B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  - .7 ASME-B31.1 - Power Piping.
  - .8 ASME-B31.3 - Process Piping.
  - .9 ASME-B36.10 - Welded and Seamless Wrought Steel Pipe.
  - .10 ASME-B36-19 - Stainless Steel Pipe.
- .3 American Society for Testing Materials (ASTM):
  - .1 ASTM A47 - Ferritic Malleable Iron Castings.
  - .2 ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - .3 ASTM A105 - Carbon Steel Forgings for Piping Applications.
  - .4 ASTM A106 - Seamless Carbon Steel Pipe for High-Temperature Service.
  - .5 ASTM A182 - Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - .6 ASTM A193 - Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose.
  - .7 ASTM A194 - Carbon Steel, Alloy Steel and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
  - .8 ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  - .9 ASTM A312 - Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .10 ASTM A380 - Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
  - .11 ASTM A403 - Wrought Austenitic Stainless Steel Piping Fittings.
  - .12 ASTM A536 - Standard Specification for Ductile Iron Castings.
  - .13 ASTM A774 - As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

.14 ASTM A778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products.
.15 ASTM B32-08 - Standard Specification for Solder Metal.
.16 ASTM B88 - Seamless Copper Water Tube.
.17 ASTM-B363 - Standard Specification for Seamless and Welded Unalloyed Titanium and Titanium Alloy Welding Fittings.
.18 ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
.19 ASTM C283 - Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
.20 ASTM C1007/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
.21 ASTM D792 - Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
.22 ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
.23 ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
.24 ASTM D2240 - Standard Test Method for Rubber Property-Durometer Hardness.
.25 ASTM D2464 - Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
.26 ASTM D2467 – Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
.27 ASTM D2564 - Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
.28 ASTM D7091 - Standard Practice for Non-Destructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
.29 ASTM E814 (UL 1479) - Standard Test Method for Fire Tests of Penetration Firestop Systems.

.4 American Water Works Association (AWWA):
.1 AWWA-C110 - Ductile Iron and Gray Iron Fittings.
.2 AWWA-C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
.3 AWWA-C151 - American Standard for Ductile Iron Pipe, Centrifugally Cast for Water.
.4 AWWA-C207 - Class D Rings and Blind Flanges.
.5 AWWA-C219 - Bolted, Sleeve Type Couplings for Plain-End Pipe.
.6 AWWA-C800 - Underground Service Line Valves and Fittings.

.5 Canadian Standards Association (CSA)
.1 CSA-B51 - Boiler, Pressure Vessel, and Pressure Piping Code.
.2 CSA-B149.6 - Code for Digester Gas, Landfill Gas, and Biogas Generation and Utilization.

.6 National Sanitation Foundation (NSF):
.1 NSF 61 – Drinking Water System Component – Health Effects.

.7 International Association of Plumbing and Mechanical Officials (IAPMO):
.1 IAPMO PS 117 – Press and Nail Connections.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS.
.1 Product Data:
.1 Schedule of all process piping services to be installed in the project schedule to include:
.1 Transport media.

.2 Range of pipe size.
.3 Pipe material.
.4 Joining method.
.5 Pipe grade, classification and applicable standards.
.6 Design pressure.
.7 Test pressure.
.8 Coating type.
.9 Corrosion allowance.

.2 For each piping system include detailed information on pipe fittings, flanges, face rings, bolting and gaskets.

.2 Operation and Maintenance Data:

.1 Operation and Maintenance Manual – refer to Division 1 and Section 15014 for requirements.

.3 Quality Control Submittals:

.1 Submit welder qualification on an annual basis. Welders to be certified for material and position within 12 months of any work being erected.
.2 Pipe fabrication contractor to submit quality control manual for the fabrication, assembly and erection of piping in accordance with CSA-B51 and ASME B31.3.
.3 Pipe coating applicator certification.
.4 Grooved pipe manufacturer's installation inspection reports.
.5 Documentation certifying that suitable solvent is being used for the intended plastic piped service.
.6 Submit chemical tubing sample along with chemical compatibility information.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment/piping accessories.

1.6 QUALITY ASSURANCE

.1 Contractor to review all piping systems and proposed routing prior to installation. The Contractor is integral to the quality control process in accordance with Division 1 and is to identify interferences between equipment, piping and the work of other trades. Plan pipe routing prior to installation of sleeves.

.2 Piping covered in this section is to confirm to ASME B31.3 unless otherwise indicated.

.3 Comply with applicable codes and regulations.

.4 For grooved pipe installations, the manufacturer or its representative shall provide on-site training for the Contractor and shall periodically visit the job site to inspect the installation and submit an inspection report.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

.2 Refer to Section 15030 for Testing Requirements.

1.8 TRAINING:

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY:

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Use various types of pipes, fittings and accessories for process piping as specified herein. Provide other piping requirements as shown on the drawings. Conform to detailed requirements of each product as listed herein.

.2 Alternate pipe materials to those already listed may be considered if demonstrated to be technically equal and there is a cost savings to the Owner. Alternates must be approved by Consultant prior to fabrication or ordering of materials. Refer to Division 1.

.3 Design the system to ASME and AWWA standards. Refer to Piping Data Sheets for additional requirements.

2.2 PIPING

.1 Refer to Process Pipe Schedule and the Piping Data Sheets which are included at the end of this specification section.

.2 The drawings indicate the preferred pipe material class for the specific service. The Pipe Schedule references the Pipe Data Sheets to provide detailed material requirements and possible alternate material options.

2.3 GLASS LINING

.1 Required where indicated on the drawings and in the Pipe Schedule. Ductile iron pipe and fittings shall be glass lined and provided by a single manufacturer.

.2 Glass lining designed to handle typical sludge and grit slurries of wastewater treatment plants.

.3 Lining applied to pipe fittings to be hard, smooth and have a continuously applied vitreous inorganic material. Liner to be molecularly bonded to prepared ductile iron surface and be of a bright colour to facilitate defect detection.

.4 Lining to have a hardness between 5 to 6 mohs and a minimum applied thickness of .254 mm consistent with ASTM D7091. Lining density to be 2.5 to 3.0 grams per cubic centimeter in accordance with ASTM D-792.

.5 Lining to be designed to withstand a strain of .001 mm/mm to the base metal without visible damage to the glass.

.6 Lining shall be capable of withstanding a pH level between 3 and 10 at a temperature of 50°C.

.7 The glass lining shall show a weight loss not exceeding 3 milligrams per square inch when tested in accordance with ASTM C283.

.8 Specified Product: Fast Fabricators Vitco S6-14.

.9 Alternate Manufacturers:
- .1 U.S. Pipe Fabrication
- .2 Custom Fab.
- .3 C & B Piping Inc.

2.4 ADAPTOR FLANGE

.1 General:
- .1 Rigid adaptor flanges for existing plain end ductile iron, steel or PVC pipe to connect to different pipe materials; also, to connect to underground services entering the building.

.2 PVC Pipes:
- .1 Positive end restraint with a series of serrations on inside of flange. Two flange haves to be bolted together without generating point loads on pipe.
- .2 Ductile Iron ASTM A536 flange drilled to ASME B16.5 150 lb. flange. Pressure Rating: 1035 kPa.
- .3 Gasket: EPDM with a 50 to 150°C temperature range.
- .4 Specified Product: Ford Meter Box Uniflange, Series 900.
- .5 Alternate Manufacturers:
  - .1 Dresser.
  - .2 Robar.
  - .3 Smith & Blair.

.3 Steel Pipes:
- .1 Ductile Iron ASTM A536 flange drilled to ASME B16.5. Flange fastened to plain end by series heat treated AISI 4140 steel set screws.
- .2 Gasket: EPDM with a 50 to 150°C temperature range.
- .3 Specified Product: Ford Meter Box Uniflange Series 200.
- .4 Alternate Manufacturers:
  - .1 Dresser.
  - .2 Robar.
  - .3 Smith & Blair.

.4 Grooved Pipe:
- .1 For use with AWWA grooved end pipe and fittings for mating to ASME B16.1, Class 125 Flanged Components.

.2 Specified Product: Victaulic Style 341.
.3 Alternate Manufacturers:
.1 Approved equal.

2.5 FLEXIBLE FLANGED COUPLING ADAPTOR:

.1 Flexibly adapt plain end pipe to flanged end. Minimum 1030 kPa pressure rating.

.2 Construction:
.1 Flange and Body: ASTM A536 ductile iron, flange drilled to AWWA C207, Class D, 150 lbs.
.2 Fasteners: Passivated 304 stainless steel nuts coated with anti-galling compound.
.3 Coating: Minimum two coats of enamel.

.3 Application: PVC, ductile iron, steel pipe, buried or above-ground application.

.4 Specified Product: Robar 7406.

.5 Alternate Manufacturers:
.1 Dresser
.2 Smith & Blair
.3 Ford Meter Box.

2.6 FLEXIBLE PIPE COUPLINGS (UNRESTRAINED)

.1 Flexible connection of plain end pipes in an unrestrained above ground application.

.2 Coupling to have progressive sealing effect to allow 5 degrees of angular deflection in any direction.

.3 Coupling to provide leakproof axial movement of connected pipes.

.4 Construction:
.1 Casing: 304 or 316 stainless steel.
.2 Bolts: Stainless or AISI 4135 steel.
.3 Bar: Stainless or galvanized steel.
.4 Sealing Sleeve: EPDM with a temperature range from -20°C to 100°C.

.5 Minimum Pressure Rating: 450 kPa.

.6 Application:
.1 Water/wastewater.
.2 Low temperature air (less than 100°C).

.7 Specified Product: Straub Flex Series.

.8 Alternate Manufacturers: Teekay Couplings.

2.7 FLEXIBLE PIPE COUPLING (UNRESTRAINED BELOW GRADE)

.1 Flexible connection of plain end pipes in an unrestrained below grade application.

.2 Coupling to comply with AWWA C219.

.3 Construction:
- .1 Centre Sleeve: ASTM A536 ductile iron.
- .2 Ending Ring: ASTM A536 ductile iron.
- .3 Gaskets: BUNA-S rubber compound to ASTM D2000.
- .4 Coating: Minimum two coats of enamel.
- .5 Fasteners: To AWWA C111 Standards. 304 stainless steel construction with anti-galling compound.

.4 Pressure Rating: 1035 kPa.

.5 Specified Product: Robar 1406.

.6 Alternate Manufacturers:
- .1 Dresser
- .2 Smith Blair
- .3 Ford Meter Box.

2.8 MECHANICAL TEE FLUSHING DRAIN CONNECTION

.1 Strap-on service saddle used to make a service outlet off of a transmission or distribution line.

.2 Outlet Size: 40 mm.

.3 Construction:
- .1 Saddle Body: ASTM A536 ductile iron with outlet thread to AWWA C-800-05.
- .2 Gasket: BUNA-S rubber compound to ASTM D-2000.
- .3 Strap: Double strap design of 14 gauge 304 stainless steel.
- .4 Fasteners: 304 stainless steel studs complete with stainless steel nuts coated with anti-galling compound.
- .5 Coating: Minimum two coats of red enamel.

.4 Pressure Rating: 1035 kPa.

.5 Specified Product: Robar 2406.

.6 Alternate Manufacturer:
- .1 Dresser
- .2 Smith Blair
- .3 Ford Meter Box.

2.9 EXPANSION JOINTS (PROCESS AIR SERVICE)

.1 Single unfilled heavy duty spool type expansion joint.

.2 Construction:
- .1 Flanges: baked enamel ductile iron backing rings drilled to ASME B16.5, Class 150.
- .2 Body: multiple ply EPDM rubber impregnated fabric and tire cord bonded between Kevlar tube and cover.
- .3 Control Rods: hot dipped galvanized steel control rods and hoop rings.

.3 Provide control rods where expansion joint is located in unanchored pipe.

.4 Temperature Rating: 175°C.

.5 Pressure Rating: 200 kPa.

.6 Axial Expansion: 100 mm (minimum).

.7 Axial Compression: 200 mm (minimum).

.8 Specified Product: Mercer Rubber Co. Series 450.

.9 Alternate Manufacturer:
- .1 Garlock
- .2 Approved equal.

2.10 COMBUSTIBLE PIPE PENATRATION

.1 Combustible pipe penetrating fire separations are to be fitted with a UL classified collar rated for the specific fire rating. Device to be tested in accordance with ASTM E814 (UL 1479).

.2 Specified Product: 3M Ultra PPD Plastic Pipe Device.

.3 Alternate Manufacturers:
- .1 Approved equal.

2.11 QUICK COUPLING

.1 Where quick couplings are shown on the Contract Drawings, provide stainless steel quick couplers complete with Buna-N rubber compound gaskets.

.2 Quick couplers to be provided with chained dust caps.

.3 Quick couplers shown in exterior locations to be lockable.

.4 Connection type to suit piping arrangement.

.5 Specified Product: Dixon Cam and Grove.

.6 Alternate Manufacturers:
.1 OPW
.2 Evertite.

2.12 HOSES AND DISCHARGE NOZZLE

.1 Provide dedicated washdown hoses for each interior water hose bib or wall hydrant location shown on the drawings.

.2 Hose to be 15 m long, 40 mm diameter, lay flat type and to be complete with stainless steel Camlock Quick Coupling fittings on both ends. Discharge end to have a fully adjustable stainless steel nozzle.

.3 Temperature Rating: -30° to 85°C.

.4 Pressure Rating: 1035 kPa.

.5 Construction:
.1 Tube: high density PVC or Buna-S rubber compound.
.2 Reinforcement: circular woven synthetic cord.
.3 Cover: polyester or PVC.

.6 Specified Product:
.1 JGB Enterprises Eagle Water HD150.

.7 Alternate Manufacturer:
.1 IRP Rubber.
.2 Trelleborg.
.3 Approved equal.

2.13 HOSE RACK

.1 Provide heavy duty hose rack for each water washdown location shown on drawings.

.2 Constructed of minimum 12 gauge carbon steel. Curved saddle design to minimize sharp bends.

.3 Coating: red enamel finish.

.4 Rack to be suitable for 15 m of 40 mm diameter lay flat hose.

.5 Specified Product: Dixon HR1610 Series.

.6 Alternate Manufacturers:
.1 Approved equal.

2.14 LOW POINT LEAK DETECTION

.1 Provide low point leak detection system for secondary containment piping systems where indicated on the drawings.

.2 Electronic low point leak detection to continuously monitor double contained pipes.

.3 Three (3) sensors required for ferric chloride chemical dosing system.

.4 Sensors: Capacitive type sensors proximity:
- .1 Installed in line to allow leakage to accumulate.
- .2 Sensors to have an LED light to signal operation.
- .3 Sensor sensitivity control to reduce nuisance activation.
- .4 Non-intrusive sensor, 3 wire, 24 VDC, normally closed solid state switch.
- .5 Power to sensor from control panel.
- .6 Sensor switch to open when fluid is detected in the outer containment pipe.

.5 Control Panel:
- .1 Control panel to be NEMA 4X FRP construction.
- .2 Control panel power requirements 120 V, 60 Hz.
- .3 Control panel to have the following requirements:
  - .1 Keyed on/off switch and alarm silence switch.
  - .2 Audible and visual alarms.
  - .3 HMI buttons to allow user to scroll through history, status and test screens.
  - .4 Form C dry contact relay rated for 5A@120 VAC for general alarm.

.6 Specified Product: Ipex Centra-Guard.

.7 Alternate Manufacturers:
- .1 Approved Alternate.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION:

.1 Before commencing work, accurately locate all existing pipes and services affected by the work. Consult with Consultant on alterations that may become necessary as a result of the investigation.

.2 Review plans of original construction, available by request from the Consultant, as required to assist in the identification and location of services. Confirm locations by field verification.

.3 Confirm that the site conditions and any relevant existing piping are ready to receive work. Ensure that new piping, fittings and connections are free from defects and are clean prior to installation. Damaged items are to be discarded and replaced.

.4 Determine and confirm that the proposed piping is of the correct size, material and location to connect to its termination point.

.5 Pipe routing and final equipment installation must be coordinated on site with other disciplines prior to fabrication. Refer to Section 15010 with respect to preparation of coordination drawings.

.6 All piping accessories to be installed in strict accordance with the manufacturer's written instructions.

3.2 INSTALLATION

.1 Install piping, joints, fittings and piping accessories as shown on the drawings and in accordance with manufacturer’s written instructions/recommendations. Notify Engineer when conflicts arise between manufacturer’s recommendations and the Contract Documents. Await direction.

.2 Become informed of installation requirements and dimensions of equipment required to be connected to piping. Where piping is to connect to equipment, preliminary dimensions have been shown that must be verified with the equipment supplier's shop drawings.

.3 Dimensions, routing and layouts indicated on the drawings are based on specified equipment. Should alternatives be approved in accordance with Section 01340, the Contractor is responsible for all required modifications. Dimensioned drawings to be submitted are subject to Consultant's approval.

.4 The Contractor is responsible to provide all necessary fittings, reducers, etc. to connect equipment and accessories to provide a complete piping system.

.5 Install piping to permit equipment access and valve servicing.

.6 Specific joint locations and requirements are shown on the drawings. Provide flanges and regular intervals to industry standards to facilitate system servicing and maintenance.

.7 Install pipes to be free of sags. Minimize the number of bends required and slope pipes where indicated in the Contract Documents.

.8 Use of fabricated fittings will not be accepted where manufactured fittings are available.

.9 Install a pipe joint on both sides of pipes penetrating a slab, wall, ceiling, floor, or foundation.

.10 Route piping so as to:

- .1 Allow the application of insulation if required.
- .2 Allow a minimum of 25 mm clearances between the outer extremities of pipe runs, including insulation, if required.
- .3 Avoid running liquid retaining pipes through electrical rooms.
- .4 Not interfere with regular operation of equipment including control panels and respect manufacturers and code mandated clearances.
- .5 Not impede any proposed travel paths, windows or ladder accesses.

.11 Maintain indicated fire ratings of walls, ceilings, floors, etc., at pipe penetrations by sealing resulting voids with approved firestop sealant.

.12 Make connections to all equipment and fixtures. Some small diameter pipe has been omitted from drawings for clarity. Connections to fixtures to be no less than 12 mm or connection size, whichever is greater.

.13 Joints:

- .1 Unless otherwise noted, all joints to be restrained.
- .2 Refer to data sheets for additional requirements.
- .3 Denso Paste to be applied to bolt threads.

.4 Buried bolted joints:
  .1 Fastener assembly to be 316 stainless steel.
  .2 Denso paste/tape shall be applied to entire fastener assembly in accordance with manufacturer's instructions.
.5 Submerged joints:
  .1 Fastening assembly to be 316 stainless steel.
.6 Threaded joints:
  .1 Apply Teflon® tape to male threads/at screwed joints.
  .2 Ensure sufficient thread length to fully secure fitting but do not exceed three completely exposed threads once fitting is installed.
.7 Solvent welded joints:
  .1 Ensure solvent proposed is in conformance to manufacturer's recommendation for use with the piped fluid.
.8 Flanged joints:
  .1 Install gasket concentrically on flange.
  .2 Use flat face flanges when connecting to flat faced ductile iron or cast iron flanges.
.9 Soldered joints:
  .1 Apply ASTM B813-08 flux suitable for use with the piped fluid.
  .2 Use ASTM B32 lead-free solder suitable for use with the piped fluid.
  .3 Clean away any excess solder after completing joint.
  .4 Ensure that any pipe component, equipment, cables, structure, etc., is protected from potential heat damage when constructing joint.

.14 Reducers:
  .1 Eccentric Reducers: Install eccentric reducers on pump suction lines so that no air can be trapped and top of both pipes is at same elevation.
  .2 Reducers to gradually transition from one diameter to the other. Drastic changes such as provided by a reducing coupling will not be acceptable.

.15 Couplings:
  .1 Weld steel tables on both sides of Straub type couplings to prevent coupling creep.

.16 Pipe sleeves:
  .1 Required for pipes:
    .1 Penetrating concrete liquid retaining structures.
    .2 Penetrating below grade building envelope.
    .3 As indicated on the drawing.
  .2 Refer to Section 15056 for sleeve details.

.17 Drains and Flushing Connection:
  .1 Drains required:
    .1 At all local low points in a pipe system.
    .2 Immediately above isolation valves in vertical installation.
    .3 Where indicated on drawings.
  .2 Flushing Connections required:
    .1 Where indicated on Drawings or wherever required to enable the flushing of the entire system and not more than every 30m.
    .2 Other drains to be a minimum of 12 mm diameter complete with end cap.
    .3 Caps for all effluent water and process lines to be Camlock Quick Coupling type.

.4 Drains on sludge and sewage lines to be a minimum 40mm diameter and to consist of a ball valve and end cap. Refer also to drawing details.

.18 Air Vents:

.1 Required:

.1 At all local high points in a pipe system.

.2 Where indicated on drawings.

.2 Manual air vent to comprise of a 20 mm diameter ball valve complete with end cap.

.19 Primary Control Elements:

.1 Install primary control elements in the piping system where shown or to manufacturer's written instruction.

.20 At completion of installation process, stainless steel pipes to be cleaned by scrubbing and washing with a pickling solution to remove any iron stains.

3.3 GROUTING

.1 Grouting required:

.1 Around equipment baseplates and anchors.

.2 Within equipment bases, where applicable.

.3 On concrete bases to provide smooth resting surface for pipes.

.4 Around pipe and sleeve penetrations.

.5 Where indicated on drawings.

.2 Grouting to be installed in accordance with Division 3.

3.4 PIPE SUPPORT AND ANCHORAGE

.1 To be in accordance with Section 15060.

3.5 TESTING AND REPAIR OF LEAKS

.1 To be in accordance with Section 15030.

3.6 CLEANING AND STERILIZATION

.1 To be in accordance with Section 15083.

.2 Take every precaution to prevent foreign material from entering pipes during installation.

.3 Thoroughly clean and swab interior of each pipe section and fitting before installation.

.4 Flush and sterilize system carrying potable water when installation is complete.

3.7 PROCESS PIPE SCHEDULE

.1 The 'Process Piping Schedule' is for convenience only and is not guaranteed to be complete. No claims will be considered on account of discrepancies or omissions in this Schedule. Refer also to drawing notes and pipe data sheets which supersede this schedule.

3.8 HEAT TRACING

.1 Heat tracing to be provided where indicated on drawings.

.2 Heat tracing to be per Division 16.

3.9 SUPPLEMENTS

.1 Process Pipe Schedule.

.2 Pipe Data Sheets:
- .1 304 Stainless Steel ID Pipe, SS-1.
- .2 304 Stainless Steel Schedule Pipe, SS-2.
- .3 316 Stainless Steel Schedule Pipe, SS-3.
- .4 PVC Pipe, PVC-1.
- .5 Copper Pipe, CU-1.
- .6 Flexible Plastic Tubing, Flex-1.
- .7 Poly Ethelene Pipe, PE-1.
- .8 Double Containment Pipe, DC-1.

END OF SECTION

SYSTEM IDENTIFIER		PIPE MATERIAL	COMMENT
PROCESS PIPING			
EFF1	Primary Effluent	SS-1; CPP	(4)
EW	Effluent Water	CU-1; SS-2, PE	(2), (7)
RSE	Raw Sewage	SS-1	
RSP	Raw Septage	SS-1	
SL	Sludge	SS-1	
RAS	Return Activated Sludge	SS-1	
WAS	Waste Activated Sludge	SS-1	
SCM	Scum	SS-1	
PA	Process Air	SS-1	
ODR	Odour Control	SS-1	
OF	Overflow	SS-1; PVC-1	(6)
DR	Drain	SS-1; PVC-1	(6)
VENT	Vent		(6)
CHEMICAL PIPING			
FCL	Ferric Chloride	PVC-1; DC-1; FLEX-1	(5)

GENERAL NOTES:

- The drawings identify the material class associated with a particular pipe. The Process Pipe Schedule defines the pipe material to be used and references the Pipe Data Sheets for detailed pipe specification.
- The Process Piping Schedule does not preclude individual specification requirements.
- In the event of conflict, the Process Pipe Schedule will supersede the Data Sheets and the Drawings.
- All sample piping to be constructed of stainless steel type SS-2.

SCHEDULE NOTES:

(1) Refer to related system piping specification and/or drawings.
(2) Copper piping for line size 50 mm and less. Stainless steel piping for larger diameter pipe.
(3) Flexible tubing to connect to equipment and/or tankage.
(4) Refer to Division 2 for Concrete Pressure Pipe details.
(5) Material in parenthesis required for connection to equipment and/or tankage.
(6) Material as indicated on Drawings or per related process fluid as approved by Consultant.
(7) All effluent water piping within the Headworks Facility to be type SS-2. Stainless Steel regardless of pipe size.

Application	• Where indicated in the Contract Documents. • SS-1 may be used for the following services: (i) Raw Sewage (iv) All Process Sludges (ii) Primary Effluent (iii) Process Air		
Design Code	ASME B31.3 Design Class: Normal Fluid Service		
Supplemental Design Code	NSF 61 for Potable Water Application		
Design Pressure	Pipe Size 0 – 250 mm 1034 kPa (150 psi) Pipe Size 300 – 750 mm 620 kPa (90 psi) Pipe Size 900 – 1500 mm 410 kPa (60 psi)		
Design Temperature	20°C (70°F)		
Testing Requirements	Refer to Section 15030.		
Item	**Size (mm)**	**Description**	**Notes**
Pipe	Under 40	Austenitic Stainless Steel ASTM A312 Seamless Grade 304 L. Dimensions: ASME B36.19. Wall Thickness: Schedule 40.	
	40 - 600	Austenitic Stainless Steel ASTM A778 as Welded Grade 304 L.	
	40 - 200	Wall Thickness = 2.0 mm (14 gauge).	
	250 - 300	Wall Thickness = 3.2 mm (11 gauge).	
	350 - 450	Wall Thickness = 3.6 mm (10 gauge).	
	500 - 600	Wall Thickness = 4.7 mm (3/16”).	
	750 - 1500	Wall Thickness = 6.3 mm (1/4”).	
Fittings	Under 40	Threaded to Socket Welded Forged Stainless Steel ASTM A182, Grade 304 L, 6900 kPa. Fitting Dimensions: ASME B16.11.	(1) (2)
	40 and Larger	Butt Welded Austenitic Stainless Steel ASTM A774, Grade304 L Fittings. Wall Thickness: Match that of Adjoining Pipe.	
Flanges	Under 40	Class 150, Raised Face, Forged Stainless Steel, ASTM A182, Grade 304 L. Threaded or Socket Welded, ASME B16.5.	(3)
	40 and Larger	Type 304 L Stainless Steel Pressed Neck or Rolled Angle Type. Backing Flange to be Type 304 L Stainless Steel, ASME B16.5, Class 125.	
	All Sizes	Flange Thickness to Meet Pressure Rating.	
Fasteners	All Sizes	Bolts: ASTM A193 Grade B8, Class1 Stainless Steel Hex Bolts. Nut: ASTM A194, Grade 8, Stainless Steel Nut Head.	
Gaskets	All Sizes	Ring or Full Face, Non-asbestos. Thickness in accordance with manufacturer recommendations . Product: Garlock Blueguard Series.	(4)

GENERAL NOTES:

- Pipes and fittings to be pickled and passivated to ASTM A380.
- Long radius elbows to be used unless indicated otherwise.
- Stub-in style tee connection not permitted.

SCHEDULE NOTES:

(1) Threaded connections only where required by equipment or otherwise indicated. Anti-seize compound required.
(2) Provide olet reinforcements for connection of small diameter piping where standard tees are not commercially available.
(3) Where indicated by equipment, flat face flanges may be used. Flat face flanges are not to be connected with raised face flanges.
(4) Gasket manufacturer to confirm chemical compatibility of gasket with intended pipe service.

Application	• Where indicated in the Contract Documents. • SS-2 may be used for the following services: (i) Raw Sewage (v) All Sludges (ii) Primary Effluent (vi) Supernatant (iii) Effluent Water (iv) Process Air		
Design Code	ASME B31.3 Design Class: Normal Fluid Service		
Design Pressure	1034 kPa (150 psi)		
Design Temperature	20°C (70°F)		
Testing Requirements	Refer to Section 15030.		
Item	**Size (mm)**	**Description**	**Notes**
Pipe	All Sizes	Annealed Austenitic Stainless Steel ASTM A312 Seamless Type 304L Dimensions: ASME B36.19 Wall Thickness: Schedule 40s	
Fittings	Under 40	Threaded or Socket Welded forged Stainless Steel ASTM A182 Grade 304L, 6900 kPa Dimensions: ASME B16.11 Wall Thickness: Match that of Adjoining Pipe	(1) (2)
	40 and Larger	Butt Welded Austenitic Stainless Steel ASTM A403 Class WP Grade 304L Fittings Dimensions: ASME B16.9 Wall Thickness: Match that of Adjoining Pipe	
Flanges	Under 40	Class 150, Raised Face, Forged Stainless Steel, ASTM A182 Grade 304L Threaded or Socket Welded, ASME B16.5	(3)
	40 and Larger	Class 150, Raised Face, Forged Stainless Steel, ASTM A182 Grade 304L Butt Welded, ASME B16.5	
Fasteners	All Sizes	Bolts: ASTM A193, Grade B8, Class 1 Stainless Steel Hex Head Bolts Nut: ASTM A194, Grade 8, Stainless Steel Head Nut	
Gaskets	All Sizes	1.6 mm Ring or Full Face, Non-asbestos, Garlock Blueguard Style	(4)

GENERAL NOTES:

- Di-electric separation required when dissimilar materials are connected.
- Pipes and fittings to be pickled and passivated to ASTM A380.
- Long radius elbows to be used unless indicated otherwise.
- Stub-in style tee connection not permitted.

SCHEDULE NOTES:

(1) Threaded connections only where required by equipment or otherwise indicated. Anti-seize compound required.

(2) Provide olet reinforcements for connection of small diameter piping where standard tees are not commercially available.

(3) Where indicated by equipment, flat face flanges may be used. Flat face flanges are not to be connected with raised face flanges.

(4) Gasket manufacturer to confirm chemical compatibility of gasket with intended pipe service.

Application	• Where indicated in the Contract documents. • SS-3 may be used for the following areas: (i) Septage Receiving Station		
Design Code	ASME B31.3 Design Class: Normal Fluid Service		
Supplemental Design Code	CSA B149.6		
Design Pressure	1034 kPa (150 psi)		
Design Temperature	60°C (140°F)		
Testing Requirements	Refer to Specification Section 15030		
Item	**Size (mm)**	**Description**	**Notes**
Pipe	All Sizes	Annealed Austenitic Stainless Steel ASTM A312 Seamless Type 316L Dimensions: ASME B36.19	
	6 - 20	Wall Thickness: Schedule 40s	(1)
	25 - 300	Wall Thickness: Schedule 10s	
	All Sizes (buried)	Wall Thickness: Schedule 40s	
Tubing	20 and less	Annealed Austenitic Stainless Steel ASTM A269 Seamless Type 316 Wall Thickness: 16 gauge	
Joining Method	All Sizes 25 - 300	Butt Welded, Flanged or Threaded	(1)
Fittings (Pipe)	All	Butt Welded Wrought Austenitic Stainless Steel ASTM A403 Class WP Grade 316L Fittings Dimensions: ASME B16.9 and MSS SP43 Wall Thickness: Match that of Adjoining Pipe	
	6 – 20 threaded	Threaded Austenitic Stainless Steel ASTM A403 Grade 316L 20700 kPa Fittings	
Fittings (Tube)	20 and less	Mechanical Compression Type ASTM A182 Type 316L Stainless Steel	
Flanges	All Sizes	Class 150 Forged Stainless Steel ASTM A182 Grade 316L Raised Face Weld Neck Drilling to ASME B16.5	(2)
Fasteners		Bolts: ASTM A193, Grade B7, Alloy Steel Hex Head Bolts, Length to Suit, ASME B18.2.1 Nuts: ASTM A194, Grade 2H Hex Head, ASME 18.2.2	(1)
	All Sizes	Bolts: 304 Stainless Steel ASTM A193 Grade B8 Class 2 ASME B18.2.1 Nuts: 304 Stainless, ASTM A194 Grade 8 ASME B18.2.2	
Gaskets	All	1.6 mm PTFE Composition Non-asbestos Gasket to be Suitable for Flange Type Garlock Gylon Style	(3)

GENERAL NOTES:

- Pipes to be pickled and passivated to ASTM A380.
- Long radius elbows unless indicated otherwise.
- Stub-in tee connections not permitted.

- Dielectric separation required when dissimilar materials are connected.

SCHEDULE NOTES:

(1) Threaded connections only where required by equipment. Anti-seize compound required.
(2) Where indicated by equipment, flat face may be used. Flat face not to be connected with raised face flanges.
(3) Gasket selection to be confirmed acceptable by gasket manufacturer.

Application	• Where indicated in the Contract documents. • PVC-1 may be used for the following services: (i) Ferric Chloride		
Design Code	ASME B31.3 Design Class: Normal Fluid Service		
Supplemental Design Code	NSF 61 for Potable Water Application		
Design Pressure	1034 kPa (150 psi)		
Design Temperature	22°C (73°F)		
Testing Requirements	Refer to Specification Section 15030.		
Item	**Size (mm)**	**Description**	**Notes**
Pipe	All Sizes	PVC Pipe to be ASTM D1784, Type 1, Grade 1 with a Cell Classification of 12454 Schedule 80	
Joining Method	All Sizes	Socket Welded, Flanged or Threaded	(1)
Fittings (Socket Welded)	All Sizes	Socket Welded Fittings Meeting the Requirements of ASTM D2467 Wall Thickness: Schedule 80	
Fittings (Threaded)	All Sizes	Threaded Fittings Meeting the Requirements of ASTM D2464 Wall Thickness: Schedule 80	
Flanges	All Sizes	Molded One (1) Piece Flat Face Design with ASME B16.1 Bolt Pattern	
Fasteners	All Sizes	Standard Environment Bolts: ASTM A193, Grade B7, Carbon Steel Hex Head Bolts Nut: ASTM A194, Grade 2H, Hex Head Nut Corrosive Environment Bolts: ASTM A193, Grade B8 Class1, 304 Stainless Steel Hex Head Bolts, Use with Anti-Seize Compound Nuts: ASTM A194, Grade 8 Hex Head	
Gaskets	All Sizes	1.6 mm Full Face, Class 150 Rubber Gasket with a Shore A Hardness of 70	(2)
Solvent	All Sizes	As recommended by Pipe Manufacturer and Conforming to ASTM D2564 Solvent to be Chemically Compatible with the Pipe Service	(3)

GENERAL NOTES:

- Installation of PVC piping system to be in accordance with manufacturer's written instructions.

SCHEDULE NOTES:

(1) Threaded joints permitted only where required to connect the equipment.
(2) Ensure gasket is suitable for the intended service.
(3) Submit manufacturer's certification confirming that appropriate solvent is being used for the particular service.

Application	• Where indicated in the Contract documents. • CU-1 may be used for the following services: (i) Effluent Water (50 mm or less)		
Design Code	ASME B31.3		
Supplemental Design Code	Ontario Plumbing Code		
Design Pressure	1034 kPa (150 psi)		
Design Temperature	20°C (70°F)		
Testing Requirements	Refer to Specification Section 15030.		
Item	**Size (mm)**	**Description**	**Notes**
Pipe	Up to 50	Copper Pipe to be Hard Drawn Seamless Type K in accordance with ASTM B88	
Joining Method	All Sizes	Soldered, Press Connect, Threaded	
Fittings (Solder)	All Sizes	Copper and Copper Alloy Fittings Conforming to ASME B16.18 or ASME B16.22	(3)
Fittings (Press Connect)	All Sizes	Copper and Copper Alloy Fittings Conforming to Material Requirements of ASME B16.18 or ASME B16.22 Fittings Conforming to Performance Requirements of IAPMO PS 117 Sealing Elements to be EPDM Suitable for the Design Conditions and Service	(1) (2)
Fittings (Threaded)	All Sizes	Copper and Copper Alloy to Conform to ASME B16.5 Threading to Conform to ASME B1.20.1	
Solder and Flux		Solder Type 95-5 in Accordance with ASTM B32 Alloy Sb5 Flux to Meet Requirements of ASTM B813	

SCHEDULE NOTES:

(1) Press connect fittings by Viega or approved equal.
(2) Press connect joints to be made in accordance with manufacturer's written instructions.
(3) Solder joints to be made in accordance with ASTM B828.

Application	• Where indicated in the Contract Documents. • Flex-1 may be used for the following services: (i) Ferric Chloride		
Design Pressure	510 kPa (75 psi)		
Design Temperature	20°C (70°F)		
Testing Requirements	Refer to Section 15030.		
Item	**Size (mm)**	**Description**	**Notes**
Tube	6 - 50	Clear Industrial Polyvinyl Chloride Longitudinally Reinforced with Spiral Wound Polyester Tubing to Have a 75 Durometer Hardness Rating Fabco Clear Nylon Braided Tubing or Equal	(1)
Fittings	6 - 50	Polypropylene Insert and Cam Coupler Fittings as Required Double Stainless Steel Hose Clamps Required at Each Fitting	

GENERAL NOTES:

- Tubing to be confirmed chemically suitable for long term exposure to the service medium.
- Used to connect equipment and/or tankage to rigid piping or as detailed on the drawings.

SCHEDULE NOTES:

(1) Horizontal runs to be routed in containment pipes or in trays. Refer to Section 11240.

Application	• Where indicated in the Contract documents. • PE-1 may be used for the following services: (i) Buried Water Service (ii) Chemical Containment Conduit		
Design Code	CSA B137.1 & ASMEB31.3		
Supplemental Design Code	NSF 61 for Potable Water Application.		
Design Pressure	510 kPa (75 psi)		
Design Temperature	-30 to 40C (-40 to 100F)		
Testing Requirements	Refer to Specification Section 15030.		
Item	**Size (mm)**	**Description**	**Notes**
Pipe	12-75	PE Pipe or tubing to ASTM D3350 UV Inhibited	
Joining Method	12-75	Mechanical compression	
Fittings	12-75	ASTM 2239 PVC barbed insertion fittings ASTM D 2609 dimensional standard	
Fasteners	12-75	15mm wide heavy duty three piece 316 Stainless Steel hose clamp	

GENERAL NOTES:

- Installation of PE piping system to be in accordance with manufacturer's written instructions.
- Provide as few joints as possible.
- All jointed connections to be double clamped.

Application	• Where indicated in the Contract Documents. • DC-1 may be used for the following services: (i) Ferric Chloride		
Design Code	ASME B31.3		
Design Pressure	1034 kPa (150 psi)		
Design Temperature	22°C (73°F)		
Specified Product	Georg Fischer Double See		
Alternate Manufacturer	Chemline; Ipex; Approved Alternate.		
Item	**Size (mm)**	**Description**	**Notes**
Pipe	All Sizes	Premanufactured piping system consisting of an inner primary pipe surrounded by an outer secondary pipe All piping to be ASTM D1785 PVC Wall Thickness: Schedule 80	
Joining Method	All Sizes	Socket welded	
Fittings	All Sizes	Socket welded double containment fittings meeting the requirements of ASTM D2467 Wall Thickness: Schedule 80 Custom Fitting: Where required. Fabricated only by pipe manufacturer	
Solvent	All Sizes	As recommended by pipe manufacturer and conforming to ASTM D2564 Solvent to be chemically compatible with pipe service	(1)

GENERAL NOTES:

- Installation of containment piping systems to be in accordance with manufacturer's written instruction.
- Provide local low point drain ties and high point vent tee in containment pipe system.
- Valves located outside containment areas to be double containment.

SCHEDULE NOTES:

(1) Submit manufacturer's certification confirming that appropriate solvent is being used for the particular service being contained.

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the following:
- .1 Municipal hot, cold and tempered water piping within facilities.
- .2 Separated water within facilities.

.2 Coordinate with Division 2 for all yard water piping.

1.2 REFERENCES

The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.

.1 American Society of Mechanical Engineers (ASME):
- .1 ASME A112.26, Waterhammer Arresters
- .2 ASME B16.5 Flanges and Bolt Dimensions Class 150 to 2500.
- .3 ASME B16.39 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300.
- .4 ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

.2 American Society of Sanitary Engineering's (ASSE):
- .1 ASSE Standard 1001, Performance Requirements for Atmospheric Type Vacuum Breakers.
- .2 ASSE Standard 1003, Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems.
- .3 ASSE Standard 1015, Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention.
- .4 ASSE Standard 1018, Performance Requirements for Trap Seal Primer Valves – Potable Water Supplied.
- .5 ASSE Standard 1044, Performance Requirements for Trap Seal Primer Devices – Drainage Types and Electronic Design Types.

.3 ASTM International (ASTM):
- .1 ASTM A 126 Standard Specification for Grey Iron Castings for Valves, Flanges and Pipe Fittings.
- .2 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 American Water Works Association (AWWA):
- .1 AWWA C501, Standard for Cast-Iron Sluice Gates.
- .2 AWWA C510 Double Check-Valve Backflow Prevention Assembly.
- .3 AWWA C511, Standard for Reduced-Pressure Principle Backflow-Prevention Assembly.
- .4 AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
- .5 AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.
- .6 AWWA C702, Standard for Cold Water Meters-Compound Type.

.5 Canadian Standards Association Group (CSA):
- .1 CSA-B356 Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .2 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
- .3 CSA-B64.4, Backflow Preventers, Reduced Pressure Principle Type.
- .4 CSA-B64.5, Backflow Preventers, Double Check Valve Type (DCVA).

.5 CAN/CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.6 National Research Council Canada (NRC)
.1 National Plumbing Code of Canada (NPC).

.7 National Sanitation Foundation (NSF):
.1 NSF 61-G, Drinking Water System Components
.2 NSF 372, Lead Content Compliance

.8 Plumbing and Drainage Institute (PDI)
.1 PDI-WH201-[R2010], Water Hammer Arresters Standard.

.9 Ontario Building Code:
.1 Part 7.

.10 National Building Code:
.1 Part 7.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Divisions 1 and 15.

.2 Submittals required for all Part 2 products.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment.

1.6 QUALITY ASSURANCE

.1 Conform to latest edition of the following standards in addition to requirements specified herein:
.1 Valve User Guide: MSS SP-92.
.2 Ontario Building Code.
.3 Relevant CSA, ASME, ANSI, MSS Standards.

.2 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier’s cost if proper supporting evidence cannot be provided.

.3 Electrical Equipment not bearing a CSA label requires an ESA field approval.

.4 Where required by Authority having jurisdiction, equipment shall bear a ULC or UL label.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 The Supplier's technical representative shall provide training of plant personnel on site including classroom and hands on instruction for one day. The training shall cover proper operation and maintenance procedures of the tanks.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

1.10 DEFINITIONS

.1 "Separated" water is municipal water downstream of a backflow preventer, i.e., there is some risk of contamination.

PART 2 - PRODUCTS

2.1 PIPING – WATER SERVICE - CPVC

.1 All CPVC piping, fitting and joining materials shall conform to CSA B137.13 Thermoplastic Pressure Piping Compendium. The pipe shall be tested to ULC S102.2 and shall have a Flame Spread rated of not greater than 25 and a Smoke Development of not greater than 50.

.2 Above grade CPVC (chlorinated polyvinyl chloride) water piping, solvent weld bell fittings. Pipe shall be SDR 11 solid wall pipe, intended for use in a pressurized piping system where the fluid conveyed does not exceed 90°C (195°F). The pipe shall be capable of a continuous working pressure of 700 kPa (100 PSI) at 82°C (180°F).

.3 Fittings: CPVC solvent weld bell type, same material as the piping.

.4 Joints: Solvent Weld Type: Pipe joint to be an integral bell used for solvent weld. Plastic solvent cement adhesive resin shall be approved by the pipe manufacturer.

.5 Fire Stops: fire stops shall be installed when CPVC piping penetrates a fire rated assembly. The fire stops shall be factory produced and ULC listed for the appropriate size of hole and size of pipe. Fire stops shall consist of a steel collar, attached to the structure, enclosing sufficient intumescent fire stop sealant to expand and close the pipe opening in the event of a fire. Prior to installation of the fire stop the appropriate fire stopping of the interstitial space has been completed and an appropriate escutcheon plate has been installed.

.6 Ball valves for the CPVC piping system shall be supplied by the piping manufacturer and shall be constructed from materials that match the piping system and meet the same standards as the piping system. System shall conform to ANSI 61 for cold and hot potable water service (temperature range below freezing to 110°C (230°F).

2.2 WATER SERVICE - PEX

.1 Applications:
- .1 Potable Domestic Cold Water Distribution
- .2 Potable Domestic Hot Water Distribution.

.2 Piping:
- .1 PEX-A Piping to CSA B137.5.
- .2 Flame spread rating <25. Smoke spread rating <50.

.3 Fittings:
- .1 Full flow, standard radius, expansion type PEX-A fittings.

2.3 PLASTIC (PVC) DRAINAGE AND VENT PIPE AND FITTINGS

.1 PVC (polyvinyl chloride) drain, waste and vent pipe and fittings to CAN/CSA-B18.2, "PVC Drain, Waste, and Vent Pipe Fittings" or CAN/CSA-B182.2, "PVC Sewer Pipe and Fittings, (PSM Type)".

.2 Pipe to have a DR of 35 and a minimum pipe stiffness of 320 kPa.

.3 Below grade pipe joint to be an integral bell and rubber gasket arrangement.

.4 Application:
- .1 All buried sanitary and storm system piping (minimum 75 mm).
- .2 All above ground forced sanitary piping 50 mm and larger.

2.4 VALVES GENERAL

.1 Include all valves indicated in the plumbing manual valve schedule, Mechanical and instrumentation drawings (M&IDs), flow diagrams, or as noted in the contract drawings. A valve indicated on any one drawing is to be considered part of the Contract whether indicated on a corresponding plan, elevation, flow diagram or not. Generally, unless indicated otherwise, valves shown on the Process Instrumentation Drawings (PIDs) and the process P drawings are not covered under this section.

2.5 GATE VALVES

.1 Size 50 mm and smaller:
- .1 Bronze gate valve, Rising, solder joint or screwed ends to MSS-SP-80.
- .2 Working pressures, non-shock:
  - .1 1380 kPa cold working pressure
- .3 Construction:
  - .1 Back-seating stem
  - .2 Precision threads truncated V design
  - .3 Deep stuffing boxes with adjustable PTFE packing
  - .4 Solid wedge disc
  - .5 Screw in bonnet and fully guided disc travel
  - .6 ASTM B62 bronze body
- .4 Application:
  - .1 Shutoff, full open, full closed service.
  - .2 Provide where indicated on drawings and to suit application.

.5 Specified Product: Kitz 41 Series
.6 Alternate Manufactures
  .1 Toyo
  .2 Combraco
  .3 Nibco
  .4 MAS

2.6 BALL VALVES

.1 Size 50 mm and smaller
  .1 MSS-SP-110, Class 150 WSP valves
  .2 Working Pressures:
    .1 1034 kPa saturated steam
    .2 4137 kPa cold working pressure
  .3 Construction:
    .1 Body: bronze, two-piece
    .2 Ball: chrome plated brass
    .3 Seat: PTFE
    .4 Provide lever actuator, memory stop and 50 mm stem extension for insulated pipe. Steel handle with plastic coated contact surface and blow out proof stem. Provide locking handle for lockshield service.
  .4 Application:
    .1 Isolation, balancing.
    .2 Municipal and separated work.
  .5 Specified Product: Kitz 58
  .6 Alternate Manufactures
    .1 Toyo
    .2 Combraco
    .3 Nibco
    .4 MAS.

2.7 BALL VALVES - PLASTIC

.1 Size 50 mm and smaller
  .1 True union full port CPVC ball valve. The valve body, stem, ball and unions shall be made of PVC compound which shall meet or exceed the requirements of cell classification 12454 according to ASTM D1784.
  .2 These compounds shall be listed with NSF to Standard 61 for potable water and Standard 372 for lead content requirements
  .3 The ball seats shall be made of Teflon® (PTFE).
  .4 The o-ring seals shall be made of EPDM.
  .5 Connections to be socket style and conform to the dimensional standards ASTM D2466 and
  .6 ASTM D2467
  .7 Application:
    .1 Isolation,
    .2 Municipal and separated water
  .8 Specified Product: IPEX VXE
  .9 Alternate Manufactures
    .1 Chemline
    .2 Nibco

2.8 CHECK VALVES

.1 Size 50 mm and smaller
- .1 Check valve to MSS-SP-80, Class 125
- .2 Working pressure, non-shock: 1380 kPa cold working pressure.
- .3 Construction:
  - .1 Y-pattern body with integral seal
  - .2 Easy access cap
  - .3 45° seat angle
  - .4 Bronze to ASTM B62.
- .4 Application:
  - .1 Provide where indicated on drawings and suit application.

.2 Specified Product: Kitz 22/23Series

.3 Alternate Manufactures
- .1 Toyo
- .2 Combraco
- .3 Nibco
- .4 MAS

.4 Size 65 mm and larger
- .1 Check valve to MSS-SP-71, Class 125
- .2 Working pressures, non-shock: 860 kPa steam, basic rating, 1380 kPa cold working pressure.
- .3 Construction:
  - .1 Body and cap, cast iron to ASTM A126, B.
  - .2 Seat rings, renewable bronze
  - .3 Rotating disc, new seat position with each operation
  - .4 Hinges, galvanized malleable iron
  - .5 Cover, bolt-on
  - .6 Flanges to ANSI B16.1
- .4 Application:
  - .1 Provide where indicated on drawings and to suit application.

.5 Specified Product: Kitz 78 Series

.6 Alternate Manufactures
- .1 Toyo
- .2 Combraco
- .3 Nibco
- .4 MAS

2.9 DIELECTRIC PIPE FITTINGS/UNIONS

.1 Isolate system components from galvanic currents, material of dielectric fittings to suit dissimilar metals in system.

.2 Type: isolating unions for pipe sizes 50 mm and smaller, flanges for pipe sizes 65 mm and larger.

.3 Unions: certify to withstand minimum 600 V on a dry line without flashover. Rate unions at 1725 kPa, conform to ANSI B16.39.

.4 Flange fittings: rate at 1200 kPa, to ANSI B16.42 for iron, to ANSI B16.24 for bronze.

.5 Provide isolating sleeves for flange bolts.

.6 Specified Product:
- .1 Unions: Watts, 3000 Series.
- .2 Flanges: Watts, 3200 Series.

.7 Alternate Manufacturers:
- .1 Zurn
- .2 Mifab

2.10 STRAINERS (SMALLER THAN 75 MM)

.1 Maximum allowable pressure rating of 2750 kPa @ 66°C.

.2 Bronze body, stainless steel Type 304 screen; NPT connections size up to 75 mm. Over 50 mm to have bolted cover.

.3 Type: cleanable Y pattern.

.4 Screens: removable and made from #20 mesh.

.5 Specified Manufacturer: Spirax Sarco; BT/TBT.

.6 Alternate Manufacturers:
- .1 Armstrong
- .2 Crane
- .3 Conbraco
- .4 Mueller.

2.11 STRAINERS (75 MM AND LARGER)

.1 Cast iron body, ANSI Class 125, ANSI flanges bronze plug. Maximum allowable pressure 1750 kPa @ 66°C.

.2 304 Stainless Steel screen: removable #20 mesh.
- .1 100 mm to 200 mm: 3.2 mm perf.
- .2 250 mm and larger: 3.2 mm perf.

.3 Specified Manufacturer: Spirax Sarco, CI-125.

.4 Alternate Manufacturers:
- .1 Crane
- .2 Armstrong
- .3 Combraco
- .4 Mueller.

2.12 REDUCED PRESSURE BACKFLOW PREVENTORS

.1 Provide lead free reduced pressure principle backflow preventer where indicated and consisting of the following:
- .1 Gate valves; rising stem
- .2 Test cocks
- .3 Backflow preventer, FDA epoxy coated cast iron
- .4 Flanged ends
- .5 Relief valve vent
- .6 Air gap/vent elbow
- .7 Bronze seals, stainless steel trim.

.2 Unit to meet AWWA C511, maximum working pressure 1200 kPa.

.3 Specified Product: Watts, 957 Series

.4 Alternate Manufacturers:
- .1 Zurn
- .2 Mifab

2.13 TEMPERATURE AND PRESSURE RELIEF VALVE

.1 Application: Temperature and pressure relief for municipal hot water side of instantaneous municipal water heating heat exchangers.

.2 CSA and ASME rated automatic relief valve, ANSI Z21.22 certified. Discharge kW capacity of device to be in excess of kW capacity of heat exchanger.

.3 Temperature relief: 99ºC.

.4 Pressure range: 5.2 – 10.3 bar; set to 5.2 bar.

.5 Lead free cast body, non-mechanical disc-to-seat alignment, tamper-resistant bonnet screws.

.6 Small capacity municipal hot water instantaneous heat exchanger: thermostat with thermo-bonded coating, with test lever and extension thermostat. Refer to Heat Exchanger Schedule.

.7 Large capacity municipal hot water instantaneous heat exchangers: stainless steel thermostat tube. Refer to Heat Exchanger Schedule.

.8 Specified Product: Watts LF 40/140/340 Series.

.9 Alternate Manufacturer:
- .1 Zurn.
- .2 Mi Fab.

2.14 PRESSURE REDUCING VALVE

.1 Application: Where indicated on drawings, pressure reducing valve with strainer for municipal water.

.2 Pressure reducing valve for municipal water. Lead free brass body and bottom plug, iron spring cage, stainless steel seat, Buna-N gasket and O-ring, reinforced Buna-N diaphragm, cast iron diaphragm plate and spring button, steel adjusting screw, brass locking nut, zinc plated wire spring, lead-free copper silicone alloy disc holder.

.3 Operating parameters:

.4 Temperature range: 0.5°C - 71°C.

.5 Maximum working pressure: 20.7 bar.

.6 Adjustable reduce pressure: 172-517 kPa.

.7 Pressure gauge to be mounted downstream of the station.

.8 Specified Product: Watts LF223S.

.9 Acceptable Manufacturers:
.1 Zurn .
.2 Mifab.

2.15 AUTOMATIC TRAP SEAL PRIMERS

.1 Provide wall mounted trap primer and manifold assembly complete with galvanized steel NEMA-4 cabinet, 24-hour timer, atmospheric vacuum breaker and distribution manifold.

.2 Manifold to supply separated water per opening once each 24-hour period. Electronic Trap Priming Manifold to be capable of equally priming individual floor drain traps.

.3 Unit to be factory assembled and pre-piped, and to include bronze body NPS ¾ female NPT, WOG rated ball valve, copper barrel with brass piston and Type “L” copper manifold with brass NPS 1/2 compression fitting and orifice opening for precision water distribution to each floor drain trap.

.4 Electronic components to include single point power connection at 120/1/60, manual override switch, minimum 5 amp breaker, 24 hour geared timer with relay and 5 second dwell function.

.5 All components to be factory assembled, tested and supplied in NEMA-4 steel enclosures suitable for surface mounting. All components to comply with nationally recognized standards and to be fully warranted for the life of the plumbing system.

.6 Specified Product: Precision Plumbing Products PTS Series.

.7 Alternate manufacturers:
.1 Zurn
.2 Mifab.

2.16 WATER HAMMER ARRESTORS

.1 Provide water hammer arrestors at each fixture connection, group of fixtures and where indicated.

.2 Lead-free copper body, brass tailpiece and brass or polypropylene piston. EPDM O-ring.

.3 Arrestor to be factory pre-charged and permanently sealed.

.4 Designed for use on domestic hot and cold water systems under the following parameters:
.1 Pressure: 1050 kPa (150 psi).
.2 Temperature: 0.5°C (33°F) to 82°C (180°F).

.5 End connection to suit piping.

.6 Water hammer arrestor to comply with the following:
.1 ASME A112.26.1M.
.2 PDI WH201.
.3 NSF 372.

.7 Specified Product: Watts LF 15M2.

.8 Alternate Manufacturers:
.1 Zurn
.2 Mifab.

2.17 YARD HYDRANTS

.1 Provide 40 mm exposed non-freeze yard hydrant.

.2 Unit to be complete with galvanized steel casing and aluminum casing guard, all bronze interior components.

.3 Yard hydrant to have non-turning operating rod with free floating compression closure valve.

.4 Hydrant to be equipped with drain port in valve housing.

.5 Specified Product: Watts HY-600

.6 Alternate Manufacturer:
.1 Zurn
.2 Mifab.

2.18 NON-FREEZE WALL HYDRANT

.1 Single outlet connection used as a wall hydrant suitable for ice rinks. Compete with 1½” (38mm) NPT female x 1½" (38mm) male hose thread adapter, brass cap & chain and brass or red aluminum escutcheon plate. Lettering “Wall Hydrant”

.2 1½” (38mm) Non Rising Stem gate valve c/w extension rod pinned to valve stem.

.3 Specified Product: National Fire Equipment Model 153 Outlet Connection, Model A53 Control Valve, Control Box Model N.264.

2.19 HOSE BIBB

.1 Bronze body construction with threaded spout, stainless steel fasteners, replaceable neoprene composition disc and integral vacuum breaker.

.2 Hose bibb to comply with the requirements of NSF 372.

.3 Hose bibb to be designed for both interior and exterior use.

.4 End Connection: NPT or soldered.

.5 Design Parameters:
- .1 Maximum water temperature: 60°C (140°F).
- .2 Maximum working pressure: 860 kPa (125 psi).

.6 Specified Product: Zurn 195 XL Series.

.7 Alternate Manufacturers:
- .1 Approved equivalent

2.20 WATER METER

.1 Provide gate valve (RS) at water entry point into building.

.2 Install municipal meter inside building, with gate valve on either side of meter and drain with globe valve and hose nipple for 3/4" hose on building side of valve downstream from meter. Provide locked (lock shield) valve, water meter bypass of size to comply with local water authority. Install water meter(s) approved or supplied by the local municipality. If meter is not immediately available, provide companion pieces and filler pipe section. Remove filler pieces and install meter when available. Provide stanchion supports within 150 mm of water meter inlet and outlet.

.3 Install pressure gauge on downstream side of meter.

PART 3- INSTALLATION

3.1 MANUFACTURERS INSTRUCTION

.1 Compliance: comply with manufacturer’s written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Installation to be in accordance with OBC.

3.2 WATER PIPING INSTALLATION

.1 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.

.2 Install groups of piping parallel to each other spaced to permit application of insulation, identification, and service access, on trapeze hangers.

.3 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.4 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.5 Brass and copper pipe and tubing to be free from surface damage. Replace damaged pipe or tubing.

.6 Ream ends of pipes and tubes before fabrication.

.7 Lay copper tubing so that it is not in contact with dissimilar metal and will not kink or collapse.

.8 Use non-corrosive lubricant or Dow-Corning Teflon tape and apply on male thread.

.9 Install dielectric couplings to join dissimilar metals.

.10 Install flanges or unions to permit removal of equipment without disturbing piping systems.

.11 Clean ends of pipes, tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

.12 Protect water system from water hammer. Air chamber type arrestors to be installed to permit chamber to be drained of water.

.13 Water services will be provided up to points indicated on drawings. Connect building water services to outside services.

.14 Connect all fixtures and equipment supplied by Division 15 or others, unless detailed otherwise.

3.3 VALVES

.1 Install valves at the following locations:
- .1 Base of each riser.
- .2 Each fixture supply
- .3 Branch from each supply main, riser and main branches.
- .4 Equipment and fixtures not furnished with its own isolating valves.

.2 Locate valves for easy access and operation.

.3 Provide hose bibbs or sediment faucets for complete system drainage.

.4 Valves not to be installed with stem below horizontal position.

3.4 DRAINAGE PIPING INSTALLATION

.1 General
- .1 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.
- .2 Install flanges or unions to permit removal of equipment without disturbing piping systems.
- .3 Clean ends of pipes, tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.
- .4 Provide traps, trap seal primers and vents for drainage systems per OBC. In areas where automatic trap seal primer valves are indicated, pipe tubing to that location and manifold.

.5 Connect building sewer services to outside services.

.6 Connect all fixtures and equipment, unless detailed otherwise. Coordinate with architectural drawings.

.2 Equipment Drainage Piping

.1 Extend equipment drain piping to discharge into hub or funnel floor drains as indicated on the drawings.

.3 Vents:

.1 Field route vents, combine where practical to reduce roof penetrations. Coordinate supply and installation of sleeves per architectural details.

3.5 PVC STORM DRAINAGE

.1 Provide PVC pipe and fittings installed in accordance with relevant standards, the manufacturer's requirements and Section 15060, Piping Provisions.

.2 Provide trenching and backfilling to ensure uniform and continuous support of the pipe and to prevent damage to the pipe in accordance with manufacturer's requirements.

.3 Maintain proper alignment and sloping during backfill and concrete pour operations.

.4 Provide thrust restraint at elbows and changes in direction to suit testing and service loads in accordance with the manufacturer's requirements.

3.6 TRAP PRIMING

.1 Provide automatic trap primers where indicated in drawings.

.2 Provide flow based trap seal primers in areas with nearby water fixtures. Refer to drawings and coordinate with Division 16 to confirm location of solenoid valve.

.3 Install in accordance with manufactures written instruction and in accordance with OBC requirements.

3.7 TESTING

.1 Test water piping in accordance with procedures outlined in Section 15030.

.2 Every pipe in drainage and venting system, except an external leader or fixture outlet pipe to be capable of withstanding without leakage a water test, air test and final test. Carry out tests as required by Section 15030, Testing and authority having jurisdiction.

.3 Every pipe in drainage system to be capable of meeting ball test. Carry out ball test as required by Section 15030, Testing and authority having jurisdiction.

.4 Contractor to carry out installation inspection, integrity (pressure leak) tests and support system inspection of piping system before system is insulated or enclosed. Piping not to be covered until all inspection and testing deficiencies have been corrected and successful re-testing has been carried out.

.5 Coordinate with authority having jurisdiction the requirement of the authority to witness tests and inspect piping system.

.6 All backflow preventers to be certified on-site by an approved Contractor as meeting requirements of CSA.

3.8 SUPPLEMENTS

.1 Building Services Piping Schedule.

END OF SECTION

MW	MUNICIPAL WATER					Section 15400
	50 mm and smaller	CPVC,	Socket	PEX (Admin building)		
MHW	MUNICIPAL HOT WATER					Section 15400
	50 mm and smaller	CPVC	Socket	PEX (Admin building)		
MHWR	MUNICIPAL HOT WATER RETURN					Section 15400
	50 mm and smaller	CPVC	Socket	PEX (Admin building)		
MTW	MUNICIPAL TEMPERED WATER					Section 15400
	50 mm and smaller	CPVC	Socket	PEX (Admin building)		
SAN	SANITARY DRAIN (GRAVITY)					Section 15400
	Buried, all sizes	PVC DWV	Bell and rubber gasket			
SAN	SANITARY DRAIN (FORCED)					Section 15400
STM	STORM DRAIN					Section 15400
	G.T. 75 mm, above	PVC DWV	Bell and Solvent Cement			
SW	SEPARATED WATER (MUNICIPAL WATER DOWNSTREAM OF A BFP)					Section 15400 Refer to Municipal Water
	50 mm and smaller	CPVC	Bell and Solvent Cement			

VENT	VENT					To match applicable drain pipe material

Notes:

1. Tables do not preclude individual specification requirements. Refer to specific requirements in specifications.
2. In the event of conflict, tables supercede drawings. Report conflicts to Consultant prior to proceeding.
3. Jointing method at valves and equipment to be dictated by specified connection for valve or equipment or as detailed on the drawing.
4. Refer also to drawings and Section 15060 for specific jointing requirements for flanges, mechanical couplings, etc.
5. Any reference to service water shall be interpreted as separated water. This applies to both drawings and specifications.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This specification covers building mechanical plumbing pumps as scheduled and as indicated on the drawings.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- .2 American Society for Testing and Materials (ASTM):
  - .1 ASTM A48: Standard Specification for Gray Iron Castings.
  - .2 ASTM B584:-Standard Specification for Copper Alloy Sand Castings for General Application
  - .3 ASTM E165: Standard Practice for Liquid Penetrant Examination for General Industry.
- .3 American Iron and Steel Institute (AISI).
- .4 Hydraulic Institute Standards:
  - .1 HI 11.6: Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Test.
- .5 International Organization for Standardization (ISO):
  - .1 ISO 9906: Rotodynamic Pumps – Hydraulic Performance Acceptance Test.
- .6 National Electrical Manufacturer's Association (NEMA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all PART 2 – PRODUCTS.

.3 Product Data:

- .1 Relevant information to confirm that the specifications have been met. Identify all deviations.
- .2 Identify construction materials for all pump components.
- .3 Relevant data illustrating full range of operation (on pump curves) including speed curves, if applicable.
- .4 Electrical motor information and specification.
- .5 Loadings imparted to the pump base.
- .6 Permissible range of vibration.
- .7 Factory finishing details.
- .8 Anchoring requirements.
- .9 A motor performance chart exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. Chart to also include date on motor starting and no-load characteristics.

.4 Operation and Maintenance Data:
- .1 Operation and Maintenance Manuals. Refer to Division 1 and Division 15, section 15014 for requirements.
- .2 Manufacturer's installation requirements.

.5 Quality Control Data:
- .1 Manufacturer's certified testing results.
- .2 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed pumps. For submersible pumps this includes verification that adequate cable length is provided to allow complete pump extraction from each sump pit.

.2 For each pump model and size, provide the following spare parts:
- .1 One set of bearings.
- .2 One set of mechanical seals.
- .3 One set of gaskets.
- .4 One impeller bolt.

1.6 QUALITY ASSURANCE

.1 Pump manufacturer to provide a written certification stating that the pump(s) has(have) been installed to their standards.

.2 Pumps and associated equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to the Electrical Safety Code.

.3 Pump manufacturer to have proven established network of service centres in Eastern Ontario. Service centres to be specialized in manufacturer's line of pumps and stock spare parts. Each service centre to be capable of removing, transporting and repairing the pump in addition to supplying a rental or temporary unit.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Training required for all Part 2 equipment

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP

.1 Sump Pump shall pump sewage, not containing solids greater that 12 mm, from a sump to a gravity sewage pipe.

.2 Pump: Centrifugal submersible pump assembly:

.3 Casing: cast iron housing, totally enclosing and sealing electrical components. Standard NPT discharge connection.

.4 Volute: cast Iron Housing. The volute shall have integrally cast legs for mounting pump on bottom of sump.

.5 Impeller: non-clogging, cast iron recessed type, machined and hydraulically balanced.

.6 Shaft: stainless steel with carbon / ceramic shaft seal.

.7 Motor: hermitically sealed within cast iron oil filled casing, CSA approved and listed, with heat sensor protection with automatic reset when motor cools to a safe operating temperature.

.8 Control:

.1 Simplex Controls: provide complete control package including circuit breaker, magnetic contactor, HOA switches, run lights, automatic alternator, override relays, high level alarm light and buzzer complete with test switch. Provide three float control system. NEMA 4X panel. Provide additional float for high high level alarm with dry contacts for communication with SCADA.

.2 Duplex Controls: where installed in duplex arrangement, provide complete package including circuit breaker, magnetic contactor, HOA switches, run lights, automatic alternator, override relays, high level alarm light and buzzer complete with test switch. Provide four float control system. NEMA 4X panel. Provide additional float for high high level alarm with dry contacts for communication with SCADA

.9 Power Cord: power cord shall be 6M (20') in length and sealed at the pump connection. Cords shall withstand a pull of 45 Kg (100#).

.10 Finish: exterior surface shall have a baked on epoxy paint finish. Pump shall have an integral stainless lifting ring and chain mounted to the top of the pump.

.11 Rated Installations: All equipment in the Headworks building is to be electrically rated to a OESC Class 1 Zone 1 hazardous installation including the pump motor, instrumentation, wiring, controls, etc.

.12 Specified Product: Barnes SP33.

.13 Alternate Manufacturer's
- .1 Myers.
- .2 Xylem
- .3 Pumpex.

2.2 MUNICIPAL HOT WATER RECIRCULATION PUMP (TYPE 2)

.1 Capacity: As Scheduled

.2 Construction: closed-coupled, in-line centrifugal pump. Pump to be UL and CSA listed.

.3 Pump to be suitable for 105°C operation at a 1035 kPa working pressure.

.4 Pump to have a shaftless, wet rotor design with ball bearing support. Cast iron body with all other wetted parts of stainless steel.

.5 Motor to be electronically commutated, permanent magnet motor and shall be non-overloading at any point on the pump curve and shall have integral overload protection.

.6 Pump starter to have dry contacts suitable for BAS monitoring and have input termination for BAS control.

.7 Pump to have dry run protection.

.8 Electrical: As Scheduled.

.9 Supports: provide as recommended by manufacturer.

.10 Specified Product: Bell & Gossett Ecocirc e3 Circulator, Size 6.

.11 Alternate Manufacturers:
- .1 Taco.
- .2 Armstrong.
- .3 Grundros.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install pump unit where indicated.

.2 Conform to manufacturer's installation instructions.

.3 Test system to verify capacity, sequence of operation and flow.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Provide floor drains as specified herein and as indicated on the drawings.

1.2 REFERENCES

The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.

.1 American Society of Mechanical Engineers (ASME):
- .1 ASME A112.21.1M, Floor Drains.
- .2 ASME B16.5 Flanges and Bolt Dimensions Class 150 to 2500.
- .3 ASME B16.39 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300.
- .4 ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

.2 Deutsches Institut für Normung (DIN):
- .1 DIN 19580, July 2010, Drainage Channels for Vehicular and Pedestrian Areas.

.3 ASTM International (ASTM):
- .1 ASTM A 126, Standard Specification for Grey Iron Castings for Valves, Flanges and Pipe Fittings.
- .2 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 Canadian Standards Association Group (CSA):
- .1 CSA B79, Commercial and Residential Drains and Cleanouts.

.5 National Research Council Canada (NRC)
- .1 National Plumbing Code of Canada (NPC).

.6 Ontario Building Code:
- .1 Part 7.

.7 National Building Code:
- .1 Part 7.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Divisions 1 and 15.

.2 Submittals required for all Part 2 products

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed equipment.

1.6 QUALITY ASSURANCE

.1 Installation shall conform to the Ontario Building Code and Ontario Plumbing Code

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE FD-1

.1 Lacquered cast iron floor drain, anchor flange adjustable head, and nickel bronze strainer. Free area 7700 mm², round 12 mm thick by 200 mm dia. nominal strainer, primary and secondary weepholes, NPS ½ trap primer tapping, minimum 75 mm outlet, match connecting pipe size.

.2 Application: Washrooms and Administration areas and where indicated.

.3 Specified Product: Watts FD-100-C.

.4 Acceptable Manufacturers:
- .1 Zurn
- .2 MiFab.

2.2 HEAVY DUTY FD-2

.1 Heavy duty floor drain, galvanized or lacquered cast iron with deep sump body, seepage flange, adjustable collar, NPS ½ trap primer tapping, 300 mm round satin bronze strainer, clamping device and sediment bucket. Free area 20,066 mm², load capacity 9060 kg, NPS 4 push on gasket outlet (ASTM C-564) unless indicated otherwise by connecting pipe size.

.2 Application: All process areas.

.3 Specified Product: Watts FD-340.

.4 Acceptable Manufacturers:
.1 Zurn
.2 Enpoco.

2.3 HUB DRAINS (HD-1)

.1 Provide drain equivalent to FD-1 complete with indirect 100 mm throat adjustable waste hub, and seepage collection sump. Outlet to match connecting pipe size, minimum 75 mm.

.2 Specified Product: Watts FD-100-C-DD.

.3 Alternate Manufacturers:
.1 Zurn
.2 Mifab.

2.4 FUNNEL DRAIN (FFD-1)

.1 Cast iron funnel floor drain, integral seepage pan with flange, clamping collar and adjustable head, cast iron 175 mm dia. nominal strainer, 230 mm x 75 mm galvanized funnel, 12 mm trap primer tapping, 75 mm outlet.

.2 Specified Product: Watts FD-100-C-EG-TSP.

.3 Acceptable Manufacturers:
.1 Zurn
.2 Mifab.

2.5 STACK AND LINE CLEANOUTS

.1 Cast iron, male ferrule with brass screws and straight threaded bronze tapered plug, mechanical joint for concealed work. Provide Tee-type or extended type as required.

.2 Specified Product: Watts CO-460.

.3 Acceptable Manufacturer:
.1 Zurn.
.2 Mifab.

2.6 WALL TYPE ACCESS COVERS CLEAN OUTS

.1 Wall access: face or wall type, stainless steel access cover with stainless steel screw, countersunk brass plug.

.2 Specified Product: Watts CO-590-RD.

.3 Acceptable Manufacturers:
.1 Zurn
.2 Mifab.

2.7 FLOOR CLEANOUTS

.1 Concrete Floors:
.1 Light duty, square; polished, scoriated, nickel bronze frame and hinged cover, securing screw.
.1 Application: General light process/ maintenance areas
.2 Specified Product: Watts CO-100-C-S.
.3 Acceptable Manufacturers:
.1 Zurn.
.2 Enpoco.
.2 Heavy duty, round; polished, scoriated, nickel bronze frame and secured hinged cover.
.1 Application: Process Areas
.2 Specified Product: Watts CO-100-C-RX.
.3 Acceptable Manufacturers:
.1 Zurn.
.2 Mifab.
.3 Epoxy coated cast iron with anchor flange, reversible membrane clamp and adjustable 130 mm round, type 304 scoriated, cast stainless steel combined access cover and plug with gasket seal.
.1 Application: Heavy process areas.
.2 Specified Product: CO-1100-C-R.
.3 Alternate Manufacturers:
.1 Zurn
.2 Mifab

PART 3 - EXECUTION

3.1 INSTALLATION (GENERAL)

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Provide floor drains with trap seal primers.

.3 Co-ordinate installation with floor construction. Equip floor drains with seepage flange where floor of waterproof construction.

.4 Equip each floor drain with 0.15 mm polyethylene sheeting under strainer to prevent dirt from entering the system during construction. Remove polyethylene only after final cleanup.

3.2 FFD/HUB DRAINS

.1 Locate to suit equipment being drained. Refer to individual equipment shop drawings.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 Provide roof drains as specified herein and as indicated on the drawings.

1.2 REFERENCES

The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.

.1 American Society of Mechanical Engineers (ASME):
- .1 ASME A112.21.1M, Floor Drains.
- .2 ASME B16.5 Flanges and Bolt Dimensions Class 150 to 2500.
- .3 ASME B16.39 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300.
- .4 ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

.2 Canadian Standards Association Group (CSA):
- .1 CSA B79, Commercial and Residential Drains and Cleanouts.

.3 Ontario Building Code:
- .1 Part 7.

.4 National Building Code:
- .1 Part 7.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Divisions 1 and 15.

.2 Submittals required for all Part 2 - Products

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all drains.

1.6 QUALITY ASSURANCE

.1 Installation shall conform to the Ontario Building Code and Ontario Plumbing Code.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 LARGE AREA ROOF DRAIN, STANDARD BUILT-UP ROOF (RD-1)

.1 Lacquered cast iron roof drain for standard built-up roof with large sump, anchor flange, bottom outlet and 360 mm cast iron mushroom dome, non-puncturing flashing clamp integral with perforated cast iron gravel stop, waterproofing flange, MJ outlet to suit connecting pipe size.

.2 Provide side outlet drain where clearances below horizontal storm drain line are limited.

.3 Specified Product: Watts RD-100-BED.

.4 Specified Manufacturers:
- .1 Zurn
- .2 Mifab.

2.2 DOWNSPOUT NOZZLE

.1 Storm wall discharge fitting. Cast nickel bronze downspout nozzle with anchor flange, countersunk mounting holes.

.2 Specified Product: Watts RD-940.

.3 Specified Manufacturers:
- .1 Zurn
- .2 Mifab.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Compliance: comply with manufacturer’s written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Coordinate roof drain installation with Roofing Contractor. Supply roof drains to installer for mounting in hollow core roof system.

.3 Make bolts for under deck clamp compatible with roof thickness.

.4 Connect storm piping.

.5 Test system.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This section covers the supply, installation, commissioning, and testing of domestic water heaters.

1.2 REFERENCES

.1 The following is a list of standards that may be utilized in this section. Unless specifically noted otherwise, the reference indicated shall be the latest standard adopted by the regulatory agency as of the tender date.

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
- .2 American National Standards Institute (ANSI)
  - .1 ANSI Z21.10.1/CSA 4.1-, Gas Water Heaters - Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.
  - .2 ANSI Z21.10.3A/CSA 4.3, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings above 75,000 Btu per Hour, Circulating and Instantaneous.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2 CAN/CSA-B139, Installation Code for Oil Burning Equipment.
  - .3 CAN/CSA-B140.0, Oil Burning Equipment: General Requirements.
  - .4 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.
  - .5 CAN/CSA-B149.2, Propane Storage and Handling Code.
  - .6 CSA B140.12, Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
  - .7 CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.
  - .8 CAN/CSA-C191, Performance of Electric Storage Tank Water Heaters for Household Service.
  - .9 CAN/CSA-C309-[M90], Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .4 National Research Council Canada (NRC):
  - .1 National Plumbing Code of Canada (NPC).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all Part 2 – Products specified herein.

- .1 Product Data:
  - .1 Relevant information to confirm that the specifications have been met. Identify all deviations.
  - .2 Factory finishing details.
  - .3 Anchoring requirements.
- .2 Operation and Maintenance Data to include:
  - .1 Operation and Maintenance Manuals. Refer to Division 1 and Division 15, section 15014 for requirements.
  - .2 Manufacturer’s installation requirements
  - .3 Safety information data for maintenance staff prior to performing maintenance requirements.

.4 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the Manufacturer.

.3 Quality Control Data to include:

.1 A certificate of proper installation submitted on OEM letterhead, signed by the Manufacturer or their representative and certifying that the equipment has been installed in accordance with their installation instructions.

.2 Confirm that guarding meets OSHA and CSA Z432 requirements.

.3 Provide copies of MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

1.4 CLOSE OUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

.2 For each heater model and size, Supplier to provide a list of recommended spare parts.

.3 Provide any specialty tools required for maintenance. Provide any tools produced by the OEM that are required to conduct regular maintenance on the heaters.

1.6 QUALITY ASSURANCE

.1 Published equipment performance ratings for manufactured items to be based on physical tests carried out by the Manufacturer or an independent testing agency in accordance with accepted industry standards, or as specified. Conformance to codes and standards to be confirmed by an independent testing agency at supplier’s cost if proper supporting evidence cannot be provided.

.2 Electrical Equipment not bearing a CSA label requires an ESA field approval.

.3 Fuel Fired equipment shall bear a CSA label and a CGA or AGA label.

.4 Where required by Authority having jurisdiction, equipment shall bear a ULC or UL label.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Training required for all Part 2 equipment

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

.2 All water heaters to have a minimum five-year warranty.

PART 2 – PRODUCTS

2.1 GENERAL

.1 Products used to be those accepted by the local AHJ (Authority Having Jurisdiction).

.2 All heaters to be low lead content compliant in accordance with NSF 372.

.3 Water storage systems shall operate at 60°C (140°F) to prevent the growth of legionella bacteria. Mixing valves shall be provided downstream of the water storage tanks to limit the discharge temperature to 45°C (115°F).

2.2 ELECTRIC TANK TYPE WATER HEATERS

.1 Electric Water Heater, Tank Type Immersion Element, CSA certified and AHRI certified, and complying with CAN/CSA C22.2 No.110, CAN/CSA-C309 and ASHRAE 90.1 Energy Efficiency Standards.

.2 Construction:
- .1 Glass lined and thermally isolated steel tank, with minimum 50 mm (2”) thick insulation and enameled steel exterior jacket. Unit shall be built for 1035 KPa (150 PSI) working pressure. Unit shall be low lead content compliant.
- .2 Anode: Replaceable magnesium sacrificial anode for corrosion protection.
- .3 Elements: Resistor type copper immersion type heating elements. Upper and lower elements, each with independent thermostat control. Wired for non-simultaneous operation.
- .4 Single thermostatic control adjustable from 26°C to 60°C (80°F to 140°F) range, set at 60°C (140°F). Over-temperature protector cuts off power in excess temperature situations.
- .5 Top inlet with internal copper distribution tube, top outlet style. Top outlet shall be piped with an internal heat trap. Inlet and outlet shall be minimum 3/4”.
- .6 Unit shall be complete with ASME approved T&P (temperature and pressure) relief valve and hose end drain connection.
- .7 The assembly shall provide a minimum energy factor of 0.97 in accordance with CAN/CSA-C191.

.3 Tempering valve, adjustable with knob, with check valves and strainers. For temperature control at the distribution point. Certified to EN 15092 standard. Maximum working pressure: 10 bar. Medium temperature range: 2–90 °C. Adjustment temperature range: 45–65 °C. Finish: nickel plated. Kv: 1,5 m³/h. Material: dezincification resistant brass DR "low lead"

.4 Capacity: as indicated and scheduled on the drawings

.5 Specified Product:
- .1 A.O. Smith.

.6 Alternate Manufacturers:
  .1 Lochinvar CLS Series
  .2 Ruud.
  .3 Rheem.

2.3 DOMESTIC WATER EXPANSION TANKS

.1 Vertically configured inline pre-pressurized expansion tank complete with integral expansion membrane and liner.

.2 Certifications:
  .1 Expansion tank designed and constructed per ASME Code Section VII, Division 1.
  .2 NSF 61 compliant.

.3 Performance:
  .1 Maximum Operating Temperature: 93°C
  .2 Maximum Working Pressure: 1035 kPa

.4 Construction Materials:
  .1 Shell: carbon steel.
  .2 Diaphragm: butyl rubber.
  .3 Liner: polypropylene.
  .4 System Connections: stainless steel.
  .5 Finish: red oxide primer.
  .6 Air Valve: Schrader type complete with EPDM seat.

.5 Factory Precharge: field adjustable.

.6 Capacity: as indicated and/or scheduled on drawings.
  .1 Specified Product:
    .1 Amtrol Therm-X-Trol.
  .2 Alternate Manufacturers:
    .1 Watts.

PART 3 – EXECUTION

3.1 GENERAL

.1 NA

3.2 APPLICATION

.1 Manufacturer’s Instructions: comply with manufacturer’s written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 INSTALLATION

.1 Install in accordance with manufacturer's recommendations andauthority having jurisdiction.

.2 Provide insulation between tank and supports.

.3 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.4 Install water heaters level and plumb on a concrete housekeeping pad, supply anchor bolts and templates for installation. Size anchor bolts to withstand seismic zone acceleration and velocity forces.

.5 Pipe temperature and pressure relief valve discharge to funnel floor drain. Ensure air gap is provided.

.6 Heat traps and thermometers required for each heater installation. Heat traps to be installed in accordance with ASHRAE 90.1 unless provided integrally with the heater.

.7 Thermometers to be installed on the water heater inlet and outlet piping and to be positioned such that they can be read standing on the floor or walkway.

.8 Dielectric unions to be provided if there are dissimilar metals between the water heater connections and the attached piping.

.9 Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater is bottom fed.

.10 Shut-off valves to be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

.2 Provide manufacturer certification that the heaters have been installed correctly.

3.5 CLEANING

.1 Clean in accordance with Division 1 requirements.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1	Toilet Partitions:	Section 10214
.2	Toilet Accessories:	Section 10800
.3	Mechanical General Provisions:	Section 15010
.4	Mechanical System Support, Anchorage and Seismic Restraint:	Section 15010
.5	Testing:	Section 15030
.6	Piping Provisions:	Section 15060
.7	Insulation:	Section 15251

1.2 REFERENCE STANDARDS

.1 Fixtures and accessories to be new, free from imperfections and labelled with CSA mark of approval.

.2 Conform to Ontario Building Code requirements.

1.3 SUBMITTALS

.1 Submit the following shop drawings:
- .1 Water closets.
- .2 Lavatories.
- .3 Urinals.
- .4 Plumbing trim.
- .5 Sinks.
- .6 Emergency Fixtures.
- .7 Shower Heads.
- .8 Accessories.

PART 2 - PRODUCTS

2.1 PLUMBING AND TRIM

.1 Plumbing fixtures to be product of one manufacturer and white.

.2 Materials:
- .1 Vitreous china or vitreous glazed earthenware to CSA B45.1.

.3 Plumbing trim to CSA B125 and be from one manufacturer.

.4 Exposed plumbing brass and metal work to be chromium plated.

.5 Water consumption not to exceed specified equipment consumption.

2.2 WATER CLOET WC-1

.1 Water closet: floor mounted, tank type dual flush 4.0/6.0 lpf,

.2 Bowl: vitreous china, siphon jet, whirlpool action, close coupled combination with elongated rim bowl, bolt caps. dual flush 4.0/6.0 lpf.

.3 Tank: low silhouette vitreous china, complete with fittings, flapper type flush valve, insulated.

.4 Supply: 9mm angle type with c.p. angle valve and c.p. escutcheon plate.

.5 Seat: elongated, open front.

.6 Specified Products:
- .1 Bowl - Crane Radcliffe 3-257.
- .2 Tank - Crane 3-575.
- .3 Supply - Crane C-30l6.
- .4 Seat - Olsonite No. 95CSS.

2.3 WATER CLOSET WC-2 ACCESSIBLE

.1 Water closet: floor mounted, tank type, dual flush 4.0/6.0 lpf, ADA compliant.

.2 Bowl: vitreous china, siphon jet, whirlpool action, close coupled combination with rim elongated rim bowl, bolt caps.

.3 Tank: low silhouette vitreous china, complete with fittings, flapper type flush valve, insulated.

.4 Supply: NPS 3/8 angle type with c.p. angle valve and c.p. escutcheon plate.

.5 Seat: elongated, open front.

.6 Specified Products:
- .1 Bowl - Crane Radcliffe 3-257.
- .2 Tank - Crane 3-575.
- .3 Supply - Crane C-30l6.
- .4 Seat - Olsonite L-210-N-CC.

2.4 URINAL UR-1

.1 Urinal: wall hung, wall outlet wash-down urinal, vitreous china, with integral extended shields, flushing rim, integral trap with stainless steel strainer, steel supporting hangers, NPS 3/4 supply and NPS 2back outlet with tucker fittings.

.2 Manual Flush Valve: chrome plated with oscilating handle, vacuum breaker, escutcheon, control stop.

.3 Carrier: floor mounted, to suit urinal provided.

.4 Specified Products:
- .1 Urinal: Crane Cromwell Model 7-72 FV.
- .2 Carrier: Mifab MC-32.

2.5 LAVATORY L-1

.1 Lavatory: vitreous china, wall-mounted type, front overflow, rear outlet, oval, 100 mm centre set drilling.

.2 Faucet: 5.7L/min pressure compensating aerator, cast brass spout (135mm high), metal lever handles (100mm).

.3 Supply and waste fitting: combination removable seats, pop-up drain, aerator.

.4 Supplies: NPS 3/8 angle type, c.p. angle valves, c.p. escutcheon plates.

.5 P-trap: adjustable NPS 1¼ with cleanout and c.p. escutcheon plate.

.6 Specified Products:
- .1 Bowl - Crane Sonnet 1-340.
- .2 Trim - Crane Citadel C-1005.
- .3 Supplies - Crane C-1151.
- .4 P-trap - Crane C-1170.

2.6 LAVATORY L-2 ACCESSIBLE

.1 Lavatory: vitreous china, wall mounted type, 100 mm centre supplies, chair carrier support, ADA compliant, with 660 mm clearance under bowl to a point 254 mm from the front, oval basin, splashback, front overflow, drilled for arm supports.

.2 Faucet: 5.7 L/min. pressure compensating aerator, cast brass spout (135mm high), metal lever handles (100mm), ADA compliant.

.3 Supplies: 12mm angle type, c.p. angle valves, and c.p. escutcheon plates.

.4 P-Trap: adjustable chrome plated NPS 1¼ trap and c.p. escutcheon plate.

.5 Specified Products:
- .1 Bowl - Crane, Barrier Free, 1-27.
- .2 Trim - Delta 541-WF.
- .3 Supplies - Crane C-1153.
- .4 P-trap - Crane C-1168.
- .5 Carrier - Mifab MC-42.

2.7 COMBINATION SHOWER/EYEWASH (ES-1)

.1 Combination emergency drench shower and barrier free eye/face wash.
- .1 Pipe and fittings: NPS 1-1/4 piping assembly manufactured of Type 316 corrosion-resistant stainless steel.
- .2 Ball Valve: NPS 1 shower ball valve and NPS 1/2 stay open eye and eye/face wash valve manufactured of Type 316 stainless steel and supplied with type 304 stainless steel pull rod and handle.
- .3 Showerhead: 78.7 mm diameter highly visible yellow impact-resistant plastic. 254 mm diameter yellow impact-resistant plastic shroud. High performance Type 316 corrosion-resistant stainless steel showerhead measures 51mm in diameter. Drench showerhead with integral 87 LPM flow control.
- .4 Eye/face wash: High performance rinsing platform that provides 16.3 LPM of water at a safe velocity while maintaining its effectiveness. The eye/face wash is protected by flip open dust covers that open when the product is activated. Contains an antimicrobial agent to protect the eye/face wash.
- .5 Bowl and dust cover: Bowl is constructed of yellow impact-resistant plastic. Dust cover is constructed of transparent yellow impact-resistant plastic.
- .6 Activation: Type 304 stainless steel push handle.
- .7 Drench hose: Perforated sprayhead with protective sprayhead cover is ABS plastic and provides soft spray for cleansing eyes and face. Chrome-plated brass valve with extended handle stays open once handle is squeezed. 2438 mm yellow reinforced thermoplastic hose has 9mm NPT male thread. Burst strength is 3103 kPa. Attachment Kit includes 13mm NPT supply, fittings and hanger for attaching hose to eyewashes or drench showers. The sprayhead contains an antimicrobial agent to protect the sprayhead.
- .8 Backflow prevention: Series N9 dual-check backflow preventer has a chrome-nickel plated brass body and includes atmospheric vent for continuous pressure applications. The check valve comes with 9 mm female dual, NPT female inlet and outlet connections. It can sustain a maximum pressure of 862 kPa. The check valve is certified to CSA B64.8.

.2 Flow Switch:
- .1 120/1/60 double pole, double throw, UL and CSA listed, with remote alarm contacts.

.3 Specified Product:
- .1 Bradley S19314 series, with S19-319 flow switch.

.4 Acceptable Manufacturers:
- .1 Haws.

2.8 FROST PROOF COMBINATION SHOWER/EYEQASH (ES-2)

.1 Combination emergency drench shower and barrier free eye/face wash. Exterior non freeze applications:

.1 Pipe and fittings: NPS 1-1/4 piping assembly manufactured of Coated galvanized steel.

.2 Ball Valve: NPS 1 shower ball valve and NPS 1/2 stay open eye and eye/face wash valve manufactured of Type 316 stainless steel and supplied with type 304 stainless steel pull rod and handle.

.3 Showerhead: 78.7 mm diameter highly visible yellow impact-resistant plastic. 254 mm diameter yellow impact-resistant plastic shroud. High performance Type 316 corrosion-resistant stainless steel showerhead measures 51mm in diameter. Drench showerhead with integral 87 LPM flow control.

.4 Eye/face wash: High performance rinsing platform that provides 16.3 LPM of water at a safe velocity while maintaining its effectiveness. The eye/face wash is protected by flip open dust covers that open when the product is activated. Contains an antimicrobial agent to protect the eye/face wash.

.5 Activation: Type 304 stainless steel push handles exterior to the building.

.6 Eyewash and showerhead located exterior to the building. Provide pipe extensions as required and escutcheons to suit wall construction. Interior components are installed in a corrosive environment and require an additional field applied coating. Piping to slope indoors to promote drainage and drain through an integral drain line to the sanitary system.

.7 Backflow prevention: Series N9 dual-check backflow preventer has a chrome-nickel plated brass body and includes atmospheric vent for continuous pressure applications. The check valve comes with 9 mm female dual, NPT female inlet and outlet connections. It can sustain a maximum pressure of 862 kPa. The check valve is certified to CSA B64.8.

.2 Flow Switch:

.1 120/1/60 double pole, double throw, UL and CSA listed, with remote alarm contacts.

.3 Specified Product:

.1 Bradley S19-310TW, with S19-319 flow switch

.4 Acceptable Manufacturers:

.1 Haws.

2.9 EYEWASH STATION (EW-1)

.1 Wall mounted, barrier-free eyewash fixture.

.1 Sink: barrier-free, wall mounted, yellow impact-resistant plastic bowl, 254 mm diameter.

.2 Valve: chrome-plated brass NPS 1/2 stay-open ball valve, hand-operated by large, highly visible safety yellow PVC push handle.

.3 Sprayhead Assembly: chrome-plated brass with twin, soft flow, eyewash heads and protective sprayhead covers. Integral flow control for safe, steady flow under varying water supply conditions from 2.0 -6.1 bar.

.4 Pipe and fittings: NPS 1/2 stainless steel supply pipe, stainless steel bracket, NPS 1-1/4 drain fitting complete with tail piece and trap.

.5 Specified Product: Bradley S19 224.

.6 Approved Manufacturers: Haws.

.2 Flow Switch
- .1 120/1/60 double pole, double throw, U1 and CSA listed, with remote alarm contacts.
- .2 Specified Product: Bradley S19-319.
- .3 Acceptable Manufacturer: Haws.

2.10 TEMPERING VALVE FOR EYE/FACE WASH STATION

.1 Factory-built and tested thermostatic mixing valve for supplying tepid water to emergency eye/face wash units.

.2 Valve to feature internal cold water bypass to ensure flow in the event of valve failure or hot water failure. Valve to feature positive shut-off of hot supply when cold supply is lost.

.3 Discharge temperature factory set to 29°C. Standard temperature range to be 18°C to 32°C.

.4 Maximum hot water inlet temperature: 82°C.

.5 Maximum operating pressure: 860 kPA.

.6 Flow capacity: 5.5 L/min minimum to 38.5 L/min maximum.

.7 Valve to trace check stops to prevent cross flow and shall have a vandal resistant locking mechanism to secure temperature setting.

.8 Rough bronze finish and complete with liquid filled dial thermometer.

.9 Cabinet: surface mounted 1.2 mm stainless steel, with plexiglass window in door, cylinder lock, knockout holes. Provide recessed mounting in Laboratory – BAF Building.

.10 Specified Product: Bradley S19-2000.

.11 Acceptable Manufacturers:
- .1 Haws.
- .2 Powers.

2.11 TEMPERING VALVE FOR EMERGENCY SHOWER

.1 Factory assembled and tested thermostatic mixing valve, rough bronze finish, for supply of tempered water to emergency showers and emergency eyewash systems.

.2 Valve with internal cold water bypass to ensure cold water flow on valve or hot water failure. Positive shutoff of hot supply when cold supply is lost.

.3 Discharge temperature factory set to 29°C. Adjustable temperature range 18°C to 32°C. Maximum hot water inlet temperature 82°C.

.4 Maximum operating pressure: 860 kPa.

.5 Flow capacity: 5.5 L/min. minimum to 137.0 L/min. maximum.

.6 Integral strainer check stops on inlets.

.7 Liquid filled thermostat with 1-year warranty. Dial thermometer.

.8 Cabinet: Surface mounted, baked white enamel finish with cylinder lock, 1.2 mm body and door, knockout holes.

.9 Specified Product:
.1 Bradley S19-2100.

.10 Acceptable Manufacturers:
.1 Haws.
.2 Powers.

2.12 SHOWER STALL SH-1

.1 Fiberglass Shower Enclosures shall comply with CSA B45.5-11/IAPMO Z124 - Plastic Plumbing Fixtures

.2 All plumbing trim shall comply with ASME A112.18.1 / CSA B125.1 - Plumbing Supply Fittings.

.3 All plumbing waste fittings shall comply with ASME A112.18.2 / CSA B125.2 - Plumbing Waste Fittings.

.4 All trim shall be lead-free and comply with ANSI / NSF Standard 61

.5 Fiberglass shower enclosure 1 piece construction, dimensions as indicated on drawings. High gloss acrylic with fiberglass reinforcement. Safety-textured shower bottom pattern. Units to be complete with integral molded soap ledges, foot ledge and convenience shelf. Units to have the following field mounted accessories:
.1 Stainless steel drain grate and seal package.
.2 Stainless steel shower curtain rod.

.6 Shower Control Valve: fixed adjustable temperature, pressure balanced with on / off flow. Chrome plated metal construction, replaceable cartridge design, pressure balancing cycle valve with. Pressure balancing mechanism maintains selected discharge temperature to ± 1.5°C. Double rotating handle design, one adjusts and sets and maintains discharge temperature, other will be lever action and control flow on/off. NPS ½ connections. 4 port design, with built-in screwdriver shut-off valves.

.7 Shower Head: Standard adjustable flow shower head: chrome plated metal, non-clog, three mode shower head with full shower, pulsating massage and soft shower water saving spray and standard female ball joint connection. Standard chrome plated bent arm and escutcheon. Maximum flow rate of 9.5 litres/minute. Flow limited orifice.

.8 Acceptable Manufacturers:
.1 Mirolin.
.2 Maax.

2.13 MOP SINK MS-1

.1 Basin: moulded stone, 610 mm x 610 mm x 254 mm deep, colour determined by Consultant during shop drawing submittal.

.2 Supply: 200 mm combination type, chrome plated, with vacuum breaker, indexed cross handles, heavy cast brass spout with NPS 3/4 hose thread and pail hook, aerator, adjustable brace to wall, integral stop valves.

.3 Strainer: cast brass, chrome plated, coupling with two (2) neoprene gaskets, combination stainless steel dome strainer and lint basket, NPS 3 I.P.S. outlet.

.4 Guard: vinyl, factory installed on basin. Provide 340 g silicone sealant cartridge to seal between basin and walls.

.5 Specified Products:
- .1 Sink: Fiat MSB 2424.
- .2 Trim: Fiat 830 AA.

.6 Acceptable Manufacturers:
- .1 Crane.
- .2 American Standard.
- .3 Chicago Faucets.

.7 Connections: NPS 3 SAN, NPS 1-½ vent, NPS ½ DCW, NPS ½ mm DHW.

2.14 STAINLESS STEEL SINK SS-1

.1 Double compartment countertop type: 18-8 SS sink with #4 commercial satin finish, self-rimming with ledge back, 430 mm x 840 mm x 200 mm deep, undercoated, below counter clamping devices.

.2 Trim: polished chrome 200 mm deck-mount combination type, with one piece cover plate and 218 mm long swing spout, aerator tip, 5.7 L/min. flow rate, single handle supply. Hot and cold water supplies NPS ½ copper; bronze body shut-off valves located below countertop, CSA B651-12 compliant.

.3 Integral SS 90 mm basket strainer with stopper, NPS 1½ brass tailpiece and NPS 1½ copper p-trap with cleanout.

.4 Connections: NPS 1-½ SAN, NPS 1-¼ vent, NPS ½ DCW, NPS ½ DHW.

.5 Specified Products:
- .1 Sink: Kindred QDLF2233/8/3.
- .2 American Standard 4175.701.F15.

.6 Acceptable Manufacturers:
- .1 Crane.
- .2 Architectural Metals.
- .3 Cambridge/Delta.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Connect fixtures complete with supplies and drains, trap separately, support level and square. Provide each fixture with lock shield valves and air chambers on supplies. Equip thermostatic controlled mixing valves with check valves on supplies. Serve fixtures with supplies from wall.

.2 Exposed piping, valves: chrome plated with chrome-plated escutcheons. Supplies in cabinets or concealed: speedway chrome-plated tubing with chrome-plated escutcheons at walls.

.3 Mount fixtures to ensure that 90 kg weight will not loosen or distort mounting. Fasten fixtures on walls or partitions with 12 mm carriage bolts passing through wall to 3 mm steel plates (recessed where required) on other side of wall.

.4 Mount fixtures on glazed tile surfaces with ground faces to finished surface.

.5 Insulate exposed supply and waste piping for accessible lavatory to Section 15251.

.6 Adjust temperature limit stops on accessible lavatories to maximum 45°Csupply temperature.

.7 Prove specified function of electronic flush valves.

.8 Verify and adjust plumbing fixtures to ensure water consumption is within guidelines specified herein.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1	Mechanical General Provisions:	Section 15010
.2	Testing:	Section 15030
.3	Piping Provisions:	Section 15060
.4	Vibration Isolation and Seismic Control Measures:	Section 15241

1.2 REFERENCE STANDARDS

.1 Conform to:

- .1 CSA B52-05, mechanical refrigeration code.
- .2 ANSI/ASHRAE 15-2007 safety code for mechanical refrigeration.
- .3 Requirements of local and provincial authorities.
- .4 ARI, ASME and ASHRAE standards specified for ratings and performance tests.

1.3 QUALIFICATIONS

.1 Process refrigeration manufacturer to be regularly engaged in production of specified equipment, and issue catalogue information with correction factors where published ratings are based on parameters different from those specified.

1.4 ENGINEERING DATA

.1 Provide manufacturer's diagrams of field installation, internal wiring, and piping for complete assembly.

.2 Provide noise criteria in free field reference to db (on A scale).

.3 Submit shop drawings in accordance with Division 01.

1.5 MAINTENANCE

.1 Provide maintenance data in English for refrigeration for incorporation into maintenance manual specified in Division 1. Include exploded views of components. Refer also to Section 15010.

1.6 DELIVERY AND STORAGE

.1 Ship equipment factory dehydrated and sealed with full charge of refrigerant and charge of lubricating oil.

.2 Store equipment in protected area.

1.7 GUARANTEE

.1 Provide welded hermetic compressors with five-year material and labour guarantee.

PART 2 - PRODUCTS

2.1 REFRIGERATION PIPING

.1 For halocarbon refrigerants, use factory cleaned and sealed seamless ACR copper.

.2 Conform to TSSA, ASTM B280-08, and CSA requirements.

.3 Relief valve discharge pipe on outdoor installations to be copper tube type "L" with brazed joints.

2.2 FITTINGS

.1 Long radius type for elbows and return bends.

.2 Wrought copper or forged brass solder type, except flared fittings may be used for soft annealed copper tubing.

2.3 JOINTS

.1 Brazing materials to be SIL-FOS-15 phosphor-copper- silver alloy for copper piping jointed by copper fittings; 170 MPa silver solder for brass fittings; 95-5 solder for connections to equipment or accessories.

.2 Flexible connections NPS 3/8 nominal or less to be made using coiled soft copper tubing. For larger sizes, use seamless flexible bronze hose with bronze wire braid covering. Use factory sealed neoprene jacket unit where freezing may occur.

2.4 VALVES

.1 Meet MSS: ANSI B31.5-1974 valve construction and provide valves as follows:

.2 Service valves:
- .1 Forged brass up to 3.5 MPa packless and cast bronze up to 2.5 MPa.
- .2 Moisture proof seal type for below freezing applications.
- .3 Back seated and ball check for inspection and replacement under pressure.
- .4 Removable seal cap and gauge port for control capillary connections for compressors.
- .5 Stop valves:
  - .1 NPS 7/8 nominal o.d. or less to be diaphragm packless type with integral mounting bracket, forged brass bodies and bonnets, globe and angle non-directional type.
  - .2 NPS 1-1/8 nominal o.d. or larger to be wing cup, heavy globe or angle body, positive sealing, self-aligning, heavy nylon disc.
  - .3 Purge, drain, charging, angle or globe type with flare or brazing type outlet connection to have stem for socket wrench and removable seal cap.

.3 Relief valves:

.1 Safety relief type with fusible plug or rupture disc in forged brass body.

.2 Reseating type with forged brass body.

.3 Duplex valves as indicated or by code regulations arranged so that only one valve can be rendered inoperative at a time.

.4 Check valves:

.1 Spring operated, guided piston type with forged brass in flare connection sizes up to NPS 7/8 nominal o.d.

.2 Guided piston type, spring operated with bolted bonnet or cover plate in sweat connections NPS 1-1/8 nominal o.d. and above.

.5 Solenoid valves:

.1 With field replaceable coil, serviceable without removing valve from line. For pump downs, use manual lift stem. Rate coils according to temperature service.

.2 Provide upstream of thermostatic expansion valves and strainers.

.6 Expansion valves:

.1 Thermostatic type with external equalizer, adjustable superheat setting, capacity and bulb charge to suit operating conditions.

.7 Back pressure valves:

.1 Direct acting or with external pilot sensing, convertible in field to internal sensing with manual opening stem for pump down. Install with solenoid valve in pilot line for stop valve operation. Provide adjustable pressure setting.

.8 Crankcase pressure regulators:

.1 Holdback valves for low and medium pressure compressor suction line to prevent overloading of motors on full "pump" down and defrost cycle. Provide range of gauge pressure 0-275 kPa with a design pressure drop of 3.5 to 7 kPa.

2.5 DRIERS

.1 Provide liquid line driers to ARI 710-71, UL approved and rated to 3.5 MPa.

.2 Size as indicated, but not less than recommended by equipment manufacturer's nominal tonnage rating for type of refrigerant used.

.3 Size 16 mm o.d. or larger to be replaceable cartridge type installed as indicated. Provide isolating and relief valves.

.4 Provide suction line driers to suit liquid line drier and manufacturer's suction line ratings, with pressure drops rated to refrigerant used and operating suction pressure.

2.6 STRAINERS

.1 Up to NPS 1-1/8 provide drawn brass shell and 0.177 mm mesh monel screen. Provide larger units with drawn steel shell and 0.297 mm mesh screen. Strainers to be suitable for field service without removing housing from line.

2.7 SIGHT GLASS

.1 Provide one moisture indicating double sight glass near receiver outlet and as indicated. Install second sight glass upstream from expansion valve.

2.8 MUFFLERS

.1 Provide as indicated and where compressor discharge would create noise or pulsation problems and as recommended by compressor manufacturer.

2.9 OIL SEPARATORS

.1 Provide as indicated and for automatic return of trapped oil to the compressor crank case using float valve. Insulate non-heated separator drum.

2.10 HEAT INTERCHANGERS

.1 Provide liquid suction type employing soldered tube of size and type as required.

2.11 SUCTION ACCUMULATORS

.1 Compute pump down capacity of receiver as being 80 per cent of internal storage volume, expressed in kilograms of refrigerant liquid at 32°C temperature or to Provincial Code.

PART 3 - EXECUTION

3.1 INSPECTION

.1 Upon delivery, inspect components for damage or gas loss.

3.2 EQUIPMENT INSTALLATION

.1 Install systems and related controls in accordance with shop drawings and manufacturers' recommendations.

.2 Provide clearance around unit for service and maintenance.

.3 Run drain lines to floor drains.

.4 Provide vibration and noise isolation. Where units are supplied with sound attenuator, conform to manufacturer's instructions. Ensure adequate base or foundation.

3.3 PIPING INSTALLATION

.1 Provide clean refrigerant lines and fittings.

.2 When multiple runs are installed, spread pipes 150 mm minimum to allow for expansion and contraction.

.3 Install straight, parallel and close to walls and ceilings, with specified pitch.

.4 Keep elbows and fittings to minimum.

.5 Grade horizontal pipe carrying gases 1:240 down in direction of flow.

.6 Provide double risers in hot gas or suction piping as required.

.7 Provide trap every 4.5 m of vertical rise in any suction riser 9 m or more in length.

.8 Install piping to prevent condensate or oil from flowing back into compressor or evaporator. Provide suction accumulator in suction line between evaporator and compressor as required.

.9 Connect branch suction lines from top of suction main using wye-fitting. Install ancillaries and accessories such as back pressure compensating regulators and back pressure regulators horizontal.

.10 Enclose tubing exposed to mechanical injury in rigid or flexible conduit.

.11 Keep piping joints sealed except when fabricating.

.12 Limit breakable joints to equipment connections not normally brazed. Limit flared assembly and NPS 3/8 nominal o.d. for field assembly and NPS 5/8 nominal o.d. for factory assembly.

.13 Bleed dry nitrogen into piping when sweating connections.

.14 Braze flexible pipe vibration isolators and stub connectors on sealed hermetic compressors using alloys that melt at 620°C or below.

.15 Directly connect vibration isolators to compressor and firmly anchor other end.

3.4 ACCESSORIES

.1 Install accessories as specified or as recommended by the manufacturer.

- .1 Ball check isolating valves at receiver sight glass.
- .2 Charging valve for high and low side filter drier, solenoid valve and thermostatic expansion valve.
- .3 Union connections for supply and return outlets.
- .4 Plugged tee connections for chemically cleaning condenser tubes.
- .5 Shut off valves, isolating condenser and controls.
- .6 Pressure reducing valve.
- .7 Basket type water strainer.
- .8 Water regulating valve for head pressure control.
- .9 Drain line and valve.

.10 Oil separator with automatic oil return to crankcase, through filter, automatic stop valve, external float valve sight glass isolating valves.
.11 Capacity controls: evaporator pressure controls; crankcase pressure controller; hot gas bypass to suction line with desuperheat control; hot gas bypass to evaporator inlet.
.12 Purge valve to be installed at high point of condenser only for units operated at vacuum suction pressure.
.13 Dehydrator assemblies: install with three valves.
.14 Liquid suction heat interchangers: as indicated.

3.5 FIELD QUALITY CONTROL

.1 Pressure and leak testing:
.1 Perform leak test before evacuating system. Meet requirements of CSA B52.
.2 Use refrigerant gas as tracer with dry nitrogen to develop pressure.
.3 Compressors with refrigerant holding charge to remain isolated from system. Protect accessories when performing test.
.4 Build 35 kPa initial refrigerant pressure in high and low side and add dry nitrogen to field test pressure.
.5 Test for leaks with electronic detector.
.6 Repair leaks and retest.

3.6 DEHYDRATION

.1 Carry out work in presence of Consultant.

.2 Evacuate using two-stage vacuum pump with gas ballast on second stage capable of pulling vacuum of 0.05 mm. Fill pump with fresh dehydrated oil.

.3 Do not use refrigerant compressors to pull vacuum.

.4 Maintain ambient temperature of 13°C or higher throughout refrigeration system for at least 12 hours before and during dehydration.

.5 Connect high vacuum hose or seamless copper tubing jumper lines to both high and low pressure sides. Provide line size not less than NPS ¼ nominal o.d. for units up to 70 L internal volume and NPS 3/8 nominal or NPS ½ nominal o.d. for larger units.

.6 Install thermo couple vacuum gauge with micron scale to measure system pressure. Provide manual isolating valve between pump and gauge and take readings only with system isolated from pump.

.7 When compressor/condensing unit has refrigerant holding charge intact, service valves to remain closed during evacuation. Evacuate equipment received with dry air, wrong refrigerant or lost holding charge.

.8 Triple evacuate field installed system as follows: twice to 1.5 mm 1500 microns and hold for four hours. Break vacuum to a gauge pressure of 14 kPa each time with refrigerant. For final evacuation, continue pumping through minimum 12 hours after reaching 0.5 mm. After completion of final evacuation, isolate pump from system and make graphic record of rate of any increase in vacuum reading that may take place inside following hours. Continue readings until vacuum has stabilized. Charge through filter drier.

3.7 CHARGING

.1 Give initial charge through high side charging valve with pressure gauge and new filter-drier installed in connection to charging valve.

.2 Charge only amount of refrigerant necessary for proper operation of refrigeration system. When amount has been charged, close liquid charging valve with system in operation, observe sight glass near receiver outlet to recheck.

.3 When refrigerant container must be changed during charging process, re-purge charging line.

.4 Low side charging to be permitted only for charging small amounts in gaseous state.

.5 Provide 48 hours notice of leak testing, dehydration and charging.

.6 Prime oil separator with operating charge of compressor oil.

3.8 START UP AND ADJUSTMENT

.1 Provide necessary instruments, gauges and testing equipment. Adjust thermostats, valves and controls to obtain design requirements and manufacturer's ratings.

.2 Test and record cooling apparatus entering and leaving air temperatures, dry bulb and wet bulb.

.3 Test and record voltage and running amperes and compare to motor nameplate data, and starter heater rating against design requirements. Check each phase that must be accurate to nearest 100 VA.

.4 Ensure that refrigerant temperatures are accurate to within 0.5°C.

.5 In cooperation with control manufacturer's representative, set and adjust automatic control system to achieve required sequence of operations.

.6 Bring equipment into operation, trial run and make up any loss of oil and refrigerant.

3.9 CLEANING

.1 Pressurize system with 35 kPa of refrigerant and hold charge for two hours.

.2 Reclaim refrigerant by pumping down through filtration system.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This specification covers ductless split system air conditioners. The capacities are as scheduled or as indicated herein. Contractor is responsible for all refrigerant line sizing and installation to the manufacturer's requirements. Refer to 15651.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- .2 American Society for Testing and Materials (ASTM):
  - .1 ASTM A48: Standard Specification for Gray Iron Castings.
  - .2 ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Application
  - .3 ASTM E165: Standard Practice for Liquid Penetrant Examination for General Industry.
- .3 American Iron and Steel Institute (AISI).
- .4 Hydraulic Institute Standards:
  - .1 HI 11.6: Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Test.
- .5 International Organization for Standardization (ISO):
  - .1 ISO 9906: Rotodynamic Pumps – Hydraulic Performance Acceptance Test.
- .6 National Electrical Manufacturer's Association (NEMA).
- .7 Canadian Standards Association
  - .1 CSA B52: Mechanical Refrigerant Code.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all PART 2 – PRODUCTS.

.3 Product Data:
- .1 Relevant information to confirm that the specifications have been met. Identify all deviations.
- .2 Identify construction materials for all major components.
- .3 Relevant data illustrating full range of operation including fan curves, if applicable.
- .4 Written sequence of operation
- .5 Wiring diagrams
- .6 Electrical motor information and specification.
- .7 Anchoring requirements.

.4 Operation and Maintenance Data:
  .1 Operation and Maintenance Manuals. Refer to Division 1 and Division 15, section 15014 for requirements.
  .2 Manufacturer's installation requirements.

.5 Quality Control Data:
  .1 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed units.

1.6 QUALITY ASSURANCE

.1 Equipment manufacturer to provide a written certification stating that the units(s) has/have been installed to their standards.

.2 Incremental unit and associated equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority. Refer to the Electrical Safety Code.

.3 Incremental unit manufacturer to have proven established network of service centres in Eastern Ontario.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements.

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Training required for all incremental units.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

.2 In addition to the Division 1 requirements, provide a ten-year parts warranty and compressor warranty.

PART 2 - PRODUCTS

2.1 INCREMENTAL UNITS

.1 The air conditioning system shall consist of:
  .1 DFS (Duct-Free Split) system with single-split, wall-mounted indoor units (208V / 1Ph / 60Hz).
  .2 VRF Multi VS system with multi-port outdoor unit and 4-way cassette indoor units (208V / 1Ph / 60Hz).

.2 All equipment shall be ETL-listed and bear the ETL label.

.3 Units shall comply with AHRI Standard 210/240 (DFS) and AHRI Standard 1230 (VRF) and bear the AHRI certification label.

.4 DFS outdoor units shall be factory-charged with R-410A for 30 m of line set. Indoor units shall be shipped with a dry air holding charge.

.5 System efficiency shall meet or exceed 13.6 SEER for DFS units: VRF system to meet minimum COP and EER as per ASHRAE 90.1 compliance.

.6 Outdoor unit control shall be via microprocessor located in the indoor unit.

2.2 INDOOR UNITS

.1 DFS Wall-Mounted Units (208V / 1Ph / 60Hz)
  .1 The indoor unit shall be factory assembled, wired and run tested including wiring, piping, control circuit board and fan motor. The unit in conjunction with the remote controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes will be charged with dry air instead of R410-A before shipment from the factory.
  .2 The casing shall have a white finish.
  .3 Provide with drain pan and integral P-trap for condensate collection.
  .4 Provide integrally powered condensate drain pump.
  .5 Fan:
    .1 The evaporator fan shall be two speed, double inlet, forward curve fans driven by a single motor.
    .2 The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
    .3 A motorized air sweep flow louver shall provide an automatic change in airflow by directing the air from side to side for uniform air distribution. Ceiling cassette models to have adjustable four-way air distribution patters.
    .4 Return air shall be filtered by means of an easily removable washable filter.
    .5 The evaporator coil shall be of non-ferrous construction with smooth plate fins on copper tubing.
  .6 Control:
    .1 The controller shall consist of an ON/OFF switch, Cool/Dry-Fan selector, Thermostat setting, Timer Mode, High-Low fan speed, Auto Vane selector, Test Run switching and Check Mode switching.
    .2 The control system shall consist of two (2) microprocessors interconnected by a single non-polar two wire cable.
    .3 Manufacturer shall provide two (2) conductor 18 Ga. Stranded wire for connection to remote controller. All control wiring to be installed in conduit to the requirements of Division 16.

.4 The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit. Provide variable refrigerant flow controller for the blower room
.5 The system shall include self-diagnostics including total hours of compressor run time.
.6 The microprocessor within the wall mounted remote controller shall provide automatic cooling, display set point and room temperature, 24-hour ON/OFF timer so that automatic operation function display, check mode for memory of most recent problem.

.2 VRF 4-Way Cassette Units (208V / 1Ph / 60Hz)
.1 Factory-assembled and run-tested including wiring, condensate drain pump, and fan assembly.
.2 Equipped with adjustable four-way air distribution louvers.
.3 Includes self-diagnostics, automatic fan operation, auto-swing, auto-restart, and 3-minute delay.
.4 Provided with integral condensate pump, drain pan, and P-trap.
.5 Filters: washable and easily removable.
.1 Fan: multi-speed, forward curved, statically and dynamically balanced with ECM motor.
.6 Controls:
.1 Microprocessor-based controller with indoor temperature sensor.
.2 Wired controller with full-function display (cooling/heating mode, temperature, fan speed, vane, diagnostics).
.3 Remote enable/disable via dry contact to SCADA (VRF units only).
.4 Up to 50 indoor units supported over 1,650 ft of non-polar two-wire shielded cable.
.5 Control wiring to conform to Division 16 requirements
.6 VRF system capable of staging each of the 4 interior units from a single controller.

2.3 OUTDOOR UNITS

.1 DFS Outdoor Units (208V / 1Ph / 60Hz)
.1 Rotary compressor, powder-coated galvanized steel casing, factory-assembled and wired.
.2 Equipped with direct-drive propeller fan and permanently lubricated bearings.
.3 Condenser coil: copper tubing with aluminum fins, metering device for refrigerant control.
.4 Capable of -20°C cooling operation with low ambient kit.
.5 Electrical: 208V / 1Ph / 60Hz.

.2 VRF Multi VS Outdoor Unit (208V / 3Ph / 60Hz)
.1 Powder-coated steel casing with factory-installed refrigerant circuitry, compressors, and fan.
.2 Multi-zone variable refrigerant flow system with individual indoor unit control.
.3 Operation range:
.1 Heating: -30°C to 16°C
.2 Cooling: -15°C to 50°C
.4 Equipped with:
.1 Scroll compressors with crankcase heater and internal overload.
.2 Integrated inverter for capacity modulation.
.3 Factory-installed wind baffles.
.4 Control via indoor unit microprocessor.
.5 Dry contact interface for integration with SCADA/BMS.
.6 Electrical: 208V / 3Ph / 60Hz.

2.4 CAPACITY

.1 As scheduled on mechanical drawings and equipment schedule.

2.5 SPECIFIED PRODUCT

.1 Wall Mounted Specified Product: Mitsubishi Mr. Slim P-Series.

.2 Ceiling Cassette Specified Product: LG Multi V - Four-Way 3' x 3' Dual Vane Ceiling Cassette.

2.6 ALTERNATE MANUFACTURERS

.1 Hisense

.2 Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Confirm exact installation location on site with Consultant.

.2 The installation shall conform to current CSA B52: Mechanical Refrigerant Code requirements, TSSA requirements, and local authorities having jurisdiction (AHJ). Submit the required documentation and correct any deficiencies as required to obtain AHJ system sign-off approval.

.3 The installing contractor shall be in conformance with the manufacturer's requirements for warranty and installation.

.4 Coordinate equipment installation to render a fully operating system meeting the intent of the contract documents. Install in accordance with the manufacturer's written instructions.

.5 Submit written documentation from the equipment manufacturer confirming proper installation.

.6 Complete refrigerant piping. Install and support to avoid interference with other services, and to protect from damage. Confirm proposed routing with the Consultant. Size refrigerant piping according to manufacturer’s instructions.

END OF SECTION

PART 1- GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 15800 Ventilation

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for [humidifiers] and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.
  - .1 Indicate following:
    - .1 Performance and Capacities
    - .2 Materials of construction
    - .3 Power requirements
    - .4 Controls and accessories

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.6 Manufacturer's Site Reports:
- .1 Submit manufacturer's site reports specified.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for humidifiers for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Section 01780 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 PACKAGED ELECTRODE STEAM GENERATING TYPE

.1 CSA certified and ULC listed.

.2 Components housed in factory fabricated cabinet with factory enameled finish and electrically interlocked door.

.3 Factory sealed disposable steam cylinder complete with factory installed electrodes to suit water condition.

.4 Controls:
- .1 Solid state panel.
- .2 Solenoid valve on water and drain lines.
- .3 Duct humidistat.
- .4 Airflow proving switch.
- .5 Duct high level humidistat
- .6 Adjustable flush cycle timer.
- .7 Amp meter.
- .8 Cylinder replacement indicator light.

.5 Duct distribution header complete with condensate drain and supply hose.

.6 ENERGY STAR certified.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for humidifiers installation in accordance with manufacturer’s written instructions.

3.2 INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Humidifier and evaporator media to be new and clean when project is accepted.

.3 Install humidistat in accessible location.

.4 Water service overflow drain: To manufacturers’ recommendation.

.5 Install access doors or panels in adjacent ducting.

.6 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 15800 Ventilation.

.7 Install capped drain connection at low point in duct.

3.3 SITE QUALITY CONTROL

.1 Manufacturer's Site Services:
- .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation, protection and cleaning, of its product(s) and submit written reports, in acceptable format, to verify compliance of Work with Contract.
- .2 Manufacturer's Site Services: provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.2 Start-up:
- .1 General: in accordance with General Requirements, supplemented as specified.
- .2 Verify:
  - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
  - .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
  - .3 Visually check distribution manifold to ensure:
    - .1 Even distribution of vapour.
    - .2 Freedom from water deposits.

END OF SECTION

GENERAL

1.1 GENERAL

.1 This section includes air handling equipment for the BAF Building second level Administrative Area and recirculation air handling units providing cooling for the BAF Building MCC/UPS Room and Blower Room.

1.2 RELATED WORK

.1	Mechanical General Provisions:	Section 15010
.2	Mechanical System Support, Anchorage and Seismic Restraint:	Section 15010
.3	Commissioning Mechanical Systems:	Sections 15010, 01021
.4	Testing:	Section 15030
.5	Balancing:	Section 15031
.6	Vibration Isolation and Seismic Control:	Section 15241
.7	Condensing Units:	Section 15771
.8	Ductwork:	Section 15800
.9	Building Automation System:	Section 15901

.10 Wiring for equipment: conform to Division 16 requirements.

1.3 QUALITY ASSURANCE

.1 Coils to be certified in accordance with ARI Standard 410.

.2 Air handling unit performance certified in accordance with ARI Standard 430.

.3 DX coils designed and tested to ANSI B9.1.

.4 Insulation to NFPA 90-A.

.5 Unit must comply with ASHRAE/IES 90.1 – Latest Edition or Model National Energy Code for Buildings – Latest Edition. Submit documents to verify compliance

1.4 SUBMITTALS

.1 Submit the following shop drawings:
  .1 Air handling units

.2 Accessories
.3 Fans and performance curves
.4 Coil performance data
.5 Motors
.6 Electrical wiring diagrams, nameplate data.

.2 Manufacturer's installation instructions.

.3 Manufacturer's field commissioning and test procedures.

PART 2 – PRODUCTS

2.1 GENERAL

.1 Provide packaged indoor air handling units meeting scheduled operating capacities, with supply and exhaust fan, filter section, heat pump coil, electric heating coil, and BACnet compatible unit controller, for monitoring and select control by BAS.

.2 Air handling units to be factory assembled, piped, wired, tested and shipped in one piece

.3 General components to include:
.1 R-454B refrigerant
.2 Energy Recovery Wheel
.3 VFD driven direct drive backward curved plenum supply fans
.4 Double wall cabinet construction
.5 Insulation with a minimum R-value of 6.25
.6 Double-sloped stainless steel drain pans
.7 Hinged access doors with lockable handles
.8 LED service lights in the control panel
.9 Designed, engineered, and manufactured in the United States of America
.10 All other provisions of the specifications must be satisfactorily addressed

.4 Unit shall have a draw-through supply fan configuration and discharge air vertically.

.5 Unit shall be shipped in four sections and factory tested including leak testing of the coils and run testing of the supply fans and factory wired system.

.6 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.7 Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.

.8 Installation, Operation and Maintenance manual shall be supplied within the unit.

.9 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.10 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

2.2 UNIT CONSTRUCTION

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam injected panels.

.2 Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel and prevents exterior condensation on the panel.

.3 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.4 Access doors shall be flush mounted to cabinetry.

.5 Units shall include double-sloped 304 stainless steel drain pan. Drain pan connection shall be on the right-hand side of unit with a 1" MPT fitting.

.6 Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

.7 Unit shall include factory wired control panel compartment LED service lights.

.8 Unit shall include exterior corrosion protection which shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

2.3 SEISMIC

.1 Design unit with suitable attachments to meet seismic restraint requirements per Ontario Building Code, Section 4.1.9 and ASHRAE Guidelines.

.2 Coordinate with Contractor’s Seismic Restraint Designer.

2.4 FILTERS

.1 Unit filter access shall be through service access door with piano hinges and draw latches.

.2 Unit shall include 4 inch thick, pleated panel filters with a MERV rating of 13, upstream of the cooling coil. Unit shall also include 2 inch thick, pleated panel pre filters with MERV rating of 8, upstream of the 4 inch standard filters.

.3 Unit shall include a clogged filter switch that senses the pressure drop across the unit filter bank and cooling coil.

2.5 FANS

.1 Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

.2 Blower and motor assembly shall be dynamically balanced.

.3 Motor shall be IE5 efficiency permanent magnet totally enclosed motor. Variable frequency drive shall be factory wired and mounted in the unit.

.4 Blower and motor assembly shall utilize neoprene gasket.

2.6 ENERGY RECOVERY

.1 Unit shall contain an energy recovery cabinet with back outside air opening, back exhaust air opening, top return air opening, and top supply air opening.

.2 Unit shall include on/off outside air and on/off exhaust air damper assemblies constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511.

.3 Outside air damper shall open with a 24VDC supply fan enable signal, and the supply fan shall not be enabled until after the outside air damper is fully opened.

.4 The exhaust air damper shall open with a 24VDC exhaust fan enable signal, and the exhaust fan shall not be enabled until after the exhaust air damper is fully opened.

.5 Unit shall include 2 inch thick, pleated panel outside air filters with MERV rating of 8, upstream of the wheel.

.6 Unit shall contain a factory mounted and tested energy recovery wheel. The energy recovery wheel shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings.

.7 Wheel frame shall slide out for service and removal from the cabinet.

.8 The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.

.9 Wheels shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.

.10 Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.

.11 All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

.12 The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.

.13 Energy recovery wheel cassette shall carry a 5-year non-prorated warranty, from the date of original equipment shipment from the factory.

.14 Total energy recovery wheels shall be coated with silica gel desiccant permanently bonded by a process without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

.15 Unit shall include energy recovery wheel defrost control to periodically stop the wheel rotation, which allows the warm exhaust air to defrost the wheel.

.16 Energy recovery wheel access shall be through service access door with piano hinges and quarter turn button fasteners.

.17 Outside air dampers, exhaust air dampers, and energy recovery wheel control panel access shall be through service access doors with piano hinges and lockable quarter turn handles.

2.7 COOLING COIL

.1 Access to cooling coil shall be through hinged access door with lockable quarter turn handles.

.2 Evaporator Coil

- .1 Coil shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
- .2 Coil shall be 4 row and 14 fins per inch.
- .3 Coil shall be hydrogen leak tested.
- .4 Coil shall be furnished with factory installed thermostatic expansion valves. The sensing bulbs shall be field installed on the suction line immediately outside the cabinet.
- .5 Coil shall have right hand external piping connections. Liquid and suction connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.

.3 Heat Pump

- .1 Air handling unit and matching condensing unit shall be capable of operation as an R-454B split system heat pump.
- .2 Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.

.3 Unit shall be configured as heat pump. Refrigeration circuit shall be equipped with a thermal expansion with an internal check valve on the indoor coil.

.4 Reversing valve, outdoor coil thermal expansion valve, bi-flow filter drier, and liquid line receiver shall be factory installed in the matching AAON condensing unit.

2.8 ELECTRIC HEATING COIL

.1 Unit shall include an electric heater consisting of electric heating coils, fuses and a high temperature limit switch, with capacities as shown on the plans.

.2 Electric heating coils shall be located in the reheat position.

.3 Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). Supply air temperature sensor shall be factory provided, and field installed in the supply air ductwork.

.4 Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). A 0-10 VDC heating control signal shall be field provided to control the amount of heating.

2.9 INTERNAL ISOLATION

.1 Provide spring isolation for entire fan, motor and drive assembly, internally mounted at factory, together with fan discharge flexible connection and thrust restraint springs.

2.10 ELECTRICAL

.1 Provide motor variable frequency drives for both fan motors, factory installed and wired, tested in NEMA 4 enclosure.

.2 Provide with factory installed and wired non-fused disconnect suitable for VFD operation c/w all control wiring.

.3 Unit shall be provided with an internal control panel with separated low and high voltage control wiring. Access to internal control panel shall be through service access door with piano hinges and lockable quarter turn handle.

.4 Unit shall be provided with standard power block for connecting power to the unit.

.5 Unit shall include a factory installed 24V control circuit transformer.

.6 Unit shall have a 5kAIC SCCR.

.7 Unit shall include high and low voltage quick connects for easy wiring at installation.

.8 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

2.11 CONTROLS

.1 Air handling unit serving Admin Building:

.1 Provide factory installed unit controller, control devices and wiring as required to provide BAS control of air handling unit according to MID 801. Provide bacnet interface for full monitoring and control by the building automation system.

.2 Refer to MID 801 for list of control points required and sequence of operations.

.3 Unit controller shall be capable of controlling all features and options of the unit if communications is lost with the BAS. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure. Unit shall modulate cooling and heating with variable airflow to meet space demand as dictated by BAS.

.2 Controller:

.1 Unit shall be provided with a proof of airflow switch. When airflow is not detected, other electrical components cannot power on.

.2 Unit shall be provided with an internal control panel with separated low and high voltage control wiring.

.3 Access to internal control panel shall be through an access door with piano hinges and lockable quarter turn handles.

.4 Factory Installed and Factory Provided Controller

.1 Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.

.2 Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.

.3 Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.

.4 Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.

.5 Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network.

2.12 HEAT PUMP

.1 General:

.1 Unit shall be certified in accordance with UL Standard 60335-2-40 and CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

.2 Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

.3 System Seasonal Energy Efficiency Ratio (SEER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

.4 4.7 W/W COP at operating conditions

.5 Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL label.

.6 Air-Source heat pump condensing unit shall include compressors, air-cooled condenser coils, condenser fans, suction and liquid connection valves, accumulator, receiver, reversing valve, filter driers with check valves, and thermal expansion valves.

.7 Unit shall be factory assembled and tested including leak testing of the coil and run testing of the completed unit. Run test report shall be supplied with the unit in the control compartment.

.8 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.9 Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.

.10 Installation, Operation and Maintenance manual shall be supplied within the unit.

.11 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's access door.

.12 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's access door.

.2 Construction:

.1 Unit shall be completely factory assembled, piped, and wired and shipped in one section.

.2 All cabinet walls, access doors, and roof shall be fabricated of G90 galvanized steel panels.

.3 Unit shall be specifically designed for outdoor application.

.4 Access to compressors and control components shall be through hinged access doors with quarter turn, lockable handles.

.5 Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

.3 Electrical

.1 Unit shall be provided with standard power block for connecting power to the unit.

.2 Control circuit transformer and wiring shall provide 24 VAC control voltage from the line voltage provided to the unit.

.3 Unit shall have a 5kAIC SCCR.

.4 Air-source heat pump shall include an optimized start defrost cycle to prevent frost accumulation on the outdoor coil during heat pump heating operation and to minimized defrost cycle energy usage. If the temperature of the outdoor heat exchanger and/or the suction line is less than a predetermined value, a deferred defrost cycle is initiated wherein the defrost cycle starts after a variable, continuously optimizing, time interval has elapsed. The defrost cycle is terminated when the relative temperatures of the outdoor heat exchanger and/or the suction line indicate that sufficient frost is melted from the heat exchanger to insure adequate time between successive defrost cycles for optimizing the efficiency and reliability of the system, or after a predetermined time interval has elapsed, whichever condition occurs first. During defrost cycle all compressors shall energize, reversing valves shall energize, and auxiliary heat shall energize.

.5 Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.

.6 Unit shall be provided with remote stop/start terminals which require contact closure for unit operation. When these contacts are open the low voltage circuit is broken and the unit will not operate.

.7 Unit shall be provided with factory supplied and factory installed controller in the matching air handling unit

.4 Refrigeration System

.1 Unit shall be provided with one independently circuited R-454B two-stage scroll compressor with thermal overload protection. Two-stage compressor shall include 2 stages of capacity control, 67% and 100%.

.2 Each compressor shall be furnished with a crankcase heater.

.3 Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to the compressors.

.4 Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

.5 Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low-pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided and installed. Field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line and insulated suction line.

.6 Unit shall include a factory holding charge of R-454B refrigerant and oil. Adjusting the charge of the system will be required during installation.

.7 Unit shall include 2 stages of capacity control.

.8 Unit shall be configured as an air-source heat pump. Refrigeration circuit shall be equipped with a bi-flow liquid line filter drier, reversing valve, suction line accumulator, liquid line receiver, and thermal expansion valve with internal check valve. Reversing valve shall de-energize during the heat pump heating mode of operation. The matching indoor air handler must include a thermal expansion valve with internal check valve.

.9 The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling. The controls shall also include an adjustable, 20 second delay timer for each additional capacity stage to prevent multiple capacity stages from starting simultaneously and adjustable compressor lock out.

.10 Each refrigeration circuit shall be equipped with a liquid line sight glass.

.11 Units shall be provided with a suction pressure transducer on the refrigeration circuit.

.5 Fans

.1 Condenser fan shall be horizontal discharge, axial flow, direct drive fans.

.2 Condensing unit shall be provided with an electrically commutated motor (ECM) condenser fan, condenser head pressure controller, and discharge pressure transducers for modulating head pressure control to allow cooling operation down to 35°F. Fan motor shall be weather protected, single phase, direct drive, and totally enclosed air over (TEAO) with electronic protection.

.6 Coils

.1 Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

.2 Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.

.3 Coils shall be hydrogen leak tested.

2.13 SPECIFIED PRODUCT

.1 Aaon V3.

.2 Approved Manufacturers:
- .1 Engineered Air
- .2 Trane
- .3 Daikin/McQuay

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Install units in accordance with manufacturer's installation instructions.

.2 Mount air handling unit on housekeeping pads, anchor with bolts, lag screws on methods indicated by Seismic Restraint Designer, connect to ductwork.

.3 Coordinate control installation.

3.2 INSPECTION, CERTIFICATION

.1 Provide factory test reports prior to shipment.

.2 Provide pulleys as required to obtain specified performance.

.3 Carry out field inspection checking for structural damage and verify electrical characteristics, unit capacities and options are provided as specified. Submit report to Consultant.

.4 Manufacturer to carry out commissioning of equipment in accordance with approved start up and commissioning procedures and sequence of operation. Submit commissioning reports progressively and as a whole upon completion.

.5 Manufacturer to submit certification that equipment has been installed in accordance with their requirements and is performing properly and in accordance with scheduled operating requirements.

3.3 INSTRUCTION OF OPERATING STAFF

.1 Provide trained personnel to instruct operating staff in maintenance, adjustment and operation of mechanical equipment.

.2 Provide instruction during regular work hours for 3 full days prior to acceptance and turnover to operating staff.

.3 Notify Consultant of instruction period and await written notice to proceed.

.4 Use operation and maintenance data manual for instruction purposes.

.5 Instruct staff on changes made under terms of warranty or modification of equipment.

3.4 FILTER REPLACEMENT

.1 Replace filter media after commissioning and provide one additional spare set of filters.

END OF SECTION

PART 1 - REFERENCES

1.1 GENERAL

.1 This section includes make-up air equipment for process areas.

.2 Refer to makeup air unit schedule.

.3 Make-up units are installed indoors.

1.2 RELATED WORK

.1 Includes, but is not limited to:

.1	Mechanical General Provisions:	Section 15010
.2	Mechanical System Support, Anchorage and Seismic Restraints:	Section 15010
.3	Commissioning Mechanical Systems:	Sections 01021, 15010
.4	Testing:	Section 15030
.5	Balancing:	Section 15031
.6	Vibration Isolation and Seismic Control:	Section 15241
.7	Plumbing:	Section 15400
.8	Ductwork:	Section 15800
.9	Field Wiring:	Division 16

1.3 QUALITY ASSURANCE

.1 Source quality control:
- .1 CSA
- .2 AMCA
- .3 Coils to ARI certified.

.2 Unit must comply with ASHRAE/IES 90.1-Latest Edition or Model National Energy Code for Buildings – Latest Edition. Submit documentation to verify compliance.

.3 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency in accordance with published methods.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Sections 01340 and 15010 and the following:
- .1 Makeup air units.
- .2 Accessories.
- .3 Fans and performance curves.
- .4 Coil performance data.
- .5 Electric motors.
- .6 Electrical wiring diagrams, nameplate data.

.2 Manufacturer's installation instructions.

.3 Manufacturer's field commissioning and test procedures.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Systems to be provided include:
.1 Headworks Building make-up air unit.

.2 Provide make-up air units with fan, filter section, inlet plenum and electric heating coil, meeting performance criteria as scheduled.

.3 Make-up air units to be factory assembled, piped, wired, tested and shipped in one piece.

.4 Make-up air unit controls will not be provided in this section unless indicated otherwise. Refer to MID drawings for coordination.

.5 Makeup air unit serving Headworks Building to be provided with a spark-proof fan.

2.2 UNIT CONSTRUCTION

.1 Exterior panels: 1.6 mm galvanized steel with baked or electrostatically applied enamel finish.

.2 Access doors: 1.6 mm steel, fully hinged with closed cell gasket and quick opening lever handles and drip lip.

.3 Provide neoprene gaskets and safety tiebacks for access doors.

.4 Insulate all interior with 50 mm R13 injected foam insulation. Provide 1.6 mm galvanized metal liner on floor, ceiling and access doors.

.5 Unit bases to be one piece welded assembly with 2 mm formed structural members. Provide 150 mm formed steel base rail.

.6 Provide supply fan opening transitions as necessary, to suit duct sizes as shown on drawings.

.7 Identify location of major components with 50 mm lamacoid plates mechanically fastened to face of panels.

.8 Construction to withstand full fan shut-off pressure without permanent deformation.

2.3 SEISMIC

.1 Design unit with suitable attachments to meet seismic restraint requirements per Ontario Building Code, and ASHRAE Guidelines.

.2 Coordinate with Contractor's Seismic Restraint Designer.

2.4 MAKEUP AIR UNIT

.1 Unit to be complete with draw-through fan section, electric heating coil, filters, inlet plenum section, and ducted outside air, complete with low leakage insulated dampers.

.2 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Insulate with R13 injected foam insulation. Cover all joints in insulation with a sheet metal break. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 210/240.Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage

.3 Provide hinged access doors to fans and motors, filters, dampers and operators, and access plenums. Doors to be gasketted and open towards positive pressure and be equipped with Lever Lok handles.

.4 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in.

.5 Unit shall include direct drive, unhoused, backward curved, plenum supply fans with OEM speed controller. Blowers and motors shall be dynamically balanced. Motor shall be a high efficiency electrically commutated motor. The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling and an adjustable compressor lockout.

.6 All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating. Outlet velocity of fan will be a maximum of 2200 FPM.

.7 Fans shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings. ABMA L10, 80,000 hour life. Fans to be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

2.5 ELECTRIC HEATING

.1 Unit shall include an electric heater consisting of electric heating coils, fuses and a high temperature limit switch, with capacities as shown on the plans.

.2 Electric heating coils shall be located in the reheat position.

.3 Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). Supply air temperature sensor shall be factory provided and field installed in the supply air ductwork..

.4 Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). A 0-10 VDC heating control signal shall be field provided to control the amount of heating.

2.6 FILTER SECTION

.1 Unit shall include 2-inch thick, pleated panel filters with an ASHRAE MERV rating of 8, upstream of the cooling coil.

.2 Unit shall include 5/16-inch lint screen pre filters upstream of the standard filters.

.3 Unit shall include a clogged filter switch.

2.7 DAMPERS

.1 Dampers shall be extruded aluminum, low leak air-foil type.

.2 Outside air damper shall be extruded aluminum low leak, thermally broken, insulated blade type. Specified Manufacturer: Ruskin CDT 150. Provide 2-position actuator with dry contacts for control by oem controller.

2.8 ELECTRICAL

.1 Provide FVNR motor starter with NEMA 4 enclosure.

.2 Provide with factory installed and wired non-fused disconnect.

2.9 CONTROL

.1 Factory Installed and Factory Provided Controller

- .1 Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.
- .2 Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
- .3 Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
- .4 Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
- .5 Makeup Air Controller
  - .1 Unit shall modulate heating with constant airflow to meet ventilation outside air loads. Heating capacity shall modulate based on supply air temperature..

.2 Controller to include the following as a minimum (coordinate with MID Drawings):

- .1 Fan On/Off
- .2 Discharge Air Temperature (include duct mounted temperature sensor)
- .3 Heating control through SCR electric coil
- .4 Outdoor air damper open/close
- .5 Fan Status
- .6 Clogged Filter
- .7 General Alarm
- .8 Damper end switch feedback.

2.10 SPECIFIED PRODUCT

.1 Specified Manufacturer: Aaon RQA.

.2 Approved Manufacturers:
- .1 Engineered Air
- .2 Trane
- .3 Daikin.

2.11 SPARE PARTS

.1 Provide initial set of filters and one complete set of spare filters.

.2 Provide one of each type of fan bearing and a complete set of spare belts.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install units in accordance with manufacturer's installation instructions.

.2 Mount units on housekeeping pads, anchor with bolts, lag screws on methods indicated by Seismic Restraint Designer, connect to ductwork.

.3 Coordinate control installation.

3.2 INSPECTION, CERTIFICATION

.1 Provide factory test reports prior to shipment.

.2 Carry out field inspection checking for structural damage and verifying electrical characteristics, unit capacities and options are provided as specified. Submit report to Consultant.

.3 Manufacturer to carry out commissioning of equipment in accordance with approved startup and commissioning procedures and sequence of operation. Submit commissioning reports progressively and as a whole upon completion.

.4 Manufacturer to submit certification that equipment has been installed to their requirements and is performing properly and in accordance with scheduled operating requirements.

3.3 INSTRUCTION OF OPERATING STAFF

.1 Provide trained personnel to instruct operating staff in maintenance, adjustment and operation of mechanical equipment.

.2 Provide instruction during regular work hours for 4 hours prior to acceptance and turnover to operating staff.

.3 Notify Consultant of instruction period and await written notice to proceed.

.4 Use operation and maintenance data manual and updated as-built prints for instruction purposes.

.5 Instruct staff on changes made under terms of warranty or modification of equipment.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

.1 This section includes indoor heat and energy recovery ventilators serving the process building and the UV building.

1.2 RELATED WORK

.1	Mechanical General Provisions:	Section 15010
.2	Mechanical System Support, Anchorage and Seismic Restraint:	Section 15010
.3	Mechanical System Commissioning:	Sections 15010 and 01021
.4	Testing:	Section 15030
.5	Balancing:	Section 15031
.6	Vibration Isolation and Seismic Control Measures:	Section 15241
.7	Ductwork:	Section 15800
.8	Field Installation and Wiring of Devices (If not specified anywhere):	Division 15
.9	Power Wiring to Main Disconnect Switch (provided with equipment):	Division 16

1.3 QUALITY ASSURANCE

.1 Packaged heat or energy recovery ventilator to be indoor design, factory fabricated, assembled, prewired, and tested prior to shipment.

.2 Equipment to meet scheduled performance requirements. Refer to HRV/ERV Schedule.

.3 Heat exchanger performance to be verified by ASHRAE Standard 84-Latest Edition, Method of Testing Air to Air Heat Exchangers. Submit verification.

1.4 REFERENCES

.1 Conform to CGA, CSA, SMACNA and ASHRAE standards.

.2 Sound rating: AMCA 301, 300.

.3 Balancing: statically and dynamically balance fans, construct in conformity with AMCA 2408-69.

.4 AHRI Standard 1060-2000 certified energy recovery component.

.5 CSA C22.2, No. 13 Standard, applicable to ventilators.

.6 CSA F444, Installation of Heat Recovery Ventilators.

.7 UL Standard 1812 – Ducted Heat Recovery Ventilators.

1.5 SUBMITTALS

.1 Submit manufacturer's construction and performance data in accordance with Section 01340 and 15010:
- .1 Capacities and performance data.
- .2 Construction, Accessories.
- .3 Electrical wiring diagram, nameplate data.
- .4 Written Sequence of Operation referenced to wiring diagram.
- .5 Installation and Maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide a packaged plate type heat or energy recovery ventilator with accessories and controls to provide a complete working system.

.2 Unit shall be constructed to CSA C22.2 standards and carry the mark label of an approved certifying body. The unit shall undergo 100% functionality testing at the factory prior to shipping. Heat exchangers shall be certified and currently listed AHRI and shall meet UL 94 flame spread and smoke generation requirements

.3 Unit shall not be used during construction. Unit shall be stored and handled in accordance with the manufacturer's written instructions.

2.2 HEAT RECOVERY UNIT (HRV)

.1 Application: Process Building.

.2 Unit shall be a horizontal configuration complete with integral face and bypass with economizer.

.3 Cabinet: The cabinet shall be double-walled construction. 0.76 mm (22 ga.) galvanized steel inner wall and 0.76 mm (22 ga.) outer wall. The unit shall be insulated with 1" R4 expanded polystyrene. All serviceable components shall be accessible through a hinged front access panel.

.4 Defrost: Economizer controls integrated with face and bypass dampers. Integral return air and outside air temperature sensors to enable free cooling. Unit to bypass heat recovery core when return air is warmer than the outdoor air in the cooling season.

.5 Motors: Motors shall be continuous duty, permanently lubricated with a minimum service factor of 1.15, matched to the fan load and required voltage and phase. Motors enclosure shall be Totally Enclosed Fan Cooled.

.6 Filter: 50 mm pleated intake and return filters. Minimum efficiency: Merv 8, with dirty filter switches and dry contacts. Unit controller to monitor air flow status of both fans through integral differential pressure switches across the fan assembly. Unit failure or loss of airflow to send alarm signal to the SCADA system.

.7 The unit shall have a single point power connection within a NEMA 4 enclosure with an integral non-fused disconnect switch. The unit shall be c/w a 24 VAC control transformer with 200 VA for internal and remote controls.

.8 Provide factory-wired and installed disconnects sized to suit electrical load c/w all required control wiring. Provide factory-wired and installed variable frequency drives (VFD). A factory-supplied and installed VFD shall be provided for each motor. The plant SCADA system will enable a high speed contact for the unit to run in either high speed occupied mode or low speed unoccupied mode.

.9 Provide devices and a controller capable of full unit control as indicated in the drawings.

.10 Provide heat exchanger HRV core with AHRI-rated sensible heat transfer properties meeting or exceeding the scheduled values. The HRV core shall be constructed flame flame-retardant polypropylene material and certified and currently listed with AHRI to Standard 1060. The heat exchanger core shall be easily removable for servicing.

.11 Intake and exhaust air blowers to be centrifugal, forward curved, with ball bearings, adjustable belt drive, and motor mount base.

.12 Provide main panel and controller for full control of unit. Provide dry contacts for monitoring by the plant SCADA control system.

.13 Auxiliary contacts for each motor shall be provided.

.14 Provide two-year equipment warranty (all parts), 15-year (HRV core) heat recovery core warranty.

.15 Specified product: Nu-air NU2540HRV.

2.3 ENERGY RECOVERY UNIT (ERV)

.1 Application: UV Building.

.2 Unit shall be a horizontal configuration complete with integral face and bypass with economizer.

.3 Cabinet: The cabinet shall be double-walled construction. 0.76 mm (22 ga.) galvanized steel inner wall and 0.76 mm (22 ga.) outer wall. The unit shall be insulated with 1” R4 expanded polystyrene. All serviceable components shall be accessible through a hinged front access panel.

.4 Defrost: Economizer controls integrated with face and bypass dampers. Integral return air and outside air temperature sensors to enable free cooling. Unit to bypass energy recovery core when return air is warmer than the outdoor air in the cooling season.

.5 Motors: Motors shall be continuous duty, permanently lubricated with a minimum service factor of 1.15, matched to the fan load and required voltage and phase. Motors enclosure shall be Totally Enclosed Fan Cooled.

.6 Filter: 50 mm pleated intake and return filters. Minimum efficiency: Merv 8, with dirty filter switches and dry contacts.

.7 The unit shall have a single point power connection within a NEMA 4 enclosure with an integral non-fused disconnect switch. The unit shall be c/w a 24 VAC control transformer with 200 VA for internal and remote controls.

.8 Provide factory-wired and installed disconnects and starter.

.9 Provide devices and a controller capable of full unit control as indicated in the drawings.

.10 Provide Enthalpy ERV core with AHRI-rated with sensible and latent heat transfer properties meeting or exceeding the scheduled values. The enthalpy core shall be constructed of a membrane treated to resist mold and odor-causing bacteria, have latent energy transfer properties, flame retardancy, and be certified and currently listed with AHRI to Standard 1060. The heat exchanger core shall be easily removable for servicing.

.11 Intake and exhaust air blowers to be centrifugal, forward curved, with ball bearings, adjustable belt drive, and motor mount base.

.12 Provide main panel and controller for full control of unit. Provide dry contacts for monitoring by the plant SCADA control system.

.13 Auxiliary contacts for each motor shall be provided.

.14 Provide two-year equipment warranty (all parts), 5-year (ERV core) energy recovery core warranty.

.15 Specified product: Nu-air NU1030ERV.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install according to manufacturer’s written instructions and according to all applicable codes.

.2 The installing contractor shall coordinate with the manufacturer and controls to render a fully operational system to meet the design intent outlined in the contract documents.

3.2 INSPECTION, CERTIFICATION

.1 Provide factory test reports prior to shipment.

.2 Carry out field inspection checking for structural damage and verifying electrical characteristics, unit capacities and options are provided as specified. Submit report to Consultant.

.3 Manufacturer to carry out commissioning of equipment in accordance with approved start up and commissioning procedures and sequence of operation. Submit commissioning reports progressively and as a whole upon completion.

.4 Manufacturer to submit certification that equipment has been installed in accordance with their requirements and is performing properly and in accordance with scheduled operating requirements.

3.3 INSTRUCTION OF OPERATING STAFF

.1 Provide trained personnel to instruct operating staff in maintenance, adjustment and operation of mechanical equipment.

.2 Provide instruction during regular work hours for three full days prior to acceptance and turnover to operating staff.

.3 Notify Consultant of instruction period and await written notice to proceed.

.4 Use operation and maintenance data manual and updated as built prints for instruction purposes.

.5 Instruct staff on changes made under terms of warranty or modification of equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This specification covers general ventilation including louvres, ductwork, and accessories.

.2 Refer to the drawings to establish duct quantity and material requirements as louvre sizes and quantities.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .2 ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, Strip.
  - .3 ASTM B209/B209M: Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  - .4 ASTM A480/A480M: Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .5 ASTM A635/A635M: Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy With Improved Formability, General Requirements for.
  - .6 ASTM A653/A653M: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - .7 ASTM 924/924M: Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - .8 ASTM A90/A90M: Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
  - .9 ASTM D2996: Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
  - .10 ASTM D3982: Standard Specification for Contract Molded “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Ducts.
  - .11 ASTM D1784: Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
  - .12 ASTM A700: Standard Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment.
- .2 American Welding Society (AWS).
- .3 Factory Mutual Laboratories (FM Approvals):
  - .1 FM 4910: Cleanroom Materials Flammability Test Protocol.
  - .2 FM 4922: Fume Exhaust Duct or Fume and Smoke Exhaust Ducts.
- .4 National Bureau of Standards (NBS):
  - .1 NBS PS 15-69: Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment.
- .5 National Fire Protection Association (NFPA):
  - .1 NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials.
- .6 Sheet Metal and Air Conditioning Contractors National Association (SMANCA).

.7 Underwriters' Laboratories (UL):
.1 UL-181: Factory-Made Air Ducts and Air Connectors.

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all PART 2 – PRODUCTS.
.1 Product Data:
.1 Relevant information to confirm that the specifications have been met. Identify all deviations.
.2 Duct engineering description, performance data, construction details; duct thickness, longitudinal seams, lateral joints, reinforcement details & spacing, connections, hanger and support system, gaskets, and sealants
.3 FRP Resin details

.2 Operation and Maintenance Data:
.1 Operation and Maintenance Manuals. Refer to Division 1 and Division 15, section 15014 for requirements.
.2 Manufacturer's installation requirements.
.3 Quality Control Data:
.1 Structural Engineer review and approval documentation confirming the design of supports, anchors and restraints prior to submission.
.2 Manufacturer's certified testing results.
.3 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed accessories.

1.6 QUALITY ASSURANCE

.1 Ventilation equipment to meet CSA Z299.4 Quality Inspection Program

.2 Ductwork and supports to be to SMACNA and ASHRAE Standards.

.3 NFPA Compliance: NFPA 90A and NFPA 90B

.4 Only firms who regularly engage in manufacture of ductwork products of types, materials, and sizes as specified herein, whose products have been satisfactorily used in similar service for not less than 5 years shall be permitted to submit.

.5 Supports, anchors and restraints to conform to and be coordinated with the structural requirements of the Ontario Building Code and the requirements of the Structural Engineer responsible for the design of structural support systems for mechanical systems and equipment.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements

1.8 TRAINING

.1 Not Required

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL DUCT REQUIREMENTS

.1 Application: Where indicated on the drawings

.2 Where no specific ductwork materials are indicated in Specifications or on Drawings, galvanized steel sheet metal shall be basis of Contract

.3 Specified components of the ductwork system, including adhesives, shall have fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.

.4 Branch duct connections to round duct mains shall be made using factory fabricated fittings

.5 Reinforcement material: Unless otherwise indicated, provide reinforcements of same material as ductwork

2.2 GALVANIZED STEEL DUCTWORK

.1 Application: Where indicated on the drawings

.2 Duct work and fittings Design Criteria:
- .1 Static pressure range: less than 2500 Pa.
- .2 Maximum Velocity 10 m/s.

.3 Steel specification:
- .1 Ducts to be galvanized steel, to SMACNA standards. Minimum duct thickness to be 24 Ga. or per SMACNA Guidelines, whichever is greater

.2 Steel to be in accordance with ASTMA653/A653M and ASTM A924/A924M ASTM A653 G90 zinc coating. Coating designation in accordance with Test Method A, ASTM A90/A90M. and ASTM A924/A924M.

.3 Provide sheet metal packaged and marked as specified in ASTM A700

.4 Joints: to SMACNA (manufactured duct joint).

.1 Specified Product: Ductmate 25/35/45.

.5 Support: duct support to SMACNA. Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:

.1 Indoors: Carbon steel, zinc electroplated.

.2 Outdoors: Carbon steel, hot-dipped galvanized after fabrication.

.6 Turns in ductwork:

.1 Standard radius (or short radius with single thickness turning vanes). Where a specific fitting is indicated on drawings, provide alternate only following Consultant's approval.

.2 Square Elbows: up to 400 mm to be single thickness.

.3 Square Elbows: over 400 mm to be double thickness.

.7 Duct sealing classifications to be in accordance with SMACNA and the following:

.1 Seal Class A: seal all transverse joints, longitudinal seams and duct wall penetrations. ASHRAE leakage Class 1.5, 1% of airflow at .5 kPa.

.2 Seal Class B: seal all transverse joints and longitudinal seams. ASHRAE leakage Class 3, 2.4% of airflow at .5 kPa.

.3 Seal Class C: seal all transverse joints. ASHRAE leakage Class 6, 4.7% of airflow at .5 kPa

.8 Leakage less than 1% of average airflow.

.9 Fasteners

.1 Rivets, bolts, or sheet metal screws

.2 Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish

.10 Dampers: Refer to 15850

2.3 STAINLESS STEEL DUCTWORK

.1 Application: Where indicated on the drawings

.2 Duct work and fittings Design Criteria:

.1 Static pressure range: Between -1kPa and 2.5 kPa.

.2 Maximum Velocity 10 m/s.

.3 Duct Classification:).

.3 Stainless Steel specification:

.1 Steel in accordance with ASTM A167, ASTM A240/A240M, and ASTM A480/A480M.

.2 Stainless Steel type 316/316L.

.3 Duct construction, including sheet metal thickness and reinforcement, shall comply with SMACNA Rectangular Industrial Duct Construction Standards and SMACNA Round Industrial Duct Construction Standards. Minimum thickness 0.86 mm (18 gauge).

.4 No. 2B (cold-rolled bright) finish.

.5 Longitudinal fusion welded butt seam, flanged fittings, and joints with all seams welded. Continuously weld all joints using Inert Gas Metal Arc process without burning parent metal. Use filler rods type AWS Class ER 316 L. Welds to be ground smooth and passivated.

.6 Fittings:

.1 Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 Continuously welded along seams.

.3 Elbows: Provide centerline equal to radius 1.5 times elbow diameter

.7 Duct support spacing shall not exceed a maximum of 4.5m

.4 Fasteners

.1 Rivets, bolts, or sheet metal screws

.2 Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated type 410 stainless steel or equivalent complete with bonded metal and fiber washer for dielectric separation.

.5 Dampers: Stainless steel construction. Refer to 15850

.6 Flexible connectors: neoprene coated glass fibre, coated both sides, minimum mass 1300 g/m², secured to ducts and fans with 25 mm x 25 mm x 3 mm stainless steel type 316 L flat bars and bands using type 410L stainless steel screws or bolts at 100 mm intervals.

2.4 PVC DUCTWORK

.1 Application: For use in corrosive environments to exhaust ambient temperature air at high humidity and containing low concentrations of H2S and where indicated on the drawings.

.2 Duct work and fittings Design Criteria:

.1 Static pressure range: Between 0 and 2.5 kPa.

.2 Maximum Velocity 10 m/s.

.3 Duct Classification: Class 5 (Corrosive Fumes).

.3 Type 1, Grade 1, seamless extruded ductwork PVC properties equivalent to ASTM D-1784.

.4 Operating limit: 60°C.

.5 Ductwork to be self-extinguishing when tested in accordance with ASTM-635. Maximum wall thickness to be 6 mm.

.6 Fittings:

.1 Equivalent to duct properties and thickness.

.2 Joints to be solvent welded except flanges required at dampers and connections to equipment.

.3 Branch connections to be at angle not exceeding 45° and shall be continuously welded in the factory.

.7 Standard of Acceptance: Fabco Plastics Instaduct.

.8 Dampers
- .1 Provide volume dampers for balancing flows on isolating branches.
- .2 PVC construction with equivalent corrosion resistant attachments and accessories; flanged ends.
- .3 Provide lockable quadrant per SMACNA Thermoplastic Duct Construction Manual Fig. 3.24 to fix damper position. Permanently fix damper to shaft and mark damper orientation on end of shaft.
- .4 Provide actuators per Section 15800 for automated dampers. Adjust motion to provide high and low flow indicated in the drawings.

.9 Specified Product: Fabco Plastics Dampers

.10 Alternate Manufacturer
- .1 Approved equal

2.5 WATERTIGHT DUCT

.1 Provide watertight duct for:
- .1 Minimum 300 mm upstream and 600 mm downstream from duct mounted humidifier discharge manifold.

.2 Form bottom of horizontal duct without longitudinal seams. Weld joints of bottom and side sheets. Seal other joints with duct sealer. Slope horizontal branch / connecting ductwork down towards sealed section of duct.

.3 Fit base of riser / plenum / manifold section, with 150 mm deep drain sump and NPS 1 drain connected with deep seal trap and ball valve, discharging to open funnel drain or as indicated.

2.6 FLEXIBLE DUCT, ACOUSTIC, LOW PRESSURE

.1 Fabricate in accordance with:
- .1 UL 181, Class 1.
- .2 NFPA 90A and NFPA 90B
- .3 Factory Mutual approved.

.2 Perforated triple-lock aluminum core, 25 mm glass fibre insulation, vinyl sleeve outer covering, temperature range -40°C to 120°C, pressure range -250 Pa to +500 Pa.

.3 Acoustic Performance (based on 200 mm diameter):

Frequency Band	125	250	500	1K	2K	4K
Attenuation (db/m)	1.5	4.5	12.0	18.0	20.0	15.0
Frequency Band	125	250	500	1K	2K	4K
Attenuation (db/ft.)	0.5	1.5	4.0	6.0	6.5	5.0

.4 Specified Product: Flexmaster T/L A.

.5 Alternate Manufacturers:
.1 Thermaflex.

2.7 FLEXIBLE CONNECTIONS

.1 Neoprene coated glass fabric, minimum weight 0.68 kg/m² field or factory fabricated, not more than 150 mm long between 24 Ga. metal parts and installed with just sufficient slack to prevent vibration transmission at 112°C rating, self-extinguishing fabric.

.2 Provide flexible connection at inlet and outlet of each in-line fan and air handling unit.

.3 Comply with NFPA 90A and 90B requirements.

.4 Airtight and waterproof construction. Flame-retarded or non-combustible fabrics, coatings, and adhesives complying with UL 181, Class 1

.5 Specified Manufacturers:
.1 DuroDyne.
.2 DynAir.

2.8 SEALANTS AND TAPES

.1 Provide sealants and tapes to suit application.

.2 Sealant: Water based indoor/outdoor sealant, permanently flexible, not to support fungal growth, non-flammable.

.3 Service temperature -7°C to 93°C; ULC listed for 0 flame speed and smoke development.

.4 Specified Manufacturers:
.1 Dyn/Air
.2 Childers.

2.9 LOUVRES

.1 Construction: all welded with joints ground flush and smooth.

.2 Blade: stormproof pattern, extruded aluminum with centre watershed in blade. Material: 6063-T5 alloy, 2 mm with reinforcing bosses and maximum blade length of 1500 mm.

.3 Frame, head, sill and jamb: one piece extruded aluminum minimum 3 mm 6063-T5 alloy with approved caulking slot, integral to unit, U-channel mounting, 100 mm 150 mm or 200 mm depth.

.4 Mullions: at 1500 mm maximum centres.

.5 Fastenings: all stainless steel SA-194-8F with SA-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, stainless steel washer and aluminum body. Heat treated, quenched in water and annealed.

.6 Screen: 12 mm mesh, 2 mm diameter (No. 14 AWG) aluminum birdscreen on inside face of louvres in formed U-frame.

.7 Finish: factory applied, baked enamel. Submit colour chip for final colour selection by Consultant.

.8 Louvre Sizes: as indicated on drawings.

.9 Specified Manufacturer: Tamco Model 3600 (Intake), Model 4600 (Exhaust).

.10 Specified Manufacturers:
- .1 Nailor.
- .2 Construction Specialties.
- .3 Alternate louvers to provide no less than the free area available with the specified manufacturer for each size of louver

2.10 DUCT ACCESS DOORS

.1 Doors: galvanized mounting frame of thickness equal to duct, provide with fastening devices to give tight closure on neoprene gasket securely formed onto door frame. Door for insulated duct to be double panel construction with 13 mm rigid insulation material between metal panels.

.2 Specified Manufacturer: Nailor.

.3 Alternate Manufacturers:
- .1 Ruskin
- .2 Greenheck
- .3 Approved equal

2.11 CASING AND PLENUMS

.1 Construct apparatus, sheet metal connections, plenum chambers and casings of 1.2 mm zinc coated prime-quality, copper bearing industrial-grade galvanized metal.

.2 Fabricate casings and connections to avoid restrictions in air flow. Where changes in shape or cross-sectional area are necessary, slope for airstream to be limited to 45° angle in direction of airflow.

.3 Form all joints in casings with 38 mm high standing seams. Stagger seams parallel to airflow in adjacent panels. Seams to be outside casing and riveted or bolted on 300 mm centres.

.4 Reinforce all seams with 38 mm x 38 mm x 4.8 mm galvanized angles. Place seams perpendicular to airflow and outside of casings on not greater than 1 m centres. Place supplemental reinforcing angles inside casing, parallel to air flow on 1 m centres, where span of casing equals or exceeds 2 m. Bolt or rivet reinforcing angles to casing wall on 380 mm centres.

.5 Construct access doors and frames of 1.2 mm galvanized steel of double panel construction with 13 mm rigid insulation between metal panels. Mount all doors on doorframe with three steel butt hinges. Frame door and brace to nearest bracing angles with galvanized reinforcing angles.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Installations to conform strictly to all local and Provincial Code requirements.

.2 Conform all work to standards of good practice recommended by SMACNA and the latest ASHRAE Guide and Data Book.

.3 Installation of rigid ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B

.4 Install ductwork in accordance with manufacturer's instructions and recommended adhesives, cement, sealant, and insulation accessories.

.5 Provide fire dampers (refer to 15850) at all fire rated duct crossings.

3.2 FLEXIBLE DUCT JOINTS

.1 Connect flexible ducts to other ductwork or equipment with triple-lock joints. Secure joints by at least three wraps of pressure sensitive, vapour seal adhesive tape, or with mastic duct sealant and sheet metal screws or stainless steel band with cadmium-plated hex screw to tighten band with worm-gear action

.2 Length of flexible ductwork not to exceed 1.5 m.

.3 Ducts to be continuous with no intermediate joints.

3.3 HANGING AND SUPPORTING SYSTEM

.1 Provide support, anchorage and restraint of ductwork designed and constructed in accordance with the latest edition of the following standards:

.1 The Ontario Building Code

.2 ASHRAE Applications, Seismic Restraint Design

.3 SMACNA Duct Construction Standards.

.2 Provide certification of the design of the ductwork support, anchorage and restraint system by a Structural Engineer licensed in the Province of Ontario. The construction of the support, anchorage and restraint system is to be reviewed and certified by the Structural Engineer.

.3 Coordinate ductwork support/anchorage/restraint systems with the requirements and constraints of the structure, vibration isolation systems and the support, anchorage and restraint systems for electrical and architectural components of the building

.4 Support flexible ducts by hangers every 1 m. Support method to prevent duct damage by vibration or other motion. Do not lay ducts across lighting fixtures or other hot surfaces.

3.4 CASINGS AND PLENUMS

.1 At floor line and at other points where casings join masonry construction, rivet casing on maximum 300 mm centres to 38 mm x 38 mm x 3.2 mm angle. Secure angles to masonry with expansion or toggle bolts on 300 mm centres and caulk airtight to masonry.

3.5 LOUVRES

.1 Check openings to ensure that dimensions conform to drawings.

.2 Ensure that louvre is compatible with wall construction prior to ordering louvre. Check that openings are free of irregularities which interfere with installation.

.3 Place louvre in wall opening and fasten to building structure.

.4 Follow procedures in manufacturer's recommended installation instructions.

.5 Prior to ductwork connection, secure birdscreen and frame to louvre interior.

.6 Repair damage to louvres to match original or replace unit.

.7 Clean louvres and screens of construction dirt, leaves and other matter.

3.6 OBSTRUCTIONS

.1 No pipes, wire, structural member or other obstruction will be allowed in ductwork.

3.7 TESTING

.1 Test high pressure risers and mains by means of a small pressure blower, a calibrated metering on face, and a U-gauge manometer to measure the test static pressure developed in the ductwork.

.2 Carry out leak tests at test pressure 500 Pa above system design pressure and repeat until leakage is proven at less than the following:

.1 Seal Class A: 1% of airflow.

.3 Test VAV systems at design pressure which could exist at maximum flow rates.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This specification covers the supply, installation, and commissioning of building mechanical fans and associated accessories.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
- .1 Air Movement and Control Association International (AMCA)
  - .1 AMCA Standard 99: Standards Handbook
  - .2 AMCA Standard 300: Reverberant Room Methods for Sound Testing of Fans
  - .3 AMCA Standard 301-14: Methods of Calculating Fan Sound Ratings from Laboratory Test Data
  - .4 AMCA Standard 500-D: Laboratory Methods of Testing Dampers for Rating
- .2 National Fire Protection Association (NFPA):
  - .1 NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .3 Canadian Standards Association: (CSA).
  - .1 CSA Z432 – Safeguarding of Machinery.
- .4 American Bearing Manufacturers Association (ABMA)
- .5 Sheet Metal and Air Conditioning Contractors National Association (SMANCA).
- .6 National Electrical Manufacturer's Association (NEMA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all PART 2 – PRODUCTS.

.3 Product Data:
- .1 Relevant information to confirm that the specifications have been met. Identify all deviations.
- .2 Identify construction materials for all fan components.
- .3 Provide fan curves, with related performance data, for all fans based on design conditions scheduled. Performance data to include fan curves at performance point as well as at 100 rpm increments through full operating range.
- .4 Electrical motor information and specification.
- .5 Loadings imparted to the fan base.
- .6 Permissible range of vibration.
- .7 Factory finishing details.
- .8 Noise data
- .9 Anchoring requirements.

.4 Operation and Maintenance Data:
- .1 Operation and Maintenance Manuals. Refer to Division 1 and Division 15, section 15014 for requirements.
- .2 Manufacturer's installation requirements.

.5 Quality Control Data:
.1 Manufacturer's certified testing results.
.2 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed fans.

.2 For each fan model and size, provide the following spare parts:
.1 One (1) set of drive belts per belt driven fan.

1.6 QUALITY ASSURANCE

.1 Design of systems is based on the specified and its inherent performance through the full range of the performance curve. Fan selection has also taken into consideration fan performance at different operating speeds. Alternate fan sections to provide a similar performance to the specified unit. The Consultant will be the sole judge of equivalency.

.2 Pwl ratings: comply with AMCA 301 tested to AMCA 300. Unit to bear AMCA certified sound rating seal.

.3 Balancing: statically and dynamically balance fans, construct in conformity with AMCA Bulletin 99.

.4 Ratings: base on tests performed in accordance with AMCA Bulletins 210 and ASHRAE 51, unit to bear AMCA certified rating seal.

.5 Selection: fans to be standard products, selected from published literature of manufacturer.

.6 Finish: factory coat over primer on all parts, colour standard to manufacturer. Paint before assembly and repaint after. Colour to be approved by Consultant.

.7 Fans and associated equipment to be approved to Canadian standards and must bear markings or labels by the Electrical Safety Authority (ESA). Refer to the Electrical Safety Code.

.8 Electrical Equipment not bearing a CSA label requires an ESA field approval

.9 Guarding to meet OSHA and CSA Z432 requirements.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Training required for all Part 2 equipment

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

.1 Provide fans with the indicated for flow rate, total pressure, total static pressure (TSP), shutoff pressure, rpm, kW, tip speed, size and pwl,

2.2 PROTECTIVE COATINGS

.1 Epoxy coating (2 mil thickness - dry) required for fans exposed to corrosive environment and where indicated on the fan schedule.

.2 Provide Eisen-Heiss 212 System, protective coating on interior of fans exposed to corrosive environment. See Schedule. Application:

.1 Coverage:

.1 212 Etch Primer - 1.0 mil (wet) - 0.1 mil (dry)

.2 212 Finish - 4.0 mil (wet) - 2.0 mil (dry)

.3 Application Preparation:

.1 Prepare fans for application of protective coatings in accordance with AMCA 99.

.2 Coating to be applied in accordance with coating manufacturer's requirements.

2.3 SQUARE INLINE CENTRIFUGAL FANS (TYPE 1)

.1 Duct mounted exhaust or supply fans shall be centrifugal, direct drive inline type constructed of heavy gauge galvanized steel and include square duct mounting collars.

.2 Include two removable access panels of sufficient size to permit easy access to all interior components.

.3 Centrifugal backward inclined wheel constructed of aluminum to be statically and dynamically balanced.

.4 A NEMA 4 disconnect switch shall be provided. Factory wiring shall be provided from motor to the handy box. NEMA 7/9 disconnect switch required for use with explosion proof motors.

.5 L50 500,000 hours bearing life at maximum catalogued speed.

.6 AMCA Certified for sound and air performance and fan efficiency. Fans licensed to bear AMCA certified ratings seals.

.7 Motor to be heavy duty, Electronically Commutated Motor (ECM) high efficiency: as scheduled and in accordance with the requirements of section 15053.

.8 Provide OEM speed controller.

.9 Accessories: as scheduled,

.10 Performance: as scheduled.

.11 Factory test fans at operating speed. Provide written record of factory test upon request.

.12 Specified Manufacturer: Greenheck SQ Vari-Green series.

.13 Alternate Manufacturers:
- .1 Twin City
- .2 Northern Blower
- .3 New York Blower.

2.4 PLASTIC INLINE CENTRIFUGAL (TYPE 2)

.1 Inline centrifugal, backward inclined fan for corrosive and/or humid exhaust.

.2 Fan housing to be bifurcated type. The velocity pressure shall be efficiently converted to static pressure. The inlet cone to be engineered to reduce incoming air turbulence to a minimum. Shaft and Bearings to be outside airflow and exposed for easy service, FRP or PVC construction.

.3 Centrifugal wheel, backward inclined blades, FRP construction. The hub to be bolted and bonded to the fiberglass backplate. A fiberglass sleeve, bonded to the hub, shall extend from the wheel to the exterior of the fan housing. The arrangement must prevent exposure of the steel shaft to the air stream in the fan housing. The wheel shall be electronically balanced, both statically and dynamically.

.4 Belt driven fan casing shall be entirely FRP. The resin may contain up to 5% of antimony trioxide in order to be fire retardant, with a flame spread rating of 15 or less. Finishing colour pigmentation to be light grey and to contain an Ultraviolet inhibitor.

.5 Bearings fixed to a fiberglass reinforced plate. The fan drive shaft shall be high strength, distortion free precision ground steel. One end to be machined with the appropriate keyway to allow keying of the drive sheave. The other end also to be keyed for impeller hub mounting. The motor to be mounted on an adjustable steel base. All steel parts to be out of the air stream and be epoxy painted, neoprene shaft seal.

.6 Ball bearing or roller bearing pillow block type. A minimum ABMA L10 life of 50,000 hours.

.7 Motors to be premium efficiency, Standard NEMA 4 frame, belt or direct drive as scheduled, TEFC with 1.15 SF.

.8 Provide factory mounted NEMA 4 disconnect switch.

.9 Specified Manufacturer: M.K. Plastics, Model AXCL.

.10 Alternative Manufacturers:
.1 Universal Fans
.2 Plasticair.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Carry out field inspection on arrival at site, checking for structural damage and verifying electrical characteristics, unit capacities and options are as specified.

.2 Coordinate roof, wall and ceiling openings, locations and sizes and positioning of roof curbs with other trades.

.3 Install according to manufacturer's written instructions.

3.2 CERTIFICATION, TESTING

.1 Conform to requirements of Balancing in Section 15031 and Testing in Section 15030.

.2 Make all adjustments necessary to meet specified airflow.

.3 Adjust fan speeds for balancing.

.4 Manufacturer to submit certification that equipment has been installed in accordance with their requirements and is performing properly.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This specification covers mechanical dampers as scheduled and as indicated on the drawings.

.2 Refer to section 15930 Primary Control Devices for information on non manual actuators.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.
- .1 Air Movement and Control Association International (AMCA)
  - .1 AMCA Standard 500-D: Laboratory Methods of Testing Dampers for Rating
- .2 National Fire Protection Association (NFPA):
  - .1 NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .3 Sheet Metal and Air Conditioning Contractors National Association (SMANCA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted sections, submit the following for all PART 2 – PRODUCTS.

.3 Operation and Maintenance Data:
- .1 Operation and Maintenance Manuals. Refer to Division 1 and Division 15, section 15014 for requirements.
- .2 Manufacturer’s installation requirements.

.4 Quality Control Data:
- .1 Manufacturer’s certified testing results.
- .2 Manufacturer’s certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS REQUIREMENTS

.1 The Contractor shall verify and demonstrate that proper access and maintenance can be performed on all installed dampers.

1.6 QUALITY ASSURANCE

.1 Provide material thickness and type of construction in accordance with ASHRAE and SMACNA Duct Construction Standards.

.2 Fire dampers to be listed and bear label of UL or ULC and meet requirements of Ontario Fire Marshal and NFPA-90A.

.3 Fire dampers to be factory fabricated for fire rating requirement to maintain integrity of membrane being pierced. Rating to be 1½ hours as defined by codes.

1.7 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements

1.8 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

1.9 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 BALANCING DAMPERS

.1 Round Duct
- .1 Provide single blade (100 mm and 150 mm diameter duct) and parallel multiple blade (over 200 mm diameter duct) low leakage dampers in low leakage square casing with round transition where indicated and at all round branches from main supplies.
- .2 Construction
  - .1 Frame: 127 mm x 22 mm x 1.6 mm galvanized steel hat channel.
  - .2 Blades: 152 mm wide on 140 mm centres, 1.6 mm galvanized steel vee grooved, parallel.
  - .3 Bearings: 13 diameter Celcon.
  - .4 Axle: 13 diameter plated steel double bolted to blade.
  - .5 Drive shaft: rigid 150 mm long x 13 dia.
  - .6 Blade seals: Dual durometer bulb type extruded PVC.
  - .7 Jamb seals: Compression type cambered metal.
  - .8 Casing: Up to 914 mm x 914 mm 1.0 galvanized steel. 914 mm x 914 mm and up, 1.31 mm galvanized steel.
  - .9 Provide 304 stainless steel construction for dampers in the following areas:
    - .1 Headworks Screening and Grit Removal Rooms
    - .2 Odour control piping
  - .10 Hand locking quadrant.

.11 Specified Manufacturers: Nailor 1810 CR – HLQ.
.1 Alternate Manufacturers:
.1 Ruskin
.2 E.H. Price
.3 Tamco

.2 Rectangular Duct
.1 Provide multi-leaf opposed blade dampers for all square or rectangular ducts where indicated.
.2 Dampers to be same size as duct.
.3 Construction:
.1 Frame to be 1.6 mm galvanized channel complete with corner braces and duct flanges.
.2 Blades to be 1.6 mm galvanized steel on 150 mm centres.
.3 Linkage to be concealed in frame.
.4 Bearings to be 13 dia. Celcon with 12 mm plated steel axles, double bolted to blades.
.5 Seals to be vinyl on blade edges and flexible metal at jamb.
.6 Provide 304 stainless steel construction for dampers in the following areas:
.1 Headworks Screening and Grit Removal Rooms
.7 Specified Manufacturer: Nailor 1820.
.8 Alternate Manufacturers:
.1 Ruskin
.2 E.H. Price
.3 Tamco

2.2 BACKDRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction. Where required, heavy duty counterbalanced damper to be steel frame and aluminum blade construction.

.2 Counterweight or spring assist as required. Equip with brass bearings.

.3 Blade at maximum 90 mm centres, minimum 1.3 mm thickness, integral extruded PVC seals, AMCA certified to maximum 202 L/s / m2 at 1.5 kPa maximum back pressure, 7.6 m/s maximum system velocity for 300 mm damper width.

.4 Specified Manufacturer: Nailor 1370 or 1390 CB, refer to drawings.

.5 Alternate Manufacturers:
.1 Ruskin
.2 E.H. Price
.3 Tamco

2.3 FIRE DAMPERS

.1 Provide fire dampers as indicated on the drawings and at all fire rated assemblies as indicated on Architectural Plans

.2 Dynamic fire dampers to be listed and bear label of UL or ULC and meet requirements of Provincial Fire Marshal and NFPA 90A authorities having jurisdiction.

.3 Factory fabricated for fire rating requirement to maintain integrity of membrane being pierced; (rating to be 1½ h as defined by codes.)

.4 Curtain type fire damper construction:
- .1 Frame: 127 x 25 x 1.52 galvanized steel hat channel.
- .2 Blades: Interlocking type, galvanized steel, 1.52 mm
- .3 Fusible Link: 100°C.
- .4 Enclosure to suit vertical or horizontal mount, round or rectangular duct arrangement, with damper outside of airstream for full flow.

.5 Provide 304 stainless steel construction for dampers located in the following areas:
- .1 Headworks Screening and Grit Removal Rooms

.6 Dampers to be gravity operated for vertical installation. Provide closure springs and latches for horizontal installation.

.7 Provide complete with frame and install as detailed and as per manufacturer's instructions.

.8 Specified Product: Ruskin DFD35 or DFD35SS.

.9 Alternate Manufacturers:
- .1 Nailor.
- .2 E.H. Price.

2.4 INSULATED CONTROL DAMPERS (TYPE 1)

.1 Application: Insulated low leakage dampers to be installed in all outside air intake or exhaust openings exposed to outside air. Provide parallel blade for two-position control, opposed blade for modulating control.

.2 Damper to be rated for 0.6% leakage at 2.5 kPa, minimum 2.7 mm extruded aluminum frames, minimum 100 mm deep, double sealed bearings on 11 mm hexagonal shaft, synthetic rubber edge seals, linkage hardware installed out of airstream. Insulate hollow blades with 22 mm polyurethane foam and similarly frame blades to be constructed complete with thermal breaks. Intake damper to be a minimum of two sections with rubber seals between sections. Flanged mounting with flanges external to airstream.

.3 Refer to Section 15930 for damper actuators.

.4 Specified Manufacturer:
- .1 TAMCO, Series 9000

.5 Alternate Manufacturers:
- .1 Nailor
- .2 Ruskin
- .3 E.H. Price

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Provide dampers where indicated on drawings and where required for adequate system performance.

.2 Fire dampers to be provided at all duct penetrations of fire rated walls, ceiling, or floors as indicated or required by code. Provide fire rated access door for each fire damper. Coordinate with wall fire ratings indicated on architectural drawings.

.3 Provide insulated dampers on all outside air openings including roof exhaust.

.4 Install fire and smoke dampers in approved manner with all sleeving suitably anchored to building structure and break away duct connections.

.5 Provide sawcut in the end of each damper shaft and position parallel with damper blade to indicate blade position. Attach labels on ductwork or equipment indicating open or closed damper positions.

.6 Verify operation of all dampers including fire dampers.

.7 Adjust linkage of insulated dampers after 11 months operation, or as required.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Includes, but is not limited to:

.1	Mechanical General Provisions:	Section 15010
.2	Testing:	Section 15030
.3	Balancing:	Section 15031

1.2 QUALITY ASSURANCE

.1 Performance based upon published manufacturers data from tests carried out in accordance with ADC 1062.

.2 Fire rated equipment to be in accordance with ULC and NFPA 90A requirements.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide diffusers, registers and grilles as indicated on schedules and/or drawings.

.2 Sizes indicated are nominal. Provide correct standard product nearest to nominal for capacity, throw, noise level, throat and outlet velocity.

.3 Furnish factory prime coated steel frames for setting into fire protecting membrane. At aluminum diffusers, registers and grilles, provide 1.2 mm thick minimum steel collar up to fire damper or fire stop flap, for suspending from the basic structure independently of membrane integrity.

.4 Where penetrating fire partitions, provide approved steel sleeve attached to structure and secured in accordance with NFPA 90A-1978. Where penetrating fire walls provide 3.4 mm thick steel sleeve with angle iron perimeter frame to NFPA 90A.

.5 Frames:

.1 Steel: exposed joints welded and ground flush and completely closed.
.2 Aluminum: extruded, mechanical fasteners and completely closed corners.
.3 Provide full perimeter sponge rubber gaskets.
.4 Provide plaster frames as plaster stops where set into plaster or gypsum board.
.5 Provide concealed fasteners and operators.
.6 Refer to schedule.

2.2 SPECIFIED PRODUCT

.1 Specified Manufacturer:

.1	Type A:	E.H. Price	Model SCDA
.2	Type B:	E.H. Price	Model 80
.3	Type C:	E.H. Price	Model 620DAL Double deflection.
.4	Type D:	E.H. Price	Model 620DAL

.5 Type E: E.H. Price Model 730 Double Deflection
.6 Type F: E.H. Price Model 600
.7 Type G: Nailor 61DGD-FR
.8 Type H: E.H. Price Model 730

.2 Specified Manufacturers:
.1 Nailor
.2 Titus.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Coordinated installation of units with ceiling construction.

.2 Install plaster frames for units in plaster ceiling.

.3 Fit frames tightly to prevent leakage and smudging.

.4 Visible screw fasteners to be countersunk and with matching finish.

.5 Properly support units and coordinate with ductwork.

.6 Carry out installation in accordance with manufacturer's requirements.

.7 Carry out installation of fire rated equipment in accordance with code requirements.

.8 Coordinate insulation and access provisions with integral balancing dampers.

.9 Refer to architectural drawings for Type G door grille sizes and quantities.

.10 Refer to grille schedule in 15860A for accessories.

END OF SECTION

IDENT	SERVICE				DESCRIPTION	FINISH AND ACCESSORIES
	SA	RA	EA	TA		
A	●				STEEL, FULLY ADJUSTABE SQUARE 600 MM X 600 MM DIFFUSER, LAY-IN TYPE, ROUND NECK	APPLIANCE WHITE BAKED ENAMEL, RADIAL OPPOSED BLADE DAMPER
B		●	●		ALUMINUM EGGCRATE, 13 X 13 X 13 GRID LAY-IN T-BAR, ALUMINUM FRAME/BORDER	WHITE POWDER COAT
C	●				LOUVERED FACE SUPPLY ALUMINUM CONSTRUCTION REGISTER COMPLETE WITH ALUMINUM BALANCING DAMPER, DOUBLE DEFLECTION, 19 mm SPACING	POWDER COAT
D		●	●		LOUVERED FACE RETURN ALUMINUM CONSTRUCTION REGISTER COMPLETE WITH ALUMINUM BALANCING DAMPER, SINGLE DEFLECTION, 19 mm SPACING	POWDER COAT
E	●				LOUVRED RETURN, FIXED 45° DEFLECTION, STAINLESS STEEL CONSTRUCTION, 19 mm SPACING	STAINLESS
F		●	●	●	LOUVERED FACE RETURN ALUMINUM CONSTRUCTION REGISTER COMPLETE WITH ALUMINUM BALANCING DAMPER, FIXED DEFLECTION, 12 mm SPACING	WHITE POWDER COAT
G				●	HEAVY DUTY STEEL CONSTRUCTION DOOR GRILLE. FLAT BORDER ON BOTH SIDES.	ALUMINUM POWDER COAT
H		●			LOUVRED RETURN, FIXED 45° DEFLECTION, STAINLESS STEEL CONSTRUCTION, 19 mm SPACING	STAINLESS

PART 1- GENERAL

1.1 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):
- .1 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-[07]), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

.2 International Organization of Standardization (ISO):
- .1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms

.3 National Fire Protection Association (NFPA):
- .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems

.4 Underwriter's Laboratories (UL):
- .1 UL 181-2005, Factory-Made Air Ducts and Air Connectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01330 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Indicate the following:
  - .1 Capacity
  - .2 Pressure drop
  - .3 Noise rating
  - .4 Leakage.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Test and Evaluation Reports:
- .1 Test data: to ANSI/AMCA Standard 210.
  - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
  - .2 Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by [independent] testing agency.
  - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01780 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air terminal units for incorporation into manual.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01610 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials [off ground] [indoors] and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect air terminal units from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.3 ELECTRONIC VARIABLE AIR VOLUME BOXES

.1 Pressure independent, reset to air flow between zero and maximum air volume.

.2 At inlet velocity of 10 m/s, differential static pressure for unit with attenuator section not to exceed 25 Pa.

.3 Provide silencers to limit sound ratings of assembly as to not exceed NC 30.

.4 Air velocity sensor pitot rack as standard to manufacturer.

.5 Signals between temperature sensing device, velocity controller, velocity sensor and damper actuator digital as indicated. Shielded or twisted wire requirements is not acceptable.

.6 Electronic thermostat furnished by terminal unit manufacturer and have lit up display, set points and velocity adjustments located in thermostat. Heating and cooling set point range 13 to 30°C. Set points not overlapping. Thermostat to provide all control functions required by sequence of operations including control of zone heating devices.

.7 Electronic control package factory calibrated and set at factory. Features to accommodate site calibration and readjustment of air volume settings to include:

.1 Metre taps for balancing with digital DC voltmeter.

.2 Adjustable flow settings at thermostat.

.8 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

.9 Terminal unit to be CSA certified. Provide BACnet interface for full control and monitoring by building automation system.

.10 Casing: 0.85mm (22ga) mm thick galvanized steel, internally lined with 25 mm. 0.7 kg density fibrous glass, to UL 181 and NFPA 90A. Mount control components inside protective metal shroud.

.11 Damper: 1.3 mm (18ga) thick steel with peripheral gasket and self-lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

.12 Sizes and capacity: as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units, installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED WORK

.1 Mechanical General Provisions: Section 15010

.2 Commissioning Mechanical Systems: Section 15010

1.2 QUALITY ASSURANCE

.1 Conform to NFPA, ULC, CGSB and CSA requirements.

.2 Filter Efficiency: ASHRAE 52-76.

.3 Air Filter Capacity: Air Filter Institute (AFI) Test.

1.3 SUBMITTALS

.1 Submit the following shop drawings:
- .1 Inline Filter Box
- .2 Filter Media
- .3 Frame Assemblies

PART 2 – PRODUCTS

2.1 INLINE FILTER BOX

.1 Cabinet: 0.759 mm (22 ga.) galvanized steel with baked enamel powder coat finish, box dimensions to limit face velocity to 500 fpm based on fan airflow. Provide removable access door with neoprene door seal.

.2 Filter: pleated, disposable, 25 mm thick, MERV 8 to ASHRAE 52.2, ULC listed. Provide two additional replacement filters with each filter box.

.3 Specified Product: Fantech FB Series.

2.2 DUCT MOUNTED INLINE FILTERS

.1 Provide inline duct mounted pleated panel filter. MERV 8 to ASHRAE 52.2, UL listed with filter holding frame sizes and locations as indicated on drawings.

.2 Media: Cotton and synthetic fiber blanket, 50 mm thick.

.3 Recommended changeout pressure drop 248 Pa at 500 fpm.

.4 Maximum continuous operating temperature 93°C.

.5 Frame: 1.519 mm (16 ga.) galvanized steel with gasketed filter seal flange, accommodates variety of fasteners.

.6 Specified Product: Camfil 30/30 with Type 8 Filter Holding Frame.

2.3 FILTER GAUGES

.1 Provide manual differential pressure gauge across filter.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Install filter boxes where indicated on drawings in accordance with manufacturer's recommendations.

.2 Provide replacement media and install upon acceptance of system.

END OF SECTION

PART 1 - GENERAL

1.1 INTENT OF SECTIONS

.1 This Section covers the design, fabrication and erection of exhaust stacks for the laboratory self supporting stack.

.2 References to the stack in the documents are conceptual only and the detailed design is the responsibility of the Supplier.

1.2 QUALITY ASSURANCE STANDARDS

.1 Ontario Ministry of Environment Requirements.

.2 SMACNA Guidelines.

.3 Manufacturer of stacks to have minimum of five years of proven experience in the design and installation of free-standing industrial stacks of a similar height.

.4 Refer to General Requirements of Section 15251 for insulation.

1.3 SUBMITTALS

.1 Provide design calculations to verify that the stack and stack support structure can safely support all live and dead loads and is capable of withstanding vortex shedding, wind and earthquake loads in accordance with the Ontario Building Code. All design calculations are to be stamped by a Professional Engineer, who has demonstrated experience in the field, and is registered in the Province of Ontario.

.2 Submit loads transferred to the stack bracing at the roof penetration.

.3 Detailed fabrication drawings indicating materials and dimensions, jointing methods, identify shop and field work.

.4 Submit details of stack finishes and application procedures. Submit cladding sample complete with finish for approval.

PART 2 - PRODUCTS

2.1 SELF SUPPORTING STACKS

.1 Construct stack and stack support structure from Type 304 or 316 stainless steel conforming to ASTM Standards.

.2 Construct stack to be fully self supporting without the use of guy wires. Install strakes if required to eliminate vortex shedding.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install fume hood stack on roof (refer to structural design for details of roof construction), provide details of any mounting frames, hardware, reinforcement etc. to structure. Confirm and submit loads transferred to structure.

.2 All welding techniques to be carried out by tradesman qualified and experienced in welding stainless steel.

3.2 CONSTRUCTION

.1 Seal joints and seams to prevent water penetration into the stack.

.2 Stack height to terminate 3,000 mm above the roof level. Provide discharge stackhead to prevent rain infiltration. Provide welded stainless steel interior ring along stack circumference as a drip ledge and drain to roof through NPS 3/8 PEX tubing c/w P-trap.

END OF SECTION

PART 1 - GENERAL

1.1 BAS DESCRIPTION

.1 The BAS (Building Automation System) shall meet all criteria of the BACnet protocol as developed and published by ANSI / ASHRAE 135 – 2008 or the Latest Edition. Including all issued and adopted addenda.

.2 The BAS shall be supplied and Installed by a listed vendor of BACNet listed devices. All devices shall be BTL (BACnet Testing Laboratories) tested and listed.

.3 Communications Protocols:

.1 As defined by BACnet the following communications protocols are acceptable.

.2 ISO 8802-2 (IEEE 802.2) Type 1

.3 MS / TP

.4 PTP

.5 LonTalk

.4 All equipment, devices, controllers, panels, and systems shall be BACnet and BTL listed, not just front end equipment and at a minimum meet all of the function requirements of the B-AWS, B-BC, B-AC, B-AAC and BASC profiles specified in ASHRAE Standard 135-2004 Annex L "Descriptions and Profiles of Standardized BACnet Devices (NORMATIVE)H in the form of Protocol Implementation Statements (PICS) as described at http,//www.bacnet.org/DL-Docs/index.html.

.5 A “Frontend” or controls communication interface shall be provided. This shall consist of a computer and software to access, monitor, and adjust the controls system parameters from all devices on the network. The frontend shall be graphics based. The ownership of the software and all controls programming shall transfer to the building owner upon completion of commissioning.

.6 Building Automation System (BAS) to possess modular architecture with all hardware and software to permit expansion of capacity and functionality, with each controller operating independently.

1.2 WORK INCLUDED

.1 Provide equipment, hardware, software, accessories, instrumentation wiring and instrument piping required for a complete and functioning system meeting the Sequences of Operation defined on the drawing and defined in the operating parameters of all equipment specified. Material and equipment to be standard components regularly manufactured and tested and proven in regular use.

.2 BAS contractor to coordinate supply of power to all BAS devices and panels. BAS contractor to review all drawings and provide all required transformers and 120V power wiring and conduits, to devices, panels, actuators, etc., as required for a complete and functioning system.

.3 Coordinate the implementation and interfacing of equipment manufacturer’s supplied control panels with the BAS system.

.4 Work with the TAB contractor to verify and balance all systems.

.5 Coordinate the verification and commissioning of all controls' components, software, and graphics. Set up control loops, trend longs, alarm events, alarm reports, and time schedules. Provide programming sufficient to achieve the objective of the sequence of operation. Fine tune and calibrate all program algorithms and control loops to ensure smooth equipment operation and maximum occupant comfort levels. Minimize equipment cycling to reduce wear and extend equipment's useful life. Maximize system energy efficiency through development of control algorithms that prevent simultaneous heating and cooling or over ventilation. Debug to ensure continuous uninterrupted operation. Provide season adjustments over the first year of operation as required to meet the objectives stated.

.6 Prepare system graphical displays and install on Webserver. Display inputs, outputs, and set points. Provide operator access from a remote operator terminal to allow the operator to command all outputs to manual value or return point to automatic control. Indicate alarm condition on graphical displays. Create separate displays that include schematic representations for each system. Create an overall graphic screen with "hot buttons" to detailed display screens. Create a separate graphic for each new system and a floor plan indicating equipment room locations and remote sensor and actuator locations.

.7 Production of CAD drawings of control system for incorporation into maintenance manual.

.8 Copies of the final programs that include all point definitions, schedules, controller set points and tuning parameters. Setup and tune all control status loops. Make as many trips to the jobsite as necessary to complete the calibration programming.

.9 Provide complete systems training for the building's operators with systems as installed. Training shall be in the format as described.

.10 Primary panel must be capable of communication over a fibre optic TCPIP network.

.11 BAS control to be limited to systems and equipment identified on MID043 and MID044. This includes heating, cooling and ventilation systems and equipment serving occupied areas of the BAF Building only.

1.3 ELECTRICAL INTERFACING

.1 Refer to system schematics, Motor Starter and Control List, electrical drawings and schedules for information relating to supply, installation and wiring of equipment specified in this division.

.2 Provide all control wiring 120 V and less between controllers, primary elements, starters and field devices unless specified otherwise.

.3 Provide all 120V power wiring and transformers to BAS panels and devices as required, unless specified otherwise.

.4 ALL wiring shall meet the requirements of the electrical specifications.

.5 ALL wiring shall be installed within EMT conduit to the specifications of Div 16. Maximum conduit capacity shall be 60% and shall have pull string left in place.

1.4 QUALITY ASSURANCE

.1 BAS Contractor to be regularly engaged in engineering, programming, installation and service of Building Automation Systems of similar size and complexity, with local office facility providing emergency service on a 24-hour, 7-day-a-week basis.

.2 BAS to consist of products of a manufacturer regularly engaged in production of Building Automation Systems. All controllers and system components to be the most recent editions / versions of current production products.

.3 Installation to comply with all current governing codes and regulations, including the following:
- .1 CSA
- .2 UL
- .3 NFPA
- .4 Ontario Building Code
- .5 Factory Mutual (FM)

.4 BAS Contractor to be a manufacturer's licensed installer of control components.

.5 BAS manufacturer shall be an ASHRAE SSPC 135 listed and known BACnet vendor.

1.5 REFERENCES

.1 ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers Inc.

.2 ASHRAE STD 135-Latest Edition, BACNET – Data Communication Protocol for Building Automation and Control Networks.

.3 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.4 ANSI/ISA 5.5-Latest Edition Graphic Symbols for Process Displays.

.5 Institute of Electrical and Electronics Engineers (IEEE).

.6 ANSI/IEEE 260.1-Latest Edition, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.7 CEA-709.1-Latest Edition, Control Network Protocol Specification.

.8 Safety Data Sheets (SDS.)

1.6 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in BAS / EMCS Systems:
- .1 AEL - Average Effectiveness Level
- .2 AI - Analog Input
- .3 AO – Analog Output

.4 BI – Digital / Binary Input
.5 BO – Digital / Binary Output
.6 BACnet - Building Automation and Control Network
.7 BC(s) - Building Controller(s)
.8 CAD - Computer Aided Design
.9 CDL - Control Description Logic
.10 CDS - Control Design Schematic
.11 COSV - Change of State or Value
.12 CPU - Central Processing Unit
.13 DP - Differential Pressure
.14 ECU - Equipment control Unit
.15 EMCS - Energy Monitoring and Control System
.16 HVAC - Heating, ventilation, Air Conditioning
.17 IDE - Interface Device Equipment
.18 I/O - Input/Output
.19 LAN - Local Area Network
.20 LCU - Local Control Unit
.21 MCU - Master Control Unit
.22 NC - Normally Closed
.23 NO - Normally Open
.24 OS - Operating System
.25 O&M - Operation and Maintenance
.26 PCMCIA - Personal Computer Micro-Card Interface Adapter
.27 PID - Proportional, Integral and Derivative
.28 P&ID – Process and Instrumentation Diagram
.29 SP - Static Pressure
.30 USB - Universal Serial Bus
.31 UPS - Uninterruptible Power Supply
.32 VAV – Variable Air Volume.

1.7 SUBMITTALS

.1 Shop Drawings, Product Data, and Samples
  .1 Submit shop drawings in accordance with requirements of Division 1 and this Section.
  .2 Shop drawing submission to include:
    .1 Riser diagram indicating all controllers, operator workstations, network devices and network wiring.
    .2 Single-line schematics and system flow diagrams identifying location of all control devices.
    .3 Points list for each DDC controller, including: Tag, Point Type, System Name, Object Name, Expanded ID, Display Units, Controller Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number.
    .4 Written sequence of operation for each system to be controlled, for normal operation, start up, shutdown, emergency, failure and alarm conditions.
    .5 User interface functional outline to include each display screen to be provided, data to be displayed, and links to other screens. Outline level hierarchy to be:
      .1 Site
      .2 Building

.3 Floor
.4 System.
.6 Control Damper and Control Valve Schedules.
.7 Catalogued cut sheets of all equipment used with range and scale information for all transmitters and sensors.
.8 Training course outline.
.9 Hardware data sheets for all operator workstations, local access panels, and portable operator terminals.
.10 Software manuals for all applications programs to be provided as part of operator workstations, portable operator terminals, programming devices, and so forth, for evaluation for compliance with the performance requirements of this Specification.

1.8 TRAINING

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program. Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

.3 Instruct Owner's designated representatives prior to substantial performance. Instruction period to be a minimum of 50 hours during normal working hours (one day = eight hours including two 15-minute breaks and excluding lunch time). Instruction to consist of both hands-on and classroom training at project site utilizing a training and maintenance manual. Training to be scheduled over an extended period of time to allow operators to become familiar with system operation between training sessions.

.4 Training to include use and application of BAS and maintenance of hardware, primary elements and control devices. To be in two phases over three-month period.

.5 Phase 1:
.1 Two-day program to begin before final commissioning at time mutually agreeable to Contractor and Owner Representative.
.2 Train O&M personnel in functional operations and procedures to be employed for system operation. Supplement with on-the-job training during commissioning period.
.3 Include overview of system architecture, communications, operation of computer and peripherals, and trending and report generation.
.4 Include detailed training on operator interface functions for control of mechanical systems, and elementary preventive maintenance.

.6 Phase 2:
.1 Four-day program to begin eight weeks after acceptance for operators, equipment maintenance personnel and programmers.
.2 Provide multiple instructors on pre-arranged schedule. Include at least following:
.1 Operators training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training (one day).
.2 Equipment maintenance training: provide personnel with 1 day training in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
.3 Programmers: provide personnel with two days training within a five-day period in following subjects in approximate percentages of total course shown:
.1 Software and architecture: 10%

.2 Application programs: 15%
.3 Controller programming: 50%
.4 Trouble shooting and debugging: 10%
.5 Colour graphic generation: 15%.

1.9 CLOSE-OUT SUBMITTALS

.1 Upon completion of installation and prior to application for substantial performance, submit operating and maintenance manuals and As-Constructed Drawings meeting requirements of Division 1 and this Section.

.2 Operation and maintenance manuals to include complete documentation of hardware and software installation, including copies of reviewed shop drawings, maintenance and calibration procedures, spare parts lists and troubleshooting guides.

.3 Provide documentation of all hardware and software installations, including operating sequences for all systems, complete point descriptions, list of controllers and workstations and summary of all system components.

.4 All manuals to be provided in hard copy format and on single compact disk (CD) as part of an on-line documentation system through operator workstation.

.5 Manuals to reflect the record condition suitable for use as Owner's As-Constructed Drawings.

1.10 WARRANTY

.1 BAS, including all hardware, devices, wiring and software components to be warranted for period of 1 year following date of Substantial Performance. Manufacturing and installation defects arising during this period to be resolved at no cost to Owner.

.2 Update software to suit product revisions during warranty period. Coordinate updates with Owner.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT DESCRIPTION

.1 BAS to integrate multiple building functions, including equipment supervision and control, alarm management, energy management, information management, and historical data collection and archiving.

.2 BAS to use open architecture and fully support multi vendor environment and be able to integrate a wide variety of third-party devices and applications via existing vendor protocols and through latest software standards.

.3 Facility management system to consist of:
.1 Primary controllers.
.2 Application specific secondary controllers.
.3 Local display devices.

.4 Portable operator's terminals.

.5 Personal computer operator workstations.

.4 System to be modular in nature, permitting expansion of both capacity and functionality through addition of sensors, actuators, Network Controllers and operator devices, while reusing existing controls equipment.

.5 System architecture to eliminate dependence upon any single device for alarm reporting and control execution. Each primary controller to operate independently by performing its own specified control, alarm management, operator input/output (I/O), and historical data collection. Failure of any single component or network connection not to interrupt execution of control strategies at other operational devices.

.6 Primary controllers to be able to access any data from or send control commands and alarm reports directly to any other primary controller or combination of panels on network without dependence upon central processing device, such as central file server. Primary controllers to be capable of sending alarm reports to multiple operator workstations, terminals, and printers without dependence upon central processing device or file server.

.7 All control panel to be constructed in accordance with CAN/CSA 22.1 and CAN/CSA 22.2, latest editions. BAS main control panel to be provided with dry contacts for general alarm communication to plant SCADA system. Locate main control panel in the BAF Building MCC/UPS Room.

2.2 SYSTEM ARCHITECTURE

.1 Communication within BAS to be implemented through multilayer network employing combination of proprietary and open protocols. System to be capable of integrating third-party devices using BACnet.

.2 Primary network to provide high-level, high-speed interface for all data traffic between primary controllers and operator workstation.

.3 Secondary network to accommodate data transmission between primary controllers and secondary application specific controllers.

.4 Network operation to be transparent to operator interface.

.5 Network configuration to accommodate following system performance targets:

.1 Update of dynamic points in any graphic display within 10 seconds of initiating refresh command.

.2 Command reaction time of less than two seconds from time command is issued to initiation of action at device.

.3 Maximum time for alarm annunciation after a point goes into alarm not to exceed 15 seconds. All remote annunciation points to be active within an additional five seconds.

2.3 OPERATOR INTERFACE

.1 Provide a laptop PC workstation for command entry, information management, network alarm management, and database management functions. Workstation to accommodate all software installed and be of a functioning capability to be referred to as a “higher capability than current PC standard”. Laptop shall be complete with DVD / CD Drive, wireless mouse, cable lock, and laser jet printer. Workstation to accommodate following functions:

.1 All historical trend logs and operating data configured in searchable databases.

.2 Access to all online operation and event data.

.3 Communication interface to primary controllers either through primary network or proprietary link.

.2 Provide software registration cards to Owner for all included software.

.3 Workstation Application Components

.1 Operator Interface to provide viewing and modification of all Inputs, Outputs, Set Points, and all other operational parameters (set points, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, etc.), complete with context-sensitive help menus.

.2 Operation of control system to be independent of operator workstation.

.3 Workstation to receive and process alarms sent by control system and generate alarms when malfunction in network operation is detected (e.g., controller is off-line). Workstation software to include alarm management package to allow for modification of alarm set points, processing and archiving of alarm events, and facilitate auditing of alarm history and response.

.4 System to be capable of generating detailed customized reports indicating status of specific operating parameters (alarms, set points, readings, status, schedules, point attributes, etc.). Reports to be generated manually by operator or automatically by system based on a triggering event (time, date, point value, etc.).

.5 Customized operating schedule options to be provided through operator workstation. Schedules to be selectable for each control element, with operator interface through spreadsheet-type schedule input form.

.6 Multiple-level password access protection to be provided to allow user/manager to limit workstation control, display, and database manipulation capabilities.

.4 System Graphic Display

.1 Operator workstation to provide graphic display of system parameters assembled to provide operator with intuitive means of monitoring complete systems. Number and types of graphics to be limited only by available memory.

.2 Graphic displays to present real-time data that is acquired derived from system parameters, with scalability to suit any display configuration, 64,000 colors, a variety of graphical objects (multiple line types, text boxes, custom shapes) and animation.

.3 Operator to have full access (based on security level) to modify operating parameters, values, states and set points from a graphic display. Changes to be facilitated through insertion of slider, dial or data entry points in graphic.

.4 Workstation software to include drag-and-drop graphic editing tool that allows for creation and editing of graphic files, including definition of all calculations to be executed as part of graphic, defining all animations, defining all data points to be displayed and importing of external graphic files.

.5 Historical Trending and Data Analysis

.1 Trend and point history data for all analog and digital inputs and outputs to be stored locally on primary controllers and uploaded to operator workstation based upon user-defined interval, manual command, or when trend buffers are full.

.2 Any point, physical or calculated, may be designated for trending, with data collection at timed intervals, upon a change of value or whenever a value is out of range.

.3 Provide configurable data storage system for collection and manipulation of historical data. Data storage to be in industry standard database format, with backup and archiving to removable media, separate hard drives, or remote network file system.

.4 Querying function for historical database to include averaging, mean, min/max, sum, variance, range and standard deviation.

.5 Provide trend viewing utility with access to all database points and capability to view up to 32 data sources at one time in tabular or graphic format with capability of printing hard copy record of trends as they are displayed on workstation.

2.4 PRIMARY CONTROL UNITS

.1 Primary Control Units (PCUs) to reside on Primary Network and to consist of DDC System Controllers providing control input, output and processing functions and/or Network Controllers to supervise operation of secondary network devices (e.g., application specific controllers).

.2 Locate PCUs as indicated on drawings and with sufficient capabilities to meet requirements of Sequence of Operation.

.3 Provide spare capacity in all PCUs to accommodate future expansion. Configure system to ensure installation does not exceed 75% of point and communication capacity for each unit.

.4 Network Controllers

.1 Network Controllers residing on primary network to be fully user-programmable, supervisory controllers capable of monitoring sub-network of distributed application-specific controllers, providing global strategy and direction, and communicating on peer-to-peer basis with other network controllers.

.2 Each controller to have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all supervised sub-network controllers.

.3 Controllers to include data communication ports for operation of operator I/O devices, such as industry-standard printers, operator terminals, modems, and portable operator's terminals.

.4 Controllers to allow temporary use of portable devices without interrupting normal operation of permanently connected modems, printers, or terminals.

.5 Controller to continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components, with both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

.6 In event of loss of normal power, controllers to be shut down in orderly manner to prevent loss of database or operating system software. Nonvolatile memory to be incorporated for all critical controller configuration data, and battery backup to be provided to support real-time clock and all volatile memory for a minimum of 72 hours.

.1 During loss of normal power, control sequences to go to normal system shutdown conditions.

.2 Upon restoration of normal power and after a minimum off-time delay, controller to automatically resume full operation without manual intervention through normal soft-start sequence.

.3 If a controller memory is lost for any reason, operator workstation to automatically reload program without intervention by system operator.

2.5 SECONDARY CONTROL UNITS

.1 Secondary Control Units (SCUs) to reside on Secondary Network and to consist of application specific and unitary controllers providing control input, output and processing functions.

.2 Use of application specific and unitary controllers is permitted where sequence of operation, including failure modes, emergency shutdown and start-up and alarm functions can be fully implemented.

.3 Application specific controllers to be microprocessor-based, multi-tasking, real-time digital control processors, operating as independent standalone networked controllers.

.4 Application specific controllers to provide customized operating sequences for following systems:

.1 Air handling units.

.2 Heat Recovery units.

2.6 ALARM MANAGEMENT

.1 Alarm management system to be implemented at each controller independently of other control functions. System to monitor, buffer, and direct alarm reports to operator devices and memory files with each performing distributed, independent alarm analysis and filtering.

.2 System to be fully configurable to allow operator selection of alarm parameters, priority, criticality and response, including logging, printing, and other response functions.

.3 Critical alarm response features to include ability to autodial an alphanumeric paging system.

.4 Alarm messages to include point descriptor, time and date, and ability to be customized to describe alarm condition or direct operator response.

.5 All alarm messages and reports to be automatically archived.

2.7 DYNAMIC ANIMATED COLOUR GRAPHIC DISPLAYS

.1 Provide colour graphic floor plan displays and system schematics for each item of mechanical equipment or system. Fully configure colour graphics and plot all associated control/monitoring points on screen. Provide copies of all colour graphics screens for approval.

.2 Operator interface to present system schematics and floor plans in a layered scheme, with point and click access to each layer. Each room or zone to display animated flow diagram of the mechanical equipment that serves that zone, with all control and monitoring points associated with equipment, including temperature values, humidity values, flow values, and status indication and set points.

.3 System analysis tools to be provided to allow operator to monitor operating parameters for major mechanical systems.

.4 Windowing environment of PC Operator Workstation to allow simultaneous viewing of several graphics or to allow display of a graphic associated with an alarm without interrupting work in progress.

.5 Points in alarm to change colour of symbol to red until no longer in alarm.

2.8 SEQUENCE OF OPERATION

.1 Configure BAS control building systems in accordance with detailed sequences of operation provided on drawings, specifications and as specified within individual equipment specifications. Provide all required instrumentation, components, appurtenance etc., to achieve indicated sequence of operation. Refer to 15930 for building control devices specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install material and equipment in accordance with manufacturer's recommendations.

.2 Start up system, perform all necessary testing and run diagnostics to ensure proper operation. Certify operation after completing all tests.

.3 Coordinate control system and devices with all systems being controlled.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION SUMMARY

.1 This specification covers building mechanical control devices. Provide all control devices and primary control elements to be per the equipment schedules, drawings, and as identified herein. All associated wiring to field devices by Division 16 for voltages greater than 24V.

.2 Coordinate control voltages with interfacing equipment. All admin controls shall be low voltage. All other process control voltages are 120V unless dictated otherwise by HVAC unit OEM controller. Coordinate with AHU equipment supplier vendors for equipment controls by others but provided under this section.

.3 Controls to go to failsafe position on equipment failure.

.4 BAS Control Devices – additional general requirements:

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, vibration-proof, assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

1.2 REFERENCES

.1 The following is a list of standards utilized in this section. Unless otherwise specifically noted, the references indicated shall be the latest standard adopted by the regulatory agency as of tender date.

- .1 National Fire Protection Association (NFPA):
  - .1 NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .2 Underwriters' Laboratories (UL):
- .3 National Electrical Manufacturer's Association (NEMA).

1.3 INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 1 and Division 15, Section 15010.

.2 In addition to the submittal requirements identified in the above-noted section, submit the following for all PART 2 – PRODUCTS.

- .1 Product Data:
  - .1 Relevant information to confirm that the specifications have been met. Identify all deviations.
- .2 Operation and Maintenance Data:

.1 Operation and Maintenance Manuals. Refer to Division 1 and Division 15, section 15014 for requirements.
.2 Manufacturer's installation requirements.

.3 Quality Control Data:
.1 Manufacturer's certified testing results.
.2 Manufacturer's certificate confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

.1 Refer to Division 1 for General Closeout Requirements.

1.5 MAINTENANCE AND SPARE PARTS

.1 The Contractor shall verify and demonstrate that proper maintenance can be performed on all installed controls.

1.6 COMMISSIONING

.1 Refer to Division 1 and Section 15010 for Commissioning Requirements

1.7 TRAINING

.1 Refer to Division 1 and Section 15010 for Training Requirements.

.2 Training required for all Part 2 equipment

1.8 WARRANTY

.1 Refer to Division 1 and Section 15010 for Warranty Requirements.

PART 2 - PRODUCTS

2.1 TWO POSITION DAMPER ACTUATOR

.1 Direct coupled 24V or 120 V actuator to be mounted over damper shaft using V-bolt and Cradle type mounting; spring return; provide means to manually operate actuator when not powered; 2-year warranty; visual position indicator.

.2 Provide all mounting brackets and shaft mounting hardware and control transformer where required.

.3 Mount outside insulation on insulated ducts.

.4 Outside damper actuators to be open/close two position. Provide position switches to indicate open/close status. Each switch to be a Form 'C' dry contact rated for a minimum of 120 V, 5 A.

.5 Provide NEMA 4X housing for motorized damper actuators where scheduled.

.6 Refer to MID drawings, P&ID drawings and equipment schedules.

.7 Specified Manufacturer: Belimo.

.8 Alternate Manufacturer:
.1 Neptronic,
.2 Siemens.

2.2 MODULATING DAMPER ACTUATOR (ELECTRONIC)

.1 Provide all mounting brackets and shaft mounting hardware.

.2 Mount outside insulation on insulated ducts.

.3 24V or 120V actuator to receive a 4 – 20 mA input with 0-10 V feedback signal.

.4 Refer to MID Series drawings.

.5 Specified Manufacturer: Belimo.

.6 Alternate Manufacturer:
.1 Neptronic,
.2 Siemens.

2.3 EXPLOSION-PROOF DAMPER ACTUATOR HOUSING

.1 Application: In addition to where scheduled or identified on the drawings explosion proof damper actuators housings a required for all damper actuators located in electrically hazardous areas.

.2 Construction material: Aluminum housing c/w stainless steel bolts.

.3 NEMA 7 and 9 approved.

.4 Specified Product: Belimo ZS-260

.5 Alternate Manufacturer:
.1 Approved Equal.

2.4 TEMPERATURE TRANSMITTERS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16.

.2 BAS controlled HVAC Systems and equipment:
- .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
- .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
- .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .4 Input and output short circuit and open circuit protection.
- .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
- .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
- .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
- .8 Integral zero and span adjustments.
- .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.
- .10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
- .11 . Transmitter ranges: select narrowest range to suit application from following:
  - .1 0 to 100 degrees C, plus or minus 0.5 degrees C.

2.5 TEMPERATURE SENSORS/THERMOSTATS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16

.2 BAS controlled HVAC Systems and Equipment:
- .1 Room temperature sensors and display wall modules.
- .2 Temperature sensing and display wall module.
- .3 LCD display to show space temperature and temperature setpoint.
- .4 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
- .5 Jack connection for access to zone bus.
- .6 Integral thermistor sensing element 10,000 ohm at 24 degrees.
- .7 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
- .8 Stability 0.02 degrees C drift per year.
- .9 Separate mounting base for ease of installation.
- .10 Standard of Acceptance: Schneider Electric I/A Series MN-S3

.3 Duct/immersion temperature sensors:
- .1 Standard of Acceptance: Schneider Electric TS-9201 or equivalent.

.4 Averaging temperature sensors:
- .1 . Standard of Acceptance: Schneider Electric TS-9422 or equivalent.

.5 Outdoor temperature sensors:
- .1 Standard of Acceptance: Schneider Electric TS-8501 or equivalent

2.6 TEMPERATURE SWITCHES

.1 Hard wire controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16.

.2 BAS controlled HVAC Systems and Equipment:

- .1 Operate automatically. Reset automatically, except as follows:
  - .1 Low temperature detection: manual reset.
  - .2 High temperature detection: manual reset.
- .2 Adjustable setpoint and differential.
- .3 Accuracy: plus or minus 1 degrees C.
- .4 . Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and BAS connections.
- .5 Type as follows:
  - .1 Room: for wall mounting on standard electrical box with protective guard.
  - .2 Duct, general purpose: insertion length = 460 mm.
  - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
  - .4 Strap-on: with helical screw stainless steel clamp.

2.7 PRESSURE TRANSMITTERS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16.

.2 BAS controlled HVAC Systems and Equipment:

- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.5 % of output.
- .5 Linearity: within 1.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.8 PRESSURE SWITCHES

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16.

2.9 PRESSURE SENSORS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16

.2 BAS controlled HVAC Systems and Equipment:
.1 Multipoint element with self-averaging manifold.
.1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
.2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.10 HUMIDITY SENSORS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16

.2 BAS controlled HVAC Systems and Equipment:
.1 Room and Duct Requirements:
.1 Range: 5 - 90 % RH minimum.
.2 Operating temperature range: 0 - 60 degrees C.
.3 Absolute accuracy:
.1 Duct sensors: plus or minus 3%.
.2 Room sensors: plus or minus 2%.
.4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
.5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
.6 Room sensors: wall mounted as indicated or in air stream near RA grille.
.7 Duct mounted sensors: locate so that sensing element is in air flow in duct.

2.11 HUMIDITY TRANSMITTER

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16

.2 BAS controlled HVAC Systems and Equipment:
.1 Input signal: from RH sensor.
.2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
.3 Input and output short circuit and open circuit protection.
.4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
.5 Output linearity error: plus or minus 1.0% maximum of full scale output.
.6 Integral zero and span adjustment.
.7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.
.8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.12 ELECTROMECHANICAL RELAYS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16

.2 Requirements:
.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
.3 Contacts: rated at 5 amps at 120 V AC.
.4 Relay to have visual status indication

2.13 SOLID STATE RELAYS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16

.2 General:
.1 Relays to be socket or rail mounted.
.2 Relays to have LED Indicator
.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
.4 Operating temperature range to be -20 degrees C to 70 degrees C.
.5 Relays to be CSA Certified.
.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
.7 Operational frequency range, 45 to 65 HZ.

.3 Input:
.1 Control voltage, 3 to 32 VDC.
.2 Drop out voltage, 1.2 VDC.
.3 Maximum input current to match AO (Analog Output) board.

.4 Output.
.1 AC or DC Output Model to suit application.

2.14 CURRENT SENSING RELAYS

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16

.2 Requirements:
.1 Suitable to detect belt loss or motor failure.
.2 Trip point adjustment, output status LED.
.3 Split core for easy mounting.
.4 Induced sensor power.
.5 Relay contacts: capable of handling [0.5] amps at 30 VAC / DC. Output to be NO solid state.
.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
.7 Adjustable latch level.

2.15 THERMOSTAT

.1 Hard wired controlled HVAC equipment and HVAC equipment controlled by SCADA system: Refer to Division 16.

.2 BAS controlled HVAC Systems and Equipment:
.1 Supplied by VAV box supplier. Refer to 15863

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Provide complete system of automatic controls to achieve sequence of operation, monitoring and alarming specified.

.2 Mount motorized dampers outside insulation on insulated ducts.

.3 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.4 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.5 Temperature transmitters, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:
.1 Protect from solar radiation and wind effects by non-corroding shields.
.2 Install in NEMA 4 enclosures.

.4 Duct installations:
.1 Do not mount in dead air space.
.2 Locate within sensor vibration and velocity limits.
.3 Securely mount extended surface sensor used to sense average temperature.
.4 Thermally isolate elements from brackets and supports to respond to air temperature only.
.5 Support sensor element separately from coils, filter racks.

.5 Averaging duct type temperature sensors.
.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
.2 Wire multiple sensors in series for low temperature protection applications.
.3 Wire multiple sensors separately for temperature measurement.
.4 Use software averaging algorithm to derive overall average for control purposes.

3.3 TESTING ADJUSTMENTS

.1 After completion of installation, test, adjust and regulate thermostats, dampers and other control or safety equipment provided under this Section.

.2 Adjust to suit balancing of systems.

3.4 SUPPLEMENTS

.1 Mechanical Control Valve Schedule (attached).

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Definition: Related Work does not define the responsibility of providing but rather refers to standards of materials and installation required. Refer to Part 2 of the appropriate section for responsibility of providing the material and Part 3 for responsibility of installation.

.1	General Requirements:	Division 1
.2	Equipment to be Salvaged:	Division 1
.3	Excavation and Backfill:	Division 2
.4	Concrete Work/Formwork/Reinforcing:	Division 3
.5	Painting:	Division 9
.6	Grounding:	Section 16045
.7	Electrical Inspection and Testing:	Section 16031

1.2 DEFINITIONS

.1 Following are definitions of terms and expressions used in specification:

.1 "Inspection Authority" means agent of any authority having jurisdiction over construction standards associated with any part of electrical work on site.

.2 "Supply Authority" means electrical power company or commission responsible for delivery of electrical power to project.

.3 "Electrical Code" means Ontario Electrical Safety Code Latest Edition.

.4 "as indicated" means as shown on drawings.

.5 "as specified" means as specified elsewhere in specification.

.6 "provide" means supply, install and connect.

.7 "Process Equipment" means any motor, operating station, instrument, etc., used in the process of treating wastewater and/or its byproducts.

.8 "House Equipment" means any devices such as lights, switches, receptacles, heaters, etc., that forms part of the building system and is not used directly in the process of treating wastewater and/or its byproducts.

.9 "Manufacturer's Representative" means factory trained person who can start up a particular device from a particular manufacturer. Manufacturer must provide written confirmation of a representative not in their direct employment.

.2 Refer to CSA C22.2 No. 0 for "Definitions and General Requirements".

1.3 ABBREVIATIONS

.1 BS means British Standard.

.2 CEC means Canadian Electrical Code.

.3 CEMA - see EEMAC.

.4 CGSB means Canadian General Standards Board.

.5 CSA means Canadian Standards Association.

.6 EEMAC means Electrical and Electronic Manufacturers Association of Canada.

.7 NBC means National Building Code.

.8 OBC means Ontario Building Code.

.9 ISA means International Society of Automation.

.10 OESC means Ontario Electrical Safety Code and its bulletins, latest revision.

1.4 ELECTRICAL ABBREVIATIONS

.1 Following abbreviations are used for electrical terms:
- .1 ac alternating current.
- .2 awg American wire gauge.
- .3 A ampere.
- .4 am/fm amplitude and frequency modulation.
- .5 db decibel.
- .6 dc direct current.
- .7 Hz hertz.
- .8 kV kilovolt.
- .9 kVA kilovolt-ampere.
- .10 kW kilowatt.
- .11 kWh kilowatt-hour.
- .12 m meter.
- .13 mA milliampere.
- .14 mm millimeter.
- .15 rms root-mean-square.
- .16 V volt.
- .17 W watt.

.2 Following abbreviations are used for equipment:
- .1 MCC Motor Control Centre.
- .2 DTT Dry Type Transformer.
- .3 SG Switchgear.
- .4 SB Switchboard.

1.5 CODES AND STANDARDS

.1 Carry out all work in accordance with these drawings and specifications, meet latest regulations of Electrical Code and applicable Municipal and Provincial Codes and Regulations. In each and every instance of application, the Code, Regulation, Statute, By-Law or Specification having most stringent requirements applies.

1.6 PERMITS AND FEES

.1 Submit to Inspection Authority and Supply Authority necessary number of working drawings and specifications for examination and approval prior to commencement of work and pay all associated fees. These documents to be provided by Consultant at no cost.

.2 Obtain and pay for all inspection fees.

1.7 ELECTRICAL SYSTEM SUPPORT ANCHORAGE AND SEISMIC RESTRAINT

.1 Refer to Division 1.

.2 Provide support, anchorage and restraint of Electrical distribution systems and equipment, designed and constructed in accordance with the latest edition of the following:

.1 National Building Code, Section 4.1.9.

.2 Ontario Building Code, Section 4.1.9.

.3 ASHRAE Applications, Seismic Restraint Design.

.3 Provide installation documents prepared by a Structural Engineer licensed in the Province of Ontario. Documents to provide all required seismic supports, fastenings and bracings. For the proposed installations, documents to be sealed and signed by the Structural Engineer and submitted as part of the shop drawing package for review prior to commencement of any work.

.4 Coordinate electrical system support, anchorage and restraint system with the requirements and constraints of the structure, vibration isolation systems and the support, anchorage and restraint systems for mechanical and architectural components of the building.

.5 At completion of project, provide confirmation in writing, signed and sealed by a Structural Engineer licensed in the Province of Ontario stating that the Electrical installation is in general conformance with the structural drawings submitted with the shop drawing package.

.6 The following items are to be specifically addressed:

.1 Anchoring of MCCs.

.2 Installation of Cable Trays.

.3 Installation of Motor Control Panels.

.4 Installation of Transformers.

.5 Installation of Distribution Panelboards (120V and 600V).

.6 Installation of Control Panels.

.7 Installation of Lighting Fixtures.

.8 Installation of Switchboards.

.9 Installation of Power Factor Correction Equipment.

.10 Installation of Freestanding VFDs.

.11 Installation of Disconnects.

.12 Installation of IT Cabinets.

.13 Installation of Unit Heaters.

.14 Installation of the Standby Power Generator.

1.8 PRODUCT DATA AND SHOP DRAWINGS

.1 As per Division 1.

.2 Show on product data and shop drawings, details of construction dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.3 Wiring drawings showing interconnection with work of other divisions are required.

.4 Submit product data and/or shop drawings for all electrical equipment (Divisions 16 and 17) and devices supplied under this contract.

1.9 OPERATION AND MAINTENANCE DATA

.1 As per Division 1.

.2 Include in manuals, information based on following requirements:

.1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features and component function and maintenance requirements to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data to be in the form of reviewed product data supplemented by bulletins, technical descriptions of items, and parts lists. Advertising or sales literature will not be acceptable.

.3 Include copies of all product data and shop drawings.

.4 Provide wiring and schematic diagrams and performance curves.

.5 In addition to printed copies, all O&M manuals to be compiled in electronic format (PDF) structured in logical directories and provided on compact disk(s).

1.10 MAINTENANCE MATERIALS

.1 As per Division 1.

.2 Maintenance materials are required, as specified in Part 1 of appropriate sections.

1.11 RECEIPTS

.1 Turn over to Owner and obtain receipts for:

.1 Maintenance materials.

.2 Portable equipment specified.

.3 Tagged keys for all equipment supplied with locks.

.4 Spare lamps.

.5 Fuses.

.2 Submit photocopies of these receipts with final Certificates of Approval

1.12 DELIVERY AND STORAGE

.1 Store all equipment indoors in a clean, dust-free, dry space in full compliance with manufacturers' recommendations and guidelines.

.2 Ship and store floor-mounted equipment in upright position.

.3 Ship channel bases and templates in advance of equipment.

.4 Keep doors locked, meters and the like protected from damage and dust.

1.13 CARE, OPERATIONS AND START-UP

.1 Instruct Owner or designated personnel in operation, care and operation of installation at times arranged with Owner.

.2 Arrange and pay for services of manufacturer's factory representative to supervise start-up of installation, check, adjust, balance and calibrate components.

.3 Where a factory representative is required, this is specified in appropriate section.

.4 Provide these services for such period and for as many visits as necessary to put installation in working order, and to ensure that operating personnel are conversant with all aspects of its care and operation.

1.14 PROJECT RECORD DOCUMENTS

.1 As per Division 1.

.2 Indicate on As-Constructed Drawings location of all buried services either discovered or installed under this contract. This information is to be certified correct by Consultant before backfilling commences.

.3 Show interconnection of mechanical and electrical components on As-Constructed Drawings.

.4 Indicate in red on Record Documents all changes from work as indicated. Include all changes made by Addendum or Change Order.

.5 These documents will be reviewed by Consultant and considered as part of the contract when reviewing monthly progress payments.

.6 Should the Contractor fail to provide satisfactory As-Constructed Drawings, these will be prepared by the Consultant at the expense of the Contractor.

.7 The Consultant will provide Contractor with two (2) sets of white prints on award of contract.

.8 Contractor to use one set for recording changes during construction. The changes to be transferred to the second set as As-Constructed Drawings. Both sets of prints to be returned to Consultant.

1.15 APPROVAL OF MATERIALS

.1 Refer to Division 1.

1.16 COOPERATION

.1 Schedule execution of work with associated work specified in other divisions.

1.17 RATINGS

.1 Operating voltages to be within those defined in CAN3-C235.

.2 All motors, electric heating, control and distribution devices and equipment provided under this contract to operate satisfactorily at 60 Hz within normal operating limits established by above standards. Equipment must be able to operate in extreme operating conditions as defined in standard without damage to equipment.

.3 All electrical equipment must be able to operate in extreme operating conditions, as defined in applicable standards, without damage to equipment. This includes voltage and frequency variations as well as installed environmental conditions.

1.18 QUALIFICATIONS

.1 Contractor to have qualified personnel to continuously direct and monitor all electrical work.

.2 Contractor may be required to list names and qualifications of supervisory personnel on tender form.

.3 Supervisory personnel to attend all site meetings.

1.19 PRODUCTS, MATERIALS AND EQUIPMENT

.1 Refer to Division 1 for the following definitions:
- .1 Specified manufacturer/supplier.
- .2 Standard of Acceptance.
- .3 Acceptable Manufacturers/Suppliers.

.2 Most of the equipment in Divisions 16 and 17 has been through an extensive review with multiple manufacturing companies and the equipment listed meets pricing and performance criteria established for this project, specifically lighting, conduits, instruments, cabinet components and UPSs submission have been made and reviewed for multiple manufacturers. Only Acceptable Manufacturers/Suppliers have been listed.

1.20 DISTRIBUTION DIAGRAMS

.1 Provide distribution diagrams in glazed frames in full compliance to OESC requirements, as follows:
- .1 Electrical distribution system within each site electrical space/room/building that contains any one of the following: at each Switchgear, Switchboard, Transfer Switch, Generator, or MCC.

PART 2 – PRODUCTS

2.1 GENERAL

.1 All equipment and material to be new, CSA certified, manufactured to minimum CSA standard quoted including additional specified requirements.

.2 Where there is no alternative to supplying equipment which is not CSA certified, submit such equipment to Inspection Authorities for special inspection and obtain approval before delivery of equipment to site.

.3 All control panels and component assemblies to be shop manufactured and CSA certified.

.4 Use material and equipment available from regular production by manufacturer concerned except where custom designed equipment is specified.

2.2 IDENTIFICATION

.1 Identify all electrical equipment supplied under this Division. Hand-painted identification will not be accepted.

.2 Use phenolic plastic laminate, machine engraved nameplates attached with self-tapping screws.

.3 Use white plates with black characters for normal power and red plates with white characters for emergency power.

	DIMENSIONS	# LINES	LETTER HEIGHT
Size 1	10 x 50 mm	1	3 mm
Size 2	13 x 75 mm	1	5 mm
Size 3	13 x 75 mm	2	3 mm
Size 4	20 x 100 mm	1	8 mm
Size 5	20 x 100 mm	2	5 mm
Size 6	25 x 125 mm	1	12 mm
Size 7	25 x 125 mm	2	7 mm
Size 8	50 x 150 mm	1	25 mm
Size 9	75 x 150 mm	2	19 mm

.4 Wording on nameplates to be approved by Consultant prior to manufacture.

.5 Allow for average of twenty-five (25) characters per nameplate.

.6 All identification to be in English.

.7 Panel nameplates, size 7, to identify panels, as indicated, and voltage characteristics.

.8 For distribution panels provide a nameplate, size 5, for each circuit appropriately engraved identifying equipment or panel controlled.

.9 For branch circuit panels provide a typed directory inside door of each panel stating type of load and room location for each circuit. Supply a protective plastic envelope for directory.

.10 Identify circuit numbers on back of receptacle and switches with wire markers.

.11 Correct existing panel legends and nameplates to reflect changes made.

.12 Transformer nameplates, size 7, to show capacity, primary and secondary voltages.

.13 Nameplates, size 5, for disconnect switches, splitters and contactors to indicate equipment being controlled, voltage characteristics, ampere or horsepower kilowatt rating of equipment.

.14 Nameplate for each stand-alone starter to be size 1 engraved "name of equipment controlled".

.15 Nameplate on each remote control device to be size 1 engraved "name of equipment controlled".

.16 Nameplates, size 5, for terminal cabinets, pull boxes and junction boxes to indicate system and/or voltage characteristics.

.17 At underground penetrations, size 9 on outside wall stating description of feed(s), and their supply source.

.18 Provide self-adhesive labelling of receptacles and switches identifying source panelboard and circuit. Submit shop drawings prior to implementation.

.19 Provide lamacoid labelling for each house services junction box. Label to list all circuits and associated panelboards spliced inside the junction box.

2.3 WIRING IDENTIFICATION

.1 Provide phase identification markings on both ends of phase conductors of feeders. Arrange uniform phase-to-main lug connection on all equipment, i.e. panelboard, starter, disconnect switches, etc.

.2 Provide numbered tape markings on all branch conductors including neutrals. Where common neutrals are used, identify branch circuit numbers.

.3 The following colour coding of conductor insulation is to be strictly adhered to:

Phase A	-	red
Phase B	-	black
Phase C	-	blue
Neutral	-	white
Ground	-	green

.4 At all junction boxes, splitters, cabinets and outlet boxes, maintain identification system.

.5 Provide labelling for each wire spliced inside a house services junction box. Label to identify the corresponding panelboard and circuit.

2.4 CONDUIT IDENTIFICATION

.1 Colour code all conduits and teck cables.

.2 Coding to be located on all conduits and cables exposed after completion of building and in suspended removable ceilings.

.3 Coding to be plastic tape or paint at all points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.4 Colours to be 25 mm wide prime colour and 13 mm wide auxiliary colour.

	Prime	Auxiliary
Up to 250 V	yellow	
Up to 600 V	yellow	green
Telephone	green	
RF Antenna Signal	green	red
Ethernet CAT6	blue	
Ethernet Fibre	blue	red
Device Net	blue	green
Modbus/RS485/RS232	blue	yellow
Intruder Alarm	red	yellow
Process Discrete	green	blue
Process Analog	green	yellow

.5 For conduits containing multiple systems, request direction from the Consultant in writing.

.6 For all cables/conduits in the cable schedule label include tag using Electrovert Uni-Labels, mounting strips, lettering 12 mm, black letters, secure with Ty-Wraps.

2.5 LABELS AND SIGNS

.1 Manufacturers' nameplates and CSA labels to be visible and legible after equipment is installed.

.2 Provide warning signs, suitable background colour and lettering as required to meet requirements of Inspection Authority and Consultant. Use porcelain enamel signs, minimum size 180 mm x 250 mm.

2.6 FINISH

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.

.2 Clean and prime exposed hangers, racks, fastenings, etc., to prevent rusting.

.3 Paint all outdoor equipment to EEMAC Y1-1.

.4 Paint all indoor equipment to EEMAC 2Y-1.

.5 Do not paint “process equipment” conduits or cabling. These include those connecting plant instrumentation and motorized equipment. Process equipment cabling and conduits are typically installed on cable trays and Unistrut brackets. All painting work shall be coordinated between Divisions 9 and 16.

2.7 TERMINATIONS

.1 All lugs, terminals, screws used for termination of wiring must be suitable for either copper or aluminum conductors.

2.8 CABLE TRAY IDENTIFICATION

.1 Provide comprehensive cable tray labelling as follows:
- .1 Provide a Size 9 lamacoid at 6 m intervals and where the cable tray stops at walls, ceilings or floors. The lamacoid shall contain the following information:
  - .1 Brief description of the types of systems associated with each cable. Example: fibre, 600 VAC power, UPS power, DC controls, etc.
  - .2 List of all cables in the tray at the location of the label.
- .2 Number of lines on the lamacoid label to suit.
- .3 Submit shop drawings for review.
- .4 Secure lamacoid to the side of the tray so it is clearly visible without the need to use ladders or other elevation aids as best as practical.

2.9 EQUIPMENT LABELLING

.1 In addition to other labelling requirements, provide comprehensive labelling at each piece of process, house services, electrical and mechanical equipment that is fed from a panelboard, MCC, MCP, CP, switchboard or switchgear. The label shall include:
- .1 The equipment tag.
- .2 Power source, example: panelboard tag.
- .3 Circuit, where applicable.

.2 Labels to be Size 9. Number of lines to suit.

.3 Submit shop drawings for review.

PART 3 - PRODUCTS

3.1 REFERENCE STANDARDS

.1 Do complete installation to The Ontario Electrical Safety Code and its bulletins, latest edition.

.2 Do overhead systems to CSA 22.3 No. 1 except where specified otherwise.

.3 Do underground systems to CSA 22.3 No. 7 except where specified otherwise. All equipment and material to be new, CSA certified, manufactured to minimum CSA standard quoted including additional specified requirements.

3.2 INSTALLATION

.1 Determine manufacturer's recommendations regarding storage and installation of equipment and adhere to these recommendations.

.2 Check all factory joints and tighten where necessary to ensure continuity.

3.3 INSPECTION AUTHORITY

.1 Obtain a Certificate of Acceptance from Inspection Authority upon completion of work and hand it over to Consultant.

.2 Notify inspection authority in sufficient time for them to inspect work.

.3 Consultant will carry out inspections and prepare deficiency lists for correction by Contractor during and on completion of construction.

.4 Contractor to correct deficiencies and advise the Consultant in writing that they have been corrected.

3.4 TESTS

.1 Conduct tests and pay for all work associated with the following for those items installed under this contract. Provide Consultant with 48 hours written notice prior to tests required to be witnessed.

- .1 Complete power distribution system including phasing, meggering, voltage, grounding and load balancing / as-constructed load measurements.
- .2 All new circuits originating from branch distribution panelboards.
- .3 All lighting and its control.
- .4 All motors, heaters and associated control equipment including sequenced operation of systems where applicable and verification of correction over-current and overload pretesting devices.
- .5 Complete operation of all systems including: Ethernet, security, access control, etc.
- .6 Obtain from manufacturers, certificates or letters confirming that entire installation as it pertains to each system has been installed to their satisfaction.
  - .1 MCCs.
  - .2 Switchboard.
  - .3 Standby generator and automatic transfer switches.
  - .4 UPSs and associated EBUs.
  - .5 Power Factor Correction Units.
  - .6 Owner’s metering and associated PT/CT installations.

.2 Provide all instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.3 Refer to Section 16031 and equipment specifications for a complete scope of inspection and testing.

3.5 INSULATION RESISTANCE

.1 Megger all circuits, feeders and equipment up to 350 V with a 500 V instrument and from 350-600 V with a 1000 V instrument. Ensure that insulation resistance to ground is not less than required by code before energizing.

.2 Approval of insulation between conductors and ground, and efficiency of grounding system is left to discretion of Inspection Authority.

3.6 LOAD BALANCE

.1 Measure and record phase current to all panelboards with normal loads operating at time of acceptance.

.2 Measure and record phase voltages at normal load and adjust transformer taps to obtain, within 2%, rated voltage of equipment.

.3 Measure and record primary and secondary currents of transformers.

.4 Submit a written report at completion of work to Consultant containing all phase and neutral currents and voltages, for panelboards, dry-type transformers and motor control centres, operating under normal load. State hour and date on which each load was measured.

.5 Measure mains and all branches extending from equipment within the new Process Building.

3.7 LOCATION OF OUTLETS

.1 Do not install outlets back-to-back in wall; allow 150 mm minimum horizontal clearance between boxes.

.2 Location of outlets indicated may be changed by Consultant at no extra cost or credit, providing distance does not exceed 3000 mm, information is given before installation, and construction similar.

.3 Check direction of door swings from architectural drawings and on site. Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms, on latch side of door.

.4 Make all necessary adjustments when interior finish is completed.

.5 In acoustic tile and inverted "Tee" bar ceilings locate equipment in centre of tile or on "Tee" bar. Obtain location ruling from Consultant if other than above.

3.8 MOUNTING HEIGHTS

.1 Mounting height of equipment is given from finished floor to centreline of equipment.

.2 Exact mounting height of unnoted equipment must be verified with Consultant before proceeding with installation.

.3 Where outlets occur at same location, or on same wall, or part of wall, locate outlets symmetrically and at comparable heights disregarding specified mounting heights.

.4 Install electrical equipment at heights outlined below unless otherwise indicated.

.1	Local Switches	1200 mm
.2	Wall Receptacles/Telephone and Data Outlets	
.1	In office spaces	400 mm
.2	Above baseboard heating	200 mm
.3	Above top of counters	200 mm
.4	In service rooms and process areas	1200 mm
.3	Lighting Panels	1500 mm
.4	Cabinets	1500 mm
.5	Telephone and Interphone Outlets	400 mm
.6	Wall Mounted Speakers	2100 mm

3.9 PROTECTION

.1 Protect exposed live equipment such as panel mains and outlet wiring during construction for personnel safety.

.2 Shield and mark all live parts "LIVE 120 VOLTS", or with appropriate voltage.

.3 Arrange for installation of temporary doors for all rooms containing electrical distribution equipment. Keep these doors locked at all times except when under direct supervision of electrician.

3.10 MOTOR ROTATION

.1 Rotate motors in direction indicated by equipment being served.

3.11 CONDUIT SLEEVES AND HOLES

.1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete floors to be plastic pipe, sized for free passage of conduit, and protruding 50 mm (or as indicated) above finished floor.

.2 Holes through exterior walls and roof to be flashed and made waterproof. Seal inside the conduit with suitable compound to prevent entry of water through conduit.

.3 Install all cables, conduits and fittings, which are to be embedded or furred in, neatly and closely to building structure so that necessary furring can be kept to minimum.

3.12 FIREPROOFING

.1 Where cables or conduits pass through floors and fire rated walls, pack space between cables or conduits and sleeve or opening with T&B Flame-safe firestop material or 3M CP25 or 303.

3.13 EXCAVATION AND BACKFILL

.1 Refer to appropriate section for responsibility.

.2 Ensure that excavation for underground electrical services is in location and depth indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work. Consultant to approve before backfilling commences.

.3 All work to be done in accordance with Electrical Code.

3.14 CUTTING AND REPAIRING

.1 As per Division 1.

.2 Assume full responsibility for laying out electrical work and for any damage caused by incorrectly located equipment or improper performance of this work.

3.15 CLEANING

.1 As per Division 1.

.2 Clean all outlets, cabinets, enclosures, tubs, etc., of construction materials.

.3 Clean and remove paint from all cover plates and wiring devices.

.4 Clean up daily all waste materials and remove from site.

3.16 USE AND PERMANENT SYSTEM

.1 The connection points and use of the permanent electrical system for construction power or lighting is to be approved by the Consultant.

.2 When permanent lighting is used prior to turning building over for occupancy, all fixtures to be cleaned.

3.17 SCOPE OF WORK

.1 The scope of work for this contract shall include all work indicated on the drawings and includes but is not limited to the following. Such drawings include E, I, ME, MID, N and PID series as well as other series as indicated.

.2 Provide new buried cabling on-site, including concrete-encased ductbank systems as indicated.

.3 Coordinate with the Mechanical Contractor for monitoring relays for submersible pumps/mixers. Mechanical Contractor to turn over such relays to the Electrical Contractor for installation inside the MCCs.

.4 Site Services:

.1 Provide a new electrical service to the facility to replace the existing one. This includes medium voltage provisions and installations, Customer supplied transformer coordination with Utility and installations, and site wide and grounding. Coordinate with Hydro One. The Municipality will pay all Hydro One fees associated with this work.

.5 Site Wide Systems and Studies:

.1 Provide new standby power generator, sized to supply power to the entire site.

.2 Provide a new turnkey 600V power distribution system for the plant. This system includes new switchboards, ATSs, MCCs and 600 V panelboards. The Contractor shall carefully plan and implement routing of the 600 V power throughout the site.

.3 Provide new power factor correction and harmonic filtering for the new 600 V power distribution system.

.4 Provide new 120 V/208 V power distribution site-wide as indicated.

.5 Provide new site-wide interior and exterior lighting, including associated controls.

.6 Provide new communications networks, including Ethernet.

.7 Provide new PLC panels and associated instrumentation and miscellaneous control panels.

.8 Provide UPS systems complete with UPS power distribution.

.9 Provide a Short-Circuit Coordination and Arc Flash Study per Section 16030.

.10 Provide Power Factor Study as per Section 16410.

.11 Provide all required documentation for all newly provided intrinsically safe circuits within classified areas. All documentation required by ESA shall be provided by the contractor as required for ESA final acceptance of intrinsically safe circuits placed into service.

.6 Systems Integration

.1 Retain the services of a Systems Integrator (SI) to provide the following:

.1 Supply and commission all CPs, LCPs, FCPs, JBps, JBas and JBds, JBs, FTPs, ITs, IBs listed under the Electrical Contractor's scope of supply in the Table of Panels and Electrical Equipment.

.2 Supply and commission all Division 17 devices listed under the SI's scope of supply.

.3 During start up and commissioning, actuate all field devices supplied by SI.

.4 Factory Acceptance Testing (FAT):

.1 Provide FAT for each of the following:

.1 All CPs supplied by SI.

.2 All LCPs supplied by SI.

.2 Provide a minimum of two (2) weeks' notice to the Consultant for each FAT.

.5 Program all PLCs and SCADA.

.6 Coordinate with the Networking Specialist for facility-wide communications.

.7 Refer to Section 17002.

.8 Acceptable Systems Integrators:

.1 Capital Controls

.2 Excelpro

.3 Summa Engineering

.7 House Services:

.1 Provide all equipment, devices, wiring and all associated appurtenances for house services, as indicated.

.2 Provide all wiring and associated controls and appurtenances for HVAC systems in the plant, as indicated.

.8 Demolition and Construction Sequencing:

.1 The Electrical Contractor shall provide demolition services as indicated. Note that the demolition drawings are based on as-built drawings from previous projects and may not reflect the exact state of the existing systems and infrastructure as it exists today. The Electrical Contractor is responsible for visiting the site prior to close of tender to obtain a thorough understanding of the scope of demolition, including its impact on construction sequencing. The Electrical Contractor is reminded that the undisturbed operation of the Plant takes precedence over all construction activities and as such the Contractor is to carefully coordinate with all personnel as required, to implement the intended upgrades.

.2 Demolish electrical infrastructure associated with equipment identified for demolition, as indicated.

.3 Provide temporary wiring as required to facilitate construction.

.9 Temporary Power and Utility Coordination:

.1 Provide temporary power as required to facilitate construction. This includes temporary standby power, as required.

.2 Provide temporary UPS power as required to facilitate construction.

.3 Coordinate all existing medium voltage circuit demolitions, new medium voltage power circuit installations as well as new service transformers and related utility metering requirements with Hydro One Networks Inc.

.4 Smoke and heat Detection and Monitoring:

.1 Provide smoke and heat detection and monitoring as outlined.

.10 Provide a shop drawing showing the proposed detailed layout for each electrical and I&C room as well as each electrical and I&C closet for review prior to procuring any equipment for that room/closet. Shop drawing to include the following:

.1 Exact dimensions for each piece of electrical equipment as well as proposed clearances.

.2 Provide an elevation drawing for each wall as well as a plan drawing for the room/closet.

.3 Labelling for each piece of equipment in the room/closet.

.4 Housekeeping pad dimensions (elevations and footprint).

.5 Cable tray routing.

.6 Locations of lighting fixtures.

.7 Location of any Mechanical equipment (including A/C units and ductwork) as well as Structural members (including columns and beams).

.11 In addition to the testing requirements outlined elsewhere (including Division 1), provide two (2) onsite load bank Site Acceptance Tests (SATs) of the standby generator. The first test is to occur during onsite commissioning. The second test is to occur immediately prior to turning the generator over to the Owner. The Contractor is to provide a load bank, generator fuel, and all associated cabling and appurtenances for the tests. The test shall be done using the breaker inside the generator dedicated for load bank connection. The test shall include staging the load bank though all stages in increasing load to 100%, then decreasing to 0%. The load bank shall be provided and sized for 100% rating of the generator with at least 5 major steps (20% load each step). The generator shall operate for a minimum of 30 minutes at each loaded stage. Provide commissioning documents as outlined in Section 16622 for each load bank test.

.12 Note that work is required in various areas of the plant, as indicated.

.13 Coordinate with the General, Mechanical and System Integrator for the preparation of shop drawings and installation of items outlined:

.1 Table of Valves.

.2 Motor Starter and Control List.

.3 Control and Instrumentation Material.

.4 Table of Devices.

.5 Table of Panels and Electrical Equipment.

3.18 NETWORKING SPECIALIST

.1 Retain the services of a Corning-approved Networking Specialist to provide the following:

.1 Splice all fibre cables as indicated.

.2 Terminate all fibre cables as indicated.

.3 Terminate all CAT 5e and CAT 6 Ethernet cables.

.4 Test and commission all Ethernet connections.

.5 Provide commissioning documentation.

.2 Scope of work in accordance with Section 17060 and drawings.

3.19 ELECTRICAL SYSTEMS TESTING AGENT

.1 Retain the services of a testing agent to implement the inspection and testing requirements of the electrical power distribution system as outlined in Section 16031.

.2 Acceptable Electrical Systems Testing Agent:

.1 Pelikan

.2 Eaton

.3 or Approved equivalent.

3.20 STANDBY GENERATOR MAINTENANCE

.1 The Contractor shall provide routine maintenance of the standby power system once installed onsite until it is turned over to the Owner. The maintenance activities shall meet the requirements as outlined by the generator manufacturer and shall include oil changes. Provide written confirmation from the generator manufacturer that the generator was maintained to their satisfaction prior to being turned over to the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

.1 The Contractor to furnish short-circuit and protective device coordination studies as prepared by the equipment manufacturer.

.2 The Contractor to furnish an Arc-Flash Hazard Analysis Study per CSA Z462 – Workplace Electrical Safety, as well as NFPA 70E – Standard for Electrical Safety in the Workplace. Where conflict may potentially exist, the CSA Z462 standards shall govern.

1.2 REFERENCES

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
- .2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- .3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
- .4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
- .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- .6 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

.2 American National Standards Institute (ANSI):
- .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
- .3 ANSI C37.010 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

.3 The National Fire Protection Association (NFPA):
- .1 NFPA 70 – National Electrical Code, latest edition.
- .2 NFPA 70E – Standard for Electrical Safety in the Workplace.

.4 Canadian Standards Association (CSA):
- .1 CSA Z462-21 – Workplace Electrical Safety

1.3 SUBMITTALS FOR REVIEW

.1 The short-circuit and protective device coordination studies to be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings (switchboards, switchgear, ATS, power factor correction equipment and panelboards) and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Consultant may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

.1 The results of the short circuit, protective device coordination and Arc-Flash Hazard analysis studies to be summarized in a final report. Provide submittal for three (3) bound copies of the complete final report, as well as in digital PDF format.

.2 The report to include the following sections:

.1 One-line diagram.

.2 Descriptions, purpose, basis and scope of the study.

.3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.

.4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.

.5 Fault current calculations including a definition of terms and guide for interpretation of the analysis software results.

.6 Incident energy and flash protection boundary calculations.

.7 Recommendations for system improvements, where needed.

.8 Executive Summary.

1.5 QUALIFICATIONS

.1 The short-circuit, protective device coordination and Arc-Flash Hazard analysis studies to be conducted under the supervision and approval of a Registered Professional Electrical Engineer in the Province of Ontario, skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer to be a full-time employee of the Engineering Services Organization.

PART 2 - PRODUCTS

2.1 STUDIES

.1 Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.

.2 The Contractor to furnish an Arc-Flash Hazard Analysis Study per CSA Z462 – Workplace Electrical Safety and NFPA 70E – Standard for Electrical Safety in the Workplace.

2.2 DATA COLLECTION

.1 Contractor to furnish all data as required by the power system studies. The contractor’s engineer performing the short-circuit, protective device coordination and Arc-Flash Hazard Analysis studies to furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor to expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

.2 Source combination may include present and future motors and generators following IEEE methods.

.3 Load data utilized may include existing and newly proposed loads obtained from Contract Documents provided by Owner and/or Contractor.

.4 Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. Contractor to obtain required existing equipment data, as is necessary, to satisfy the study requirements.

.5 Contractor shall coordinate with the Owner with a minimum of two (2) weeks notice in order to gain access and investigate existing equipment within each building. Contractor to provide as many visits to site as necessary in order to complete these study requirements.

.6 Where feeder line lengths cannot be easily measured, the Contractor shall estimate line lengths. All estimated quantities MUST be clearly identified in the final report.

.7 Contractor's engineer performing this study shall provide all coordination with the local utility in determining current positive, negative and zero sequence fault current available at the point of connection to the utility grid.

.8 Include all collected data supporting the report and its recommendations as Appendix reference information.

2.3 SHORT-CIRCUIT AND PROTECTION DEVICE EVALUATION STUDY

.1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141-1993.

.2 Transformer design impedances to be used when test impedances are not available. Include all high resistance grounding devices.

.3 Provide the following:

- .1 Calculation methods and assumptions.
- .2 Selected base per unit quantities.
- .3 One-line diagram of the system being evaluated.
- .4 Source impedance data, including electric utility system and motor fault contribution characteristics.
- .5 Typical calculations.
- .6 Tabulations of calculated quantities.
- .7 Results, conclusions, and recommendations.

.4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

- .1 Electric utility's supply termination point.
- .2 Incoming switchgear.
- .3 Motor control centres.
- .4 Standby generators and automatic transfer switches.
- .5 Branch circuit panel boards.
- .6 Other significant locations throughout the system.

.5 Coordinate with the local utility, obtain and incorporate most recent design and future service impedances in short circuit calculations, protective device evaluations and arc-flash analysis.

.6 Protective Device Evaluation:

- .1 Evaluate equipment and protective devices and compare to short circuit ratings.
- .2 Adequacy of switchgear, motor control centres, and panel board bus bars to withstand short-circuit stresses.

.3 Adequacy of transformer windings to withstand short-circuit stresses.
.4 Cable and busway sizes for ability to withstand short-circuit heating.
.5 Notify consultant in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

.1 Proposed protective device coordination time-current curves to be graphically displayed on log-log scale paper. Provide a separate curve for all branch circuits and combinations with ATSs.

.2 Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.

.3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

.4 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

.5 Plot the following characteristics on the curve sheets, where applicable:
.1 Electric utility's protective device.
.2 Medium and low voltage equipment relays.
.3 Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
.4 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
.5 Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters.
.6 Conductor damage curves.
.7 Ground fault protective devices, as applicable.
.8 Pertinent motor starting characteristics and motor damage points.
.9 Pertinent generator short-circuit decrement curve and generator damage point.
.10 Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor centre.

.6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC-FLASH HAZARD ANALYSIS

.1 The Arc-Flash Hazard analysis to be performed according to the IEEE 1584 equations that are presented in CSA Z462 – Workplace Electrical Safety as well as NFPA 70E, Annex D.

.2 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods to be presented in the proposal.

.3 The flash protection boundary and the incident energy to be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centres, panel boards, busway and splitters) where work could be performed on energized parts.

.4 The Arc-Flash Hazard Analysis to include all significant locations in 240 volt and 208 volt systems.

.5 Safe working distances to be specified for calculated fault locations based upon the calculated Arc Flash boundary considering an incident energy of 1.2 cal/cm².

.6 The Arc-Flash Hazard analysis to include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation to assume that the utility contribution is at a minimum. Conversely, assume a maximum contribution from the utility while motors to be operating under full-load conditions.

.7 Arc Flash computation to include both line and load side of main breaker calculations, where necessary.

.8 Arc-Flash calculations to be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584, section B.1.2.

2.6 REPORT SECTIONS

.1 Input Data:
- .1 Short-circuit reactance of rotating machines.
- .2 Cable, conduit materials and lengths.
- .3 Bus ducts.
- .4 Transformers ratings and impedances.
- .5 Reactors.
- .6 Aerial lines.
- .7 Circuit resistance and reactive values.

.2 Short-Circuit Data:
- .1 Utility actual source fault impedance and/or generator impedances.
- .2 X to R ratios.
- .3 Asymmetry factors.
- .4 Motor contributions.
- .5 Short circuit kVA.
- .6 Symmetrical and asymmetrical fault currents.

.3 Recommended Protective Device Settings:
- .1 Phase and Ground Relays:
  - .1 Current transformer ratio.
  - .2 Current setting.
  - .3 Time setting.
  - .4 Instantaneous setting.
  - .5 Specialty non-overcurrent device settings.
  - .6 Recommendations on improved relaying systems, if applicable.
- .2 Circuit Breakers:
  - .1 Adjustable pick-ups and time delays (long time, short time, ground).
  - .2 Adjustable time-current characteristic.
  - .3 Adjustable instantaneous pick-up.
  - .4 Recommendations on improved trip systems, if applicable.

.4 Incident Energy and Flash Protection Boundary Calculations:
- .1 Arcing fault magnitude.
- .2 Device clearing time.
- .3 Duration of arc.
- .4 Arc-Flash boundary.
- .5 Working distance.
- .6 Incident energy.
- .7 Hazard Risk Category.
- .8 Recommendations for Arc-Flash energy reduction.

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

.1 Contractor to adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer during start-up and commissioning of electrical systems. Allow for multiple adjustments as required to suit project phasing.

.2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

.3 Notify Owner in writing of any required major equipment modifications.

3.2 ARC-FLASH WARNING LABELS

.1 The vendor to provide a 3.5” x 5” thermal transfer type label of high adhesion polyester for each work location analyzed.

.2 The label to have an orange header with the wording “WARNING, ARC-FLASH HAZARD”, and to include the following information:
- .1 Location designation.
- .2 Nominal voltage.
- .3 Flash protection boundary.
- .4 Hazard risk category.
- .5 Incident energy.
- .6 Working distance.
- .7 Engineering report number, revision number and issue date.

.3 Labels to be machine printed, with no field markings.

.4 Arc-Flash labels to be provided in the following manner and all labels to be based on recommended overcurrent device settings:
- .1 For each 600 and applicable 208 volt panel boards, one Arc-Flash label to be provided.
- .2 For each motor control centre, one Arc-Flash label to be provided.
- .3 For each low voltage switchboard, one Arc-Flash label to be provided.
- .4 For each switchgear, one flash label to be provided.
- .5 For medium voltage switches one Arc-Flash label to be provided.

.5 Labels to be field installed by the engineering service division of the equipment manufacturer under the Start-up and Acceptance Testing contract portion.

3.3 ARC-FLASH TRAINING

.1 The equipment vendor to train personnel of the potential Arc-Flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements CSA Z462 – Workplace Electrical Safety and NFPA 70E – Standard for Electrical Safety Requirements for Employee Workplaces, are to be provided in the equipment manuals.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

.1 The work covered by this section of the specification is to be coordinated with the related work as specified elsewhere under the project coordination.

.2 Contractor to provide all inspection and testing for all equipment, regardless if the equipment is pre-purchased, preselected or otherwise.

1.2 REFERENCES

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
- .2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- .3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
- .4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
- .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- .6 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

.2 American National Standards Institute (ANSI):
- .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
- .3 ANSI C37.010 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

.3 The National Fire Protection Association (NFPA):
- .1 NFPA 70 – National Electrical Code, latest edition.
- .2 NFPA 70E – Standard for Electrical Safety in the Workplace.

.4 Canadian Standards Association (CSA):
- .1 CSA Z462-21 – Workplace Electrical Safety.

1.3 STANDARDS

.1 The tests and inspections shall comply with NETA, International Electrical Testing Association.

.2 Burn-in periods are 100 hours for continuous use equipment or 7 days for cyclic duty equipment.

1.4 SCOPE

.1 The work covered by this section of the specification, includes the furnishing of all labour, test equipment, and performance tests for installations shown on drawings and as herein specified during and at conclusion of project.

.2 Contractor shall hire a Professional Engineer licensed in the province of Ontario and skilled in the area of electrical start-up, commissioning and testing activities as a single point of coordination for the accuracy and reliability of required tests on all electrical equipment on this project. Upon conclusion of the project, the contractor's engineer shall submit a bound document in both hardcopy and electronic PFD formats, which is signed, sealed, and complete with a cover document identifying the accuracy and completeness of submitted tests, data, and measurements for future use and reliability purposes.

.3 Testing requirements to be provided under this section have been organized and identified on contract drawings as the "Inspection and Testing Matrix". This specification section shall not supersede but rather augment and append to any other electrical testing requirements specifically identified within any other specification section.

PART 2 – PRODUCTS

2.1 SITE TESTING SERVICES

.1 Provide all equipment, materials and labour as required to provide testing as indicated by Article 1.3 – Scope, in coordination with the "Inspection and Testing Matrix" on contract drawings.

.2 Refer to Part 3 of this section for additional procedural and execution requirements of the "Inspection and Testing Matrix" on contract drawings.

2.2 TEST EQUIPMENT

.1 General:
- .1 Ensure suitable power supply is available for test equipment, be it 120 VAC or battery-powered devices. Record make, model, and calibration date of test instrument(s).
- .2 All test equipment to have valid calibration stickers displayed on the equipment and must be calibrated within the last 12 months by a company who regularly engages in this service.

.2 Transformer Doble® Test (High Voltage Power Factor Tip-up Test):
- .1 Doble® test equipment to be Type MH to 10 kV at 60 cycles.
- .2 Test equipment voltage to be variable from 2.0 kV to 10 kV depending on ratios of transformers.

.3 Transformer Turn Ratio Test:
- .1 Three-phase powered unit with solid state controls.
- .2 Unit capable of tests on multiple transformer winding configurations.
- .3 Single-phase units may be used on specially wound transformers.
- .4 Turn ratio to 3 decimal place accuracy and display.

.4 Protection Relay Test Equipment:
- .1 Relay test equipment to be designed for relay testing, secondary current injection.
- .2 Current output to be capable of 60 A for testing of instantaneous features.
- .3 Indicators to detect open signals, pick-up signals and other required signals.
- .4 Timers accurate to 1 millisecond.
- .5 MultiAmp or equivalent relay test units. Specifically designed relay testers for specific relays should be used if available.
- .6 For equipment required on three phase systems, have a three-phase voltage and current output test unit.

.7 For equipment required on three-phase differential test, have a six-channel current output test unit(s) or equivalent.

.5 DC High Pot Units:

.1 Test instruments to have minimum output of 60kV DC, 2000 uA capacity.

.2 120 VAC powered.

.3 Test to be conducted with full safety measures in force, including “barrier” of conductor ends, proper bonding, “flag-person”, as necessary.

.6 AC High Voltage Units:

.1 To have a minimum output of 27kV AC, 2000 mA capacity.

.2 Use an AC high voltage unit for insulation tests and other tests as indicated, at voltage levels indicated or required by manufacturer’s recommendations.

.3 Approved equipment is Doble® insulation test unit.

.7 Insulation Resistance Meter (Megger):

.1 DC megger to have insulation scale to 100,000 megohms (1000 V scale).

.2 Output voltages on DC megger units to be 500 V, 1000 V, 2500 V and 5000 V.

.3 DC megger units to be suitable for 10-minute megger tests and polarization index tests.

.8 Low Resistance Test Units (Ductor):

.1 Low resistance test units to have 10 A output.

.2 Digital display and accuracy to 1 microhm.

.9 Load Survey:

.1 Test equipment shall be Fluke, 3-phase Power/Power Quality monitor or equivalent. With capability to harmonic measurements, amplitude and phase angle for each harmonic, watts, VA, VAR, true power factor, and displacement power factor, Power Quality standard measurements with high-speed sampling of impulses at 2 MHz to measure impulses to 6400 V peak, 500 nanoseconds duration and displays peak voltage.

.10 Thermographic Infrared Equipment:

.1 Test equipment to be minimum equal to Agema Thermo Vision 570 Portable Infrared camera system. Must be capable of taking a colour infrared image of all observation and noted irregularities.

.11 Phase and Rotation Testing:

.1 Test equipment shall be adequate to safely confirm project phasing and sequence of power phase rotation. Fluke 9040 or approved equivalent.

2.3 TESTING REPORT

.1 Final Report of all tests to be in typewritten form with field measurements for reference in appendix. Test results report shall be organized into sections comprised of each area of testing undertaken for this project, as delimited to be a scope of work requirement within the “Inspection and Testing Matrix”, as indicated on the contract drawings. Final test results report shall be signed and sealed by the contractors testing engineer overseeing field measurement activities.

.2 Include copy of final test results report in maintenance manuals.

.3 General:

.1 All test results to be input to an electronic test sheet program.

.2 All test sheets to include equipment nameplate data, customer identification, time and date of tests, environmental conditions during tests and test results.

.4 Test Results and Reporting - Data for Inclusion:

.1 The following data to be included in the test report:

.1 Equipment data with selected position, if applicable, e.g., transformer tap.

.2 Protective device(s) make, model number, rating, "as found" settings. These to include CT, PT relays, overloads, fuses, breakers.

.3 Adjustments, modifications and repairs made on the equipment on site with explanation on such work (necessity and method of execution).

.4 Observations recorded and summary of conclusions upon technician's review of the inspection and testing observations.

.1 The acceptable criteria and limiting values of measured figures by the equipment manufacturer. These are to include the insulation resistance (megohm), contact resistance (microhm), leakage current (microampere).

.2 Include observation photographs of each key components tested, including thermographic scans thermal gradients observations.

.5 Recommendations for long-term and short-term remedial work.

.5 Report Format:

.1 Final report to be submitted in electronic and print format in three (3) bound copies neatly in 3-ring binders with separate sections for each item as listed therein.

.2 Include comprehensive high resolution digital colour photographs of equipment settings, test setup, equipment tested, etc. Date and provide descriptive names and references for the photographs.

.3 Photographs to be mounted on background sheet complete with labels. Curves and graphs to be neatly plotted on appropriate graph paper. Result tables to be made electronically and logically arranged.

.4 The enclosed test report forms are samples of the data required on the reporting forms. It is not intended to imply that these are the only forms required. The contractor to submit all forms necessary to fully describe the inspection, testing and maintenance of all items.

PART 3 – EXECUTION (TEST PROCEDURES)

3.1 GENERAL

.1 Coordination of all tests and shutdowns with Owner with a minimum of four (4) weeks' notice.

.2 Pre-service and Post-service Inspection and Testing of equipment shall be provided as identified in the "Inspection and Testing Matrix" within contract drawings.

3.2 INSULATION RESISTANCE TESTS (MEGGER)

.1 Insulation Resistance Tests:

.1 Use a megger with 100,000 megohm @ 1000 V resolution for megger tests.

.2 Record ambient temperature and humidity and adjust the measured megohm reading to 20°C ambient.

.3 Use 5 kV megger for 13.2 kV equipment, 2.5 kV megger for 2.4 kV equipment and 1000 V megger range for power equipment of 600 V and below.

.4 For 10-minute megger test, record megohm values in megohms at 30 seconds, 60 seconds, 3 minutes, 5 minutes, and 10 minutes. Plot megohms against time for each electrical connection and phase. Calculate and record the ratio of measured megohms data from each test as follows:

.1 60-second megohm/30-second megohm = dielectric absorption.

.2 10-minute megohm/60 second megohm = polarization index.

.3 Report the 60 second megohm as the insulation resistance value.

.4 Submit tabulated measured megohm figures for all values observed over the 10-minute insulation tests. Submit both in table and graphical format.

3.3 DC HIGH POTENTIAL TEST

.1 DC High Potential Tests:

.1 Conduct 10-minute insulation resistance test immediately before high voltage tests and submit test reports. Conduct HV test only if the insulation resistance test result is satisfactory.

.2 Test instrument to have minimum output of 60 kV DC, 2000 uA capacity.

.3 Conduct test to IEEE Standard 400-1980.

.4 Coordinate with motor manufacturer for acceptable safety limits.

.5 Compile test report.

3.4 SURGE TEST OF WINDING TURNS INSULATION

.1 Surge Tests:

.1 Using a skilled and qualified technician, conduct a Surge Test of Winding Turns Insulation following IEEE 522 Standard on all three motor windings. This test shall only be performed upon successful completion and results of both winding Insulation Resistance Testing and winding High Potential Testing.

.2 Coordinate with motor manufacturer for acceptable safety limits.

.3 Compile test report showing characteristic ring-wave and amplitudes from surge test results.

3.5 DC RESISTANCE MEASUREMENT

.1 DC Resistance Tests:

.1 Using a skilled and qualified technician, conduct a DC resistance test of all three motor windings following IEEE Standard 112, 118 and 119 procedures and test equipment.

.2 Ensure motor winding temperatures have stabilized to ambient and record ambient temperature at the time of test. Report to include both observed resistances and standardized equivalent resistances at 25 Deg. C.

.3 Compile test report.

3.6 DOBLE AC RESISTANCE MEASUREMENT

.1 Doble AC Resistance Tests:

.1 Using a skilled and qualified technician, perform high voltage AC insulation test on high voltage windings to ground, low voltage windings to ground, high voltage windings to low voltage windings using Doble® insulation tester.

.2 Inspect bushings, and measure insulation resistance with use of high voltage AC insulation tester.

.3 Compile test report.

3.7 TURNS RATIO TESTING

.1 Turns Ratio Tests:

.1 Using a skilled and qualified technician, perform transformer turn ratio test on all available tap positions.

.2 Compile test report.

3.8 LOW RESISTANCE DUCTOR TEST

.1 Low Resistance Ductor Tests:

.1 Using a skilled and qualified technician, perform low resistance test across contacts and mechanical connections to confirm proper operation of equipment and obtain confidence at each point measured. The corresponding I^2R heating under continuous current load will be within manufacturers design tolerances and conform to NETA standards.

.2 All tests to be carried out with a calibrated low resistance Ductor.

.3 Compile test report.

3.9 DEVICE SETTINGS CALIBRATION

.1 Device Settings Calibration:

.1 Coordinate with manufacturer and calibrate equipment for intended operation prior to pre-startup review. Where applicable confirm CT and/or PT ratios.

.2 Data and record as calibrated settings as well as any following adjustments required throughout the start-up and commissioning phases of the project. Note the before and after adjusted settings in each report.

.3 Compile test reports complete with final “as commissioned” report.

3.10 PROTECTIVE SETTINGS VERIFICATION AND SECONDARY INJECTION TEST

.1 Protective Settings Verification and Secondary Injection Tests:

.1 Review protective settings against final coordination study. Where applicable confirm CT and/or PT ratios. Report to Consultant any discrepancies.

.2 Sign and date each over-current device and protective relay as being effectively reviewed and confirming field accuracy with the conclusions and recommendations of the coordination study.

.3 Confirm time response of breakers and protective relays using manufacturer’s recommended secondary injection testing device. Contractor shall hire manufacturer’s technician or provide the manufacturer’s recommended tools for secondary injection testing. Note the equipment utilized with injection testing on test reports. Indicate relative accuracy of device against prescribed settings in the coordination report. Notify Consultant of any significant discrepancies prior to placing into service.

.4 Compile test reports complete with final “as commissioned” report.

3.11 AC PHASE SEQUENCING TEST AND VERIFICATION OF MARKINGS

.1 AC Phase Sequencing Test and Verification of Markings:

.1 Review three phase equipment and confirm correct ABC rotation is consistently applied on all electrical equipment with phase rotation tester. Confirm markings are consistent. Correct any deficiencies as required. Provide motor lead markings on branch circuit side of motor lugging as well as on motor lead side after proper motor rotation is confirmed.

.2 Compile report indicating master ABC rotation coloring standard and equipment confirmed to be verified to following the indicated standard.

3.12 LUGGING AND MECHANICAL ASSEMBLIES TORQUE CHECK

.1 Lugging and Mechanical Assemblies Torque Checks:

.1 Check the torque of busbar bolts and cabling termination lugging for correct tightness against manufacturer's recommendations and in compliance with the Ontario Electrical Safety Code.

.2 Provide bolt marking for future inspection of possible movement after correct torque has been verified.

.3 Compile a dated report indicating applied torque requirements and equipment confirmed to be verified.

3.13 CURRENT TRANSFORMER (CT) TESTING

.1 CT Tests:

.1 Using a skilled and qualified technician, conduct inspections and tests on current transformers (CTs).

.2 Perform CT saturation tests, polarity tests, ratio, winding resistance and insulation resistance tests for each CT to verify and document correct operation.

.3 Verify correct taps and ratios on CTs.

.4 Ensure CT circuits are not open circuited, and ensure any temporary shorting devices are removed.

.5 Compile separate test report for each set of CTs. Test reports may be included within the results of the devices that the CTs service.

3.14 POTENTIAL TRANSFORMER (PT) TEST

.1 Potential Transformer (PT) Tests:

.1 Using a skilled and qualified technician, conduct inspections and tests on potential transformers (PTs).

.2 Ensure correct fusing on PTs.

.3 Perform PT ratio and winding resistance tests for each PT to verify and document correct operation.

.4 Verify correct taps and ratios on PTs.

.5 Compile separate test report for each set of PTs. Test reports may be included within the results of the devices that the PTs service.

3.15 DEVICE SETTINGS CALIBRATION

.1 Device Settings Calibration:
- .1 Coordinate with manufacturer and calibrate equipment for intended operation prior to pre-startup review. Where applicable confirm CT and/or PT ratios.
- .2 Data and record as calibrated settings as well as any following adjustments required throughout the start-up and commissioning phases of the project. Note the before and after adjusted settings in each report.

3.16 LOW VOLTAGE BREAKER AND PROTECTIVE RELAY TESTING

.1 Low Voltage Breaker and Protective Relay:
- .1 Perform contact resistance testing on all breakers at or above 100 A.
- .2 If available, perform secondary injection testing of zero sequence current transformers and ensure pick-up value is in accordance with its respective ground fault relay. Function test each breaker via its zero sequence CT to ensure reliable operation.
- .3 Inspection and testing to include visual inspection of breaker and auxiliary device(s). Note any deficiencies.
- .4 All relays to be adjusted and tested to show conformance with recommended settings in coordination study. Verify protective relay settings with coordination study.
- .5 Perform secondary current injection tests to confirm proper operation of trip devices.
- .6 Record:
  - .1 Long-time pick-up current.
  - .2 Long-time trip times at 200% and 300% of pick-up.
  - .3 Short-time pick-up current.
  - .4 Short time trip time at 150% of pick-up.
  - .5 Instantaneous pick-up.
  - .6 Ground pick-up.
- .7 Overcurrent and Ground Fault Tripping Relays:
  - .1 Test by secondary current injection, tripping of device or alarms to be confirmed.

3.17 PHASE AND PHASE ROTATION TESTING

.1 Phasing and Phase Rotation:
- .1 Test and coordinate the phase continuity throughout the distribution (ABC).
- .2 Test and coordinate phase rotations between the utility-supplied power and generator.
- .3 Test and rearrange phases as required to ensure generator and motor rotations are coordinated prior to identifying/labeling conductors.

3.18 DRY-TYPE TRANSFORMER TESTING

.1 Dry-Type Transformer Tests:
- .1 General
  - .1 Conduct inspections and tests and compile test reports.
  - .2 Compile separate test report for each transformer.
- .2 Inspections:
  - .1 Conduct external inspections in accordance with layout shop drawings. Check nameplates and vector diagrams against test results.

.2 Where present, inspect temperature gauge and fans. For devices with settings, record the settings in use. Record actual reading of all gauges and ambient temperature.
.3 Check to ensure transformer is properly anchored to floor or pad.

.3 Performance Tests:
.1 Perform insulation tests on high voltage windings to low voltage windings.
.2 Confirm proper grounding of transformer frame and core assembly.
.3 Measure winding resistances.
.4 Provide Thermographic Scans.

3.19 POWER MONITOR TESTING

.1 General:
.1 Use special test equipment and methods as available from monitor manufacturer. Take all recommended precautions from the manufacturer.
.2 Include a copy of power monitor manufacturer's test and commissioning schedule as part of the test report.
.3 Submit calculations to substantiate current/voltage figures used in tests where these are not obvious.
.4 Verify current transformer and potential transformer windings.
.5 Use 3-phase current and voltage relay test units for verification of power monitoring devices, including verification of power flow quadrant.

3.20 THERMOGRAPHIC INFRARED SURVEY

.1 Thermographic Infrared Survey:
.1 Visual and Mechanical Inspection:
.1 Remove all necessary covers prior to scanning.
.2 Inspect for physical, electrical, and mechanical condition.

.2 Test Parameters:
.1 Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
.2 Equipment shall detect emitted radiation and convert detected radiation to visual signal.
.3 Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

.3 Test Results:
.1 Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:
.1 Temperature gradients of 3°C to 7°C indicate possible deficiency and warrant investigation.
.2 Temperature gradients of 7°C to 15°C indicate deficiency; repair as time permits.
.3 Temperature gradients of 16°C and above indicate major deficiency, repair immediately.
.4 Provide infrared and digital photo recording (thermograms) of each irregularity. Submit an electronic photograph of the general area around the hot spot. Label and identify data/photo clearly.

.4 Report Sheets:
.1 Report shall be provided consisting of the following:
.1 List of equipment by name that was scanned.

.2 Deficient items to be identified on a separate page of the report.
.3 Separate page to consist of the following:
  .1 Equipment identification and location.
  .2 Photograph of item.
  .3 Thermograph of item.
  .4 Temperature measurement in °C of the following:
    .1 Defective component.
    .2 Reference component.
    .3 Over temperature of component.
    .4 Difference to ambient.
  .5 Electrical load on device during inspection:
    .1 Phase unbalance, if present.
    .2 Probable cause of deficient item.
    .3 Recommendation for corrective action.

3.21 LOAD SURVEY MEASUREMENT

.1 Load Survey Measurements:
  .1 Measure and record Phase-to-Phase Voltage, Phase to Neutral Voltage, Phase Current, Neutral Current and Ground Current.
  .2 Measure and record Magnitudes of Harmonic Phase and Neutral Currents at all the equipment mentioned in paragraph 3.1. Identify the current magnitudes for the 3rd, 5th, 7th, 9th, 11th, 13th, 15th, 17th, 19th and 21st harmonic (based on 60 Hz).
  .3 Utilize test instruments with a maximum error of ±2% and submit two copies of typed result sheets, signed, dated and bound to the Consultant.
  .4 Measure power quality standard measurements: sags, swells, and wave shape fault events, rms volts, rms amps, and frequency summaries. Transients to 1000 volts peak, 130 microseconds duration.
  .5 Measure at the main switchboard, Power Consumption.: Watts, VA, VAR, PF (true and displacement), Demand, KWh.
  .6 Compile report of all surveyed equipment and identify any areas of concern with respect to IEEE standards, complete with recommendations for improvement if necessary. Contractor to carry out any load balancing and transformer tap setting adjustments as needed to ensure good voltage regulation to IEEE guidelines.

3.22 GENERAL INSPECTION AND PERFORMANCE VERIFICATION

.1 Liquid-Filled Transformers:
  .1 Conduct external inspections in accordance with layout shop drawings.
  .2 Check nameplates and vector diagrams against test results.
  .3 Inspect silica gel breathers, oil gauge, temperature gauge and similar devices where fitted. For devices with settings, record the settings in use. Record actual reading of all gauges and ambient temperature.
  .4 Check to ensure transformer properly anchored to floor or pad.
  .5 Inspect for oil leaks, correct oil level, and signs of rusting.
  .6 Confirm proper grounding of transformer tank.
  .7 Exercise the manual tap changer to check its functions and ease of access.
  .8 Operate and simulate alarm and trip conditions of each protective device.

.2 Switchgear:

.1 Inspection of all protective devices and auxiliaries after the equipment is isolated and grounded and the switchgear room is cleaned.

.2 Provide operational tests of protection and monitoring devices.

.3 Confirm circuit breaker trip and closing coil pick up and trip off voltages are present.

.4 Check that nameplate and equipment identification corresponds with shop drawings, where available.

.5 Check switchgear interior and exterior for cleanliness, and enclosure distortion.

.6 Inspect the physical conditions and damage of termination, shutters and mechanism.

.7 Check the structural supports and connections, grounding security and connection.

.8 Check access of CT for replacement and routine inspection/testing.

.9 Check mechanical and electrical interlocks.

.10 Check the auxiliary switches operation and contacts.

.3 Low Voltage Distribution Equipment Inspection:

.1 Inspect and clean.

.2 Clean frames/mechanisms/auxiliary devices and apply lubricant per manufacturer's recommendations.

.4 Low Voltage Power Circuit Breaker and Protective Relay:

.1 Inspection and clean. Provide visual inspection of breaker and auxiliary device(s). Note any deficiencies.

.2 Check draw-out devices, electrical and mechanical functions, interlock sequences.

.5 Cables/Busbar:

.1 Inspect and record installed type and size of cables on test sheets and confirm against the single line drawing.

.2 For cables likely to have sheath current, check to ensure metal supports are not used, e.g., fiber plates used.

.3 Check for the proper physical protection of cables through concrete opening or metal plating.

.4 Check all power cables, e.g., Teck cables properly spaced (by one cable diameter unless specifically indicated otherwise) and secured by proper clips.

.5 Check insulators and bushings for cracks and other physical defects.

.6 Visually inspect cables where possible throughout their run and check conditions of the following:

.1 Use of proper lugs.

.2 Cables are properly shaped without sharp bends.

.7 Open cables are properly supported on racks, trays or ladders in buildings. No concentrated stress points exist.

.8 Insulation jacket damage.

.9 Cables at duct mouth for wear or cracking.

.6 Current Transformer and Potential Transformer:

.1 Check that nameplate and equipment identification corresponds with shop drawings.

.2 Check the provision and correctness of phase markers for power connections and cabling.

.3 Inspect the physical conditions and damage of housing and terminations.

.4 Check the structural supports and connections, grounding security and connection.

.5 Terminal and wire numbering to record drawings. As-Constructed Drawings.

.7 Coordination Study Related:

.1 Test and calibrate, using relay test equipment, all settings as indicated by the coordination study, and approved by the Consultant. Show "as found" and "as left" settings and test results.

.2 Test and calibrate new breakers that have been installed after the coordination study. Incorporate test results as part of the study.

.3 Relays (including, but not limited to; feeder protection, differential protection, synchronization, generator protection and transformer protection), motor starters relays and power meters to be calibrated and tested prior to final energization.

.4 Listing relays (including, but not limited to; feeder protection, differential protection, synchronization, generator protection and transformer protection), motors starters relays and power meters to be calibrated and tested during switchovers or scheduled power outages.

END OF SECTION

PART 1 - GENERAL

1.1 GROUNDING SYSTEMS

.1 Provide service entrance grounding to each building location as per Ontario Electrical Safety Code requirements.

.2 Provide utility medium voltage service entrance and transformer grounding as indicated on drawings.

.3 Bond all piping, grating, railings, and structural steel.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Grounding equipment to CSA C22.2 No. 41-Latest Edition.

.2 Copper grounding conductors to ASA G7.1-Latest Edition.

2.2 EQUIPMENT

.1 Rod electrodes, copper clad steel 19 mm dia. by 3 m long to Ontario Electrical Safety Code acceptance.

.2 Grounding conductors to be green insulated, stranded copper, soft annealed, sized as indicated.

.3 Direct-buried conductors to be bare copper.

.4 Provide all non-corroding accessories necessary for grounding system.

2.3 MANUFACTURERS

.1 Acceptable grounding manufacturers:
- .1 Burndy Corp. Hy-ground Compression Connections.
- .2 Pre-approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of Engineer and local authority having jurisdiction over installation.

.2 Protect exposed grounding conductors from mechanical injury.

.3 Make buried connections, and connections to conductive water main, electrodes as indicated.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Install bonding wire in flexible conduit.

.6 Install grounding conductor in all power conduits.

.7 Install separate ground conductor, to outdoor lighting standards.

.8 Connect building structural steel and metal siding to ground by welding copper to steel as indicated.

.9 Make grounding connections in radial configuration only, with connections terminating at a single grounding point. Avoid loop connections unless explicitly indicated.

.10 Use tinned copper conductors for aluminum structures or where perimeter fencing bonding is required.

3.2 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install concrete-encased electrodes in building foundation footings, with terminal connected to grounding network.

.3 Install rod electrodes and make grounding connections as indicated.

.4 Bond separate, multiple electrodes together.

.5 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails. Ground as indicated.

3.3 EQUIPMENT GROUNDING AND BONDING

.1 Provide perimeter grounds and service grounding triads.

.2 Ground electrical distribution panels.

.3 Ground control panels and junction boxes.

.4 Bond structural steel.

.5 Bond metallic piping.

.6 Bond grating and railings.

.7 As required by the Ontario Electrical Safety Code.

3.4 TESTS

.1 Perform Ductor low impedance ground continuity tests to approval of Engineer and local authority having jurisdiction over installation.

.2 Perform final grounding system resistance tests using fall of potential test method, or as otherwise appropriate to site conditions and to approval of Consultant, ESA and local authority having jurisdiction. Provide testing prior to energization of the Electrical Services Building as well as prior to final trial operation of the completed facility upgrades.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
.1 ANSI/IEEE 837,

.2 Canadian Standards Association (CSA)
.1 CSA C22.2 No. 0.4, Bonding and Grounding of Electrical Equipment (Protective Grounding).

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 01330 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Rod electrodes: as per Section 16045– Grounding.

.2 Conductors: bare, stranded, soft annealed copper wire, size No. 4/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

.3 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
.1 Grounding and bonding bushings,
.2 Protective type clamps,
.3 Bolted type conductor connections,
.4 Burndy Hy-ground compression type conductor connectors,
.5 Bonding jumpers, straps.

.4 Wire connectors and terminations: to Section 16153 – High Voltage Connectors and Terminations.

PART 3 - EXECUTION

3.1 GROUNDING INSTALLATION

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.2 No. 0.4 and requirements of local authority having jurisdiction.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to electrodes, structural steel work, using Burndy Hy-ground compression connectors.

.5 Use No. #2/0 AWG bare copper cable for grounding of concentric neutral on power cables.

.6 Use tinned copper conductors for aluminum structures.

3.2 ELECTRODE INSTALLATION

.1 Install ground rod electrodes. Make grounding connections to station equipment.

.2 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.

3.3 POLE MOUNTED SWITCHING DEVICE GROUNDING

.1 Refer to Drawings for patterns and spacings.

.2 Connect operating handle of switch to handle base with No. 3/0 AWG extra flexible copper conductor.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16031 - Inspection and Testing.

.2 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL

.1 Dispose of demolished materials except where specifically noted otherwise.

.2 Where existing materials are to be reused, the Contractor for this division is responsible for their removal, storage, cleaning and re-installation.

.3 Where existing materials are to be turned over to the Owner, the Contractor for this division is responsible for their removal and delivery to the Owner on site.

.4 Where electrical equipment is to be demolished, the Contractor for this division is responsible to ensure that they have been isolated from the power supply prior to demolition under another division.

.5 Where some existing materials are to be retained in place, it is the responsibility of the Contractor for this division to identify the materials and equipment to remain prior to commencement of demolition.

.6 Maintain adequate structural support for equipment and material during demolition process.

1.2 MAINTAIN SERVICES

.1 It is the responsibility of the Contractor for this Division to maintain electrical services and systems at all times to areas beyond the construction area.

.2 Reinstate immediately any existing circuits disrupted during construction not intended to be removed as part of this contract.

.3 Extend, relocate, replace or modify existing wiring as required to facilitate construction at no additional cost to the Contract. Provide temporary supports, as required.

.4 Relocate or modify any existing control or electrical panel as required to facilitate construction. Provide temporary supports, as required.

1.3 RELOCATION OF EXISTING EQUIPMENT

.1 Refer to General Arrangement drawings for equipment to be relocated from other areas.

.2 Include for disconnection of electrical services to equipment and where circuit conductors are left exposed terminate in box with blank cover and identify with circuit number.

.3 Non-electrical equipment will be physically relocated by another Division.

.4 Include for reconnection of electrical services to equipment as indicated.

1.4 WIRING

.1 Remove all existing surface wiring and outlets as noted.

.2 Remove all wiring exposed where walls are removed or openings made for doors. Reinstate affected circuits.

.3 Where flush outlets are abandoned:
.1 remove wire from conduit; and
.2 boxes behind finished surface to be patched over by another division. If flush with finished surface remove the box.

.4 Remove all abandoned armoured cable, conduit and wiring becoming obsolete in the execution of this contract that is exposed or in removable ceiling spaces.

1.5 EQUIPMENT CONTAINING PCBS

.1 Refer to Designated Substances Report per Division 1.

.2 Equipment to be removed may contain PCBs (i.e., transformers, capacitors or fluorescent ballasts).

.3 When equipment containing PCBs is discovered, contact Consultant immediately for instructions.

.4 Store such equipment on site in a secure location as directed until such time as disposal is determined.

PART 2 – PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 – EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

1.2 REGULATORY REQUIREMENTS

.1 Underground electrical installations shall be fully compliant with Ontario Electrical Safety Code (OESC) requirements and related bulletins. Installation dimensions shall comply with OESC diagrams D8 through D11, as is applicable. In the event of conflict, the more stringent shall apply to the satisfaction of the local hydro inspector.

PART 2 - PRODUCTS

2.1 MATERIALS FOR DIRECT BURIED SERVICES

.1 Sand bedding, free from aggregate particles retained on a minimum 6 mm sieve to Division 2.

.2 50 mm thick concrete patio stones, where indicated. Size to suit, as indicated.

.3 Provide Brady "Identoline" red warning tape 150 mm embossed - Electrical. Coordinate with ESA.

.4 Refer to trenching cross section details for additional material and installation requirements. Configuration of trenching details is illustrative only. In the event of conflict, Contractor shall provide installation configurations which are fully compliant to the applicable Ontario Electrical Safety Code Diagram D8 to D11."

2.2 CABLE PULLING EQUIPMENT

.1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.3 MATERIALS FOR BURIED CONCRETE ENCASED SERVICES

.1 Sand bedding, free from aggregate particles retained on a minimum of 6 mm sieve to Division 2.

.2 PVC conduit to be DB2 when encased in concrete and transition to rigid PVC (RPVC) conduit when not protected by concrete in below grade installations. Transitions from DB2 to RPVC to be encased in concrete.

.3 Provide Brady "Identoline" red warning tape 150 mm embossed – Electrical. Coordinate with ESA.

.4 Refer to trenching cross section details for additional material and installation requirements. Configuration of trenching details is illustrative only. In the event of conflict, Contractor shall provide installation configurations which are fully compliant to applicable Ontario Electrical Safety Code Diagram D8 to D11.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Install ducts as indicated and to manufacturer's instructions.

.2 Ensure that excavation for direct burial of underground services is to satisfaction of Consultant, prior to proceeding with installation.

3.2 TRENCH INSTALLATIONS

.1 Provide 100 mm of bedding material on bottom of trench before laying ducts and conduits.

.2 Side fill with bedding material up to top of ducts and conduits. Tamp around ducts with hand tampers.

.3 Provide 150 mm of bedding material above ducts and conduits.

3.3 DIRECT BURIAL OF WIRES AND CABLES

.1 Grade bottom of trench to smooth surface, free of stones or soft spots, and secure sides from caving-in.

.2 Cover bottom of trench with 150 mm of sand.

.3 Lay wires or cables maintaining 75 mm clearance from each side of trench. Pulling wire or cable into trench or dragging along trench not permitted.

.4 Underground splices not acceptable.

.5 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.6 Maintain 75 mm minimum separation between different circuits. Maintain 300 mm horizontal separation between low and high voltage wires or cables. When low voltage wires cross high voltage cables maintain 300 mm vertical separation with low voltage in upper position. At crossover, maintain 75 mm minimum vertical separation between low voltage wiring and 150 mm between high voltage cables. Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables and wiring, with fire alarm and control cables in upper position. Install 50 mm thick concrete patio stones on lower cables 600 mm in each direction at crossings.

.7 Cover wiring or cables with 150 mm bedding sand, compacted to a degree of compaction not less than 95% standard proctor density as determined by AASHO method T99-70.

.8 Install continuous row of overlapping 50 mm concrete patio stones as indicated to cover length of run.

.9 Balance of trench backfilling by Division 2.

3.4 CABLE INSTALLATION IN DUCT

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.5 CABLE REMOVAL FROM DUCT

.1 Remove existing wires from existing duct, as indicated.

.2 Provide fish cords in ducts.

3.6 MARKERS FOR UNDERGROUND SERVICES

.1 Install Identoline tape below grade mid span between buried service and finished grade.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 CSA C22.2 No. 126.

.2 NEMA VE 1-2009 Metal Cable Tray Systems.

.3 NEMA VE 2-2013 Cable Tray Installation Guidelines.

.4 NEMA FG 1-1993 Fiberglass Cable Tray Systems.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

.2 Submit detailed shop drawings for proposed cable tray system, including all accessories and support appurtenances.

1.3 SEISMIC RESTRAINT

.1 Installations in this section are subject to support and anchorage requirements, as directed by the seismic restraint consultant retained by Contractor.

PART 2 - PRODUCTS

2.1 ALUMINUM CABLE TRAY

.1 Cable trays shall be ladder style and shall consist of two longitudinal members (side rails) with traverse members (rungs) welded to the side rails. Rungs shall be spaced 300 mm on centre. Rung spacing in radiused fittings shall be industry standard 229 mm and measured at the centre of the tray's width. Each rung must be capable of supporting a 90 kg concentrated load at the centre of the cable tray over and above the cable load with a safety factor of 1.5.

.2 Cable tray loading depth shall be 128 mm per NEMA VE 1.

.3 Straight sections shall have side rails fabricated as I-beams.

.4 Cable tray widths as indicated.

.5 Splice plates shall be the Wedge-Lock design with 4 nuts and bolts per plate. The resistance of fixed splice connections between adjacent sections of cable tray shall not exceed 0.00033 ohm.

.6 All fittings must have a minimum radius of 300 mm.

.7 Materials and finish: straight section and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052.

.8 The cable tray system shall be capable of carrying a uniformly distributed load of 174 kg/m on a 3 m support span with a safety factor of 1.5 when supported as a simple span and tested per NEMA VE 1 Section 5.2. In addition to the uniformly distributed load, the cable tray shall support 90 kg of concentrated load at the mid-point of the span. Load and safety factors specified are applicable to both the side rails and rung capacities. Cable tray shall be made to manufacturing tolerances as specified by NEMA.

2.2 FIBERGLASS CABLE TRAY

.1 Material and finish: straight section structural elements, side rails, rungs and splice plates shall be pultruded from glass fibre reinforced vinyl ester resin.

.2 Pultruded shapes shall be constructed with a surface veil to ensure a resin-rich surface and ultraviolet resistance.

.3 Pultruded shapes shall meet ASTM E-84, Class 1 flame rating and self-extinguishing requirements of ASTM D-635.

.4 Cable trays shall be ladder style and shall consist of two longitudinal members (side rails) with transverse members (rungs) mechanically fastened and adhesively bonded to the side rails. Rungs shall be spaced 300 mm on centre. Rung spacing in radiused fittings shall be industry standard 229 mm and measured at the centre of the tray's width. Each rung must be capable of supporting a 90 kg concentrated load at the centre of the cable tray with a safety factor of 1.5.

.5 Cable tray loading depth shall be 128 mm per NEMA FG1.

.6 Cable tray widths as indicated. Outside width shall not exceed inside by more than a total of 50 mm.

.7 Straight and expansion splice plates shall be of "L" shaped lay-in design with an eight-bolt pattern in 128 mm fill systems. Splice plates shall be furnished with straight sections and fittings.

.8 All fittings must have a minimum radius of 300 mm.

.9 Fittings shall be of mitred construction.

.10 Dimension tolerances per NEMA FG1.

.11 Cable trays shall meet NEMA class designation: 20C.

.12 The cable tray system shall be capable of carrying a uniformly distributed load of 217 kg/m on a 6 m support span with a safety factor of 1.5 when supported as a simple span and tested per NEMA VE1 Section 5.2.

2.3 ACCESSORIES AND FITTINGS

.1 Accessories and Fittings:

.1 Provide all bends, end plates, dropouts, vertical and horizontal risers and drops, tees, wyes, expansion plates, reducers, splice plates, hold down clamps, guides, connectors, brackets, isolator pads and all other hardware and appurtenances for a complete system. Where possible, all accessories and fittings shall be manufactured by the specified cable tray manufacturer.

2.4 SPECIFIED PRODUCT

.1 Specified product:
  .1 Eaton B-Line.

2.5 ALTERNATE PRODUCT(S)

.1 Alternate product(s):
  .1 Thomas and Betts.
  .2 Canadian Electrical Raceways.

PART 3 - EXECUTION

3.1 DETAILED DESIGN

.1 The drawings indicate a proposed routing for bid purposes. Field condition may indicate alternate routing in concentrated areas.

.2 The Electrical Contractor is to outline the outside edges of the cable tray runs with nylon rope. Coordinate this routing with the other trades. Coordinate this routing with cable buses and conduit runs.

.3 Review the proposed routing with the General Contractor, Mechanical Contractor and Consultant.

.4 It may be necessary to review various tray runs separately and possibly even phase single runs.

3.2 GENERAL

.1 Keep number of elbows, offsets and connections to minimum.

3.3 SUPPORT SYSTEM

.1 Provide supports as required to meet Seismic Restraints as per Section 16010. Locate supports to minimize deflection.

.2 Vertical supports on both sides of cable tray, or wall brackets.

.3 Lay cables in cable tray. Do not pull in.

3.4 JOINTS

.1 Use manufacturer recommended fittings to splice trays to provide:
  .1 Interior surface free of sharp burrs and projection that could damage cables.
  .2 Exterior surface free of projections that could cause personnel.

3.5 GROUNDING

.1 Provide green insulated copper ground wire throughout length of cable tray.

.2 Ground cable tray to ground wire at 6 m centres, using approved ground clamps.

.3 Ground cable tray to building steel at 15 m maximum centres.

3.6 CABLES IN CABLE TRAY

.1 Install cables individually.

.2 Secure all cables in cable tray at 6000 mm centres at entry and exit points and at change in direction. Use P clips on vertical runs at 1500 mm centres. Use Ty-raps on horizontal runs. Use weatherproof black Ty-raps for all areas.

.3 Identify cables with size 2 nameplates to Section 16010 secured at 12000 mm centres with Ty-raps.

3.7 FIRE BARRIERS

.1 Arrange for opening in fire rated wall or floor, width and depth of cable tray and run trough through opening.

.2 After cables have been installed, cut and install 3M fire barrier system consisting of CS-195+ composite sheets, FS-195+ wrap/strip, CP 25WB+ caulk and GIS. For penetrations through wall follow W-L-4004; for floors follow C-AJ-4003.

.3 Coordinate with Divisions 1 and 7.

3.8 WALL AND CEILING PENETRATIONS

.1 Do not run cable trays through walls or ceilings, unless indicated otherwise. Stop cable tray at each side of wall or ceiling slab and run cables through. Seal opening around cables as outlined.

3.9 EXPOSED SIDE RAIL ENDS

.1 Provide side rail protective caps for all exposed cable tray side rail ends below 2.2 m above the finished floor to minimize personnel injury due to these edges. Protective caps to be manufactured from a rubberized or foam material and shall have a reflective appearance.

3.10 GALVANIC CORROSION

.1 Provide all required appurtenances to prevent dissimilar metals from coming in contact and resulting in galvanic corrosion.

3.11 FIBERGLASS CABLE TRAY CUTS

.1 Treat all fiberglass cable tray cuts with the manufacturer recommended resin to contain fibres.

3.12 USE OF CABLE TRAYS

.1 Install fiberglass cable trays inside areas containing chlorine gas/vapours or other chemicals that are corrosive to aluminum. Install aluminum cable trays in the other areas, not containing corrosive gases or vapours. Refer to drawings.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA):
- .1 CSA C68.10-20 - Shielded power cable for commercial and industrial applications, 5-46 kV.

1.2 SUBMITTALS

.1 Submit all product data in this section for shop drawing review.

PART 2 – PRODUCTS

2.1 CONCENTRIC NEUTRAL POWER CABLES

.1 Concentric neutral power cable to CSA-C68.10 listed as FT4, SR, LTGG (-40 Deg.C) TC, complete with rugged PVC jacket with resistance to flam, oil, acids and most chemicals.

.2 Provide single conductor high voltage cables as plan layouts, schematics and details.

.3 Rated for 105°C continuous operation temperature, strand aluminum core single conductor cable per ASTM B-609, complete with tape shield as well as semi-conducting EPR stand and insulation screens. Size as indicated on contract drawings.

.4 Insulation: 15 kV - 100% rated ethylene-polyethylene rubber (EPR) material with 175 mils minimum average thickness.

.5 Extruded PVC jacket rated to minus 40°C.

.6 CSA compliant to Ontario Electrical Safety Authority acceptance.

.7 Acceptable manufacturer:
- .1 OKONITE
- .2 Prysmian.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Concentric Neutral Power Cables to dip underground to transformer primary bushings in concrete encased duct bank. Provide insulated green cable ground wire in each duct to Ontario Electrical Safety Code requirements.

.2 Install primary cables in ducts in accordance with Section 16106 – Underground Ducts, Conduits and Wiring.

.3 Provide all other tests outlined in Section 16031 or as required by the manufacturer, ESA or local utility.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 16151 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131, Type Teck 90 Cable.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

PART 2 - PRODUCTS

2.1 HOUSE SERVICES (BUILDING) WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors only.

.3 Size as indicated and per Code.

.4 XLPE RW-90; 1000 V insulation for 600 V circuits; 600 V insulation for 120/208V circuits.

.5 Refer to cable schedule on drawings.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:
- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.

.3 Insulation:
- .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic material.

.7 Fastenings:

.1 One-hole straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
.2 Channel type supports for two or more cables at 600 mm centres.
.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:
.1 Wet, damp or dry locations.
.1 Thomas and Betts ST Series, Star-Teck jacketed metal-clad cable connector.
.2 Classified areas (Class 1, Zone 1 or Class 1, Zone 2).
.1 Thomas and Betts STX Series, Star-Teck jacketed metal-clad cable connector.
.2 Install with manufacturer recommended sealing compound, to maintain classified area rating of connector.

.9 Identification:
.1 Each conductor to be identified with a numbered stick-on exclusive number.
.2 Each cable to be identified by its cable tag and number, as indicated in the Cable Schedule, and as per Identification Requirements, specified in Section 16010.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from aluminum strip.

2.4 CONTROL CABLES

.1 This section applies to "house equipment" only. For process control. Refer to Teck cables.

.2 600 V type: stranded annealed copper conductors, #14 AWG with PVC insulation type TWH, with shielding of wire braid over each pair of conductors with sheath of aluminum interlocked armour and jacket over sheath of PVC.

2.5 VFD CABLES

.1 Use Belden Classic Foil/Braid and Symmetrical VFD Cable (Series 2950X) for VFDs.

.2 Unarmoured.

.3 Use parallel runs for sizes above 2/0.

.4 Refer to drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:
- .1 In conduit systems in accordance with Section 16133.
- .2 In cable tray in accordance with Section 16114.
- .3 In underground ducts in accordance with Section 02582.
- .4 In trenches in accordance with Section 16106.
- .5 In concrete encased ducts in accordance with Section 02581.

3.2 INSTALLATION OF TECK CABLE 0-1000 V

.1 Group cables wherever possible on cable trays.

.2 Install cable in trenches in accordance with Section 16106.

.3 Lay cable in cable tray in accordance with Section 16114.

.4 Terminate cables in accordance with Section 16151.

.5 Do not install cables on building exterior unless otherwise explicitly indicated. Seek direction from the Consultant prior to such installation.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 16151.

3.4 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit or in mechanically protected areas.

.2 Ground control cable shield at one end only.

3.5 USE OF CABLES

.1 Process cables are defined in the Cable Schedules on the drawings.

.2 For "house equipment" use:
- .1 As indicated on the drawings.

.3 For temporary cables, use:
- .1 Teck or
- .2 SOOW with mechanical protection below 2 m above grade or finished floor.

3.6 FIRE BARRIER

.1 Arrange for opening in fire-rated wall or floor.

.2 After cables have been installed, cut and install 3M fire barrier system consisting of CS-195+ composite sheets, FS-195+ wrap/strip, CA 25WB+ caulk and GIS. For penetrations through wall follow W-L-4004; for floors follow C-AJ-4003.

.3 Coordinate with Divisions 1 and 7.

.4 Conceal cables in administration areas.

.5 Do not use Teck cables in return air plenums.

.6 Do not use Teck in stairwells. Only conduit with wire is approved for use in these areas.

3.7 SPLICING

.1 All 600 V wiring and cables shall be continuous and free of splices.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

.1 This Section refers to electrical power equipment only. Controls and Instrumentation boxes and accessories are defined in Division 17.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MATERIAL STANDARDS

.1 Splitters to CSA C22.2 No. 76-M.

.2 Junction, pull boxes, and cabinets to CSA C22.2 No. 40.

.3 Enclosures CSA Type 1 to CSA C22.2 No. 14.

.4 Enclosures CSA Types 2, 3, 4 and 5 to CSA C22.2 No. 94.

.5 For "process equipment", refer to Division 17.

2.2 JUNCTION AND PULL BOXES

.1 Junction and pull boxes of welded steel construction with screw-on flat covers for surface mounting, unless noted otherwise.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

.3 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.4 Junction and pull boxes to be the same material as the associated conduits. Refer to Section 16133.

2.3 IDENTIFICATION

.1 Refer to Section 16010.

PART 3 - EXECUTION

3.1 INSTALLATION OF JUNCTION, PULL BOXES AND CABINETS

.1 Install junction and pull boxes in inconspicuous but accessible locations.

.2 Install terminal blocks or strips as described in Section 17051 and per the miscellaneous control panel drawing.

.3 Mark location of all pull boxes on As-Constructed Drawings.

END OF SECTION

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Outlet box: means sheet steel enclosure for either electric wiring or fittings, having knockout openings in either sides or back, or both, for entrance of wire in conduit, electrical metallic tubing, cable, or flexible tubing. Cover is fastened by screws, not hung on hinges.

.2 Conduit box: means cast box having threaded openings for conduit, bushings and clamps or connectors for cable or threadless openings for electrical metallic tubing and conduit.

.3 Fitting: means fitting intended to secure rigid conduit or electrical metallic tubing to enclosure or to adjacent length of rigid conduit or electrical metallic tubing. Such fitting may be integral part of conduit or other box.

.4 Conduit outlet body: means cast fitting installed in conduit systems to act as pull outlets for conductors being installed or to make 90° bends.

.5 Conduit: a raceway as defined in Section 16133.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Outlet boxes, conduit boxes and fittings to CSA C22.2 No. 18.

.2 All fittings and boxes used to be manufactured as accessories to the associated raceway and of consistent material e.g. OCAL where OCAL conduit is used.

2.2 OUTLET AND CONDUIT BOXES GENERAL

.1 Gang boxes where wiring devices are grouped.

.2 347 V outlet boxes for 347 V toggle switches.

2.3 SHEET STEEL OUTLET BOXES

.1 Electrogalvanized steel single and multi-gang device boxes for flush installation, minimum size 76 mm x 51 mm x 38 mm unless otherwise indicated.

.2 100 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Electrogalvanized steel utility boxes for outlets connected to surface-mounted EMT rigid heavy wall galvanized steel conduit, minimum size 102 mm x 54 mm x 48 mm.

.4 100 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 100 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.4 MASONRY BOXES

.1 Electrogalvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.5 CONCRETE BOXES

.1 Electrogalvanized sheet steel concrete type boxes for flush mount in poured in-place concrete with matching extension and plaster rings as required.

2.6 CONDUIT BOXES

.1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface installation.

.2 Conduit box to match associated conduit.

2.7 CONDUIT FITTINGS GENERAL

.1 Bushings and connectors with nylon insulated throats.

.2 Pushpennies to prevent entry of foreign materials.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Factory "ells" where 90°bends are required for 25 mm and larger conduits.

2.8 FITTINGS FOR RIGID CONDUIT

.1 Threaded type steel couplings and fittings, to match conduit.

.2 Double locknuts and insulated bushings on sheet metal boxes.

.3 Use explosion-proof fittings in areas indicated.

2.9 FITTINGS FOR THIN WALL CONDUIT

.1 Watertight steel type connectors and couplings in concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Use FS boxes in process areas.

.2 Use boxes rated for use in Zone 1 in areas designated as Hazardous.

.3 Use OCAL fittings with OCAL conduit.

.4 Support boxes independently of connecting conduits.

.5 Fill boxes with paper or foam to prevent entry of construction material during construction.

.6 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.7 Provide correct size of openings in boxes for conduit, armoured cable connections, reducing washers not allowed.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA):
- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .2 CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5 CAN/CSA C22.2 No. 227.3, Flexible Nonmetallic Tubing.

1.2 SEISMIC RESTRAINT

.1 Installations in this section are subject to support and anchorage requirements, as directed by the seismic restraint consultant retained by Contractor.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

PART 2 - PRODUCTS

2.1 CONDUITS

.1 Rigid metal conduit (RGS): to CSA C22.2 No. 45, galvanized steel threaded.

.2 Thomas & Betts PVC coated corrosion resistant rigid galvanized steel conduit system (OCAL).

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One-hole malleable iron straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 3 m o.c.

.4 Threaded rods, 6 mm diameter to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT in surface mounted or exposed areas. Set-screws are acceptable in concealed spaces.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

2.5 FISH CORD

.1 Polypropylene.

2.6 ROOF PENETRATIONS

.1 Prefabricated conduit sleeves sized to suit conduit at each location.

.2 Turn sleeves over to the roofer for installation in each location.

.3 Specified Manufacturer/Supplier:
- .1 Thaler Industries MEF-1 for rigid conduit.
- .2 Thaler Industries MEF-2A for flexible conduit.

.4 Coordinate with Architectural.

PART 3 - EXECUTION

3.1 USE OF CONDUITS

.1 No electrical services (power, controls or communications) shall be run in roof or floor slabs or beneath floor slabs unless specifically indicated on drawings – in such cases the Contractor shall notify the Consultant prior to such installations. Should the Contractor install such conduits without prior notification to the Consultant the Contractor may be required to correct deficiencies at its own cost.

.2 Provide OCAL conduit in the following areas or for the following systems:
- .1 As indicated on drawings.

.3 EMT can be used for house services in Electrical rooms only.

.4 RGS as indicated.

.5 Rigid PVC conduit for underground direct buried services not in OCAL.

.6 DB2 conduit for concreted duct banks.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations, when Teck is not used.

.8 Use explosion proof flexible connection for connection to explosion proof motors.

.9 Do not install conduits directly beneath or in proximity to roof decks or other structures that may be punctured by fasteners resulting in injury to the conduits. Provide sufficient spacing and barriers between conduits and such structures.

3.2 DETAIL DESIGN

.1 The drawings indicate a proposed routing for bid purposes. Field condition may indicate an alternate routing in concentrated areas.

.2 The Electrical Contractor is to outline the centreline of the OCAL conduit runs for fibre runs with nylon rope. Coordinate this routing with the other trades. Coordinate routing with tray, cable bus runs.

.3 Review the proposed routing with the fibre installer, General Contractor, Mechanical Contractor and Consultant.

.4 It may be necessary to review various OCAL runs separately and possibly even phase single runs.

.5 For outdoor buried runs, spray paint the ground to show centreline of trench proposed.

3.3 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits in drywall partitions and in ceiling plenums.

.3 Surface mount conduits in process areas.

.4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations, when Teck is not used.

.5 Use explosion proof flexible connection for connection to explosion proof equipment.

.6 Minimum conduit size for lighting and power circuits: 19 mm.

.7 Minimum conduit size for communications cabling, including Ethernet, DeviceNet and Modbus is: 27 mm.

.8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter, or if coating is damaged in any way.

.9 Mechanically bend steel conduit over 19 mm diameter.

.10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight. Coat OCAL threads with manufacturer approved products.

.11 Install fish cord in empty conduits.

.12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

.14 Repair damage to OCAL coating per manufacturer's recommendation.

.15 Install OCAL conduits to the manufacturers' recommendation. Electrical contractor to employ OCAL certified personnel for installation of the OCAL conduit system. Submit proof of OCAL training prior to commencing installation of any OCAL conduits. Only OCAL approved tools and products to be used for the OCAL conduit system.

.16 Do not install conduits on building exterior unless otherwise explicitly indicated. Seek direction from the Consultant prior to such installations.

.17 Label all conduits as outlined in Section 16010.

3.4 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.5 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.6 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize crossovers.

3.7 CONDUITS IN CAST-IN-PLACE SLABS-ON-GRADE

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.8 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.9 FIRE BARRIERS

.1 Arrange for opening in fire rated wall or floor, width and depth of cable tray and run trough through opening.

.2 After cables have been installed, cut and install 3M fire barrier system consisting of CS-195+ composite sheets, FS-195+ wrap/strip, CA 25WB+ caulk and GIS. For penetrations through wall follow W-L-4004; for floors follow C-AJ-4003.

3.10 ROOF PENETRATIONS

.1 Coordinate with roof installer.

.2 Installation as per manufacturer’s recommendations.

3.11 OCAL WARRANTY

.1 Provide OCAL extended warranty for the OCAL conduit system. Warranty to extend a minimum of two years beyond warranties outlined in other Divisions.

3.12 CONDUIT COLOUR

.1 Manufacturer applied colour coating to conduits, boxes and all associated fittings and appurtenances.

.2 Colour code conduits per the following:

.1 Dark Grey: Power, controls and other systems. Unpainted conduit where EMT or RGS is used.

.3 Colour to be the same regardless of the type of conduit used.

END OF SECTION

PART 1 - GENERAL

1.1 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MATERIAL STANDARDS

.1 Manually operated general purpose AC switches to CSA C22.2 No. 111-M and 55-M.

.2 Receptacles, plugs and similar wiring devices to CSA C22.2 No. 42-M.

2.2 SWITCHES

.1 Industrial (Extra Heavy Duty) Use:
- .1 Toggle Switches 20 A, 120 V. Specified Product(s):
  - .1 Single pole: Hubbell HBL1221 Series.
  - .2 Double pole: Hubbell HBL1222 Series.
  - .3 Three-way: Hubbell HBL1223 Series.
  - .4 Four-way: Hubbell HBL1224 Series.
  - .5 Key switch: Hubbell HBL122? RKL Series. Number of poles to suit.
  - .6 Momentary Control Switch: HBL1557 Series.

.2 Alternate Product(s):
- .1 Leviton equivalent.

.3 Colour to be brown in process areas and white in areas designated for recessed conduits.

.4 In hazardous areas and outdoors, use:
- .1 Crouse-Hinds EDS Series with general use snap switches, front operated.

2.3 RECEPTACLES

.1 “Duplex receptacle”:
- .1 Duplex receptacles to be industrial grade heavy duty complete with the following features:
  - .1 One piece brass integral ground strap.
  - .2 Triple wipe brass contacts.
  - .3 Suitable for #10 AWG for back and side wiring.
  - .4 Non-tamper resistant.
  - .5 Impact resistant thermoplastic cover and body.
  - .6 Provide wet location cover plates in all process and damp/wet areas as well as exterior. Provide required appurtenances to meet OESC’s requirements per 26-702(2).
  - .7 Refer to drawings for additional requirements.
  - .8 Specified Products:
    - .1 Non-GFCI: Hubbell HBL 5?62 Series heavy duty receptacles.
    - .2 GFCI: Hubbell GF5?62 Series heavy duty, industrial grade GFCI receptacle.

.9 Alternate Product(s):
.1 Leviton equivalent.

.2 Colour to be brown in process areas and white in areas designated for recessed conduits. Receptacles fed from UPS power to be blue.

2.4 SPECIAL WIRING DEVICES

.1 Horsepower rated toggle switches, voltage, amperage, NEMA enclosure rating to suit. Padlockable Hubbell, series to suit.

.2 Portable equipment (fan, pump, welding) outlet to be Hubbell Circuit Lock Series. Size, number of poles and pin orientation to suit. Provide twice the matching plug quantity to the outlet quantity.

.3 Use Hubbell Acceptor ® in hazardous locations.

2.5 CONTACTORS

.1 Lighting contactors to be electrically held. Enclosure to suit the environment. Number of poles as required with minimum of two (2) spares.
.1 Specified Product:
.1 Allen-Bradley 100L Series Finger-Safe.

.2 Power contactors to be electrically held. Enclosure to suit the environment. Number of poles as required. Contact rating equivalent to the upstream breaker plus 20%.
.1 Specified Product:
.1 Allen-Bradley 100-D Series Finger-Safe, complete with conventional coil.

2.6 COVER PLATES

.1 Provide cover plates for all wiring devices.

.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.3 Stainless steel 1 mm thick cover plates, for all wiring devices mounted in a flush-mounted outlet box.

.4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.5 Weatherproof double lift spring-loaded cast aluminum cover plates complete with gaskets for duplex receptacles as indicated.

.6 Blank plates - finish to match other plates in area, for boxes without wiring devices.

.7 OCAL cover plates for OCAL boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is shown in one location.

.2 Receptacles:

.1 Install receptacles vertically in gang type outlet box when more than one receptacle is shown in one location.

.2 Install straight blade receptacle with ground pin up.

.3 Provide “controlled” receptacles only where explicitly indicated. All other receptacles to be “non-controlled” per Article 2.3.1.

.3 Cover Plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until all painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use flush type cover plates on surface-mounted boxes.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 CAN/CSA-C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .2 CSA C22.2 No. 65, Wire Connectors.

.2 National Electrical Manufacturers Association (NEMA).

1.2 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to NEMA to consist of:
- .1 Connector body and stud clamp for stranded copper conductors.
- .2 Clamp for stranded copper conductors.
- .3 Stud clamp bolts.
- .4 Bolts for copper conductors.
- .5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable or flexible conduit, as required to: CAN/CSA-C22.2 No.18.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:
- .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  .1 IEEE 48 - IEEE Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV Through 765 kV.

1.2 SUBMITTALS

.1 Submit all product data in this section for shop drawing review.

PART 2 – PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

.1 Contact aid for aluminum cables where applicable.

2.2 INSULATED POWER CABLES

.1 Cable terminations to be at minimum 4.16 kV rated, complete with lugs for all cable ends.

.2 Terminate power cables with 3M Quick Term II series stress cones and termination kit.

.3 CSA compliant to Ontario Electrical Safety Authority acceptance.

.4 Acceptable manufacturer:
  .1 3M
  .2 Pre-approved equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.

.2 Ground stress cone shield wires at both ends to Ontario Electrical Safety Authority acceptance.

.3 Obtain inspection certificate of compliance covering high voltage stress coning from electrical safety inspection authority and include it with maintenance manuals.

END OF SECTION

PART 1 - GENERAL

1.1 STANDARDS

.1 Dry type transformers to CSA C22.2 No. 47 and CSA C9.

.2 ASHRAE 90.1, Section 8.

1.2 SHOP DRAWINGS

.1 Submit product data in accordance with Division 1.

.2 Include power rating, temperature rating, winding configuration, voltage ratings, BIL, taps, %Z, X/R, % regulation at full load and 0.9 pf, no load losses, full load losses, sound level.

PART 2 - PRODUCTS

2.1 TRANSFORMERS

.1 Provide transformers with the following characteristics:
- .1 Type: ANN.
- .2 3-phase, 600 V input, 120/208 V output, 60 Hz, as indicated.
- .3 Delta primary, wye grounded secondary, as indicated.
- .4 kVA ratings: as indicated.
- .5 Voltage taps: 2-2½% FCAN, 2-2½% FCBN.
- .6 Insulation: 115°C temperature rise.
- .7 Basic Impulse Level (BIL): 10 kV.
- .8 Copper windings.
- .9 Average sound level: 45 dB.
- .10 Efficiency per ASHRAE 90.1, Section 8 for dry-type low voltage transformers.
- .11 Enclosure: EEMAC 1, removable metal front panel, sprinkler-proof.
- .12 Mounting: floor or wall complete with vibration isolation pads.
- .13 Finish: Standard ASA 61 grey.
- .14 Regulation: 3.1% or less at full load and 0.9 pf.
- .15 CAN/CSA-802 Compliant.
- .16 Sprinkler-proof to meet the requirements of the OESC.
- .17 Insulation Class: 220 C.
- .18 Electrostatic shield.
- .19 Ovoid shaped windings.
- .20 Stacked laminations with isolated bolts through the entire core.
- .21 Epoxy impregnation.

.2 Characteristics for each transformer type per 2.1.1

.3 Unless indicated otherwise, K factor: 1 (standard transformer).

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 16010.

2.3 ACCEPTABLE MANUFACTURERS/SUPPLIERS

.1 Specified product:
  .1 Bemag.

.2 Alternate product(s):
  .1 Hammond.
  .2 Delta.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install mounted dry type transformers as indicated.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Ground as shown.

.8 Energize transformers after installation is complete.

.9 Testing per Section 16031.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Section 01330 - Submittal Procedures.

.2 Section 01780 - Closeout Submittals.

.3 Section 01820 - Factory Acceptance Testing of Preselected Equipment.

.4 Section 16031 - Inspection and Testing.

1.2 REFERENCES

.1 Equipment to be designed, factory assembled and tested in accordance with the following:
- .1 CAN/CSA-C88-M90 – Power Transformers and Reactors.
- .2 CAN/CSA-C88.1-96 – Power Transformer and Reactor Bushings.
- .3 C227.5-08 (R2013) - Three-Phase Live-Front Pad-Mounted Distribution Transformers.
- .4 Low Losses - C802.3-01 – Maximum Losses for Power Transformers.
- .5 ANSI C57.12.00 – General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers (ANSI).
- .6 ANSI C57.12.90 – Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers (ANSI).
- .7 Tamper Resistant - All tamper resistant equipment must meet the general principals of Standard CAN/CSA C227.

1.3 SOURCE QUALITY CONTROL

.1 Submit to Consultant standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C88 in addition to those tests noted in Section 1.5.

.2 Manufacturer shall be specialized in the manufacturing and assembly of Stacked Core, Circular Coil type transformers for a minimum of 20 years**.**

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01330 - Submittal Procedures.

.2 Indicate:
- .1 Anchoring method and dimensioned foundation template.
- .2 Dimensioned cable entry locations.

.3 Identified internal and external component layout on assembly drawing.

.4 Insulating liquid capacity and type of insulating oil.

.5 Submit all accessories and ancillary devices provided with transformer.

.6 Submit transformer design impedance, design X/R ratio, winding configuration, design temperature rise, BIL ratings, winding voltage ratings, full load continuous current and CSA compliance certifications.

1.5 TRANSFORMER ELECTRICAL CHARACTERISTIC TESTING

.1 Provide standard testing for final transformer as per IEEE C57.12.90-2010 methods for transformer:
- .1 Winding Resistance (normalized to 25°C).
- .2 Ratio Tests.
- .3 No-Load Loss Tests (@100%, 110% volts).
- .4 Excitation Current Tests (@100/110%).
- .5 Impedance Test (normalized to 75°C) complete with X/R ratio.
- .6 Full-Load Loss Tests (at 75°C).
- .7 Voltage Regulation (1.0 PF/0.8 PF).
- .8 Applied and Induced Potential Test c/w Polarity and Phase relation.
- .9 Core Insulation Test.
- .10 Pressure Test.
- .11 RIV Partial Discharge Test.

.2 Submit three (3) copies of the final as-constructed testing report for review prior to shipping to site.

1.6 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 01780 - Closeout Submittals.

.2 Include insulating liquid maintenance data.

1.7 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01780 - Closeout Submittals.

1.8 WARRANTY

.1 Manufacturer warrants equipment to be free from defects in materials and workmanship for one (1) year from date of installation or eighteen (18) months from date of purchase, whichever occurs first.

PART 2 - PRODUCTS

2.1 TRANSFORMER CHARACTERISTICS

.1 Transformer(s) shall be tamper-proof, rated 750 kVA ONAN.

.2 Primary Voltage shall be 4,160 V, 250 kV BIL, Delta Connected.

.3 Secondary Voltage shall be 600 / 347 V, 30 kV BIL, Grounded Wye Connected.

.4 The impedance of the transformer shall be 5.25 ± 0.25%.

.5 The transformer shall be designed to meet the average sound level as listed in CSA C8.

.6 Winding Connection Group DYn1 and rated for a temperature rise of 65º C.

.7 The transformer(s) shall be suitable for continuous year-round outdoor service in Brighton, Ontario, Canada.

.8 The transformer shall be Tamper-Resistant and must meet CAN/CSA C227 Standard.

.9 Transformer to be equipped with Primary Side Loadbreak switch that meets the requirements of Section 36 of the Ontario Electrical Safety Code.

.1 Acceptable Manufacturer. Cooper Power Systems: Two Position Loadbreak Switch (800-65) or approved equivalent.

.10 Transformer(s) shall be tamper-proof, rated 750 kVA ONAN.

.11 The standard liquid insulating media shall be mineral oil.

.12 Less-flammable liquids shall have a flash point not less than 300°C.

.13 Sealing and gasketing materials shall be compatible with less-flammable transformer liquids.

.14 The transformer(s) shall be designed and manufactured to operate without derating capacity in an ambient not exceeding +40°C and never below –50°C, with an average ambient of +30° C in any day.

.15 Provide a no-load tap changer with 2 ± 2 ½% FCAN (full capacity above normal) & FCBN (full capacity below normal) located in the primary windings. The tap changer shall have an externally operated handle, position indicator with provision for padlocking. The tap position shall be clearly marked on the tap changer dial plate. A warning notice shall be applied adjacent to the handle of the tap changer stating: “WARNING OFF CIRCUIT TAP SWITCH – OPERATE ONLY WHEN TRANSFORMER IS DE-ENERGIZED.

.16 The coils shall be circular wound with adequate bracing and blocking to minimize the effects of short circuit. Use of adhesive as a primary means for strength is not acceptable. Strong “keep back” insulation is required on the outer layers of the HV windings along with proper mechanical bracing between winding sections.

.17 The conductor material shall be 99.9% high conductivity copper and/or aluminum.

.18 Copper windings shall be designed using a maximum current density of 1800 Amps/square inch and aluminum windings shall be designed using a maximum current density of 1200 Amps/square inch.

.19 Pressboard with withstand voltage >60 kV @ 60 Hz, minimum dielectric constant of 3.5 K, high electrical strength, excellent aging characteristics, low shrinkage and good bending properties shall be used for high-low barriers and yoke and tank shields.

.20 3/16” duct strips with high compressive strength, low power factor at high temperatures and excellent transformer oil impregnation shall be allocated evenly throughout the winding to allow for uniform heat dissipation.

.21 Thermally upgraded plain insulation paper shall be used.

.22 Delta-Wye connected transformers only - The stacked and semi-mitered core shall be manufactured from a minimum of M4 grain oriented electrical grade silicone steel. The core shall be designed using a maximum of 1.7 Tesla, in-rush current of < 6 times rated current and excitation current of < 1% @ rated voltage.

.23 Formed and welded core clamps, joined by tie rods from top to bottom suitably braced to stop movement, shall support the core. The core shall be painted to inhibit any rust development, to strengthen the core laminations and to reduce sound levels.

.24 The core and coil assembly shall use wood or TX blocking between the coil and clamp to reduce the effects of short circuit. The blocking shall be grooved to allow easier circulation of oil flow within the core and coil assembly.

.25 Provide a core ground bushing to facilitate testing of the core insulation without removing the handhole.

.26 The transformers shall be designed to meet the minimum short circuit requirements of CSA C88.

.27 The transformers shall be designed to meet the maximum losses for power transformer requirements of CSA C802.3-01.

.28 Transformer total load losses to be less than 13,000 watts and no-load losses to be less than 3,000 watts.

.29 Bus bar for high voltage termination and connectivity to lightning arrestor and high voltage bushing.

2.2 MECHANICAL FEATURES

.1 The transformers shall be of sealed tank construction, with welded steel plate of thickness suitable to withstand without permanent deformation positive and negative pressures 25% greater than stated limits on rating plate.

.2 The tank wall stiffeners shall be made of formed steel to maximize strength in order to ensure field filling.

.3 The transformer exterior surfaces shall be sand or grit blasted clean, all oil and foreign materials shall be removed before painting. The exterior shall be coated with one coat of rust inhibiting primer followed by two coats of topcoat to a total minimum dry film thickness of 3 mils. The interior of the tank shall be washed clean to remove all metal scale and foreign materials. The interior shall be painted with an oil resistant paint to an area four inches below the normal oil level.

.4 All welding shall be in accordance with CSA W47.1 and CSA W57 standards.

.5 Lifting moving and jacking facilities capable of handling the total filled mass shall be supplied.

.6 A minimum of four (4) heavy duty lifting lugs complete with a hole suitable for securing the transformers for transportation shall be used. The lugs must be sized to ensure that repeated use will not result in any permanent deformation.

.7 The transformers shall have a structural steel I-beam base.

.8 The cover shall be welded to the tank.

2.3 TRANSFORMER ENCLOSURE

.1 The HV, LV and Instrument enclosures shall be manufactured from 11-gauge steel and shall be bolted to the transformer to allow for interchangeability.

.2 The HV enclosure shall have a 50 mm gable sloped roof to ensure proper water run-off.

.3 Full height - the bottom of the enclosures shall have a minimum 50 mm return and shall provide for flush mounting on a flat, rigid mounting surface.

.4 Tamper Resistant including the following requirements:

- .1 All gauges, valves, primary and secondary terminations, tap changers, oil pressure relief vents etc., shall be contained within the transformer enclosure.
- .2 All enclosures shall be full height and shall restrict the entry of water (other than floor water) so as not to impair the operation of the transformer.
- .3 The bottom of the enclosure shall have a minimum 50 mm return and shall provide for flush mounting on a flat, rigid mounting surface.
- .4 Access to the compartment shall be provided by a door hinged with a minimum of 5 pin type hinges and shall have three (3) Pentahead bolts with at least one having provision for padlocking. The door shall be constructed of a minimum of 11 gauge steel. Normal entry shall be possible only with the use of proper access tools.
- .5 All access doors shall be hinged and be capable of being locked with a single lock.
- .6 A permanent, legible warning sign carrying the wording “High Voltage, 4,160 volts. Do not enter this compartment unless visibly isolated”, shall be applied to the door of the primary compartment.
- .7 All access doors shall have no exposed bolts or nuts and have a minimum of two Pentahead bolts complete with sleeves as detailed in Clause 5.2.1.2 and Figure 7 of CAN/CSA C227.4
- .8 Pentahead bolts must be corrosion resistant and their design shall minimize the possibility of misalignment and cross threading. The Pentahead bolt shall be supplied with a non-rotating guard such that removal of the bolt is possible only by the proper tools.
- .9 Equipment shall have no external means of operation of switching equipment. It shall have a viewing window only for the loadbreak switch.
- .10 There shall be no exposed screws, bolts, or other fastening devices that are externally removable, except for any auxiliary fastening device that may be specified by the purchaser.
- .11 There shall be no openings through which foreign objects such as sticks, rods, or wire may be inserted to contact live parts.
- .12 The low and high voltage enclosures shall be full height, complete with open bottom and front access panel.

2.4 ACCESSORIES

.1 Provide a rating plate and connection diagram showing the serial number of the transformers and the data required as per CSA C88 shall be attached to the transformers.

.2 All contacts, gauges and valves shall be closed on the end and enclosed in a tamper resistant enclosure.

.3 Provide an ESA accepted emergency pressure relief device with an operating pressure of 10 PSI, self-re-sealing complete with hood for deflecting away from the controls.

.4 Provide a magnetic liquid level gauge with two (2) contacts.

.5 Provide a direct mount liquid temperature indicator complete with two (2) contacts.

.6 Provide a winding temperature indicator with alarm contacts.

.7 Provide a liquid leak detection indicator with two (2) preset alarm contacts.

.8 A 1” bronze globe liquid drain valve complete with 3/8” sampling valve installed with center of valve 1-1/8” from tank bottom.

.9 Two 1” pipe connections installed on the cover so that liquid may be filtered and recirculated in the transformer.

.10 Provide oil immersed primary fuses as accepted by ESA within the transformer tank.

.11 Provide a pressure vacuum gauge as manufactured by Weidmann.

.12 Cable strain relieve tie bars to remove conductor weight stresses from high and low voltage bushings.

.13 High Voltage Bushings shall be at least 100 Amp rated @ 250 kV BIL.

.14 Low Voltage Bushings shall be at least 800 Amp rated @ 30 kV BIL with at least 8 NEMA PAD bolt holes per bushing spade.

2.5 GROUNDING

.1 Copper grounding bus size 50 mm x 8 mm x 600 mm complete with two rows of standard NEMA pad bolt holes.

.2 Connectors for grounding conductors as required to suit project requirements.

2.6 FINISH

.1 Finish exterior of unit in accordance with Section 16010 – Electrical General Requirements.

.2 Paint Color: ASA 70 Grey.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

.2 Nameplate showing information in accordance with CSA C88.

2.8 WARNING SIGNS

.1 Provide warning signs in accordance with Section 16010 – Electrical General Requirements.

2.9 MANUFACTURERS

.1 Acceptable transformer manufacturers are:
  .1 CES Transformers or approved equivalent.

PART 3 - EXECUTION

3.1 INSPECTION

.1 Check factory made connections of transformer unit for mechanical security and electrical continuity.

.2 Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

3.2 INSTALLATION

.1 Ensure concrete pad is fully cured before transformer is installed.

.2 Set and secure transformer unit in place, rigid, plumb and square.

.3 Make connections.

.4 Connect transformer unit ground bus to system ground.

.5 Wire one set of contacts on liquid temperature thermometer, liquid level gauge, to sound alarm when unsafe condition reached, wire second set of contacts to trip transformer circuit interrupter.

.6 Ensure care is taken to prevent contamination of liquid and components when field filling transformers.

.7 Use only metal hose when field-filling transformer with oil: never, under any circumstances, use rubber hose.

.8 Set taps to produce rated secondary voltage at no-load.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010 – Electrical General Requirements, Section 16031.

.2 The transformer shall be subjected to standard production tests including but not limited to include the following:
  .1 Resistance measurements.
  .2 Ratio tests.
  .3 Polarity and phase relationship.
  .4 Exiting current and losses on rated voltage and 110% of rated voltage.
  .5 Impedance and load loss.
  .6 Applied potential.
  .7 Induced potential.
  .8 Pressure test.

.9 Core insulation test.

.10 Insulation power factor test.

.3 In addition to the standard production tests the following shall also be provided:

.1 The transformer shall be energized five (5) consecutive times at 110% of rated voltage.

.2 The manufacturer shall provide certification that the fully assembled and installed transformer is suitable for full field vacuum filling.

.4 Rectangular designs shall confirm with test data that the impedance changes occurring during testing do not exceed the values required during testing of circular coil designs.

.5 A certified test report will be supplied if requested prior to or at time of shipping.

.6 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20°C.

.1 High voltage to ground with secondary grounded for duration of test.

.2 Low voltage to ground with primary grounded for duration of test.

.3 High to low voltage.

.7 Inspect primary and secondary connections for tightness and for signs of overheating.

.8 Inspect and clean bushings and insulators.

.9 Check oil level and temperature indicators.

.10 Set transformer taps to rated voltage as specified.

.11 Inspect for oil leaks and excessive rusting.

.12 Inspect oil level.

.13 Check fuses for correctness of type and size.

.14 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

.15 Provide all other tests outlined in Section 16031 or as required by the manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 The specifications in this section describe the electrical and mechanical requirements for a protection system provided by high-energy SURGE PROTECTIVE DEVICES (SPDs). The specified system shall provide effective, high-energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B and C environments (as tested by ANSI/IEEE C62).

1.2 STANDARDS

.1 The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:

- .1 Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, C62.45).
- .2 American National Standards Institute.
- .3 Federal Information Processing Standards Publication 94 (FIPS PUB 94).
- .4 National Electrical Manufacturer Association (NEMA LS-1 1992 Peak Current Testing).
- .5 National Fire Protection Association (NFPA 70, 75 and 780).
- .6 MIL Standard 220A Method of Insertion Loss Measurement.
- .7 National Electric Code.
- .8 Underwriters Laboratories UL 1283 and UL 1449 (Second Edition).
- .9 Canadian Standards (cUL or cETL).

1.3 ENVIRONMENTAL REQUIREMENTS

.1 The operating temperature range shall be -40° to 70°C.

.2 The unit shall be capable of operation up to 3,950 m above sea level.

.3 No appreciable magnetic fields shall be generated. Unit shall be capable of use in computer rooms without danger to data storage systems or devices.

1.4 SUBMITTALS

.1 Product Data: Provide catalogue sheets showing voltage, physical size, IEEE let through voltage for each waveform listed, UL 1449 latest revision, latest edition, suppressed voltage ratings, dimensions showing construction, lifting and support points, enclosure details, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period and replacement terms, conductor size, conductor type and lead length.

.2 Submit product data for all components and accessories.

.3 Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product. Indicate maximum size of circuit breaker or fuse to be connected for each unit.

.4 List and detail all protection systems such as fuses, disconnecting means and protective features.

.5 Provide verification that the SPD device complies with the required UL1449 latest edition, latest revision, and CSA approvals.

.6 Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and A1 (ringwave) tested in accordance with ANSI/IEEE C62.45.

.7 Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 10 kHz and 100 kHz verifying the devices noise attenuation equals or exceeds 40 dB at 100 kHz.

.8 For retrofit mounting applications, provide electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

.9 Provide test report from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on a per mode basis using the IEEE C 62.41, 8x20 microsecond current wave. Test data must be on a complete SPD with internal fusing in place. Test data on an individual module is not acceptable.

.10 Submit product data in accordance with Division 1.

1.5 QUALITY ASSURANCE AND WARRANTY

.1 The panel mounted SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a period of thirty (30) years from the date of substantial completion of service and activation of the system to which the suppressor is attached. Additionally, the warranty shall state that during the applicable warranty period any SPD which fails due to any transient surge activity, including lightning, shall be repaired or replaced by the manufacturer without charge. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.

.2 Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPDs shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this particular section. That is, the warranty must specifically provide for unlimited free replacements of the SPD in the event of failure caused by the effects of lightning and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

.3 Provide electrically operated equipment specified in this Section that is listed and labeled. As defined in the Ontario Electrical Safety Code, Article 2-024.

.4 Comply with NFPA 70 and Nema LS1.

.5 Refer to Division 1.

1.6 MANUFACTURER QUALIFICATIONS

.1 The SPDs shall be manufactured in North America by a manufacturer that has been regularly engaged in the design, manufacturing and testing of SPDs of the types and ratings required for a period of not less than five (5) years. Manufacturers requesting product approval must meet or exceed the written specification contained herein. Manufacturers requesting approval must receive written verification of product acceptance by the Consultant prior to close of tender.

PART 2 - PRODUCTS

2.1 PERFORMANCE

.1 The SPDs as installed must be UL 1283 and UL 1449 Third Edition listed, and not merely the components or modules.

.2 The SPDs shall protect all modes L-G, L-N, L-L, and N-G, have discrete suppression circuitry in L-G, L-N and N-G, and have bidirectional, positive and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified and accordingly reduced mode units with suppression circuitry built into only 4 modes are not acceptable.

.3 Obtain all surge suppression devices through one source from a single manufacturer.

.4 The maximum continuous operating voltage (MCOV) of all components shall not be less than 125% for a 120V system and 120% for 220 and 240V systems, and 115% for 347 and 600V systems.

.5 All SPDs shall be equipped with a comprehensive monitoring system, which shall include a visual LCD panel display providing information on unit status and phase loss/protection loss.

.6 If a disconnect switch is required, the disconnect switch and the SPD as a system shall be capable of interrupting up to a 200kA symmetrical fault current with 600 VAC applied.

.7 The SPDs shall have component level fusing.

2.2 SPECIFIED PRODUCTS

.1 Specified Products:

.1 Total Protection Solutions. Part numbers as indicated on Drawings. Or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install the SPDs with the conductors as short and straight as practically possible.

.2 Follow the SPD manufacturer’s recommended installation practice as outlined in the equipment installation manual. The electrical contractor shall ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.

.3 The installing contractor shall comply with all applicable codes.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 NEMA SG2, High-Voltage Fuses.

.2 ANSI C37.46, Power Fuses and Fuse Disconnecting Switches, Specifications.

1.2 SUBMITTALS

.1 Submit product data for all products in this section.

.2 Indicate:
- .1 Mounting design.
- .2 Fuse holder mechanism.
- .3 Ratings (voltage, continuous current, short circuit).
- .4 Fuse characteristics.

1.3 MAINTENANCE MATERIALS

.1 Provide maintenance materials for switch as recommended by manufacturer.

.2 Provide three (3) spare fuses.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Fuses: to NEMA SG2 and ANSI C37.46.

2.2 PRIMARY FUSES

.1 Non-disconnect vertical 180° opening type.

.2 Voltage Rating: 4.16 kV.

.3 Continuous current Rating: 100E (or as revised at HONI / Owners request)

.4 Three phase symmetrical short circuit rating: 300 MVA min. at 4.16 kV

.5 Refill unit consisting of:
- .1 Fusible element: silver.
- .2 Arcing rods: main rod copper, silver clad, auxiliary rod stainless steel.
- .3 Solid material arc-extinguishing medium contained in filament wound glass-epoxy tube.

2.3 ACCEPTABLE MANUFACTURERS

.1 Acceptable grounding manufacturers:
  .1 Compatible with S&C Alduti-Ruptor Series.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Install in accordance with manufacturer's instructions.

.2 Connect switch terminals to primary overhead line and to fuses.

.3 Locate, mount and connect fuses.

.4 Connect ground terminals to ground.

3.2 TESTS

.1 Perform tests in accordance with Industry Standards, "NETA".

.2 Energize switch.

.3 Open and close switch several times to ensure proper mechanical and electrical performance of installation.

.4 Provide all other tests outlined in the Texting Matrix as per Section 16031 or as required by the manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 APPLICABLE STANDARDS

.1 NEMA CP1.

.2 IEEE Standard 519.

.3 ANSI/IEEE Standard 18.

.4 UL Standard 810.

.5 CSA Standard C22.2 No. 190.

.6 Ontario Electrical Safety Code.

1.2 SUBMITTALS

.1 As per Section 16010.

.2 Submit shop drawings and manufacturer's installation instructions.

.3 Submit manufacturer's operation and maintenance manual.

.4 Submit report of anticipated operational PF range of the power factor correction unit under various operating conditions detailed on Part 2.

.5 For harmonic modelling purposes, submit targeted shut frequency as well as minimum and maximum shunt inductance and capacitance when minimum or maximum unit capacitance is engaged.

PART 2 - PRODUCTS

2.1 SCOPE

.1 Provide areas specific Automatic Switching Power Factor Correction Unit (ASPFCU)s to raise total system Power Factor to 0.93 - 0.97 lagging, as seen by the local utility, under the following facility operating modes:

.1 Base building loads, average daily flows rates.

.2 Base building loads, peak facility nameplate flow rates.

.2 Provide multiple discrete stages to dynamically adjust in response to changing loads on the facility. Provide at least a 15% safety margin in determination of required stages.

.3 Each kVAR stage is to be provided with series connected inductance to detune the electrical system, providing a low impedance harmonic trap at the most effective harmonic frequency (presumed to be between the 4.2nd to 4.7th harmonic order) in order to lower bus harmonics to IEEE 519 requirements (as observed at each electrical process area’s main MCC service board).

.4 Manufacturer to provide a load study report prior to submitting equipment shop drawings. Report shall confirm, with calculations provided for review, the rational of the proposed power factor correction kVAR capacity and stages/step sizes. Submit a detailed power factor report, sealed by a Professional Engineer licensed in the province of Ontario.

.5 System capacitor and inductor detuning frequency shall be compensated for natural effects of heating in both the capacitors and inductors.

2.2 COMPONENT SPECIFICATIONS

.1 Capacitor Cell:

.1 Capacitor cells are made of low-loss polypropylene foil interlayed with metalized Kraft paper. The cells are inserted in their case, dried under high vacuum and then impregnated with a mineral oil in a sealed vat for several days. The metalized paper sheets serve as electrodes, while the oil acts as a coolant and provides instant self-healing.

.2 Capacitor cells will be individually replaceable with a 3-phase design delta connected. ASPFC unit to be made up of single phase cells wye connected to form a 3 phase assembly will not be acceptable.

.3 Capacitor cells will have a pressure actuated interrupter, which will disconnect all three phases at the same time to maintain a balance circuit and prevent cell case rupture. Single-phase cells with a single-phase interrupter will not be acceptable.

.4 Capacitor cells will have 3 threaded, insulated terminal studs for positive wire terminal connections. All connections will be by wire and not bus bar so that cells and wire may be easily replaced in the field.

.5 Capacitor cell construction will be a hermetically sealed case.

.6 Each capacitor cell will be provided with 3 phase delta connected discharge resistor network. The resistors will be sized to reduce residual voltage to less than 50 volts within one minute of de-energization. Resistors mounted internal to the cell will not be acceptable.

.7 Capacitor cell will be rated at ½ Watt loss per KVAR.

.8 Capacitor cells will be life tested and designed for 20-year life. Individual cells will be covered by a three-year warranty.

.9 Capacitor cells will be approved for use no less than 150 percent of fundamental current.

.10 Capacitor cells are to be rated for at least 690 V and should account for naturally occurring overvoltage's as well as the potential for overvoltage due to the presence of Neutral Grounding Resistor located elsewhere within the 600 V, 60 Hz electrical distribution system.

.2 Enclosures:

.1 Enclosures will be steel with no knockout and ground lug.

.2 Enclosures will be gasketted, NEMA 12 or better – font access only.

.3 Switching Contactors:

.1 Contactors will provide maximum limitation on inrush current with inrush reactors. These inrush reactors will be bypassed once the contacts are closed in order to reduce heat loss.

.2 Maximum kVAR to be switched as per step sizes.

.4 Unit Termination:

.1 Termination lugs to be top entry rated.

.5 Microprocessor Controller:

.1 Controller is to rotate capacitor selection for even operating time. First-in, first-out (FIFO) step selection.

.2 Controller has anti-resonance and high harmonic lockout feature.

.3 Controller has dry contact for remote General Fault alarm.

.4 Automatic self-adjustment to any capacitor step value.

.5 Digital indication of Power Factor, preset parameters and specified installation data.

.6 Controller has No-Volt release feature to disconnect all capacitors in event of power failure.
.7 Controller has discrete interlock capabilities to disable engaged stages via Owner's remote PLC.
.8 CAT 6 Interface for data acquisition.
.9 Digital setting of individual parameters including Target Power Factor, Switching Time Delay, Step Limit, etc.
.10 Indication and elimination of defect capacitor steps (e.g. Welded Contactors).
.11 Inquiry of switchings per step.
.12 Inquiry of step sizes (proportional).
.13 Visual display of control alarm (cosØ).
.14 Visual display of Harmonic Overload Alarm (dv/dt).

2.3 ACCEPTABLE MANUFACTURERS/SUPPLIERS

.1 Acceptable Manufacturers/Suppliers:
.1 Eaton.
.2 Schneider/Square D.
.3 Power Survey.
.4 Cos Phi Inc.

PART 3 - EXECUTION

3.1 STUDY REPORT AND SHOP DRAWINGS

.1 Provide power factor report based on the single line diagram. Contractor to coordinate as required providing necessary data for kVAR study purposes.

.2 Upon acceptance of final recommendations by the Consultant, submit shop-drawings in compliance with the balance of this specification for actual power factor correction unit.

3.2 INSTALLATION

.1 Make power and control connections following manufactures recommendations and contract drawings.

3.3 INITIAL START-UP

.1 Engage the services of the manufacturer to review installation prior to start-up.

.2 Manufacturer to provide a report following each site visit outlining observations, deficiencies, test procedures and results.

3.4 TESTS

.1 Conduct the following test:
.1 Feeder insulation megger tests.

.2 Operate switches and controls to verify correct functioning in presence of Owner and Consultant.

.3 Provide all other tests outlined on the Testing Matrix and Section 16031 or as required by the manufacturer.

.4 Submit written test results to the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 STANDARDS

.1 CAN3-C13, Instrument Transformers.

.2 ANSI/NEMA ICS 2, Industrial Control Devices, Controllers and Assemblies.

.3 EEMAC Standard ICS 2.

.4 CSA C22.2 No. 178, Automatic Transfer Switches.

1.2 SHOP DRAWINGS

.1 Provide engineering data sheets for all products indicated, including but not limited to:
- .1 Make, model and type.
- .2 Schematic(s), including power and control/relays systems.
- .3 Description of operation as it will be configured for this project.
- .4 Field control wiring interfaces.
- .5 Programmed delay settings interlocks.

.2 Submit shop drawings for all products in this section.

1.3 OPERATION AND MAINTENANCE

.1 Provide operation and maintenance data for automatic transfer switch and incorporate into manual.

.2 Provide detailed instructions to permit effective operation and maintenance and repair, including but not limited to:
- .1 Complete illustrated parts list with catalog numbers.
- .2 Spare parts list.
- .3 Installation instructions for future maintenance.
- .4 Schematic diagram(s).
- .5 Troubleshooting procedures.
- .6 Certificate(s) of testing and commissioning.

1.4 SYSTEM DESCRIPTION

.1 ATS to be provided under the scope of the Standby Power System contractor. Standby power systems contractor is to coordinate with Service entrance board manufacturer to provide a complete and operational system. Refer also to Section 16622 – Standby Power System.

.2 Automatic Transfer Switch (ATS) for load transfer to:
- .1 Be open transition type.
- .2 Monitor voltage on all phases of normal power supply.
- .3 Monitor voltage on all phases of the standby power supply.

.4 Automatically request the start-up of the Standby Power System when a loss of Normal Power is detected.

.5 Automatically transfer load from normal supply to the standby power source when the loss of normal power supply or power quality is detected. This is confirmed by sensing of voltage on any phase below an adjustable preset limit for adjustable time period.

.6 Re-transfer load from the standby to normal power supply when normal power is brought on line. This is confirmed by sensing of voltage on all phases above an adjustable preset limit for adjustable time period. Once determined, a “Re-transfer” request signal shall be first sent from the ATS for permission to re-transfer away from the standby power source. When loads are suitably controlled in anticipation of this “re-transfer” request, a complimentary “Re-transfer permissive” signal will be sent back to the ATS. Once detected, the ATS will carry out load transfer back to the Normal Power source.

.7 The ATS shall include line and load by-pass via a separate manually operated draw-out assembly within the ATS.

.8 Suitable for supplying standby power to critical station loads where maintenance of the main transfer switch, without interruption of power to the load, is required.

.9 Identical and interchangeable ATS as well as Bypass draw-out cassette power contactor assemblies.

.10 Normal power source sensing of over/under voltage (including unbalance) as well as over/under frequency.

.11 Cable entry locations to suit service entrance board.

1.5 PERFORMANCE REQUIREMENTS

.1 Ensure transfer switch monitors power and automatically transfers power to the standby source from a utility source and back; provides all other necessary plant interlocks and requirements.

.2 Suitable for critical standby power applications (emergency response or planned demand reduction).

.3 System Design Control: The system design control is the minimal operational controls that the transfer switch must support.

.1 Have two incoming sources of power, and one load power feed, with one source considered as normal source, and other as the standby source.

.2 Monitor the voltage and frequency for each of the three phases for normal and emergency sources.

.3 Able to detect and react to a voltage or frequency (source problem) outside of a selectable band limit.

.4 The Automatic Transfer Switch shall provide:

.1 Local/Remote switch allow for local testing and remote operation.

.2 Remote PLC support in order to:

.1 Manage loads safety before power interruption when re-transferring back to normal power. This is achieved with a “Request to Re-transfer” signal provided from the ATS and a complimentary “Re-transfer Permissive” signal returned to the ATS from the remote PLC (when ready).

.2 Disable Automatic supervision and directly transfer to the Standby Power source, regardless of normal power status, when a control signal is received from the remote PLC. The ATS shall also directly re-transfer back to the Normal Power source when this control signal is removed (re-instating automatic supervision of the ATS).

.3 Monitoring of ATS contactor positions, sources available, and faults. Provide DPDT form C relay output contacts for these monitored status points:
  .1 Normal Power Available.
  .2 Emergency Power Available.
  .3 ATS in Standby Position.
  .4 ATS in Normal Position
  .5 Remote Auto Mode Status (Use of bypass contactors shall place the ATS out of remote auto status).
  .6 General Fault / Trouble Alarm.
.4 Provide full manual bypass capabilities for maintenance.
.5 Field programmable time delays.
.6 General control operation in automatic mode:
  .1 Wait until there is a source problem on the normal source, when this happens then:
    .1 Wait a selectable time to ensure the problem is not a momentary issue.
    .2 Issue as standby power source “Start” signal.
    .3 Wait until standby power source is detected.
    .4 Open the Normal circuit.
    .5 Wait an amount of time for open transition (neutral position delay).
    .6 Close into the standby power source.
    .7 Now operating in a standby mode of operation.
  .2 Wait until the Normal Power is re-established:
    .1 Advise PLC that Normal Power is available.
    .2 Wait a selectable time to ensure the normal power source is stable.
    .3 Request a “Re-transfer” permission from the remote PLC.
    .4 Wait for PLC to confirm that the system can be safety switched off Standby Power.
    .5 Open the Standby Power circuit.
    .6 Wait an amount of time for open transition (neutral position delay).
    .7 Close into the normal power circuit.
    .8 Now operating under normal operation.

PART 2 – PRODUCTS (Pre-purchased Materials)

2.1 MATERIALS

.1 Instrument transformers: to CAN3-C13.

.2 Contactors: to ANSI/NEMAICS2.

.3 Incoming Line Termination
  .1 Refer to Article 1.5.

2.2 CONTACTOR OR BREAKER TYPE TRANSFER EQUIPMENT

.1 1200 A continuous rms currently rated, 600 V rms, 60 Hz, 3 wire plus ground.

.2 Bolted Three Phase Fault withstand rating: 35 kA min., full rating.

2.3 STANDARDS

.1 Comply with standards listed in 1.2, Standards.

2.4 OPERATOR DEVICES, INSTRUMENTS AND CONTROLS

.1 Operator's devices: heavy duty, industrial, oil tight, functions as indicated (pushbuttons, selector switches and LED indicating lights), rated 120 VAC and prewired to starter terminal blocks. Lock-out pushbutton to be red mushroom type, lockable in depressed position, complete with pad-lockable clasp.

.2 Indicating lights: long-life or clustered LED lamps replaceable from front without disconnecting power supply.

.3 Controller:

.1 Shall provide N+1 redundancy in the event of a fault within the power assembly. In the event the ATS assembly is fail to respond, the controller shall remain active and controller the bypass isolation power section while issuing a general alarm.

.2 LCD display for programming, system diagnostics and help menu display.

.3 Mimic diagram with source available and source connected LED indications.

.4 Time stamped historical log.

2.5 AUTOMATIC TRANSFER SWITCH FEATURES

.1 ATS is to be provided as a section within the service entrance board. Normal and Standby power sources are to be top and bottom fed. Configure bus and lugs to accept incoming cables. Refer to drawings for space constraints.

.2 ATS is not to require rear access.

.3 The logic of the transfer switch will function via a microprocessor or solid-state controls. The set points to be field adjustable without the use of special tools. LED lights to be included on the exterior of the switch to show:

.1 Normal Source available.

.2 Emergency Source available.

.3 Connected to Normal Source.

.4 Connected to Emergency Source.

.4 Manual transfer facilities: for maintenance, bypassing and testing.

.5 Line and load side bypass for maintenance.

.6 PLC interface for handshaking sequence back to normal power.

.7 Control power: 120 V, single phase, from control transformer fed from source to which load is being transferred or to which load is connected after transfer.

.8 Time delay features:

.1 Time delay for standby power source start (0-300 seconds min.).

.2 Time delay for normal to emergency power (0-300 seconds min.).
.3 Time delay for emergency to normal (0-300 seconds min.). Note this delay is applied prior to requests for retransfer permissive.
.4 Time delay for standby power source cool down (0-300 seconds).

.9 Auxiliary relays rated for 10 A at 120 VAC.

.10 Engine start relay: two form C contacts.

.11 Indicating LED lights.

.12 Front accessible complete with dual draw-out cassette power assemblies. Each assembly shall be interchangeable between the ATS and manual bypass sections.

.13 NEMA Type 1 enclosure complete with compartmentalized separation between the control and power components and provided with hinged doors.

2.6 FINISH

.1 Painted surfaces: grind smooth, thoroughly clean, etch in phosphate solution and coat with rust-inhibiting primer. Exterior finish colour to be verified during shop drawing review.

2.7 NAMEPLATE, IDENTIFICATION AND MARKINGS

.1 Provide equipment identification, Lamacoid Nameplates, and designed ratings. Lamacoid to be 13 mm font, with white letters on black background, centrally mounted on front.

.2 Provide Warning Signage to CSA standards.

2.8 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Engineer.

.2 ATS(s) to be Factory Tested in conjunction with the standby power generation system.

.3 Notify Consultant two (2) weeks minimum in advance of date of factory test.

.4 Tests:
.1 Operate equipment both mechanically and electrically to ensure proper performance.
.2 Check selector switch, in all modes of operation Test, Auto, Manual, Engine Start and record results.
.3 Check voltage sensing and time delay relay settings.
.4 Check:
.1 Automatic starting and transfer of load on failure of normal power.
.2 Retransfer of load and its permissives when normal power supply resumed.
.3 Remote PLC transfer controls with and without normal/standby power available.

.4 Integration of the ATS into the Standby Power System control philosophy. ATS(s) to be Factory Tested in conjunction with the standby power system.

2.9 SPECIFIED PRODUCT

.1 Eaton Bypass Isolation Transfer Switches, complete with Dual Drawout power contactor assemblies.

2.10 ALTERNATE PRODUCT

.1 ASCO pre-approved equivalent.

.2 Schneider pre-approved equivalent.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Install following manufacturer guidelines and recommendations.

.2 Provide a pre-start up review. Check connections for mechanical security, electrical continuity and phasing. Provide written review complete with comments of concerns and corrective action where necessary.

.3 Provide testing and commissioning of integrated controls between the standby power system and the station control system. Provide programming of the ATS to calibrate time delays with the overall system. Provide written report complete with as commissioned settings and details.

.4 Provide on-site training of owner staff (four (4) hours min) of ATS operation and maintenance requirements.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Motor starter and control list.

1.2 STANDARDS

.1 Disconnect switches to CSA C22.2 No. 4.

1.3 SHOP DRAWINGS

.1 Submit product data in accordance with Division 1.

.2 Include voltage, current and NEMA ratings as well as physical dimensions.

.3 Include a detailed breakdown of part number.

1.4 SUMMARY

.1 Provide a disconnect switch for each HVAC equipment.

.2 Provide a disconnect switch for each equipment as indicated.

.3 Disconnect switch to be non-fusible, unless otherwise indicated.

.4 Disconnect switch to be installed next to equipment and within sight as per the latest revision of the Ontario Electrical Safety Code. Provide all mounting brackets and hardware as required for a complete installation. Mounting brackets to be aluminum, unless otherwise indicated. Mounting hardware to be stainless steel, unless otherwise indicated.

.5 Disconnect switch NEMA rating to match intended environment:
- .1 NEMA 4 (painted steel) in non-hazardous dry non-process areas.
- .2 NEMA 4X (stainless steel) in process or damp locations as well as outdoors.
- .3 NEMA 7 and 9 in hazardous (rated) areas.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCH

.1 Each disconnect switch to have the following characteristics:
- .1 Heavy duty construction, rated for industrial environments.
- .2 Voltage and current rating to match intended load.
- .3 Number of poles to meet requirements of intended load.
- .4 Short circuit (kA) rating to suit intended circuit.
- .5 100% load break and load make rated.
- .6 Horsepower rated.

.7 Visible double break rotary blade mechanism. Two points of contact.

.8 Triple padlocking capability. Cabinet door to also accommodate a padlock at the top as well as at the bottom of the cabinet door.

.9 Interlocking mechanism. Door cannot be opened when the handle is in the ON position. Provide a built-in defeater mechanism for user access when necessary.

.10 De-ionizing arc chutes. Arc chutes to confine and suppress the arcs produced under load.

.11 Provide optional Factory installed Normally Open early break auxiliary dry contacts for control circuit interlock. Provide a minimum of two (2) contacts per disconnect.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 16010.

.2 Each safety switch to be labeled as indicated.

2.3 SPECIFIED PRODUCT

.1 Specified Product:

.1 Eaton Cutler-Hammer safety switch, or approved equivalent.

2.4 ALTERNATE PRODUCT(S)

.1 Alternate Product(s):

.1 Siemens.

.2 Schneider.

.3 Allen-Bradley.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Installation as per the latest revision of the Ontario Electrical Safety Code.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE

.1 Provide dead front-type low voltage metal enclosed switchboard for SEB-0001, utilizing both rack-out power circuit breakers as well as moulded case circuit breakers, as indicated. Ratings as indicated on drawings.

1.2 RELATED REQUIREMENTS

.1 See also the following related requirements:

- .1 Section 16010: Electrical General Provisions.
- .2 Section 16031: Electrical Inspection and Testing.
- .3 Section 16289: Surge Protective Devices (SPD).
- .4 Section 16414: Automatic Transfer Switch.

1.3 REFERENCES

.1 The low voltage metal enclosed switchboard assembly and all components shall be designed, manufactured and tested in accordance with the latest applicable ANSI, NEMA, CSA, and UL standards.

1.4 SHOP DRAWINGS

.1 Provide Submittals for all products in this section.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for switchboards and include product characteristics, performance criteria, physical size, finish, and limitations.

1.5 OPERATION AND MAINTENANCE

.1 Provide operation and maintenance data for Switchboards and incorporate into manual specified under Division 1.

.2 Provide detailed instructions to permit effective operation and maintenance and repair, including but not limited to:

- .1 Complete illustrated parts list with catalog numbers.
- .2 Spare parts list.
- .3 Installation instructions for future maintenance.
- .4 Schematic diagram(s).
- .5 Troubleshooting procedures.
- .6 Certificate(s) of testing and commissioning.

.3 Submit maintenance materials for all products in this section.

1.6 SEISMIC RESTRAINT:

.1 Installations in this section are subject to support and anchorage requirements, as directed by the seismic restraint consultant retained by Contractor.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS (TYPE SB)

.1 Switchboards (SEB-0001) are to be provided with:
- .1 cUL/CSA ratings complete with engraved nameplate.
- .2 Front accessible only, full height, stand-alone enclosure. Conduit and cable shall be allowed to penetrate the switchboard from top, bottom or sides near the top/bottom.
- .3 Horizontal and/or vertical tin-plated copper bus, rated as indicated on single line drawings.
- .4 Coordinated break selection for third party surge protection equipment. See also Section 16289 – Surge Protective Device (SPD).
- .5 Lugging in compliance with feeder and branch circuit sizes as indicated on the single line diagrams.
- .6 Owner's power meter complete with provisions for separate source 120V power supply (via UPS).

.2 Switchboards SEqB-001 is to be also provided with:
- .1 Service entrance ratings as required.
- .2 Allowance for incoming utility metering CP/TP section to Hydro One standard.
- .3 An Automatic Transfer switch.

2.2 CIRCUIT BREAKERS

.1 Circuit breakers shall be bolt on, moulded case type ("MCCB") or rack-out type, low voltage power circuit breaker ("LVPCB"), as indicated on drawings.

.2 All "MCCB" devices shall be fixed low voltage moulded case circuit breakers. Frame ratings shall be as indicated. All breakers shall be cUL/CSA listed for application in their intended enclosures with the following features:
- .1 Adjustable long time, short time and instantaneous settings where indicated as "LSI":
  - .1 All LSI breakers to be 100% continuous ampere rated.
  - .2 All LSI breakers shall be provided with fully adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and Instantaneous settings.
- .2 Frame size as indicated on drawings.
- .3 Trip settings as indicated on drawings.
- .4 Trip plug-units are not final and may change within the frame rating, upon shop drawings review.
- .5 A minimum of 22 kAIC symmetrical interrupting rating without additional current limiters.
- .6 Integral, front adjustable electronic trip unit.

.3 Breakers shall be manually operated.

.4 Bolt-on type, pad-lockable, model case circuit breaker complete with the following options, as indicated on single line diagram:
- .1 LSI trip units and/or 100% breaker ratings.
- .2 Moulded Case Switch (MCS) with only instantaneous breaker response.
- .3 Auxiliary Form C, 120V rated NO/NC contacts.

.5 Low voltage moulded case circuit breakers shall comply with the following standards:
- .1 ANSI UL 489 – MCCB.
- .2 ANSI UL 1087 – Molded Case Switches (MCS).
- .3 NEMA AB1 – MCCB and MCS.
- .4 NEMA AB3 – MCCB Application.

2.3 OWNER'S POWER MONITOR

.1 Within Switchboard SEB-0001, as indicated on the single line drawing E010, provide a unit compartment within each switchboard for Owner's Power Monitors (designated PM-0001A).

.2 Owner's Power Monitors shall be provided with the following minimum requirements:
- .1 Voltage inputs: up to 600 Vac L-L without the use of additional Potential Transformers.
- .2 Designed by the switchboard manufacturer, directly mounted within the switchboard, to use a common main bus voltage reference and measure power flow from multiple three-phase branch circuits, via dedicated current sensor inputs from each branch. Minimum of twelve (12) branch ANSI C12.20 (accuracy class 0.5%) measurement sensors per power monitoring unit.
- .3 Capable of storing energy profile data for each branch circuit metering point and identify both peak demand and coincidental peaks. Minimum of 256 MB of base memory per meter.
- .4 Provided with color touch screen display and fully programmed by the contractor or manufacturer's representative upon start-up and commissioning activities. Programming to include branch circuit data logging, touch screen programming and remote communications with Owner's PLC system.
- .5 Provided with Modbus TCP communications over CAT 6 with Owner's PLC system. Owner's PLC shall be capable of remotely poling and logging power metering data within the Owner's SCADA / Historian System.
- .6 Expandable in the future by adding additional branch CT input cards to the base metering unit.
- .7 Capable of measuring the following:
  - .1 Current, per phase.
  - .2 Voltage, line to line.
  - .3 All standard power metrics (Watts, Vars, VA), in total as well as per phase.
  - .4 Demand measurements, total and per phase, for all standard power metrics, including power factor.
  - .5 Total energy consumption measurements for all standard power metrics.
  - .6 Resettable minimum and maximum readings on measured voltages, currents, and standard power metrics.
- .8 To be separately powered from Owners 120V UPS system, located within the installed area. Provide integral step-down transformer to 24 V, complete with fusing, as maybe required.
- .9 Provide all software and licences required for Owner to remotely monitor and program each power monitor.

2.4 EQUIPMENT IDENDIFICATION

.1 Refer also to Section 16010.

.2 Provide a nameplate for each panel board, size 4, engraved as indicated on single line drawings.

.3 Provide a nameplate for each branch circuit breaker and power monitors, size 2, engraved as indicated on single line drawings.

.4 Submit nameplates for Shop Drawing review prior to installing.

2.5 ACCEPTABLE MANUFACTURERS/SUPPLIERS

.1 All switchboards are to be the product of one manufacturer.

.2 Acceptable Manufactures/Suppliers:
- .1 Eaton.
- .2 Schneider.
- .3 Siemens.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: contractor’s field installations shall comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install switchboard as per manufacturer’s recommendations and seismically restrain.

.2 Coordinate all field cable and/or conduit installations with manufacturer’s allowed connection points.

.3 Coordinate with Hydro One and provide all metering support and installations as required.

.4 Test switchboard as per Section 16045 and manufacturer’s recommendations before energization.

.5 Provide all Owner’s Power Monitor setup and programming to fully integrate into the control and monitoring system.

.6 Coordinate with Standby power systems contractor to provide an integrated ATS within the service entrance board.

END OF SECTION

PART 1 - GENERAL

1.1 PRODUCT DATA

.1 Submit product data in accordance with Division 1.

1.2 PLANT ASSEMBLY

.1 Install all circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

1.3 SEISMIC RESTRAINT

.1 Installations in this section are subject to support and anchorage requirements, as directed by the seismic restraint consultant retained by Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Panelboards and Custom Built Panelboard Assemblies to CSA C22.2 No. 29.

.2 Copper buses only.

2.2 CONSTRUCTION FEATURES

.1 Panels to be door in door construction.

.2 Provide two (2) keys for each panel and all panels to be keyed alike.

.3 Panelboard mains suitable for bolt-on breakers including all necessary hardware to allow future breaker installation in all pole positions shown as spaces.

.4 Refer to Section 16010 and finish to indoor equipment specification.

.5 All panel trims 1000 mm or higher to be hinged.

.6 One (1) spray bomb enamel in same colour for touch-up.

2.3 BREAKERS

.1 Breakers 200 A or larger to be solid state with adjustable LSIG settings. Other breakers to be LSIG as indicated.

.2 Non-LSI breakers to operate automatically by means of thermal and magnetic tripping devices to provide inverse time-current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

.3 Use Class A ground fault protection breakers where specifically noted.

.4 Provide padlockable handle locks for all breakers supplied and installed.

2.4 BRANCH CIRCUIT BREAKER PANELS

.1 250 V branch circuit panels to have 225 A mains with bus and breakers rated for minimum symmetrical interrupting capacity, indicated on panel schedule and/or Table of Panels. If a conflict arises, select the higher value for bid purposes.

.2 600/347 V branch circuit panels to have mains as indicated with bus and breakers rated for minimum symmetrical interrupting capacity, indicated on panel schedule and/or Table of Panels. If a conflict arises, select the higher value for bid purposes.

2.5 DISTRIBUTION PANELS

.1 Distribution panels to have bus capacity as indicated and breakers suitable to withstand fault current indicated in amperes symmetrical as indicated.

2.6 EQUIPMENT IDENTIFICATION

.1 Refer to Section 16010.

2.7 ACCEPTABLE MANUFACTURERS/SUPPLIERS

.1 All panelboards to be from one manufacturer.

.2 Specified Product:
- .1 Eaton.

.3 Alternate Products:
- .1 Schneider.
- .2 Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Connect neutral conductors to common neutral bus with respective neutral identified.

.2 Connect ground conductors to common ground bus in panel.

.3 Locate panelboards where indicated and mount securely, plumb, true and square, to adjoining surfaces.

.4 Install surface-mounted panelboards on non-combustible surface.

.5 Mount panels over 1500 mm high on housekeeping pad. Housekeeping pad height as indicated; minimum of 100 mm.

.6 Connect all loads to circuits as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE

.1 The Lighting Fixture Schedule on the drawings lists the only Acceptable Manufacturers/ Suppliers as defined in Division 1.

1.2 PRODUCT DATA

.1 Submit photometric data prepared by independent testing laboratory for all fixtures for review by Consultant.

1.3 SHOP DRAWINGS

.1 Shop drawings in accordance with Division 1.

1.4 SEISMIC RESTRAINT

.1 Installations in this section are subject to support and anchorage requirements, as directed by the seismic restraint Consultant retained by Contractor.

1.5 MAINTENANCE MATERIALS

.1 Provide at least 5%, minimum three (3), spare lamps in original containers for all lamps, types and sizes used on project. Turn over to Owner and obtain receipt.

1.6 GUARANTEE FOR LAMPS AND BALLASTS

.1 Replace:

.1 All incandescent and tungsten halogen lamps burnt out within three (3) months of substantial completion.

.2 All fluorescent or high pressure sodium lamps burnt out within twelve (12) months of substantial completion.

.3 All fluorescent ballasts that fail within twelve (12) months of substantial completion.

PART 2 - PRODUCTS

2.1 MATERIAL STANDARDS

.1 Incandescent and electric-discharge fixtures to CSA C22.2 No. 9.

.2 Socket screw-shell lampholders to CSA C22.2 No. 43.

.3 Electric discharge lampholders and ballasts to CSA C22.2 No. 74.

.4 Radio interference suppressors to CSA C22.2 No. 8.

.5 Exit lights to CSA C22.2 No. 9.

.6 LED lighting to IES LM-79 and IES LM-80.

.7 C22.2 No 14 – Industrial Control Equipment.

.8 C22.2 No. 223 – Power Supplies for ELV Class 2 Outputs.

2.2 LED LAMPS

.1 Optical Assemblies: LEDs shall be provided with discreet optical elements to provide IESNA Type II, III, IV or V distributions. Additional distributions for spill light control shall be utilized when light trespass must be mitigated. All optical assemblies will be mounted parallel to the ground, aimed in the same direction and shall provide the same optical pattern such that catastrophic failures of individual LEDs will not constitute a loss in the distribution pattern. The luminaire shall have minimum efficacy of 85 lm/W as reported by an LM-79 report for each luminaire wattage and photometric distribution considered.

.2 All photometric data will be measured by the IESNA LM-79-08 standard and formatted per IESNA LM-63-02 as an electronic .ies file.

.3 Lumen depreciation shall not decrease by more than 30% over the expected operating life of a minimum of 80,000 hours @ 25°C. The measurements shall be calibrated to standard photopic calibrations. The LED device manufacturer shall have tested the lumen maintenance characteristics of the LED package in accordance with the guidelines of IESNA LM-80-08 “Approved Method for Lumen Maintenance Testing of LED Light Sources”. A copy of the manufacturer’s LM-80 reports shall be submitted for review, accompanied by lumen depreciation estimates for 10, 15 and 25 degrees Celsius luminaire ambient operating temperatures.

.4 Light Colour/Quality: The luminaire shall have a correlated colour temperature (CCT) range or 4,000 K to 4,500 K. The colour rendition index (CRI) shall be 70 or greater. Binning of LEDs shall conform to ANSI/G.NEMA SSL 3-2010.

.5 Backlight-Uplight-Glare: The luminaire shall not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical. The luminaire shall not allow more than 2.5 percent of the rated lumens to project above 90 degrees from vertical. Backlight and Glare ratings as per fixture schedule and calculated per IESNA TM-15.

2.3 LED DRIVERS

.1 Power Consumption: maximum power consumption allowed for the luminaire shall be determined by application. The luminaire shall not consume power in the off state.

.2 Operation Voltage: the luminaire shall operate from a 60 Hz AC line over a voltage ranging from 108 Vac to 305 Vac. The fluctuations of line voltage shall have no visible effect on the luminous output.

.3 Power Factor: the luminaire shall have a power factor of 0.90 or greater.

.4 THD: total harmonic distortion (current and voltage) induced into an AC power line by a luminair shall not exceed 20 percent over entire load range 0 – 100%.

.5 Surge Suppression: the luminaire on-board circuitry shall include surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes and other interference. The SPD shall protect the luminaire from damage and failure for common mode transient peak voltages up to 10 kV (minimum) and transient peak current up to 5 Ka (minimum). SPD performance shall be tested per the procedures in ANSI/IEEE C62.41-1992 (or current edition) for Category C (standard). The SPD shall fail in such a way as the luminaire will no longer operate. The SPD shall be field replaceable.

.6 The power supply driver enclosure should be sealed to protect against the entry of dust and water. This area should be sealed to minimum Ingress Protection level 65 (IP65).

.7 RF Interference: LED drivers must meet Class A emission limits referred in Federal Communications Commission 9FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

.8 The total current harmonic distortion of power supply drive induced into an AC power line shall not exceed 20%.

2.4 VACANCY/OCCUPANCY SENSORS

.1 Provide lighting vacancy/occupancy sensors as indicated, complete with required backboxes, hardware and accessories to provide a complete and operational system.

.2 Sensor backboxes and power packs, junction boxes to set equipment and be as per manufacturer’s recommendations.

2.5 CHAIRS FOR CHAIN HUNG FIXTURES

.1 Provide 304 stainless steel chairs for all chain hung fixtures. Size chains to suit. Refer to Section 16010 for seismic requirements.

PART 3 - EXECUTION

3.1 FIXTURE INSTALLATION

.1 Install lighting fixtures in acceptable manner for type of fixture and in accordance with manufacturer's installation instructions, using fixture studs or other recommended methods.

.2 Align fixtures shown in continuous lines or rows so that they appear as straight lines, unless otherwise indicated.

.3 Do not mount fixtures above pipes, ducts or equipment. Check layouts of work by other trades on project and plan cooperatively with others to avoid conflict. Provide longer hangers to clear obstructions, in event of unavoidably tight locations.

.4 Use ball and socket aligners on fixtures suspended from sloped ceiling to allow rods to hang vertically.

.5 Determine proper fixture accessories and mounting method for installation of recessed fixtures based on ceiling construction. Leave at least 12 mm air space between recessed incandescent fixture enclosures and combustible material other than that to which they are attached. Provide stick-on foam gaskets between frame of recessed fixture and ceiling to prevent light leakage, if any occurs.

3.2 FIXTURE SUPPORT

.1 Support fluorescent fixtures recessed in T-bar ceilings independently from building structure. When installed, fixture to lie on T-bar grid system but should grid system fail, fixture must not drop more than 12 mm. Use galvanized coil chain with 36 mm links for support.

3.3 EMERGENCY AND EXIT LIGHT INSTALLATION

.1 Install unit equipment and remote-mounted fixtures as indicated.

.2 Cut and recap cords to remove surplus.

.3 Direct heads to illuminate path of exit route.

.4 Size wire to limit voltage drop to 3%.

3.4 EMERGENCY AND EXIT LIGHTING TESTING

.1 Test system as per manufacturer's recommendations under battery load for minimum 30 minutes.

.2 Repeat test 24 hours later for 30 minutes to confirm battery charger.

.3 All tests to be witnessed by building official.

3.5 VACANCY/OCCUPANCY/DAYLIGHT SENSORS

.1 Occupancy Sensors:

- .1 Install and wire vacancy/occupancy/daylight sensors and power packs, including required low voltage control wiring as per manufacturer's instructions.
- .2 Note that sensors work in conjunction with switching (and lighting contactors as noted in this section). Provide a shop drawing schematic for each "non-standalone" room.
- .3 Set all time delays to minimum. Set sensitivity to suit use of room. Consultant and Owner to review.
- .4 Set time as indicated. General settings:
  - .1 Corridors and public areas – 20 minutes.
  - .2 Private offices, storage rooms and service rooms – 10 minutes.
  - .3 Classrooms – 30 minutes.
- .5 Provide a complete and operational system, including required 18 AWG, 3 conductor minimum FT-6 rated control wiring between sensors and/or power packs.
- .6 Provide manufacturer's inspection certificate and Owner training of all equipment as part of project commissioning.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

.1 Provide one (1) diesel driven Standby Power Systems, generator protection switchgear, fuel and cooling systems. The genset is to be suitable for outdoor installation in Brighton, Ontario. Size as indicated.

.2 Provide one (1) Automatic Transfer Switch. The standby power system function with the new Automatic Transfer Switch (ATS) located within the main Service Entrance Board (SEB-0001). Refer to Section 16414 – Automatic Transfer Switch and drawing layouts.

.3 System will be Diesel.

.4 Provide factory integrated testing of the Standby Power System and ATSs.

.5 Provide all cables specified; or detailed on Contract Drawings.

.6 Testing and startup of all normal and emergency cabling and protective devices as per Section 16031.

.7 Provide all grounding and accessories as shown, and as required.

.8 Provide 120/208 V, 3-phase power circuit panel and branch circuits for all genset support systems.

.9 Provide all fuel for factory and site testing as well as final fill up upon project completion.

1.2 RELATED WORK

.1 16414 - Automatic Transfer Switch

.2 16622.1 – Standby Power System Factory Report – Safety Devices.

.3 16622.2 – Standby Power System Factory Report – Operations.

.4 16622.3 – Standby Power System Site Report – Safety Devices.

.5 16622.4 – Standby Power System Site Operational Test.

.6 16622.5 – Standby Power System Site Full Load Test.

.7 16622.6 – Standby Power System Site Cycle Crank Test.

1.3 REFERENCES

.1 ANSI/API 650, Welded Steel Tanks for Oil Storage.

.2 ANSI/NEMA MG1, Motors and Generators.

.3 CAN/CGSB 3.6, Automotive Diesel Fuel.

.4 ISO 3046/1, Specification for Reciprocating Internal Combustion Engines: Performance.

.5 CAN4-S601, Steel, Aboveground Horizontal Tanks for Flammable and Combustible Liquids.

.6 CAN/CSA C282, Emergency Electrical Power Supply for Buildings (with exceptions).

1.4 SEISMIC RESTRAINT

.1 Installations in this Section are subject to support and anchorage requirements, as directed by the seismic restraint Engineer retained by the Contractor.

1.5 DESCRIPTION OF SYSTEM

.1 Generating system consists of:
- .1 Engine (Diesel).
- .2 Alternator.
- .3 Alternator control panel.
- .4 Battery charger and battery.
- .5 Fuel supply system.
- .6 Weatherproof sound attenuated enclosure. tight skin type.

.2 System designed to operate as standby power source for emergency utility power Standby utilization of the generator shall be considered 200 hrs of runtime, or less, per year.

1.6 DRAWINGS

.1 Submit design and shop drawings as per Division 1.

.2 Drawings to include:
- .1 Overall dimensions.
- .2 Dimensional locations of all field tie points, including sizes and fittings.
- .3 Clearly indicate field work to be completed by others.
- .4 Wiring diagrams and cable schedules clearly indicating prewired, field wiring, terminal numbers, etc., for a complete installation.

.3 Provide complete heat and mass balance for equipment operating at design load.

.4 Include make, type, model and quantity of each:
- .1 Engine: BHP including fan, BMEP, with performance curves; include heat dissipation of each fuel injector and indicate that this heat is accommodated by fuel tank/pumps system.
- .2 Exhaust emissions compliance and Data Sheet.

.3 Alternator; exciter; temperature rise; transient, subtransient and open circuit constants; continuous standby rating as per MG1-1998 Part 32.7, 32.8 and 32.9; short circuit capability as per MG1-1998 Part 32.13; Non-Linear load capability as per MG1-1998 Part 32.15.
.4 Voltage regulator.
.5 Battery.
.6 Battery charger.
.7 Alternator control panel: type and accuracy of meters and controls; main output circuit breaker with trip curves and electronic adjustments.
.8 Governor.
.9 Engine control panel.
.10 "Hospital" grade silencer complete with eight (8) octave band sound spectrum.
.11 Alternator cooling air requirements in m^3/s.
.12 Engine cooling air requirements in m^3/s.
.13 British standard or DIN rating of engine.
.14 Enclosure:
    .1 Weather-protective, sound-attenuated.
.15 Flow diagrams for:
    .1 Fuel.
    .2 Cooling air.
.16 Electrical:
    .1 Block diagram clearly indicating all components shipped to site and requiring field wiring.
    .2 Wiring schematics.
.17 Local Annunciator Panel.
.18 Block Heater.
.19 Fuel Filter(s).
.20 Air Filter(s).
.21 Radiator cooled heat exchanger.
.22 Dimensioned drawing showing complete generating set mounted on structural steel base, including vibration isolators, exhaust system, drip trays, and total weight.
.23 Continuous full load output of set at 0.8 PF lagging; expected engine life (number of hours of operation under prime rating conditions).
.24 Description of set operation including:
    .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
    .2 Manual starting.
    .3 Automatic weekly load cycler.
    .4 Automatic shut down and alarm on:
        .1 Overcranking.
        .2 Overspeed.
        .3 High engine temp.
        .4 Low lube oil pressure.
        .5 Short circuit.
        .6 Alternator overvoltage.
        .7 Lube oil high temperature.
        .8 Over temperature on alternator.
        .9 Low coolant level.
    .5 Manual remote emergency stop.
.25 Steady state and transient performance response to voltage and frequency.

.26 THD and TIF performance.
.27 Load starting capability vs. voltage dip (actual time curve as per MG1-1998-Part 32, 32.18).
.28 Motor starting capability in KVA vs. voltage dip (actual curve as per MG1-1998-32.18 Figure 32-3).
.29 Details on warranty.

.5 To facilitate the coordination study, provide the following:
.1 Generator breaker frame size, trip unit type and interrupting rating.
.2 Generator parameters including the following:
.1 kVA
.2 Voltage
.3 Current
.4 Power Factor
.5 Number of Poles
.6 RPM
.7 Type of excitation (fixed voltage, current boost, PMG)
.3 Decrement Curve with all the following in % based on generator rated kVA.
.1 Sub-transient Reactance (%Xd")
.2 Transient Reactance (%Xd')
.3 Synchronous Reactance (%X'd)
.4 Negative Sequence Reactance (%X2v)
.5 Zero Sequence Reactance (%Zo)
.6 Generator X/R OR 3P armature short circuit current (TA3) and armature DC resistance (%Ra) based on Generator kVA.

1.7 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for diesel alternator and accessories as per Division 1.

.2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:
.1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, battery charger, battery, fuel system, enclosure ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.
.2 Technical data:
.1 Illustrated parts lists with parts catalogue numbers.
.2 Schematic diagram of electrical controls.
.3 Flow diagrams for:
.1 Fuel system.
.2 Lubricating oil.
.3 Cooling system.
.4 Emissions control system(s).
.5 Certified copy of factory test results.
.6 Certification of Factory Torsional Vibration Analysis on Engine-Alternator set.
.7 Maintenance and overhaul instructions and schedules.

1.8 SOURCE QUALITY CONTROL

.1 Factory test each generator set, including engine, alternator, control panels and accessories.

.2 Notify the Consultant 21 days in advance of any test date.

.3 Provide suitable inductive loadbank to test the generator.

.4 Running Test Load to have 0.8 lagging power factor.

.5 Starting Test Load to be the equivalent of the load described in 2.2 (unit sizing).

.6 Install continuous digital chart recorders or equivalent to record frequency and voltage variations during load switching procedures.

.7 Provide certification of torsional vibration analysis and performance compliance of engine alternator unit.

.8 Confirm MECP compliance with generator emissions under full load testing.

.9 Factory tests: complete Forms 16622.1 and 16622.2.

1.9 WARRANTY

.1 Refer to the General Conditions for warranty details.

1.10 CARE, OPERATION AND START-UP

.1 Manufacturer to provide a certificate indicating that Standby Power System has been installed to his satisfaction and verify test results.

.2 Manufacturer and Consultant to be present during site test and to verify field test report Section 16622.3, 16622.4, 16622.5, 16622.6.

.3 Manufacturer to instruct the Owner regarding routine maintenance and operation of the Standby Power System. Submit a certificate to show that Owner has been instructed in operation of system and maintenance procedures required. A signature certifying this to be obtained.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide Standby Power system, including fittings and accessories necessary for proper and satisfactory operation as both as standby emergency power source under the loss of utility power, as well as alternative power source under high plant demand loading scenarios.

.2 Alternator direct coupled to engine by a flexible drive disc, flywheel housing and coupling to prevent misalignment between engine and generator.

.3 Mount assembly on a common structural steel base supported on adjustable spring vibration

isolators.

.4 Unit rating will be defined as follows, in accordance with ISO3046 or MG1
.1 Standby power generator at 100% kW output.

2.2 PROJECT PARAMETERS AS PER MG1-1998 PART 32

.1 Duty: Standby (200 hours runtime per year, or less).

.2 Maximum Voltage Dip @ 35% of nominal.

.3 Maximum Running Surge Voltage Dip: 5% of nominal.

.4 Maximum Frequency Dip: 3% of nominal.

.5 Site Ambient Temperature: -35°C to 40°C.

.6 Maximum Non-Linear Load with a crest factor of 2.1: 35% of total.

.7 Maximum Alternator Temperature Rise: 125°C.

2.3 ENGINE

.1 Radiator cooled engine.

.2 Use heavy-duty, industrial type radiator mounted on engine base. Provide flanges for connection with ductwork.

.3 Forced-type cooling fan, engine, driven, to direct airflow through radiator from engine side.

.4 Engine to have sufficient Bhp to produce full-rated electrical output when operating all engine-driven accessories at an ambient temperature of 40°C and 90 metres elevation.

.5 Engine emissions at full and partial load to meet all applicable Provincial and Federal regulations under continuous emergency operation, under all ambient operating conditions. All testing to be to MOE Source Testing Code for NOx, hydrocarbons, co-particulate and capacity.

.6 Engine to have following additional fittings and features:
.1 Provision to prevent or reduce emission of crankcase fumes into enclosure.
.2 Engine driven fuel oil lift pump for Number 2 diesel fuel.
.3 Heavy-duty air cleaners.
.4 Fuel and lubrication oil filters.
.5 Electronic, isochronous governor to control speed.
.6 Electric fuel rack shutoff solenoid, energized to run.
.7 Complete electric starting system with starting motor, starting solenoid and batteries. Batteries with sufficient ampere-hour capacity to provide two (2) consecutive starts without necessity of recharging when engine and batteries are exposed to winter conditions. Battery cables of ample capacity to be included.

.8 Engine wiring to have heat and oil resisting insulation, carefully routed and supported away from all hot metal parts and brought to suitable junction box.
.9 Lubricating oil drainpipe complete with gate valve and end plug beyond concrete base; flexible fuel lines.
.10 Thermostatically controlled engine coolant heater.
.11 Thermostatically controlled engine lube oil heater.
.12 Supply first filling of lubricating oil and antifreeze suitable for -40°C.
.13 Carbon steel oil drip pan. Pan is to be accessible for cleaning.
.14 Lube oil cooler.
.15 Safety guards to OSHA Standards.
.16 4-cycle engine.
.17 Enclosed steel battery box mounted on genset frame(s).
.18 Fuel filters.
.19 NC solenoid shutoff valve (for fuel) powered from battery circuit and interlocked with operation.
.20 Fusible link valve.

2.4 DIESEL FUEL SYSTEM

.1 Sub-base, double-wall tanks with a minimum 24-hour capacity at full load complete with integral leak detection and local visual level indication.

.2 Provide the following signals:
.1 Tank Leak (form C contact).
.2 Low Level (form C contact).

2.5 ALTERNATORS

.1 Alternators to be rated for load indicated in 2.2, 600 V, 3 phase, 4 wire, solidly grounded neutral at the generator, 60 Hz, 1800 rpm manufactured for standby operation.

.2 125°C temperature rise alternator per NEMA MG1.22.40, IEEE 115 and IEC 34-1, single-bearing, revolving field, brushless 4-pole drip-proof exciter with dynamically balanced flexible drive coupling to engine.

.3 Rotor supported by pre-lubricated, maintenance-free ball bearing.

.4 PMG excitation for starting capacity and isolation from non-linear load distortion effects.

.5 Amortisseur windings, 2/3 pitch.

.6 AC waveform THD voltage less than 3%, no load to full load, with 20% loads having a crest factor of up to 2.1.

.7 Telephone Influence Factor (TIF) less than 50.

.8 Radio Frequency Interference (RFI) to IEC-801 and to MIL-STD-461C, Part 9 (EMI).

2.6 EXHAUST SYSTEM

.1 Provide the following factory installed equipment:
- .1 Heavy-duty, critical grade exhaust silencer for horizontal mounting, complete with condensate drain and plug.
- .2 Minimum 610 mm in length of heavy-duty flexible exhaust pipe with flanged connections both ends.
- .3 Guards to CSA or OSHA standards over all moving parts to protect maintenance workers.

2.7 EXHAUST EMISSIONS COMPLIANCE

.1 Provide data for nitrogen oxides, hydrocarbons, carbon monoxide and particulate matter completed at factory.

2.8 CONTROL PANEL

.1 Control panel unit can be mounted on Genset if proper isolation is provided.

.2 Electronic voltage regulator, 3 phase rms sensing:
- .1 delta V = + 1.0% for loads 0 to 100%, steady state.
- .2 delta f = + 0.25% for loads 0 to 100%, steady state.
- .3 transient voltage dip on application of 100% load at 1.0 pf: 35%.
- .4 transient voltage rise on removal of 100% load at 1.0 pf: 10%.
- .5 transient voltage dip on motor start of 25 hp across the line: 35% maximum.

.3 AC digital voltmeter 2% accuracy, 0 to 650 V, true rms sensing, phase to phase.
- .1 AC digital ammeter 2% accuracy, 0 to 500 A, true rms sensing, phase.
- .2 Voltmeter switch – 3-position.
- .3 Ammeter switch – 3-position.

.4 AC frequency digital meter 1% accuracy, 59 Hz to 61 Hz.

.5 Running time meter.

.6 kW digital meter 2% accuracy, full scale kW, true rms sensing.

.7 Voltage adjusting rheostat or transformer - screwdriver adjustable only.

.8 Current transformers as necessary.

.9 Potential transformers as necessary.

.10 Analog DC voltmeter and ammeter, 0 to 14 V and 0 to 20 A respectively or as required.

.11 Digital meters for:
- .1 Engine Oil Pressure (psi)
- .2 Engine Coolant Temperature (°C)

.3 Engine Oil Temperature (°C)

.4 Engine rpm.

.12 Safety Indications and Shutdowns:

	Indicator/Function	CV	S
.1	Overcrank	X	X
.2	Low engine temperature	X	
.3	High engine temperature	X	X
.4	Low lube oil pressure	X	X
.5	Overspeed	X	X
.6	Low fuel	X	
.7	Standby Power supply system supplying load	X	
.8	Control switch not in automatic position	X	X
.9	Low battery voltage	X	
.10	Lamp test	X	
.11	Contacts for local and remote common alarm	X	
.12	Audible alarm silencing switch	X	
.13	Remote emergency stop		X
.14	Low coolant level	X	X
.15	Low AC voltage	X	
.16	High AC voltage	X	
.17	Underfrequency	X	
.18	Overcurrent	X	
.19	Short circuit	X	X
.20	Fuel reservoir leak indicator/function	X	
.21	Lube oil high temperature	X	X
.22	Over temperature on alternator	X	X

CV = Control panel mounted, individual visual and audible indication.

S = Shutdown of Standby Power system.

Note: All fault indicating lights are to remain sealed in until manually reset.

.13 MANUAL-OFF-AUTO key-operated selector switch. Removal of key possible in "AUTO" position, only.

.14 600 V, 3-pole, 22 kA output moulded case circuit breaker. Rating to suit generator at 100% continuous current as per UL489 listing.

.15 Clearly label terminal blocks for all external connections.

.16 Sign will be installed on the equipment stating that the equipment is automatically controlled and may start at any time.

.17 Provide E-stop button with adequate protection to prevent accidental activation. E-stop to the latest applicable regulations.

.18 Provide the following minimum PLC interface via dry contacts. Each contact to be rated for 120 VAC, 5A.
- .1 Generator Alarm.
- .2 Generator Ready.
- .3 Generator Running.

2.9 AUTOMATIC BATTERY CHARGER

.1 Semi-constant voltage type with an output voltage which varies not more than +3% of preset voltage when input voltage varies plus or minus 15% of line voltage. Charger to incorporate overload protection and charging current ammeter. Charger will be capable of recharging a completely discharged battery to 80% of capacity within 4 hours and to full capacity in not more than 12 hours. Charger to be 120 VAC input.

.2 Battery charger to provide the generator panel with a fault signal upon failure.

2.10 ENGINE LIQUIDS REFILL

.1 Provide all initial fills for engine coolant and lubricating oils.

.2 Refill fuel tank(s) after site testing and commissioning has been successfully completed.

2.11 ENCLOSURE

.1 Provide the following enclosure assembly. Complete enclosure, fuel system, cooling and electrical to be factory assembled.
- .1 A weather-protective skin-tight enclosure for the diesel alternator set complete with fuel tank, and all other accessories per 2.1 through 2.10 above.
- .2 Lifting eyes at all four corners welded directly to the main structure.
- .3 Drain pan under engine.
- .4 Exterior Walls, Roof and Access Panels:
  - .1 Exterior sheathing made of minimum 16 gauge galvanized steel with baked enamel paint to match existing building. Colour chip to be submitted and approved by Owner prior to fabrication.
  - .2 Steel frame spaced as required.
  - .3 Fire retardant polyurethane insulation in between exterior wall and interior perforated galvanized sheathing. Insulate and line roof.
  - .4 Heavy-duty stainless steel hinges and/or locking hasps and door handles complete with panic hardware.
  - .5 All latches and handles to be pad-lockable.
  - .6 Design enclosure to be vandal resistant. All joints to be welded or designed with a positive mechanical seal. Doors to be provided with P-type gasket seals.
- .5 Sound Attenuation:
  - .1 In conjunction with the exhaust system published levels must be equal to or less than 84 dBA at 7 m operating at full load.

.2 Sound data to be obtained using approved ANSI procedures and be acceptable to minimum MECP criterial for acceptance and operation. Provide full 8-octave band sound spectrum.

.6 Heavy-duty vandal resistant aluminum or galvanized steel louvers minimum 1.5 mm thickness, complete with removable bird screens on all louvres and air filters on air intake.

.7 Provide insulated low leakage dampers equivalent to Tamco Series 9000.

.8 Enclosure anchors for mounting on site concrete base to meet NBC seismic requirements. Engine, fuel tank, piping and accessory mounting to meet NBC seismic requirements.

.9 120/208 V, 3-phase panel and breakers for heaters, charger, lights etc., that are part of the enclosure.

.10 Provide interior service lighting and 120 V receptacles.

.11 All components normally requiring service to be serviceable and removable without disassembling the enclosure as major components. Allow for removal or major components from enclosure. Design enclosure to be weatherproof and free-draining to avoid the accumulation of water from rain or snow melt. Design enclosure such that all louvres will not be obstructed as a result of accumulated snowfall and leaves.

2.12 REMOTE EQUIPMENT

.1 Supply, loose, one (1) REPO (Remote Standby Power Off) switch for surface mounting.

.2 Supply, loose, one (1) remote monitoring panel providing critical engine status monitoring.

2.13 ELECTRICAL ACCESSORIES

.1 All electrical components necessary to automatically operate the standby generator installation to be powered by the battery circuit as necessary for start-up and operation.

2.14 SPARE PARTS

.1 Provide the following spare parts for each genset.

.1 Two sets of air, fuel and all other filters. The first spare set is to be installed with the oil and coolant change following commissioning.

2.15 ACCEPTABLE MANUFACTURERS

.1 Acceptable Manufacturers:

.1 Cummins Power

.2 Toromont Caterpillar

.3 Bluestar.

PART 3 - EXECUTION

3.1 INSTALLATION OF GENSETS

.1 Provide concrete pad and anchor devices for genset as per Divisions 2 and 3.

.2 Install power cables and control cables.

.3 Install all grounding devices.

.4 Make all connections as indicated and as per manufacturer's recommendations.

.5 Provide all necessary core drilling required for power and control cables.

3.2 STANDBY POWER FACTORY ACCEPTANCE TEST

.1 Factory test generator set, including engine, alternator, control panels, transfer switches and accessories.

.2 Notify the Consultant 21 days in advance of any test date.

.3 Provide suitable inductive loadbank to test the generator.

.4 Running Test Load to have 0.8 lagging power factor.

.5 Starting Test Load to be the equivalent of the load described in 2.2 (unit sizing).

.6 Install continuous digital chart recorders to record frequency and voltage variations during load switching procedures.

.7 Provide certification of torsional vibration analysis and performance compliance of engine alternator unit.

.8 Factory tests: complete Forms 16622.1 and 16622.2.

3.3 STANDBY POWER SYSTEM SITE TESTS

.1 Supplier to perform testing and commissioning on-site.

.2 Any deficiency in the operation of the genset and accessories will be the responsibility of the Manufacturer. Corrective action will be taken promptly by manufacturer.

.3 Test and commission unit, after installation by others is complete, and submit test reports to Consultant.

.4 Site Operational Tests:

.1 With the engine in a "cold start" condition and the building emergency load at its normal operating level, a power failure will be simulated by opening all switches or breakers that supply the normal power to the building or facility. The test load will be that load which is normally served by the Standby Power system.

.2 The operational test will be continued for 1 hour, after which normal power will be restored to the building or facility and satisfactory transfer of the load and shutdown of the genset will be demonstrated.

.3 The following data will be observed and recorded:

.1 the time delay on start;

.2 the cranking time until the engine starts and runs;

.3 the time required to come up to operating speed;

.4 the time required to achieve a steady-state condition with all switches transferred to the emergency position;

.5 the voltage, frequency, and amperes at start-up and at any observed change in load;

.6 the engine oil pressure, water temperature where applicable, and battery charge rate at 5 minute intervals for the first 15 minutes, and at 15 minute intervals thereafter;

.7 the time delay on retransfer for each transfer switch; and

.8 the time delay on engine cool down and shutdown.

.4 Complete Test Report 16622.4.

.5 Site Full Load Test:

.1 Following the operational test prescribed in Clause 3.3.4, the genset will be subjected to a 7-hour, 100% load test.

.2 The supplier to supply a load bank including all necessary temporary wiring and controls required for a full load test on-site. Allow for the provision of an adjustable dummy load rated for generator 100% full load output.

.3 Complete Test Report 16622.5.

.6 Site Cycle Crank Test:

.1 The engine will be prevented from running by utilizing any method recommended by the manufacturer. The control switch will then be placed in the "run" position to cause the engine to crank.

.2 The crank cycle will consist of either a 30 second continuous crank or three 10-second crank attempts separated by 10-second rest periods; start batteries will have sufficient capacity for two complete crank cycles at 10°C ambient room temperature, with a battery end voltage of not less than 80% of the rated voltage. The crank cycle will be observed and recorded.

.3 The time required to recharge the batteries after the above two crank cycles will be demonstrated to be within 4 hours.

.4 Complete Test Report 16622.6.

.7 Site Safety Devices Test:

.1 Complete the test report of 16622.3.

.2 Shorting of safety devices not acceptable.

3.4 SITE TESTS

.1 Testing of the following to be by the Contractor.

.1 All normal and Standby Power feeders.

.2 Proper operation of each feeder and device, phase rotation, ground resistance and continuity measurements.

3.5 TRAINING

.1 Refer to Division 1.

.2 Provide two (2) four (4) hour training sessions onsite. Training sessions to be at least 2 weeks apart. These two (2) training sessions shall be separate from any onsite commissioning and startup sessions. First training session to include the following:

- .1 Operation of the standby system including manually switching from normal-to-Standby Power and the converse; plus ATS bypassing.
- .2 The Operator interface for the generator and the associated panels, including the ATS. Train Owner's personnel on how to interpret the equipment status from the Operator interface.
- .3 Operation of the equipment via the Operator interfaces provided on all the associated panels and interfaces for the equipment.
- .4 Maintenance requirements of the equipment, including the various periodic maintenance activities that are required per the manufacturer's recommendations.
- .5 The generator software on the Owner's computer. Train the Owner's personnel on how to use and interpret the data from this software. Coordinate with the Owner. Generator manufacturer's representative to install the software on the Owner's computer.
- .6 Other items per the manufacturer's recommendation as well as per Owner's request. Provide a training agenda at least two (2) weeks prior to scheduling for their review and feedback. The equipment O&M manuals shall be provided at least two weeks prior to the first training session.

.3 The second training session is to re-cap the items covered in the first training session plus any other items raised by Owner's staff.

END OF SECTION

PROJECT: _____ Test Date:

ADDRESS:

Engine Mfg. _____ Model _____ Serial

Generator Mfg. _____ Model _____ Serial

Utility-Parallelling Equipment

Diesel Generator Supplier

Rated kVA _____ PF _____ Volts _____ Amps _____ Speed

DEMONSTRATION			TEST CONDUCTED
.1	Overcrank		
.2	Overspeed		
.3	High engine temp. (°C)		
.4	Oil pressure kPa		
.5	Low battery alarm		
.6	Generator overvoltage		
.7	Low coolant level		
.8	Automatic start		
.9	Automatic stop		
.10	Selector switch modes		
.11	Low engine temp. alarm		

Manufacturer's Supervisor:

END OF SECTION

PROJECT: _____ Test Date:

MANUFACTURER:

LOAD ON ALTERNATOR (@ 0.8 pf)		25 %	100%	0 to 100% step	100% to 0% step
RUNNING TIME (hrs.)		0.1	2.0	0.1	0.1
.1	Ambient temperature				
.2	Frequency				
.3	Amps phase A (true rms)				
.4	Amps phase B (true rms)				
.5	Amps phase C (true rms)				
.6	Volts phase A-B (true rms)				
.7	Volts phase B-C (true rms)				
.8	Volts phase C-A (true rms)				
.9	kW 3 phase (true rms)				
.10	Oil pressure kPa				
.11	Oil temperature (°C)				
.12	Coolant temp. (°C) (IN)				
.13	Coolant temp. (°C) (OUT)				
.14	Outdoor air temp. (°C)				
.15	Ambient air temp. (°C)				
.16	Air temp. leaving radiator (°C)				
.17	Exhaust temperature (°C)				
.18	Battery charge amps				
.19*	Transient voltage response	N/A	N/A	*, **	*, **
.20*	Transient frequency response	N/A	N/A	*, **	*, **
.21*	Start-up of a 25 hp induction motor full voltage start	N/A	N/A	N/A	N/A

* Provide an oscillographic recorder

** Record voltage dip magnitude and transient frequency response, including overshoot and recovery time.

Manufacturer's Supervisor:

END OF SECTION

PROJECT: _____ Test Date:

ADDRESS:

Engine Mfg. _____ Model _____ Serial

Generator Mfg. _____ Model _____ Serial

Utility-Parallelling Equipment

Diesel Generator Supplier

Rated kVA _____ PF _____ Volts _____ Amps _____ Speed

DEMONSTRATION		WITNESSES		
		Manufacturer	Division 16	Engineer
.1 Overcrank				
.2 Overspeed				
.3 High engine temp. (°C)				
.4 Oil pressure kPa				
.5 Low battery alarm				
.6 Generator overvoltage				
.7 Low coolant level				
.8 Automatic start				
.9 Automatic stop				
.10 Selector switch modes				
.11 Low engine temp. (°C)				
BUILDING SYSTEMS				
.1 Low fuel alarm				
.2 Fuel pump				

END OF SECTION

PROJECT: _____ Test Date:

CONTRACTOR:

.1 Time delay on start: ____ seconds

.2 Cranking time until engine starts and runs: ____ seconds

.3 Time to operating speed: ____ seconds

.4 Time to synchronize engine: ____ seconds

.5 Time delay on engine cool down and shutdown: ____ minutes

BUILDING EMERGENCY LOAD ON GENERATOR (available load)	0%	100%	100%	100%	100%	100%
RUNNING TIME	0	5 min.	10 min.	15 min.	30 min.	1 hr.
.1 Ambient temperature						
.2 Frequency						
.3 Amps phase A (true rms)						
.4 Amps phase B (true rms)						
.5 Amps phase C (true rms)						
.6 Volts phase A-B (true rms)						
.7 Volts phase B-C (true rms)						
.8 Volts phase C-A (true rms)						
.9 KW 3 phase (true rms)						
.10 Oil pressure kPa						
.11 Oil temperature (°C)						
.12 Coolant temp. (°C) (IN)						
.13 Coolant temp. (°C) (OUT)						
.14 Outdoor air temp. (°C)						

BUILDING EMERGENCY LOAD ON GENERATOR (available load)		0%	100%	100%	100%	100%	100%
RUNNING TIME		0	5 min.	10 min.	15 min.	30 min.	1 hr.
.15	Ambient air temp. (°C)						
.16	Air temp. leaving radiator (°C)						
.17	Exhaust temperature (°C)						
.18	Battery charge amps						

Fuel consumption during test: _____ litres

Contractor:

Manufacturer's Supervisor:

Engineer's Representative:

END OF SECTION

PROJECT: _____ Test Date:

DUMMY LOAD ON GENERATOR		0%	100%
RUNNING TIME (hrs.)			
.1	Ambient temperature		
.2	Frequency		
.3	Amps phase A (true rms)		
.4	Amps phase B (true rms)		
.5	Amps phase C (true rms)		
.6	Volts phase A-B (true rms)		
.7	Volts phase B-C (true rms)		
.8	Volts phase C-A (true rms)		
.9	kW 3 phase (true rms)		
.10	Oil pressure kPa		
.11	Oil temperature (°C)		
.12	Coolant temp. (°C) (IN)		
.13	Coolant temp. (°C) (OUT)		
.14	Outdoor air temp. (°C)		
.15	Ambient air temp. (°C)		
.16	Air temp. leaving radiator (°C)		
.17	Exhaust temperature (°C)		
.18	Battery charge amps		

Fuel consumption during test: _____ litres

Contractor:

Manufacturer's Supervisor:

Engineer's Representative:

END OF SECTION

PROJECT: _____ Test Date:

CONTRACTOR:

.1	Enclosure Ambient Temperature:	____ (°C)
.2	Outdoor Air Temperature:	____ (°C)
.3	Either Test A or Test B below is acceptable:	

TEST A

.1	Rated Battery voltage:	____ volts
.2	First cycle Crank - (30 seconds):	____ sec.
.3	Rest period - (30 seconds):	____ sec.
.4	Second cycle crank - (30 seconds):	____ sec.
.5	Battery end voltage:	____ volts
.6	Manufacturer's Battery Capacity Normalized to +10°C ambient temp:	____

TEST B

.1	Rated Battery voltage:	____ volts
.2	First cycle crank - (10 sec):	____ sec.
.3	Ten second rest:	____ sec.
.4	Second cycle crank - (10 sec):	____ sec.
.5	Ten second rest:	____ sec.
.6	Third cycle crank - (10 seconds):	____ sec.
.7	Rest period - (30 seconds):	____ sec.
.8	Repeat steps 2, 3, 4, 5, 6 (50 sec):	____ sec.
.9	Battery end voltage:	____ volts
.10	Manufacturer's Battery Capacity Normalized to +10°C ambient temp:	____

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

.1 Provide MCCs as specified.

.2 Provide all wiring.

1.2 SEISMIC RESTRAINT

.1 Installations in this section are subject to support and anchorage requirements, as directed by the seismic restraint Engineer retained by Contractor. Refer to Section 16010.

1.3 REFERENCE

.1 Single line diagrams Motor Starter Schematics and Motor Starter and Control List.

.2 Section 16801.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

.1 Not Applicable.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install new MCCs and remove existing where indicated.

.2 Provide new MCC feeders.

.3 Provide new branch load feeders to new loads and to existing loads that are designated to remain. Remove all existing branch load feeders from existing MCCs being removed.

.4 Install new control devices make power and control connections as shown.

3.2 WIRING

.1 Provide all necessary 120 VAC wiring and signal wiring as shown.

.2 Provide all control wiring under 120 VAC as shown.

.3 Label phasing in all new starters and contactors: Phase A, Phase B, Phase C.

3.3 INITIAL START-UP

.1 Coordinate schedule with supplier of MCC.

3.4 TESTS

.1 Conduct the following tests:

- .1 Feeder insulation megger tests.
- .2 Ground bonding system continuity and resistance measurement tests.
- .3 Verify voltage and current on starting and running cycles on each phase of supply circuit and for each load.
- .4 Operate switches and controls to verify correct functioning in presence of Owner and Consultant.
- .5 Other tests outlined in Section 16031 and as required by the MCC manufacturer.
- .6 Submit written test results to Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE

.1 Single line diagrams and Motor Starter Control List.

.2 Section 16800 - 600 Volt MCC – Installation.

.3 Section 16812 - Variable Frequency Drives (in New MCCs).

.4 Section 17051 - Motor Starter Cabinet and PLC Panel Details.

1.2 OPERATION AND MAINTENANCE DATA

.1 Submit operation and maintenance data for each type and style of starter.

1.3 SHOP DRAWINGS

.1 Submit shop drawings of MCC including a complete wiring diagram in PDF format, trip curves for each type of fuse, circuit breaker and overload to Consultant for approval.

.2 Shop drawings must indicate short circuit rating (interrupting and withstand) of each breaker, fusible switch and starter.

.3 Shop drawings to indicate short circuit bus bracing.

.4 Shop drawings to indicate VA requirements (inrush and sealed) at 120 VAC/60HZ for each coil unit.

.5 Include a copy of PC software for communication to each type of device complete with cables.

.6 VFD Harmonic profiles with and without filters.

.7 Submit shop drawings per Division 1.

PART 2 - PRODUCTS

2.1 MATERIAL STANDARDS

.1 Provide starters and auxiliary control devices to CSA C22.2 No. 14 and EEMAC E14 No. 1.

.2 Control transformers to CSA C22.2 No. 66.

.3 All starters to be NEMA-rated for HP and AMP.

2.2 MCC

.1 New CSA approved MCCs to be rated at rated amperage 50°C rise/600 VAC/3 phase 4 wire/60HZ with minimum 22 KAIC bracing, as indicated.

.2 Class I, Type B wiring, Type 1-A gasketted enclosure.

.3 Constructed with 14-gauge steel minimum frame and welded corner channels; side, back, roof and covers of 14-gauge steel.

.4 Tin-plated copper bussing.

.5 Captive horizontal splice bars with self-contained nuts and hardware.

.6 Grounding in each section.

.7 Quarter-turn fasteners on unit and wireway doors, all hinged.

.8 A full-depth vertical wireway.

.9 Unit door hinge pins easily removed with a screwdriver for general maintenance.

.10 Each unit is fully compartmentalized, having solid side, back, and bottom plates.

.11 A hinged, unit bottom plate for more wiring space.

.12 Leveling notches in the base channel provide a means of aligning the section during installation.

.13 Main Lugs for incoming feeder to be copper.

.14 MCC shall contain individual units as per drawings.

.15 Supply all fuses, type to be suitable for the application.

.16 Starter to have defeatable mechanically interlocked equipment door, to prevent opening when handle in "on" position.

.17 Copy of wiring and schematic diagram inside starter enclosure in readily visible location and permanently secured.

.18 All enclosure parts to be phosphatized and electrostatic powder paint coat.

.19 Provide one (1) copy of software and one USB cable for each type of device for each of the MCCs.

.20 Provide screw-type terminal blocks for all internal component wiring terminations within the MCC and for all incoming field wiring, including network communications wiring. Only one wire under each screw is permitted, unless otherwise approved by Consultant. Provide 20% spare terminals for future use.

.21 Switches and indicators and other devices as per Section 17051.

.22 MCC manufacturer to ensure that the MCC is designed to prevent nuisance communications alarms associated with the loss of Hydro power on the MCC. Acceptable solutions may include distributing UPS power (120 VAC and/or 24 VDC) to the motor starters, VFDs and other network components within the MCC.

2.3 FIELDBUS COMMUNICATIONS

.1 All starters, VFD and overload relays supplied under this contract are to be intelligent devices capable of two-way communication.

.2 Communication is to be Ethernet/IP. Fully compatible with specified Rockwell CompactLogix/ControlLogix PLCs.

.3 For the Shop Drawing stage, the MCC supplier is to provide wiring details specific to selected communication protocol. Drawings are to be project specific.

2.4 ETHERNET SWITCHES

.1 Provide managed Ethernet switch(es) as indicated. Each switch is to be equal to (or better than) the Allen-Bradley Stratix 5700 Series c/w full software. rovide sufficient number of switches for the number of ports required in the MCC. Provide a minimum of four (4) spare ports in the switch.

.2 Each switch is to be powered via a 24 VDC power supply system. 24 VDC power supply system to be provided by the MCC supplier and located inside the MCC.

.3 Full mounted starters (or equipment) can share an Ethernet switch. This switch may reside in a separate section from the full mounted equipment.

2.5 24 VDC POWER SUPPLY

.1 24 VDC power supply system for the Ethernet switches inside the MCC.

.2 Power supplies to be fed from external 120 VAC (UPS) power. Provide circuit breakers, terminal blocks, and other appurtenances required.

.3 Provide an alarm dry contact on the power supply for external monitoring by a PLC.

2.6 ETHERNET BACKBONE CABLING

.1 Provide Category 5e/6 Ethernet cabling throughout the MCC for connection to all the components that communicate on Ethernet.

.2 Cable lengths between switches not to exceed 90m.

.3 Cable to meet the following minimum requirements:

- .1 Foil and braided shield, PVC, eight conductors (4-pair).
- .2 600V PVC cable designed to support high voltage applications.
- .3 On-machine rated cable for use in a cable tray shared with high voltage power cables.
- .4 RJ 45 insulation displacement connector available for field terminations.
- .5 Wide thermal operating range of -20°C to 80°C.
- .6 CSA/cUL listing.

.4 Star topology.

.5 Provide Ethernet adapters, as required for Ethernet cable connections.

2.7 VOLTAGE SEPARATION AND EMI

.1 MCC manufacturer to ensure that the Ethernet cabling is fully protected and isolated from the 600VAC and other power inside the MCC. Run Ethernet cabling in wiring ways and via other means for protection.

.2 Ensure Ethernet cabling is fully protected and isolated from EMI, particularly from VFDs.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide a lamacoid nameplate for each starter and disconnect unit with description of load.

.2 Lamacoid nameplates to be 6 mm black letters on white background, screwed onto covers.

2.9 MANUAL OPERATOR INTERFACE (PUSHBUTTONS, PILOT LIGHTS, ETC.)

.1 Each pilot light to meet the following:
- .1 Factory assembled.
- .2 Push-to-test.
- .3 120VAC LED.
- .4 NEMA 12.
- .5 Colour as indicated.
- .6 30 mm diameter.
- .7 Heavy industrial rated.
- .8 Finger-safe guards.
- .9 CSA certified.
- .10 Acceptable product:
  - .1 Allen-Bradley 800TC series, or approved equivalent.
- .11 Pilot light colours:
  - .1 Amber: Fault.
  - .2 Red: Stopped.
  - .3 Green: Running.
  - .4 Colours not final until shop drawings have been reviewed.

.2 Each 3-position selector switch to meet the following:
- .1 Factory assembled.
- .2 Finger-safe guards.
- .3 Non-illuminated.
- .4 Standard knob with white insert.
- .5 Maintained Operator function.
- .6 Contact rating of 600VAC and 600VDC.
- .7 30 mm diameter.
- .8 NEMA 12.
- .9 Number of contacts as required for the control circuit. Capable of accepting additional contact blocks.

.10 Heavy industrial rated.
.11 CSA certified.
.12 Acceptable product:
.1 Allen-Bradley 800TC series, or approved equivalent.

.3 Each potentiometer to meet the following:
.1 Factory assembled.
.2 Finger-safe guards.
.3 Non-illuminated.
.4 Standard knob with white insert.
.5 30 mm diameter.
.6 NEMA 12.
.7 Resistance rating to suit.
.8 Heavy industrial rated.
.9 CSA certified.
.10 Acceptable product:
.1 Allen-Bradley 800TC series, or approved equivalent.

.4 Each pushbutton to meet the following:
.1 Factory assembled.
.2 Finger-safe guards.
.3 Non-illuminated.
.4 Colour as indicated.
.5 Contact rating of 600VAC and 600VDC.
.6 30 mm diameter.
.7 NEMA 12.
.8 Number of contacts as required for the control circuit. Capable of accepting additional contact blocks.
.9 Heavy industrial rated.
.10 Extended head for stop operations, flush head otherwise.
.11 CSA certified.
.12 Acceptable product:
.1 Allen-Bradley 800TC series, or approved equivalent.

.5 Each legend plate shall meet the following:
.1 Provide a legend plate for each of the following:
.1 Pilot light.
.2 Selector switch.
.3 Potentiometer.
.4 Pushbutton.
.5 Emergency stop.
.2 Aluminum.
.3 NEMA 12.
.4 Engraved by the manufacturer.
.5 Gray in colour.
.6 Acceptable product:
.1 Allen-Bradley 800T standard or jumbo legend plate, or approved equivalent.

.6 Each AC Hour meter to meet the following:

.1 Records up to 99,999 hours; automatically resets to zero.
.2 120VAC, 60Hz.
.3 Accuracy of at least ± 0.02%.
.4 Screw termination.
.5 Glass lens.
.6 CSA certified.
.7 Acceptable manufacturer:
  .1 Hobbs, or approved equivalent.

2.10 MCC STARTERS

.1 NEMA rated FVNR starters for HP and AMPS, with 120 VAC/60HZ coils complete with surge suppressor.

.2 Series C or better magnetic moulded case 3-phase circuit breaker with 18 KA sym. rms interrupting capacity.

.3 Self-protected fully programmable electronic 1-NC starter. 1-NC spare auxiliary contacts on contactor, 1-NO 1-NC on switch and 1-NO 1-NC trip indicating contacts.

.4 Network Communications capable of:
  .1 Monitoring individual currents.
  .2 Monitoring faults.
  .3 Monitoring auxiliary devices.
  .4 Monitoring status.
  .5 Setting O/L and trip settings.
  .6 Operating starter.
  .7 Trip reset.

.5 Hand-Off-Auto, 3-position selector switch:
  .1 Hand = Motor Runs.
  .2 Off = Motor Stops.
  .3 Auto = Motor controlled by PLC via Network communications. Network communications advise PLC that switch is in Auto.

.6 Pilot Lights, individual units, heavy duty, LED cluster type bulbs, push to test:
  .1 Running (Green).
  .2 Stopped (Red).
  .3 Tripped (Amber).

.7 Fault reset via local reset button as well as over the Network Communications.

.8 Remote station supplied by the contractor will include .5, .6 and above. Include standard wiring diagrams for remote stations as part of shop drawings.

.9 Hardwired run time meter: 100,000 hrs.

.10 Motor overload protective device in each phase, manually reset.

.11 FVNR overload relays to be E300 series, or approved equivalent.

.12 Soft starters to meet the following:
- .1 Soft start with selectable kickstart.
- .2 Dual ramp start.
- .3 Current limit start with selectable kickstart.
- .4 Full voltage start.
- .5 Pump control.
- .6 Built-in electronic motor overload protection.
- .7 Built-in SCR bypass/run contactor.
- .8 CT on each phase.
- .9 Soft stop.
- .10 Metering.
- .11 Keypad programming.
- .12 Minimum of three (3) programmable auxiliary contacts.
- .13 LCD display.
- .14 600VAC.
- .15 CSA C22.2 No.14 compliant.
- .16 Acceptable product:
  - .1 Allen-Bradley SMC™ Flex series Ethernet soft starter, or approved equivalent.
- .17 For each soft starter provide the following Operator interface on the door of the motor starter cell to facilitate manual operation of the soft start:
  - .1 AC Hour Meter.
  - .2 Fault pilot light.
  - .3 Stopped pilot light.
  - .4 Running pilot light.
  - .5 Fault reset pushbutton.
  - .6 3-position Hand-Off-Auto selector switch.

.13 Each starter to be wired to facilitate local manual control at the motor. Refer to Section 17051.

2.11 MCC FEEDER UNITS

.1 Series C thermal-magnetic moulded case 3 phase circuit breaker with 18 KA sym. rms interrupting capacity or disconnect and fuses as indicated.

.2 1-NO and 1-NC spare auxiliary contacts on switch.

2.12 MCC MAIN

.1 As indicated.

2.13 SPD

.1 Surge Protective Device equal to Innovative Total Protection Services Service Track ST-160 series to be mounted in the MCC, as indicated, or approved equivalent.

2.14 POWER MONITOR

.1 Voltage input: up to 600 Vac L-L without the use of PTs. Note the use of NGRs.

.2 Capable of measuring the following:
- .1 Voltage.
- .2 Amperage.
- .3 Watts.
- .4 Vars.
- .5 VA.
- .6 Power Factor.
- .7 Frequency.
- .8 Voltage and current to the 31st harmonic.
- .9 Watt-Hours.
- .10 Var-Hours.
- .11 VA-Hours.
- .12 Demand (Ampere, Watt, Var, VA).

.3 Capable of holding minimum and/or maximum values for the following:
- .1 Volts (L-L, L-N).
- .2 Current (A, B, C).
- .3 Power (Watts, Var, VA).
- .4 Power Factor.
- .5 Frequency.
- .6 THD (Volts, Amperes).
- .7 Demand Values.
- .8 2 Alarms.

.4 Display: Remote, LCD with back lighting, adjustable contrast.

.5 Outputs: 4 programmable, optically isolated discrete output ports.
- .1 Provide relay board C/W two Form C relays. Program one relay to change state upon a loss of 600V power to the MCC. Provide wiring to terminal blocks inside the MCC. Contractor to wire this relay to the associated PLC panel.

.6 Inputs: 4 programmable, optically isolated discrete input ports.

.7 Ethernet Communications.

.8 Acceptable product:
- .1 Allen Bradley Power Monitor 5000 M5 Series, or approved equivalent.

2.15 VFD

.1 Refer to Section 16812.

2.16 MANUAL TRANSFER SWITCH

.1 Reserved.

2.17 SPARE FUSES

.1 For three phase circuits provide six (6) spare fuses of each type and size.

.2 For single phase circuits provide four (4) spare fuses of each type and size including control circuits.

2.18 ACCEPTABLE MCC

.1 Acceptable product:
- .1 Allen-Bradley Ethernet 2100 Series with Intellicenter.
- .2 Eaton equivalent.
- .3 Schneider equivalent.

PART 3 – EXECUTION

3.1 INITIAL START-UP

.1 Before placing motor on load:

.2 Ensure that overload relays are properly sized and wired into circuit.
- .1 Check all circuit protective devices.
- .2 Ensure that external control wiring has been verified. Record any changes on control diagrams.
- .3 Perform phase rotation check.

.3 Refer to General Conditions for Reporting procedures.

3.2 ETHERNET NETWORK COMMISSIONING

.1 MCC manufacturer to fully test the Ethernet network to ensure conformance with ODVA Ethernet/IP requirements.

.2 Tests to include, traffic, analysis, including collisions, bandwidth issues, cable length issues, packet losses, etc. Provide test reports upon completion of commissioning.

3.3 TRAINING

.1 Refer to Division 1.

.2 Provide two (2) four (4) hour training sessions onsite. Training sessions to be at least 2 weeks apart. These two (2) training sessions shall be separate from any onsite commissioning and startup sessions. First training session to include the following:
- .1 Operation of the starters and devices on the MCC.
- .2 The Operator interface for the MCC, including accessing the different screens on all the displays on the MCC, including the VFDs, softstarts, and power monitor.
- .3 Operation of the equipment via the Operator interfaces provided on the MCC, including starting and stopping motors as well as changing the speed and resetting alarms and breakers.

.4 Maintenance requirements of the equipment, per the manufacturer's recommendations.

.5 The Intellicentre software on the SCADA computer. Train Owner's personnel on how to use and interpret the data from this software. Coordinate with the Systems Integrator. The Systems Integrator will install this software on the SCADA computer.

.6 Other items per the manufacturer's recommendation as well as per the Owner's request. Provide a training agenda to the Owner at least two (2) weeks prior to scheduling, for their review and feedback. The equipment O&M manuals shall be provided to the Owner at least two (2) weeks prior to the first training session.

.3 The second training session is to re-cap the items covered in the first training session plus any other items raised by the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Refer to motor starter and control list on drawings, to establish materials supplied under other Divisions for installation and/or wiring in this Division.

1.2 PRODUCT DATA

.1 Check reviewed mechanical shop drawings before roughing-in electrical service.

.2 Check single line diagrams submitted with mechanical shop drawings or product data to ensure that functions of each mechanical system can be performed.

.3 Where mechanical equipment submitted for review requires service or controls other than specified, advise Consultant.

.4 Coordinate the characteristics and the integration of the variable frequency drive units with Division 15 and the manufacturer of the drive motor equipment. Obtain shop drawings and motor nameplate data from General Contractor.

1.3 AS-CONSTRUCTED DRAWINGS

.1 Show interconnection of mechanical and electrical components on As-Constructed Drawings.

1.4 MOTOR VOLTAGES

.1 Motor voltages characteristics are generally as follows:
- .1 400 W and smaller: 120 V, 1 phase, 60 Hz.
- .2 600 W 1/2 hp and larger: 600 V, 3 phase, 60 Hz.
- .3 Refer to motor starter list for exceptions to above.

1.5 OPERATION AND MAINTENANCE DATA

.1 Submit operation and maintenance data for each type and style of starter.

1.6 SHOP DRAWINGS

.1 As per Division 1, submit shop drawings, including a complete wiring diagram and faceplate layout in PDF format, trip curves for each type of overload to Consultant for approval.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR STARTERS

.1 Provides overload protection as well as manual on/off control for small motors.

.2 Number of poles to suit. Provide two-pole as required for controls, as indicated.

.3 Horsepower, voltage and phase as indicated.

.4 “Quick-make” and “quick-break” mechanism.

.5 NEMA rating as indicated.

.6 Rated for industrial applications.

.7 Red neon pilot light. Pilot light energized when motor is running.

.8 Terminals rated for intended wire size.

.9 Mounting style as indicated.

.10 Toggle, padlockable handle. Padlockable in the OFF position.

.11 Provide plug-in heater element, keyed to ensure proper positioning. Heater to have adjustable knob to allow setting of plus or minus ten percent of nominal heater rating.

.12 For each manual motor starter provide three (3) spare thermal units in original packing to Owner.

2.2 ACROSS-THE-LINE MAGNETIC MOTOR STARTERS

.1 Across-the-line magnetic motor starters of size, type and W, hp or kW rating as indicated.

.2 Combination across-the-line magnetic motor starters with moulded case circuit breaker.

.3 CSA Type 4 ANSI 61 Grey enclosure for all starters except where indicated otherwise. Refer to Section 17051 for requirements of enclosures.

.4 Power and control terminals.

.5 Half-size starters not acceptable.

.6 All starters to be IEC rated.

2.3 STARTER COMPONENTS

.1 Each starter to have motor overload protective device in each phase, manually reset from outside of enclosure.

.2 All starters to have defeatable mechanically interlocked equipment door, to prevent opening when handle in "on" position.

.3 Copy of wiring and schematic diagram inside starter enclosure in readily visible location and permanently secured.

2.4 AUXILIARY CONTROL DEVICES

.1 As per Section 17051.

.2 Control transformer, 600 V, 60 Hz primary, 120 V single phase secondary, VA rating to suit loading of controls plus 20% margin, fused on secondary side.

.3 2-NO and 2-NC spare auxiliary contacts in addition to maintained auxiliary contact and those shown.

.4 Hand-Off-Auto selector switch oil tight, heavy duty type labelled as indicated with 3-N/O, 3-N/C contacts.

.5 Pilot lights oil tight, heavy duty, LED type. Lens colour Red to indicate equipment stopped, Green for running and Amber for faults.

.6 Momentary contact fault reset push buttons. Colour to be blue.

.7 Magnetic control relays, operating coil voltage as indicated. Contacts interchangeable from N/O to N/C.

2.5 FINISH FOR STARTERS

.1 Finish interior and exterior in accordance with Section 16010.

2.6 EQUIPMENT IDENTIFICATION

.1 Refer to Section 16010.

2.7 MANUFACTURERS

.1 All motor control equipment to be product of one manufacturer.

.2 Acceptable manufacturers:
- .1 Eaton
- .2 Rockwell Automation
- .3 Square D.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install enclosed starters and auxiliary control devices, make power and control connections as indicated.

3.2 WIRING

.1 Provide all necessary wiring for mechanical controls, panels, damper motors, thermostats, etc., as detailed in Division 15. Only principal connections are shown on electrical drawings.

.2 Identify each wire, and terminal for external connections, with permanent number marking identical to diagram.

3.3 INITIAL START-UP

.1 Before placing motor on load:
- .1 Ensure that overload relays are properly sized and wired into circuit.
- .2 Check all circuit protective devices.
- .3 Ensure that external control wiring has been verified. Record any changes on control diagrams.
- .4 Division supplying motor must be present.

3.4 TESTS

.1 Conduct tests in accordance with Section 16010.

.2 Verify voltage and current on starting and running cycles on each phase of supply circuit.

.3 Check rotation of motors.

.4 Operate switches and controls to verify correct functioning in conjunction with Division 15.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 NEMA MG1, Part 30.

.2 NEMA MG1, Part 31.

.3 IEEE – 819.

.4 CSA 22.2.

.5 UL 508c.

.6 EMC emissions-EN50081-2, EN61800-3.

.7 Section 16801, MCCs.

1.2 INTENT OF SECTION

.1 Provide all labour, equipment, material, supervision and design, testing, supply, installation and commissioning services required for complete variable frequency AC induction motor drive (VFD) systems.

.2 Confirm the application of each drive and provide variable torque units to suit the specific requirements of each drive.

1.3 SUBMITTALS

.1 Shop Drawings as per Division 1:
- .1 Submit shop drawings to Consultant for approval, per Division 1.
- .2 Include the following:
  - .1 Dimensioned outline drawing.
  - .2 Schematic diagram.
  - .3 Component list, including makes and models.
  - .4 Component heat generation and cabinet heating/cooling.
  - .5 Power and control connection diagram(s).
  - .6 Table of Programmable Parameters and VFD software and one Programming Cable.
  - .7 AMP and HP full load ratings, short circuit input withstand rating.
  - .8 The harmonic current shall not exceed IEEE-519 recommendations.
  - .9 Performance data and rating of input reactor, inductance, and resistance values.
  - .10 Performance data on EMC emissions RFI filter.
  - .11 Harmonic filter complete with contractor cutout.
- .3 Provide two (2) copies of VFD software (latest MS Windows operating system), and two (2) programming interface cables.

.2 Operation and Maintenance Manual:
- .1 Include updated Table of Programmable Parameters reflecting site calibration settings and adjustments in electronic and paper format.

1.4 ON-SITE START-UP

.1 See General Conditions.

1.5 COORDINATION WITH DIVISION 15

.1 Coordinate the characteristics and the integration of the variable frequency drive units with the manufacturer of the drive motor equipment. Obtain shop drawings and motor nameplate data from General Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide a continuous duty, solid state, variable frequency drive (VFD) system suitable for operation on the plant electrical power system and controlled locally and remotely via hardwired logic and PLC I/O as indicated.

.2 Each VFD system to consist of, but not be limited to, the following major components:
- .1 Enclosure.
- .2 Padlockable main disconnect and fusing.
- .3 3% input line reactor.
- .4 Input RFI filter.
- .5 VFD-IGBT type.
- .6 5% output line reactor/harmonic filter.
- .7 Program and display interface.
- .8 Hand-off-auto.
- .9 Speed control (manual mode).
- .10 Run, stop, fault indicators.
- .11 Run time meter.
- .12 Provide optional Ethernet communication module.

.3 All VFD motors shall be inverter duty to NEMA MG1, Part 31.

2.2 ENCLOSURE

.1 Mounted inside MCC, as indicated.

.2 Provide the following Operator Interface on the door of the MCC cell:
- .1 AC hour meter.
- .2 Fault pilot light.
- .3 Stopped pilot light.
- .4 Running pilot light.
- .5 Fault reset pushbutton.
- .6 3-position Hand-Off-Auto selector switch.
- .7 Speed Potentiometer (0% to 100%).
- .8 Human Interface Module (HIM).

.9 Provide additional pilot lights per Section 16801 if the VFD is setup as a hybrid starter. For example, if forward-reverse functionality will be implemented using the VFD, then provide forward-reverse pilot lights and corresponding 3-position selector switch as well.

.3 Refer to Section 16801 for requirements of the Operator Interface devices.

.4 Provide adequate ventilation in cabinet to suit heating load from all components including VFD, line reactor, harmonic filters, control transformers, and power supplies. Provide itemized heat load as part of the shop drawings. Include feedback control for ventilation fan, for example via thermostat to extend the operating life of the ventilation fan. Ventilation fan to run when the VFD is running and remain on until the VFD cools down after it has stopped.

.5 Provide terminal blocks and Panduit wire ducts to keep installation neat. Label all wires and terminals. Assemble panels in such a way that the power feeders are kept clear of the analog control signals (minimum of 150 mm clearance).

.6 Input 600 VAC fusible switch with fuses shall be provided.

2.3 INPUT LINE REACTOR

.1 Provide input line reactor to suit. Refer to drawings.

2.4 LOAD SIDELINE REACTORS

.1 Provide output load reactor inside the MCC to suit. Refer to drawings.

2.5 VFD

.1 The VFD shall be rated as indicated 600 VAC, 60 Hz with selectable motor control; sensorless vector with full tuning; standard V/Hz with custom capability and vector control.

.2 The VFDs shall be of the Pulse Width Modulated (PWM 6 or 12 pulse) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Insulated gate bipolar transistors (IGBT) shall be used in the inverter section.

.3 The VFDs shall have efficiency that exceeds 97% at 100% speed and load. The load efficiency shall exceed 80% at 10% speed and load.

.4 The VFDs shall maintain the line side displacement power factor at no less than 0.90, regardless of speed and load.

.5 Normal duty drives shall have a 110% overload rating for one (1) minute when applied to variable torque loads and 150% overload rating for one (1) minute when applied to constant torque loads.

.6 Heavy-duty drives shall have a 150% overload rating for one (1) minute when applied to variable torque loads and 200% overload rating for one (1) minute when applied to constant torque loads.

.7 The VFDs shall be capable of operating any NEMA B squirrel cage induction motor, with an SF=1.15, regardless of manufacturer, with a load rating equivalent to the capacity of the VFDs.

.8 The VFDs shall be able to start into a spinning motor. The VFDs shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

.9 Standard operating conditions shall be:

.1 Incoming Power: Three-phase, 600 V (+10% to -15%) and 47 to 63 hertz.
.2 Frequency stability of +/-0.5% for 24 hours with voltage regulation of +/-2% of maximum rated output voltage.
.3 Motor slip dependent speed regulation of +/-0.5%.
.4 Logic Control Ride-Thru, 0.5 seconds minimum, 2 seconds typical.
.5 Insensitive to input line rotation.
.6 Humidity: 0 to 95% (non-condensing and non-corrosive).
.7 Altitude: 0 to 3,300 feet above sea level.
.8 Ambient operating Temperature: 0 to 40 C (NEMA 1).
.9 Storage Temperature: -40 to 60 C.
.10 Starting Torque: 150% for constant torque loads and 110% for variable torque loads.
.11 Output frequency: 0 to 400 HZ.
.12 Frequency resolution: 0.01 HZ.
.13 Switching frequency: 2 to 10 KHz. Drive rating based on 4 kHz.
.14 Acceleration time: 0.1 to 20 seconds.
.15 Deceleration time: 0.1 to 20 seconds.
.16 Vibration: 0.152 mm displacement, 1G peak. Vibration to IEC721-3-3.
.17 Shock: 15G peak for 11 mg duration (+/- 1.0 ms). Shock to IEC68-2-27.
.18 Braking Torque: 30% Tn with regeneration limit circuitry.

2.6 COMMUNICATIONS

.1 Compatible with starters.

.2 Communication capable of:

.1 Monitoring individual phase currents.
.2 Monitoring faults.
.3 Monitoring auxiliary devices.
.4 Monitoring status.
.5 Setting O/L and trip setters.
.6 Configuring drive parameters.
.7 Operating VFD.
.8 Trip reset, fault clear.

.3 VFD to include Ethernet communication module, as indicated.

2.7 VFD OPERATING CONTROLS

.1 HOA via selector switch.

.2 Manual: HIM, potentiometer.

.3 Remote (Auto): PLC controlled on/off, direction (if used) and speed via hardwired logic, PLC I/O or Network communication as indicated.

.4 E-STOP (emergency stop): via keypad regardless of operating mode.

.5 Pilot Lights:
- .1 Run (Green)
- .2 Stopped (Red)
- .3 Fault (Amber)

.6 Run time meter: 0 to 100,000 hrs.

.7 For local control stations (LOC), the VFDs to be configured for start/stop operation via Hand-Off-Auto switches, which shall be located remotely from the VFD, as indicated.

2.8 VFD CONTROL FUNCTIONS

.1 All VFD programmable parameters shall be adjustable from a digital operator keypad located on the front door of the VFD or via Microsoft Windows software and RS232 communications. Parameters shall include:
- .1 Programmable speed command (keypad, remote).
- .2 Programmable start command (keypad, remote).
- .3 Forward or reverse start, stop and digital speed control.
- .4 Programmable maximum and minimum frequency limits.
- .5 Programmable acceleration and deceleration times (2 each).
- .6 Programmable critical frequency avoidance lockout zones.
- .7 Programmable electronic overload and torque limits.
- .8 Programmable multiple attempt restart.
- .9 Programmable jog and preset speeds.
- .10 Programmable "Catch a Spinning Motor" function.
- .11 Programmable output digital relay (2).
- .12 Programmable output analog signal.
- .13 Programmable DC Injection Braking Time.
- .14 Programmable PI process control.
- .15 Programmable digital potentiometer.

.2 Provide minimum 2 programming cables and no less than 1 cable per 3 VFDs.

.3 Input Interfaces:
- .1 Process control speed reference interface to receive either a 0-10 Vdc, 4-20 mA dc or speed potentiometer signal.
- .2 Remote mode start and stop contacts.
- .3 Remote forward/reverse contacts.
- .4 Remote preset speed contacts.
- .5 Remote external trip contact.
- .6 Remote reset contact.
- .7 Remote jog contact.
- .8 Remote analog speed control

.4 Output Interfaces:
- .1 Programmable digital relays N/O and N/C contacts. Number of contacts as indicated.
- .2 Form C contact to indicate protective function trip.
- .3 Two (2) programmable analog output signals.

.5 PLC I/O Interfaces:
- .1 Provide the PLC I/O interface as indicated.

2.9 VFD DISPLAY

.1 Monitoring and Display: Have a 2-line, 16-character display, indicating monitored functions as described in the following:
- .1 Output current.
- .2 Output frequency.
- .3 Motor rpm.
- .4 Output voltage.
- .5 Power.
- .6 Load.
- .7 Elapsed time.
- .8 Trip cause.
- .9 Active alarms

2.10 VFD PROTECTIVE FUNCTIONS

.1 Overcurrent protection.

.2 Overvoltage protection.

.3 Undervoltage protection.

.4 Phase loss protection.

.5 Over-temperature protection.

.6 Ground fault protection.

.7 Adjustable current limit.

.8 Line-to-line and line-to-ground output short-circuit protection.

.9 DC injection braking.

.10 Motor winding over-temperature sensor input.

.11 Overload capability shall be 150% full capacity amperes for 60 seconds.

2.11 INPUT LINE REACTOR

.1 Built-in 3% load reactor.

2.12 INPUT RFI FILTER

.1 Mount inside the enclosure.

.2 To meet EN50128, EN61800-3.

2.13 WIRING

.1 Provide all internal wiring, copper conductor, stranded, 600 V rated, 75℃ minimum.

.2 Each wire is to be uniquely identified by a wire marker on either end. Wire identification to correspond to wire numbers on the schematic and control diagrams. Colour coding is not acceptable.

.3 Provide modular terminal blocks for all external control wiring connections, 600 V, 25 A rating, DIN rail mounted. Label each terminal with same designation as the connecting wire.

.4 Group terminal blocks according to voltage or signal level and function. Provide 150 mm space between rows of terminals blocks. Install no more than two conductors per block.

2.14 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 16010.

.2 Provide nameplates for all face-mounted components.

.3 Identify all interior sub-assemblies' compartments with adhesive backed labels.

.4 Provide lamacoid warning nameplates, 5 mm white lettering on red background, indicating presence of live circuit when VFD is in normal mode. Mount on all access doors and internal compartment doors or barriers.

2.15 HEAVY DUTY

.1 VFDs to be heavy duty.

2.16 ACCEPTABLE PRODUCTS

.1 Acceptable Products:
- .1 Allen-Bradley Power Flex Series (70/700 series or latest revision)
- .2 Eaton equivalent, or
- .3 Schneider equivalent.

PART 3 - EXECUTION

3.1 CABINET ASSEMBLY

.1 In addition to shop drawings, provide hard and electronic assembly drawings, AutoCAD compatible.

.2 Provide test reports to the Consultant prior to shipping the cabinet to the site.

3.2 START-UP

.1 Refer to General Conditions.

END OF SECTION

PART 1 - GENERAL

1.1 NOT APPLICABLE

.1 Not Applicable.

PART 2 - PRODUCTS

2.1 MATERIAL STANDARDS

.1 Electric heaters to CSA C22.2 No. 46

.2 Controls to CSA C22.2 No. 24.

2.2 GENERAL

.1 Provide electric heaters complete with relays, contactors, switches, thermostats and wiring required to make a complete installation. Install all control wiring in conduit. Refer to 16133.

.2 Use heaters of type and wattage, as indicated. Provide all fittings and hangers to complete installation and install to manufacturer's recommendations.

.3 Cabinet unit heaters and unit heaters to be provided with OEM wall mounted thermostats to be field installed and wired.

2.3 HEATER TYPES

.1 Baseboard Electric Heaters (Type EBB): Ouellet OFM series baseboard heater. Use standard watt density type 275W/ft. Relay for low voltage control by Div 16.

.2 Electric Cabinet Unit Heater (Type CUH): Oulette OCA series surface mounted cabinet unit heater. Voltage and capacity as scheduled. White finish. Provide wall mounting bracket and backplate for bottom inlet top discharge. Provide OEM low voltage thermostat for field installation on wall c/w transformer and relay.

.3 Electric Unit Heater (Type UH): Oulette OAS series wall mounted unit heater. Voltage and capacity as scheduled. Almond finish. Provide swivel wall mounting bracket. Provide OEM low voltage thermostat for field installation on wall c/w transformer and relay. Epoxy coated fan blades. Sealed element.

.4 Explosion Proof Electric Unit Heater (Type UH variant) Oulette OHX series wall mounted unit heater. Voltage and capacity as scheduled. Red finish. Provide swivel wall mounting bracket. Provide OEM explosion proof low voltage thermostat for field installation on wall c/w transformer and relay. Baked phenolic coating and all component exposed to environment. All components to be rated for an OESC Class 1 Zone 1 installation.

2.4 MAUNUFACTURERS

.1 Acceptable Manufacturers:
- .1 Chromalox
- .2 Stelpro
- .3 Oulette
- .4 Westcan

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install wiring to heaters and thermostats to manufacturer's instructions.

.2 Install heaters to manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

.1 Electrical contractor to provide CSA Certified electric heat trace cable with temperature control for freeze protection on Sampling Lines and Chemical Injection Lines noted on design drawings.

.2 Mechanical contractor is responsible for providing and installing all piping and insulation.

.3 Power and electrical details as per electrical design drawings.

.4 Insulation details as per mechanical design drawings.

1.2 SUBMITTALS

.1 Provide shop drawings per Division 1. Include heat trace calculations.

PART 2 - PRODUCT

2.1 HEATING CABLES

.1 Heating cable to be a self-regulation type cable to be used for freeze protection on process piping (insulated) above ground.

.2 Cable to have power output to suit and operate on 120 V or 208 V, as required by the application. Other series per the manufacturer's recommendation.

.3 Standard type jacket (polyolefin).

.4 Specified Manufacturer: Raychem BTV Series.

.5 Provide Pentair Mineral Insulated Heating cables in hazardous locations.

2.2 ACCESSORIES

.1 High temperature glass filament tape attaching cable to pipe at 300 mm intervals. Metal or plastic cable ties are not permitted.

.2 Power connection, splice/tee and end seal kits to be compatible with selected heating cable.

.3 "Electric Traced" label. One (1) installed every 10 feet of pipe.

.4 Installation shall not require installing contractor to cut into the heating cable core to expose the bus wires.

.5 Connection kits shall be NEMA 4X rated to prevent water ingress and corrosion. All connection kits to be UV resistant.

.6 Connections kits shall be CSA Certified.

2.3 CONTROL

.1 Provide Pentair JBS-100-ECP-A and Pentair JBS-100-ECW-A electronic temperature controllers in non-hazardous areas. Select wall mount/pipe mount to suit application. Use Pentair Raystat-EX-03-A electronic thermostat in hazardous locations. Each controller to be equipped with at least one Form C contact for alarm monitoring by the plant control system.

PART 3 - EXECUTION

3.1 DESIGN

.1 Heat trace manufacturer to provide final heat trace design complete with component selections, including heating cable, controllers and all required appurtenances. Refer to drawings for specific heat trace requirements.

3.2 INSTALLATION

.1 Install heat trace cables according to design details and manufacturer's instructions.

.2 Secure cable to piping at 300 mm intervals with recommended tape.

.3 Allow cable for valves, flanges, etc.

.4 Do not bunch or cross cable.

.5 Provide ground fault breakers, sized to suit.

.6 Provide contactors as required.

.7 Install labels on insulation.

.8 Follow manufacturer's recommendations.

3.3 TESTING

.1 Test heating cable after installation on pipe and prior to insulation being installed.

.2 Test cables as per the manufacturers testing requirements:
- .1 Test A: Inner Dielectric jacket integrity test.
- .2 Test B: Outer jacket integrity test.

.3 Follow all required safety precautions, including locking out power.

.4 Megohmmeter to readings should be done at 500Vdc for 1 minute. Record the insulation resistance in the inspection report. Repeat above using 1000 and then 2400 Vdc.

.5 Refer to manufacturer's insulation resistance criteria for acceptable testing results.

.6 Submit all test reports.

3.4 EQUIPMENT SELECTION

.1 Heat trace supplier shall provide written confirmation in the shop drawing that the selected cables, controllers and accessories will meet the requirements for the various applications as outlined in the drawings and per site conditions. Supplier to visit site as required.

3.5 CERTIFICATION

.1 Provide written documentation from the heat trace supplier confirming that the heat trace system is installed and commissioned and meets the manufacturer's requirements. The heat trace installation shall be inspected prior to installation to any pipe insulation or other materials that may obstruct visual inspection. The written documentation shall include annotated high quality colour photographs of the installations.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE SECTIONS

.1 Reference Sections:
- .1 Section 17210 - PLC Specification, Basic Programming Requirements
- .2 Section 17310 - SCADA Specifications, Basic Programming Requirements
- .3 Section 17500 - Control Narrative, General Overview
- .4 Section 01021 - Equipment Testing, Commissioning and Operator Training

1.2 SCOPE OF SUPPLY

.1 The scope of supply will generally be as listed in Part 2 of this specification section.

1.3 REFERENCE STANDARDS

.1 Electrical: CSA and local Electrical Inspection Authority Approval for complete installation.

.2 Electrical: any requirements of local Electrical Authority.

.3 Designed to be in compliance with all applicable municipal, provincial and national codes and standards.

.4 Industry standard for water/wastewater plant control systems.

.5 Municipality of Brighton PLC and SCADA Standards.

.6 The SCADA system is considered an “Engineered” solution rather than just “programming”. The SI’s approach shall thus be in accordance with this consideration. The SI shall employ trained and experienced personnel in the development of Engineered SCADA solutions for water/wastewater applications. This encompasses a wide range of subject areas including, but not limited to: Software Engineering, IT Systems, Electrical Engineering, Human Psychology and Physiology, and associated latest Industry best practices. As such, the SI to remain current with the latest developments in industry and how to successfully employ them in delivering Engineered SCADA solutions for water/wastewater applications.

1.4 TESTING AND COMMISSIONING

.1 Plant controls to be thoroughly tested and verified in accordance with the specifications provided herein.

PART 2 - PRODUCTS

2.1 SCOPE OF SUPPLY

.1 The following is a summary of major services to be supplied. The list is not necessarily all inclusive and the proponents should include for all necessary options and accessories to meet the intent of the specifications.

.1 Provide all programming required for the new PLC(s). This may include temporary programming of new PLCs and/or HMIs as required by the commissioning process.

.2 Provide all programming required for the plant PLC and SCADA, including modifications to the existing PLC and SCADA system.

.3 Provide Operations and Maintenance Manuals as per Division 1.

.4 Provide Operator Operations and Maintenance ing as per Sections 17210 and 17310 as well as per Division 1.

.5 Allow for an increase of up to 20% in the number of hardwired and networked I/O points.

.6 Configure all Ethernet switches and routers. This will include setting up VLANs, VPNs and other traffic management measures.

.7 Commission all Ethernet communications.

.8 Commission the alarm system including alarm dialing of new alarms.

.9 Commission PLC and SCADA communications.

.10 SCADA to PLC I/O verification of all hardwired and network I/O points.

.11 SI to coordinate with the Electrical Contractor for up-to-date equipment shop drawings, including shop drawings for pre-packaged equipment.

.12 Provide a detailed automation checkout report. The report to document normal and abnormal scenarios. Such scenarios shall test the system response to the failure of certain equipment and instruments as well system response to abnormal process conditions.

.13 Provide a detailed alarm verification report. All alarms to be set up with the assistance of the Operator, verified in the presence of the Operator and signed off by the Operator.

.14 Allow for a minimum of fifteen (15) days on site for system verification with the Consultant. System verification may require more time onsite, depending on the issues that may be identified. System verification to occur over a minimum of a three-week period. Provide at least three (3) weeks notice to the Consultant for the system verification.

.15 Provide a SCADA reporting system to monitor all functions of the plant as defined by Division 11, 15, 16 and 17.

.16 Provide PLC logic to automatically log certain key process parameters in the PLC, as a backup to the SCADA system. The parameter list to be coordinated with the Municipality and includes only data that is pertinent for MECP compliance. Provide SCADA programming to retrieve this data in report format, as a backup to the main process report. To manage PLC memory, each PLC is to manage only the data for parameters physically wired to that PLC. All such PLCs would then communicate with SCADA to generate the report.

.17 Develop Process Control Narratives (PCNs) based on the Process Narratives (PNs) provided in the contract documents. Programming can commence only once the PCNs have been approved.

.18 Meet with and coordinate with the Municipality’s Operations personnel to obtain their input on the development of the PLC and SCADA programs. This is to be done via a series of workshops to be organized and chaired by the SI. A minimum of three (3) workshops are required: (1) Initial investigation and data gathering phase; (2) concepts, HMI Style Guide, including SCADA look and feel, tagging and colour standard, screen navigation, annotation and documentation standard, graphics, reports, alarms, proposed network configuration; and (3) details. Each workshop to be held at the Brighton WPCP and is expected to last a full day. It is expected that the contents of the PNs as well as pertinent shop drawings and I/O lists will also be discussed in the workshops. The first workshop is to precede the first PCN submission. The SI to provide a plan for each workshop at the onset of the project, for review by the Municipality and the Consultant. SI to submit a detailed SCADA system shop drawing prior to the second and third workshops. This shop drawing to detail the SCADA system at that stage, including screenshots, HMI Style Guide, graphics, tags, alarms, operational settings, PLC and SCADA annotation and documentation standard, historical trends, proposed network configuration, event logs, process reports, draft PCNs, etc. The SCADA shop drawings to also provide a summary of where and how the various physical and networked PLC I/O points are utilized in the SCADA system.

.19 Coordinate and Provide a Bell internet to site, per drawing N001.

.20 In addition to process SCADA screens, the SI to also develop ancillary SCADA screens for miscellaneous systems in the plant. These include but are not limited to: Hydro service and power distribution, HVAC (including room temperatures) and plant networks. In addition, the SCADA system to include links to pertinent documentation for the plant, such as maintenance manuals. This is to be discussed and coordinated with the Municipality's Operations staff.

.21 The SI to make use of the various data available over the plant networks to provide information to the plant personnel that may be beneficial in the efficient maintenance of the facility, while not overloading the SCADA system with data that may not be beneficial to the Operators. Such details to be discussed in the workshops.

.22 SI to coordinate all PLC firmware for the site, including PLC firmware for pre-packaged PLC-controlled equipment suppliers. SI to ensure that such firmware is not outdated at the end of the project.

.23 SI shall provide (supply, install and commission, as defined in Division 1) all SCADA hardware and software required for the complete SCADA system. This includes the installation, configuration, and commissioning of all software on the various computers as well as commissioning of ancillary systems.

.24 SI to provide a detailed SCADA hardware and software shop drawing for review. This shop drawing to include, but not limited to:

.1 SCADA Architecture (including physical and virtual components)

.2 Detailed make and models for all proposed hardware, including servers, workstations, secondary storage, printers, switches, and all software associated with the hardware, including operating systems and virtualization software as well software associated with the secondary storage system and the switches. The shop drawing to also detail all peripherals proposed.

.3 Details about all software related to the SCADA and PLC programming scope. Such details to include, but not limited to: tag counts, license validity periods and associated renewal requirements, estimates and options for license renewals, options available for the various software packages, and support details.

.25 All software and hardware to be registered to the Municipality of Brighton. Coordinate exact details with the Municipality.

.26 The SI is to work around the operation of the existing WPCP. The continuous operation of this facility takes priority over their work.

.27 Refer to Section 01021 for further commissioning requirements, including system and facility testing as well as sequencing and scheduling.

.28 Provision of custom Control Panels (CP) and Local Control Panels (LCP), as outlined. In addition, the provision of custom Field Control Panels (FCPs), as outlined.

.29 Provision of control systems instrumentation. In some cases, the supply and installation of some third party and HVAC instrumentation may be provided separately by other disciplines; however, the SI shall still provide systems coordination, start-up and commissioning assistance as well as control system documentation of such instruments as it integrates with custom control panels.

.30 A functional understanding of all interconnected control systems and intent of these systems in the general operation of the Plant.

.31 Coordinate with other divisions and manufacturers' representatives to provide optimal installation drawings on how the various instruments will be installed on this project. These drawings shall be submitted with the individual instrument shop drawings for review.

.32 Provide, coordinate, oversee and document:

.1 The calibration of all instruments. The SI shall coordinate with manufacturer's representative for the startup and initial calibration of all instruments supplied prior to testing and commissioning activities.

.2 All network installation details including (but not necessarily limited to), testing and verification results, and applied settings. Network configuration, router and switch settings shall be provided by the SI. Provide initial switch configuration, as required for FATs and SATs.

.3 Programming of PLC systems and HMI displays for either factory and/or site testing purposes (this is separate from the SI's programming requirements for the final facility as a cohesive system).

.4 All interconnective loop drawings between all monitoring and control points on this project. This shall include (but not necessarily limited to), instruments, electrical equipment, VFD drives, MCCs, control panels, local control panels, field control panels, HVAC and generator systems.

.33 Provide continuous planning and coordination with both the general contractor's commissioning personnel, the mechanical and electrical contractors as well as with pre-packaged equipment suppliers. This is to be provided at all stages of this project:

.1 The SI shall review and provide shop drawing feedback on the general contractor's behalf for the overall cohesiveness of the interconnected systems and components that are to be provided on this project (including equipment that may be supplied by other divisions (i.e. boiler system, valving, pre-packaged equipment, etc.). The SI's signature of review and acceptance shall be provided on applicable contractor's shop drawing submittal sheets when submitting for Consultant review.

.2 The SI's shall assist in planning, organization and execution of all start-up, calibration, acceptance testing, commissioning and trial operation phases of the project.

.34 Prior to performance testing of completed systems, the SI shall submit for review:

.1 Signed and sealed drawings (control panel layouts, instrumentation installation details, and loop drawings) by a Professional Engineer, licenced in the Province of Ontario.

.2 All instrumentation calibration reports demonstrating each instrument is setup for optimal operation.

.3 All documented 'as commissioned' settings and specific system details

.4 SI to facilitate both factory acceptance testing (FAT) as well as site acceptance testing (SAT) of all panels and equipment that is integrated into the overall control system architecture. SI to provide comprehensive test plans for review prior to scheduling any acceptance test. Test plans to include pictures showing the state of the panels. A comprehensive logic testing plan shall be provided for all panels containing hardwired logic. All testing plans shall include, but is not limited to the following:

.1 Verification of all panel component settings

.2 Comprehensive testing of all control panels, including hardwired logic and their overall functional intent.

.3 Verification of all PLC I/O inside the PLC I/O registers.

.4 Verification of proper and secure wiring of the panel.

.5 Verification of proper installation of all panel components.

.6 Verification of proper operation of all panel components.

.7 All labels and CSA/ESA stickers have been applied.

.8 Proper labelling of all components and wiring.

.9 Correct components and wires have been provided.

.10 Fabrication of the panel in accordance with the contract documents including any shop drawing comments.

.11 Documentation of all testing results.

2.2 SCOPE OF SUPPLY BY OTHERS

.1 The following services will be provided by the Contractor:

.1 The Electrical Contractor to terminate and label all field wiring, including field wiring to the Control Cabinets.

.2 The Electrical Contractor to retain the services of an Ethernet network specialist to terminate and test all Ethernet cabling.

.3 An Electrician shall be available for system verification. System verification will involve disconnecting and reconnecting control wiring to simulate various conditions.

.4 The contractor to coordinate with its pre-packaged suppliers to follow the plant HMI and PLC standard.

.5 The Electrical Contractor shall ensure that all information that is required for the SI to complete its work is provided in a timely fashion. This includes but is not limited to: up-to-date I/O lists; latest equipment shop drawings, including pre-packaged equipment; latest construction schedule; sufficient notice on dates and times when pertinent commissioning personnel will be onsite to facilitate coordination with the SI; and coordination with commissioning personnel for the various equipment and systems. Extras associated with any additional costs associated with the failure of the Contractor to coordinate with its subs will not be entertained.

.6 The Contractor to facilitate coordination amongst its various suppliers and sub-contractors for the efficient execution of the project requirements. This includes coordination between the SI and the MCC supplier as well as other pertinent suppliers and sub-contractors.

2.3 SCADA HARDWARE

.1 The SCADA system shall be implemented as stand-alone-based system consisting of, one (1) desktop workstation.

.2 SI to provide all required SCADA hardware workstation The workstation is to be a SCADA computer c/ windows 11, historian software, all required PLC communications drivers, SCADA software. Final equipment selection to be coordinated with the Municipality and the Consultant. Submit detailed shop drawings for review prior to procurement.

.3 Given the construction duration, the timing of hardware procurement to be optimized to take advantage of advances in technology so the hardware does not become outdated by the time the project is completed. While at the same time, the hardware shall be procured early enough to allow the SI to meet the Contractor’s construction schedule.

.4 Ensure that the hardware meets or exceeds the requirements of the associated software.

.5 All hardware shall be registered to the Municipality. Warranty requirements in accordance with Division 1.

2.4 SCADA COMPUTER SPECIFICATIONS

.1 Office SCADA Computer Specifications:

.1 The SI to provide one (1) SCADA Workstation inside the office of the new Administration Building. The new SCADA Workstation to meet the following minimum requirements:

.1 8 GB RAM

.2 500GB Free Disk Space (solid state drive)

.3 1 GBPS Network Speed
.4 Processor Speed 2.8GHz min
.5 Acceptable products:
  .1 Lenovo
  .2 Dell
  .3 HP Inc
.6 Monitor: One (1)
  .1 6N4E2AA#ABA HP E27 G5 FHD.
  .2 Approved alternative.
.7 Mouse and Keyboard: One (1)

2.5 SCADA/PLC SOFTWARE

.1 SI to provide all PLC, SCADA and Reporting software required for the project. SCADA computer is to operate the latest version of FactoryTalk. In addition, the SI to turn over all programming licenses to the Municipality for the full unrestricted self-performed maintenance of all PLC and SCADA programs developed by the SI as well as for the maintenance of the SCADA hardware, network switches and backup storage system. This includes all software and associated licenses for the programming and configuration of:

  .1 PLCs
  .2 SCADA System
  .3 Network Switches
  .4 Secondary Storage
  .5 SCADA Hardware
  .6 Process Reporting System

.2 Submit detailed shop drawings for review prior to procurement.

.3 Provide and turnover all software tools and associated licenses for the programming and configuration of the plant network switches and routers to the Municipality, for the full unrestricted self-performed maintenance of the network equipment.

.4 Train the Municipality on the use of all software tools supplied.

.5 All software licenses shall be registered to the Municipality and be valid for full support for at least two (2) full years beyond the expiration of the general contract warranty period.

.6 The plant SCADA and reporting software to have a minimum of 25% additional capacity for additional tags and screens for potential future updates.

.7 The SCADA programs shall be developed using the High-Performance HMI approach to the ISA101 HMI Design Standard.

.8 SI to coordinate all software revisions, including PLC firmware, to ensure that such software is not outdated upon project completion. Plan for and provide updates, as required, to ensure that the final delivered system at the end of the project is current.

2.6 PLC I/O COMMISSIONING

.1 The I/O commissioning report to include but not limited to the following:
- .1 I/O tags.
- .2 Tag description.
- .3 I/O address (rack, slot and point) or network address, equipment tag and parameter.
- .4 Pass/fail for each discrete I/O point. Provide separate pass/fail results for the I/O card LED status check, the PLC software check and the SCADA software check.
- .5 Date and time each discrete I/O point was witnessed as well as initials of the witness.
- .6 Measured (Engineering) value (plus units) calculated by the PLC at 4, 8, 12, 16 and 20 mA for each analog I/O point. Provide actual mA measurements using a NIST traceable digital multimeter. mA to be to two (2) decimal places. Measured values to be to one (1) decimal place for flows, levels, pressures, temperatures, currents and voltages. Measured values to be to two (2) decimal places for all analytical values, frequencies, power factor, valve position and valve feedback. Detail the upper and lower range limit for each measured value, for each analog I/O point.
- .7 Provide separate measurements for all new and modified analog I/Os as indicated by the multimeter, the PLC and the SCADA verification.
- .8 Date and time each new or modified analog I/O point was witnessed as well as initials of the witness.
- .9 Completed functional testing and system check sheets for all IO and equipment. Refer also to Section 01021.

.2 Submit the template I/O commissioning report for review by the Consultant prior to commissioning.

2.7 AUTOMATION VERIFICATION

.1 Provide a detailed automation verification report for each system/process including, but not limited to the following:
- .1 Normal operating sequence.
- .2 System reaction to various equipment/device failures as well as abnormal process conditions. List all such scenarios and detail system reaction to these scenarios. It is understood that such a list may not capture all possible conditions; however, a "reasonable" attempt shall be made to identify the more likely and important failure scenarios. Provide the Consultant with a proposed automation checkout report template for review. The template to list the scenarios proposed for testing. The template should be forwarded before commissioning commences.
- .3 Once automation verification has been completed submit the reports to the Consultant for review. After which system verification can be scheduled.

2.8 ALARM COMMISSIONING

.1 Provide a detailed alarm verification report. The report to include, but not limited to the following fields:
- .1 Tag
- .2 Description
- .3 I/O point/Ethernet node
- .4 Alarm registered on SCADA process screen (Yes/No)
- .5 Alarm registered on SCADA alarm banner (Yes/No)
- .6 Alarm listed in SCADA alarm history (Yes/No)

.7 Alarm dialed to the Operator (Yes/No)
.8 Alarm received by the Operator (Yes/No)
.9 Alarm registered on WPCP SCADA (Yes/No)
.10 Assigned autodialer channel
.11 Comments
.12 Name and signature of the person performing the test as well as that of the person accepting the test results (typically the Operator), plus the date the test was performed.
.13 The verification report to cover alarm dialing on the plant Autodialer.

.2 Submit the template alarm commissioning report for review by the Consultant prior to commissioning.

2.9 SCADA REPORTS

.1 Program the PLC and SCADA system to automatically generate SCADA reports and to meet (or exceed) the following minimum requirements:
.1 The following reports shall be provided:
.1 Daily process
.2 Daily equipment
.3 Weekly process
.4 Weekly equipment
.5 Monthly process
.6 Monthly equipment
.7 Yearly process
.8 Yearly equipment
.2 Process reports shall contain the following:
.1 Minimum, average, maximum and total (flows) for key parameters in the plant. These parameters may include turbidity, plant flows, chlorine levels, turbidity, etc. The exact listing of parameters will be determined during construction.
.2 The reporting system shall be flexible enough to allow for the inclusion of any monitored or calculated analog value.

The Operator shall have access to the selection of process parameters to be included in the SCADA report via a SCADA screen.
.3 Equipment reports shall contain the following:
.1 Runtimes (hours) and number starts for key equipment in the plant. Such equipment may include High lift pumps. The exact listing of equipment will be determined during construction.
.2 The reporting system shall be flexible enough to allow for the inclusion of any monitored equipment. The Operator shall have access to the selection of equipment to be included in the SCADA report via a SCADA screen.
.4 Provide the option to automatically print each report (individually selectable). For example, the daily report may be automatically printed at the end of the day; the monthly report may be automatically printed at the end of the month, etc.
.5 Data shall not be automatically deleted from the database. Provide logic to monitor the size of the database as well as the hard drive space remaining and issue an alarm at SCADA once insufficient hard drive space remains or the database is approaching its limit.
.6 Provide form(s) to allow the transfer of data to an external storage device and to purge the database to free memory.
.7 Provide forms to allow access to data from a secondary storage device. The Operator is to have the option to “merge” such data with the data already in the database or to have the data remain on the secondary storage device.
.8 Provide the following data storage in the PLC memory as a backup to the computer system:

.1 Last eight days of process and equipment data.
.2 Last week's process and equipment data.
.3 Last month's process and equipment data.
.4 Last year's process and equipment data.

.9 Provide the option to manually transfer the data stored in the PLC to the database in the event that there was a failure in automatic data transfer to the database from the SCADA system.

.10 Provide link(s) from the SCADA system to the reporting system.

2.10 PLC LOGGING

.1 Automatically log key process parameters in the PLC. The logged data will automatically be overwritten once the allotted PLC memory is full. This PLC storage of data is a backup to the SCADA system.

.2 Automatically log key process events in the PLC. The logged data will automatically be overwritten once the allotted PLC memory is full. This PLC storage of data is a backup to the SCADA system.

.3 Program the PLC to carefully manage memory for the efficient operation of the plant as well as future modifications to the system.

.4 Provide the feature to transfer all logged data from the PLC to the SCADA system.

.5 The list of parameters to be logged as well as sample times is to be determined during construction.

.6 Each PLC shall be programmed to log the data associated with that PLC. Such data will include the process parameter values being monitored by that PLC over hardwired and device level network connections.

2.11 INSTRUMENTATION AND CONTROL PANEL COMMISSIONING

.1 Commissioning documents to include:
.1 Upper and lower range settings of all instrumentation provided.
.2 All settings of all devices
.3 Serial number for each device supplied.
.4 Make and model for each device supplied.
.5 Date (month and year) of manufacture of each device supplied.
.6 Calibration certificate for each instrument.

PART 3 - EXECUTION

3.1 START UP, TRAINING AND PERFORMANCE TESTING

.1 Allow for as many site visits as required for the thorough and complete testing and commissioning of the plant control system.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Refer to Section 16010.

1.2 PRODUCT DATA

.1 Provide shop drawings for cabinets and components as per Division 1. Indicate any conflicts with design drawings.

1.3 OPERATION AND MAINTENANCE DATA

.1 Operation and Maintenance Data:
  .1 As per Division 1.

1.4 SCOPE

.1 This section pertains to control panels, field control panels, local control panels, motor control panels, controls junction boxes and controls pull boxes.

PART 2 - PRODUCTS

2.1 ENCLOSURE

.1 Acceptable enclosure manufacturers:
  .1 Hammond
  .2 Hoffman
  .3 Cooper Industries (for NEMA 7/8 enclosures)

.2 Size enclosures to suit. Provide a minimum of 25% spare DIN rail and panel space.

.3 Enclosure to be ANSI 61 grey, except for stainless steel enclosures, which shall be unpainted.

.4 Enclosure to be rated for the intended environment and be a minimum of NEMA 12. Outdoor panels to be NEMA 4X, stainless steel. Provide NEMA 7 rated panels in hazardous indoor locations and NEMA 8 panels for hazardous outdoor locations.

.5 For each enclosure provide the following accessories at a minimum:
  .1 18” x 18” folding shelf. Folding shelf to be mounted at 1000 mm above finished grade and on the exterior of the cabinet door. Folding shelf is to be made of steel and be the same colour as the enclosure. Folding shelf make and model to be Ralston Z-5020 (or approved equivalent). Folding shelf only required for PLC panels.
  .2 Thermoplastic data pocket sized to hold 11” x 17” data sheets.

.3 All panels (back and side) to be painted white and to be “full” panels. Panels to be from same manufacturer as enclosure. Provide full side (depth) panels, as required for additional panel space.

.4 Provide enclosure climate control as required. If climate control is provided, then provide temperature monitoring by the PLC and SCADA. At a minimum provide temperature monitoring via thermostats. Climate control details:

.1 Heaters: Hoffman DAH series electric heater with built-in fan and thermostat; or Hammond equivalent. Brushed aluminum finish.

.2 Thermostats: Hoffman ADLTEMP dual thermostat; or Hammond equivalent. Temperature units to be Celsius.

.3 Provide passive cooling, as required. If passive cooling is not sufficient, then provide active cooling. Cooling products shall be from Hoffman or Hammond. If fans are employed, provide dampers. Dampers from Belimo.

.4 Include climate control design calculations and design in the shop drawings.

.5 For each outdoor panel, provide vent drain(s). Number to suit. Vent drains to be Hoffman H2OMIT series, or Hammond equivalent.

.6 For each PLC panel, provide LED lighting, sized to suit. Lighting to be activated when the enclosure door is open. Manufacturer to be same as for the enclosure.

.7 Copper ground bars, sized to suit plus 25% spare.

.8 Ground lugs capable of accepting 2/0 ground wire.

.9 Each PLC control panel to be free standing, single or double door and will be located indoors.

2.2 PROGRAMMABLE LOGIC CONTROLLER (PLC)

.1 Hardware:

.1 As indicated.

.2 Analog signal multiplexing:

.1 Phoenix Contact MCR-SL-UI-2UI analog isolator/duplicator where analog signal duplication is required.

.2 As indicated.

.3 Acceptable PLC isolation, where required:

.1 Phoenix Contact PLC-RSC Series 24VDC and 120VAC terminal style relays, screw connection.

.2 Phoenix Contact MINI MCR-SL-UI-UI-NC configurable analog signal 3-way isolating amplifier, screw connection.

.3 As indicated.

.4 PLC I/O Termination:

.1 For each PLC I/O point, provide a Phoenix Contact UKK-5-MTK-P/P 2-tier knife disconnect terminal block.

.2 Provide ground bars for drain/shield I/O wires, as required. Provide one (1) ground bar for each analog I/O card.

.3 Group PLC I/O terminals according to the PLC slot # using Phoenix Contact Clipfix 35 end anchors complete with matching labels.

.4 As indicated.

2.3 BONDING

.1 Each DIN Rail in each control cabinet is to be bonded using Phoenix Contact USLKG5 ground terminal. Analog I/O drain wires to be connected to ground bars, not ground terminals.

.2 Each panel and cabinet door is to be bonded as per manufacturer's recommendations.

.3 Each component is to be bonded as per manufacturer's recommendations.

.4 Bonding is to be in accordance with the latest revision of the Ontario Electrical Safety Code.

2.4 LABELLING

.1 All components and wires to be labeled.

.2 Each wire to be labelled individually. The use of one label for two or more wires is unacceptable. Similarly, where two wires are connected to the same connection point – each wire to be labelled.

.3 Labels to be printed by machine and should be done in a neat, organized manner, identifying each wire at its point of termination.

2.5 LOOSE COMPONENTS

.1 Provide the following loose components:
- .1 Five (5) of each type of terminal block.
- .2 Four (4) of each type of isolation (Analog and Discrete) device used.
- .3 Four (4) end brackets.
- .4 Four (4) spare 4A supplementary protectors.
- .5 Four (4) spare 2A supplementary protectors.

2.6 SHOP DRAWINGS

.1 Shop Drawings to include but not be limited to the following:
- .1 I/O diagrams.
- .2 Detailed enclosure/panel layout drawings and dimensions.
- .3 Detailed wiring diagrams, including wire labels and wire specifications.
- .4 Detailed loop diagrams, including junction boxes and associated terminals. Loop drawings to follow the ISA-S5.4 standard.
- .5 Symbols on controls drawings to follow the NEMA ICS standards.
- .6 Detailed network diagrams, including port and I/P address assignments.
- .7 Complete Bill of Materials.
- .8 Detailed shop drawing/data sheet for each device to be used in the enclosures.
- .9 Shop drawings to be on 8.5" x 11" and/or 11" x 17" sheets.

2.7 CONTROL CIRCUIT OVERCURRENT PROTECTION (120VAC/24VDC)

.1 Control Power Circuit Breakers/Supplementary Protectors:
- .1 Use only one manufacturer for all control circuit breakers and supplementary protectors.
- .2 Size circuit breakers/supplementary protectors to suit as per equipment manufacturer's recommendations.
- .3 Circuit breaker/supplementary protector installation according to the latest version of the Ontario Electrical Safety Code.
- .4 For each I/O card wiring provide a supplementary protector, sized to suit. Monitor the status of each I/O card supplementary protector on the PLC via a Phoenix Contact PLC-RSC series relay.
- .5 Each PLC control panel will be fed by non-UPS and UPS 120VAC power. Provide a circuit breaker for each power source. Also provide a circuit breaker on the output of each 24VDC power supply as well as each 24VAC power source.
- .6 Each circuit breaker is to be CSA C22.2 No. 5 compliant.
- .7 Each supplementary protector is to be CSA C22.2 No.235 compliant.
- .8 Acceptable products (Circuit Breaker):
  - .1 Allen-Bradley 1489-M series
  - .2 Schneider equivalent
- .9 Acceptable products (Supplementary Protectors):
  - .1 Allen-Bradley 1492-SP series
  - .2 Schneider equivalent

.2 Fuses are not acceptable unless used on the primary of a control transformer.

.3 Acceptable fuse holders (600V/120V/24V):
- .1 Ferraz Shawmut UltraSafe™ series complete with matching Bussmann fuses.

2.8 DC POWER SUPPLY

.1 Single-Phase Primary-Switched mode.

.2 120VAC input; 24VDC output.

.3 Mountable on 35 mm DIN rail without the need for additional accessories.

.4 IP20 Degree of protection.

.5 Mean Time Between Failures (MTBF) > 500,000 hours.

.6 cUL listed.

.7 Power supply to be a minimum of 10 A @ 24 VDC.

.8 Acceptable product:
- .1 Allen-Bradley 1606-XLS Series.

.9 Monitor the status of the 24VDC power supply on the PLC via the relay contact on the power supply.

2.9 ETHERNET SWITCH

.1 Provide Ethernet switch(es) in the PLC panel, as indicated.

.2 Ethernet switch(es) to be fully managed and rated for industrial applications.

.3 Ethernet switch(es) to be powered by a dedicated power supply.

.4 Acceptable product:
- .1 As indicated, complete with matching dedicated power supply.

.5 Monitor the status of the Ethernet switch 24VDC power supply on the PLC via a Phoenix Contact PLC-RSC series relay.

2.10 ETHERNET PATCH PANEL

.1 Provide a Belden MIPP series modular industrial patch panel for the termination of incoming Ethernet Category 5e/6 and Fibre optic cables to the PLC panel. Provide sufficient ports as required plus 25% spare. Patch panel connectors to match intended connections. Provide separate patch panels for STP and UTP cables.

2.11 ETHERNET PATCH CABLES (INSIDE CONTROL PANEL)

.1 Provide all patch cords required for Ethernet connections internal to each control cabinet.

.2 Select cord lengths to suit. Cords to be as short as possible.

.3 Provide three (3) spare 2 m long Cat. 6 patch cords.

.4 Category 6 patch cords to be Belden 7940 A series Category 6 patch cables.

.5 Each end of each patch cord is to be labelled with the matching manufacturer’s label. All labels to be printed by machine. Handwritten labels are not acceptable.

2.12 MANUAL OPERATOR INTERFACE (PUSHBUTTONS, PILOT LIGHTS, ETC.)

.1 Each pilot light to meet the following:
- .1 Factory assembled
- .2 Push-to-test
- .3 120VAC LED
- .4 NEMA 4/13 watertight rated. NEMA 7&9, as required to suit area classification.
- .5 Colour as indicated
- .6 30 mm diameter
- .7 Heavy industrial rated
- .8 Finger-safe guards
- .9 CSA certified
- .10 Acceptable product:
  - .1 Allen-Bradley 800TC/800H series

.11 Pilot light colours:
- .1 Amber: Fault
- .2 Red: Stopped
- .3 Green: Running
- .4 Colours not final until shop drawings have been reviewed.

.2 Each 3-position selector switch to meet the following:
- .1 Factory assembled
- .2 Finger-safe guards
- .3 Non-illuminated
- .4 Standard knob with white insert
- .5 Maintained Operator function
- .6 Contact rating of 600VAC and 600VDC
- .7 30 mm diameter
- .8 NEMA 4/13 watertight rated. NEMA 7&9, as required to suit area classification.
- .9 Number of contacts as required for the control circuit. Capable of accepting additional contact blocks.
- .10 Heavy industrial rated
- .11 CSA certified
- .12 Acceptable product:
  - .1 Allen-Bradley 800TC/800H series

.3 Each 2-position selector switch to meet the following:
- .1 Factory assembled
- .2 Finger-safe guards
- .3 Non-illuminated
- .4 Standard knob with white insert
- .5 Maintained Operator function
- .6 Contact rating of 600VAC and 600VDC
- .7 30 mm diameter
- .8 NEMA 4/13 watertight rated. NEMA 7&9, as required to suit area classification.
- .9 Number of contacts as required for the control circuit. Capable of accepting additional contact blocks.
- .10 Heavy industrial rated
- .11 CSA certified
- .12 Acceptable product:
  - .1 Allen-Bradley 800TC/800H series

.4 Each potentiometer to meet the following:
- .1 Factory assembled
- .2 Finger-safe guards
- .3 Non-illuminated
- .4 Standard knob with white insert
- .5 30 mm diameter
- .6 NEMA 4/13 watertight rated. NEMA 7&9, as required to suit area classification.
- .7 Resistance rating to suit.
- .8 Heavy industrial rated
- .9 CSA certified
- .10 Acceptable product:

.1 Allen-Bradley 800TC/800H series

.5 Each pushbutton to meet the following:
- .1 Factory assembled
- .2 Finger-safe guards
- .3 Non-illuminated
- .4 Colour as indicated
- .5 Contact rating of 600VAC and 600VDC
- .6 30 mm diameter
- .7 NEMA 4/13 watertight rated. NEMA 7&9, as required to suit area classification.
- .8 Number of contacts as required for the control circuit. Capable of accepting additional contact blocks.
- .9 Heavy industrial rated
- .10 Extended head for stop operations, flush head otherwise
- .11 CSA certified
- .12 Acceptable product:
  - .1 Allen-Bradley 800TC/800H series

.6 Each emergency stop to meet the following:
- .1 Factory assembled
- .2 Finger-safe guards
- .3 Non-illuminated
- .4 Red cap
- .5 Contact rating of 600VAC and 600VDC
- .6 30 mm diameter
- .7 NEMA 4/13 watertight rated. NEMA 7&9, as required to suit area classification.
- .8 Number of contacts as required for the control circuit. Capable of accepting additional contact blocks.
- .9 Heavy industrial rated
- .10 Mushroom head, 2-position push-pull
- .11 CSA certified
- .12 Acceptable product:
  - .1 Allen-Bradley 800TC/800H series

.7 Each legend plate shall meet the following:
- .1 Provide a legend plate for each of the following:
  - .1 Pilot light
  - .2 Selector switch
  - .3 Potentiometer
  - .4 Pushbutton
  - .5 Emergency stop
- .2 Aluminum
- .3 NEMA 4/13 watertight rated
- .4 Engraved by the manufacturer
- .5 Gray in colour
- .6 Acceptable product:
  - .1 Allen-Bradley 800T standard or jumbo legend plate.

.8 Provide a machine engraved lamacoid for equipment identification for each set of Operator

Interface devices on each control panel. Each lamacoid to be 20 mm x 100 mm with white background and black 5 mm characters.

.9 Each AC Hour meter to meet the following:
- .1 Records up to 99,999 hours; automatically resets to zero
- .2 120VAC, 60Hz
- .3 Accuracy of at least ± 0.02%
- .4 Screw termination
- .5 Glass lens
- .6 CSA certified
- .7 Acceptable product:
  - .1 Hobbs 20000 series Round 3 Screw AC Hour Meter, or approved equivalent.

.10 For each discrete valve (excluding solenoids) provide the following manual Operator interface:
- .1 Open status pilot light (if status is available; green in colour)
- .2 Closed status pilot light (if status is available; red in colour)
- .3 Fault status pilot light (if status is available, amber in colour)
- .4 3-position selector switch (Open-Close-Auto)

.11 For each modulating valve provide the following manual Operator interface:
- .1 Open (fully) status pilot light (if status is available; green in colour)
- .2 Closed (fully) status pilot light (if status is available; red in colour)
- .3 Fault status pilot light (if status is available, amber in colour)
- .4 Potentiometer
- .5 2-position selector switch (Hand-Auto)

.12 For each FVNR provide the following local Operator interface at the motor:
- .1 Fault pilot light
- .2 Stopped pilot light
- .3 Running pilot light
- .4 3-position Hand-Off-Auto selector switch

.13 For each FVR provide the following local Operator interface at the motor:
- .1 Fault pilot light
- .2 Stopped pilot light
- .3 Running forward pilot light
- .4 Running in reverse pilot light
- .5 3-position Hand-Off-Auto selector switch
- .6 Forward-auto-reverse 3-position selector switch

.14 For each soft starter provide the following local Operator interface at the motor:
- .1 Fault pilot light
- .2 Stopped pilot light
- .3 Running pilot light
- .4 3-position Hand-Off-Auto selector switch

.15 For each VFD provide the following local Operator interface at the motor:
- .1 Fault pilot light
- .2 Stopped pilot light

.3 Running pilot light
.4 3-position Hand-Off-Auto selector switch
.5 0-to-100% potentiometer

.16 For hybrid starters provide local Operator interface at the motor based on the combination as outlined above. For example, such hybrid starters may include a VFD that also has forward-reverse capabilities. In that case, as well as the interface outlined above for a VFD, provide a forward-auto-reverse 3-position selector switch plus forward and reverse running pilot lights.

.17 For each solenoid provide a push-to-test relay c/w manual override lever to facilitate manual override in the event of PLC failure. Relay per Section 17051 item # 2.26 below.

2.13 GRAPHICAL OPERATOR INTERFACE (HMI)

.1 120VAC, 60Hz

.2 1280x800 resolution

.3 CSA certified

.4 Acceptable product:
.1 Allen Bradley 2711P-T12W22D9P

2.14 SURGE SUPPRESSION AND EMI

.1 Provide all accessories required to mitigate surges for all components, such as relays, that cause surges in power distribution.

.2 For each of the 120VAC power sources into the PLC panel provide a Total Protection Solutions
TK-LTE120/TK-120LT series surge protective device. Size SPD to suit.

.3 Ensure proper voltage separation is observed as per manufacturer’s recommendations.

.4 Route wires and cables to minimize EMI effects on Class 2 wiring.

.5 Provide ferrite collars and other accessories as required to minimize EMI.

.6 Follow manufacturer’s recommendations with respect to EMI mitigation.

2.15 FINGER-SAFE WIRING

.1 All wiring to be IP-2X (Finger-safe) rated. Provide all accessories as required for finger-safe ratings.

2.16 FAIL-SAFE WIRING

.1 All alarms to be wired fail-safe. Provide all accessories as required.

2.17 CABINET LABELLING

.1 Cabinet labeling to be finalized upon shop drawing review.

2.18 PROGRAMMING/ACCESS OUTLETS

.1 For the PLC control panel, provide a programming outlet on the door of the panel. Outlet to be mounted at a height of approximately 150 mm above the shelf. Programming outlet to meet the following:
- .1 CAT 6, RJ45 (female)
- .2 Duplex GFCI receptacle with test/reset pushbuttons on the outside
- .3 NEMA 4/12 housing, clear cover
- .4 Non-GFCI inside/outside version
- .5 Acceptable product:
  - .1 Grace Engineered Products Inc. P-R62-?3R?0 series.

.2 For the PLC control panel, provide a USB access outlet on the door of the panel. Outlet to be mounted at a height of approximately 150 mm above the shelf. USB access outlet to meet the following:
- .1 4-port USB (female)
- .2 NEMA 4/12 housing, clear cover
- .3 Acceptable product:
  - .1 Grace Engineered Products Inc.
- .4 USB access outlet intended for use with HMI panel PC for keyboard, mouse and memory sticks.

2.19 UTILITY RECEPTACLE

.1 Provide a Hubbell DRUB15 series 5-15R duplex utility receptacle inside the PLC control panel, as indicated.

.2 Utility receptacle to be fed from UPS power.

.3 Provide appropriate marking.

.4 Receptacle to be orange in colour.

2.20 WIRING DUCT

.1 Control cabinet wiring ducts to be Panduit F series narrow slot. Provide Panduit corner ducts where side (depth) panels are used. Duct colour to be light grey. Use blue duct for intrinsically safe circuits.

2.21 DATA DISPLAYS

.1 Provide a data display to display each critical process parameter, as indicated.

.2 Acceptable products:
- .1 Precision Digital PD6000 Series

2.22 INSPECTION

.1 All cabinets to pass CSA inspection. Provide labels in conspicuous locations.

2.23 CONTROL POWER

.1 Control power shall be 120VAC. 24VDC power to be used for the analog instrumentation and other components, as required.

.2 Where required, 24VAC is acceptable for certain equipment.

.3 Control transformers to be Allen-Bradley 1497 series or approved equivalent, complete with IP2X appurtenances, as required for IP2X wiring rating.

2.24 DIN RAIL

.1 DIN rails to be Allen-Bradley 199-DR1 35 mm x 15 mm symmetrical zinc plated or approved equivalent.

2.25 MISCELLANEOUS TERMINAL BLOCKS

.1 Miscellaneous terminals blocks in the control cabinets to be Phoenix Contact UK 5N or approved equivalent.

.2 Phoenix Contact UK 6N (or Weidmuller equivalent) shall be employed if any of the following applies:
- .1 Wiring is #12 AWG or larger
- .2 Current exceeds 20A
- .3 600VAC applications.

2.26 GENERAL PURPOSE RELAYS

.1 General purpose control relays shall meet the following:
- .1 Minimum of 2-poles.
- .2 Minimum pilot duty rating: NEMA C300 (AC) and R300 (DC)
- .3 Rated thermal current: 7A (4-pole); 10A (2-pole)
- .4 Dielectric withstand voltage: 2000V (pole-to-pole) and 4000V (contact to coil)

.5 IP20 (guarded terminal sockets)
.6 Mechanical life cycles: 20 x 106 (AC) and 50 x 106 (DC)
.7 Switching frequency operations: 1800/hour
.8 Minimum operating rate: 8 cycles/second
.9 Operating time: max pickup: 10ms; max dropout: 3ms
.10 Rated insulation voltage: 300V
.11 Standards: CSA 22.2 No. 14
.12 Contact material: AgNi
.13 Specified Product:
.1 Allen-Bradley 700-HC Series complete with push-to-test and LED options. Provide matching surge suppressor.

2.27 600V POWER DISTRIBUTION BLOCKS

.1 Each power distribution block shall meet the following:

.2 Finger-safe (IP20) construction, per IEC 529, without the need for special covers such as plexiglass sheets.

.3 Mountable on 35 mm DIN rail without the need for additional accessories.

.4 600V rated.

.5 Captive termination screws.

.6 Multiple wire ratings.

.7 CSA certified.

.8 Specified Product:
.1 Ferraz Shawmut FSPDB series finger-safe power distribution blocks complete with the following matching accessories:
.1 Accessory pin to form multiple pole block
.2 Cap plugs for spare 2/0 and 350 MCM openings
.3 End anchors

2.28 FIELD WIRING CONNECTIONS

.1 Each panel shall be wired such that field wiring is connected to terminal blocks and not directly to a panel component. This includes motor and power field connections.

2.29 PANEL LAYOUT

.1 During shop drawing review, the Consultant reserves the right to request changes to the panel layout to suit site conditions, at no extra charge.

.2 The CSS is to review the contract drawings to determine how field wiring will enter the panel – the layout of the panel shall be designed accordingly, subject to the approval of the Consultant.

2.30 CONTROL CABINET (INTERNAL) WIRING

.1 Refer to drawings for wiring requirements.

PART 3 - INSTALLATION

3.1 TERMINAL BLOCKS

.1 Follow manufacturers recommendation.

.2 Fasten railings to back planes, on panel doors using S.S. button head type bolts. Bolt size and length to suit. Provide nuts and washers as required.

.3 Label terminals clearly with scratch resistant machine produced plastic inserts.

.4 Label strips as per the drawings. For strips greater than 20 blocks, label at each end and for strips greater than 40 blocks label intermittently to suit.

.5 Provide terminal blocks in all control panels, motor control panels, field control panels, local control panels and junction boxes for wire management.

3.2 WIRE DUCTS

.1 Follow manufactures recommendations.

.2 Fasten ducts to back planes, on panel doors using S.S. button head type bolts. Bolt size and length to suit. Provide nuts and washers as required.

.3 Provide wire ducts in all control panels, field control panels, motor control panels, local control panels and junction boxes for wire management.

3.3 WIRING

.1 Keep analog and digital wiring separate.

.2 Use ties and spiral wrap to maintain a neat appearance.

.3 Ensure adequate cable lengths for minor adjustments in the terminal blocks.

.4 All alarm and warning signals to be wired fail-safe unless otherwise indicated. Provide all appurtenances required to facilitate such wiring, including but not limited relays, terminal blocks, etc.

.5 All wiring to be terminated on terminal blocks. The use of marrettes (or equivalent) is not acceptable.

.6 All internal wiring for all control panels, motor control panels, field control panels and local control panels shall be terminated using crimp-on ferrules. Only one wire per ferrule. Ensure all strands of the wire are crimped within the ferrule and that there are no stray strands of wire.

.7 No more than two (2) wires to be connected to the same side of a terminal. Provide additional terminals as required.

.8 Wiring in accordance with the latest revision of the Ontario Electrical Safety Code as well as applicable CSA Standards.

.9 Follow manufacturer's recommendations for installation and wiring of components.

.10 Secure wires in wire duct using cable ties. Leave enough slack on the cable ties for wire manipulation. Remove excess cable tie ends. Cable tie application to be done in a neat and organized manner.

.11 All PLC and RIO/MIO I/O points to be terminated, including spare I/O points.

.12 All alarms to be wired in a fail-safe manner, such that an input is always present on the PLC input card, unless there is an alarm.

.13 Provide a two-tier knife terminal block for each discrete and analog I/O point.

.14 Each DIN rail in each control panel shall be bonded. Provide ground terminals to suit.

.15 Refer to the contract drawings for additional details.

3.4 LOOP SHOP TEST

.1 Notify Consultant of date of testing. The Consultant will at his discretion attend the shop tests. Make available marked-up copies of the cabinet and loop drawings for the shop test.

.2 Test all wiring loops, display devices and hand switches in the shop and prepare report.

.3 Provide the Consultant with a copy of the results of the loop test for review prior to delivery of the cabinets to the site.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED SECTIONS

.1 Section 16010 – Electrical General Provisions.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
  .1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
  .1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  .2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  .3 TIA/EIA-568-B.3-(2001), Commercial Building Telecommunications Cabling Standard, Part 3: Optical Fiber Standards.
  .4 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.
  .5 ANSI J-STD-607-A, Joint Standard – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

1.3 DEFINITIONS

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms.

1.4 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of twisted-pair cables, terminations, connectors, cross-connection hardware, and related equipment installed inside building for control system communication.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
  .1 Horizontal cables link work areas (Ethernet ports) to control/IT cabinets located in the same area.
  .2 Backbone cables link control/IT cabinets to control/IT cabinets.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Division 1.

.2 Submittals to include, but not limited to the following:
  .1 Datasheets for each network product.
  .2 IT cabinet details, including:
    .1 Layouts.
    .2 Detailed wiring diagrams.

.3 Component datasheets.
.4 Network diagram, including port assignments.
.5 Proposed labels for all cables, ports and components.

.3 As-Built Records and Drawings as per Division 1.

1.6 CERTIFIED INSTALLER

.1 All work related to this section to be carried out by a certified network installer. The installer shall be certified by Belden and Corning to supply, install, test and commission the products and systems identified in this Section and as outlined in the drawings. Verification of such qualifications shall be provided with the submittals. The submittals will not be reviewed without such verification.

PART 2 - PRODUCTS

2.1 FOUR-PAIR BALANCED UNSHIELDED TWISTED PAIR (UTP) CATEGORY 6 CABLE

.1 Ethernet/IP compliant.

.2 UV sunlight resistant.

.3 Industrial grade jacket.

.4 Solid conductors.

.5 CEC CMR FT4 (riser).

.6 Operating temperature range: -40°C to 75°C.

.7 Third party verified to TIA/EIA-568-B.2, Category 6.

.8 Colours per drawings.

.9 Specified Product:
.1 Belden 7940 A. Provide armoured version, where indicated.

2.2 FOUR-PAIR BALANCED SHIELDED TWISTED PAIR (STP) 600 V CATEGORY 6 CABLE

.1 Ethernet/IP compliant.

.2 UV sunlight resistant.

.3 Industrial grade jacket.

.4 Solid conductors.

.5 CEC CMR FT4 (riser).

.6 Operating temperature range: -40°C to 75°C.

.7 Third party verified to TIA/EIA-568-B.2, Category 6.

.8 Colours per drawings.

.9 600 V rated.

.10 Shielded.

.11 Specified Product:
.1 Belden 7953A. Provide armoured version, where indicated.

2.3 WORK AREA UTP 4-PAIR MODULAR OUTLET

.1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568- B.2:
.1 In self-contained single-gang surface-mount box, four jacks per box.
.2 Mounted in compatible single gang faceplate, angle entry, 4 jack positions per faceplate.
.3 Faceplates to be white in colour in office areas. Provide stainless steel faceplates in process area.

.2 Multi-user telecommunications outlet assembly (MUTOA), 4 ports, each port equipped with factory installed "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-B.2.

.3 All horizontal cabling to be terminated at work area on 8 pin type modular connectors (RJ45) with insulation displacement-type connection.

.4 All Category 6 modular jacks to be terminated in accordance with TIA/EIA-568.

.5 Modular RJ45 connectors to be compliant with Keystone mechanical mounting configuration.

.6 Eight-position modular telecommunications outlet/connectors to accept four- or six-position modular plugs while providing proper electrical connection and not damaging telecommunications outlet/connector (jack) or modular cord. Manufacturer to warrant all eight-position modular outlets used in such a manner to be usable for eight-position modular plugs in the future.

.7 The durability of the jack module to be 1000 mating cycles minimum.

.8 The IDC termination on the modular jack to make a reliable contact without cutting the wire. The change in IDC contact resistance not to exceed 1 m□ over the life of the modular plug.

.9 Performance of Category 6 modular jacks to be equal to or better than, the TIA/EIA-568-B.2 Category 6 pair to pair NEXT performance specifications.

.10 The UTP connector module to be FCC Part 68, Subpart F compliant.

.11 Terminate all ports on each outlet.

.12 Provide faceplate and all appurtenances required for a complete installation.

.13 Colours per drawings.

.14 Specified Product:
  .1 Belden EZ-MDVO modules complete with matching faceplates.

2.4 UTP PATCH CORDS

.1 2 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568-B.2.

.2 Provide one patch cord for each terminated port plus twelve (12). This does not include patch cords internal to the control panels which shall be provided by the Panel Builder. Turnover spare patch cords to the Owner in original unopened packaging.

.3 Patch cord colours per drawings.

.4 Specified Product:
  .1 Belden 7940A series.

2.5 THREE-PAIR UNARMOURED MM FIBRE CABLE (INDOOR/OUTDOOR)

.1 Indoor/outdoor, unarmoured all-dielectric multimode (OM4) cable. UV-resistant, flame-retardant FT4 rugged jacket with water-blocking technology. Three (3) pairs (6 strands) to: CSA-C22.2 No. 232 and TIA/EIA-568-B.3.
  .1 Specified Product:
    .1 Corning FREEDM® One-Tight-Buffered Riser Cable. Part Number 006T8F-31190-29 Series.

2.6 SIX-PAIR ARMOURED MM FIBRE CABLE (INDOOR/OUTDOOR)

.1 Indoor/outdoor, aluminum armoured multimode (OM4) cable. UV-resistant, flame-retardant FT4 rugged jacket with water-blocking technology. Six (6) pairs (12 strands) to: CSA-C22.2 No. 232 and TIA/EIA-568-B.3. Outer jacket colour: yellow.
  .1 Specified Product:
    .1 Corning FREEDM® One-Tight-Buffered, Interlocking Armoured Riser Cable. Part Number 012T8F-31190-A1 Series. Adjust part number to include specified jacket colour.

2.7 OPTICAL-FIBRE PATCH CORDS

.1 Interconnect cable, 2 strands, 2 metres long, each end equipped with LC connectors to match associated Ethernet equipment. Multimode (OM4), laser-optimized to: TIA/EIA-568-B.3. UPC connectors – coordinate with equipment requirements.
  .1 Acceptable Products:
    .1 Corning OFNR listed multimode zipcord 2.9 mm cable.

.2 Provide one patch cord per pair of terminated fibre, per end, plus twelve (12). Turn over spare patch cords to the Owner in original unopened packaging.

.3 Jacket colour to be yellow.

2.8 FREESTANDING IT CABINET

.1 EIA compliant 19” network equipment rack. Overall dimensions of rack shall be 83.58”H x 24”W x 42”D. Useable height of rack shall be 44 rack spaces, useable depth shall be 40”. Rack shall come equipped with two pairs of fully adjustable steel rackrail with tapped 10-32 mounting holes in universal EIA spacing, black e-coat finish and numbered rack spaces. Rack shall include vented pad-lockable and latching rear and front doors. Racks shall have a configurable open top with vertical cable management entry points. Rack shall accept tool-free and hardware-free internal cable and device management system accessories. Rack shall have pre-threaded ganging holes. Rack shall be capable of ganging while fully loaded, using bolts only. Rack shall have marked rackrail depth indicators. Rack shall be of fully welded construction. Rack shall be finished in an environmentally friendly, durable black powdercoat. Grounding and bonding studs installed in top and base of enclosure.

.2 Specified Product:
- .1 Hammond C4F247742BK1 Series.
  - .1 Include the following with the freestanding enclosure:
    - .1 C4PR2477SZPL Series pairs of square hole mounting rails.
    - .2 Matching solid side panels.
    - .3 Top panel with fan vents.
    - .4 Package of 10-32 rack screws and cage nuts.
    - .5 Lace strip vertical cable managers. Select final style to suit. In front and rear of cabinet.
    - .6 Horizontal cable managers, as indicated.
    - .7 Shelves as required. Provide a minimum of one shelf.
    - .8 Other items as indicated.

2.9 WALL MOUNTED IT CABINET

.1 EIA compliant wall mount rack. Overall dimensions shall be 30.68" W x 27.81” H x 34.78" D. Weight capacity shall be 350 lbs. Useable depth shall be 32.50”. Centre section and backpan shall be 16-gauge steel, phosphate pre-treated and finished in a black textured powder coat. Rackrail shall be constructed of 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing with black e-coat finish and marked rackspaces. Rack shall be constructed to swing open for component cabling access, centre section shall pivot for either left or right opening.
- .1 Specified Products:
  - .1 Hammond model # HWC3012U35BK with clear window lockable front door.

.2 Include the following accessories with the IT cabinet:
- .1 Lace strip vertical cable managers. Select final style to suit in front and rear of cabinet.
- .2 Horizontal cable managers, as indicated.
- .3 Shelves, as required. Provide a minimum of one shelf.
- .4 24-port copper patch panel.
- .5 6-port fibre patch panel.
- .6 Type 1 PDU.
- .7 Other items as indicated.

2.10 TYPE 1 POWER DISTRIBUTION UNIT (PDU)

.1 High density thin power distribution unit with 8 outlets, each rated at 15 amps. Coordinate PDU dimensions with available space inside the IT cabinet. Thin power distribution shall feature 8 NEMA 5-15R (T-slot) outlets. Corded power strip includes 15 amp protection and mounting hardware. Corded models shall be terminated with 10' power cord and NEMA 5-15P plug. PDU shall feature a black anodized finish. Regular and top feed models shall be provided to accommodate installations where ground prongs must be positioned at the top of each outlet. PDU shall include a permanently installed supplementary grounding and bonding stud. PDU shall be listed to CAN/CSA C22.2 #21. PDU shall be manufactured by an ISO 9001 and ISO 14001 registered company.

.1 Acceptable Products:

.1 Hammond model # 15852T8B1 series. Coordinate final PDU selection with the dimensions of the IT cabinet and the connection requirements of the equipment to be fed from the PDU.

2.11 TYPE 2 POWER DISTRIBUTION UNIT (PDU)

.1 Switched.

.2 Zero U.

.3 30 A, 120/208V.

.4 Overload protection.

.5 Input connection: L14-30P, cord length to suit.

.6 Output connection: 5 – 20R.

.7 User – customizable power control and active monitoring.

.8 Power sequencing delays.

.9 Specified Product:

.1 APC (Schneider) PDU 9000 Series or approved equivalent.

2.12 48-PORT COPPER PATCH PANEL (CAT6)

.1 Patch panel, 2 rack units high, 48 ports:

.1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-B.2.

.2 Patch panel to be the straight type (not angled).

.3 Keystone format.

.2 To be made of steel frame with black powder coat finish. To be modular and of keystone construction to allow the possibility of changing connector type in the future without replacing the entire unit. To be manufactured by an ISO 9001 certified manufacturer.

.3 Provide separate patch panels for STP and UTP cables. Dedicated patch panels for STP and UTP cables may not be shown on drawings. Provide sufficient numbers of patch panels to terminate all cables connected to the IT cabinet.

.4 Specified Manufacturer:
.1 Belden.

2.13 RACK MOUNT FIBRE OPTIC PATCH PANEL

.1 Panels shall provide cross-connect, interconnect, splicing capabilities and contain cable management for supporting and routing of fibre cables/jumpers.

.2 Shall feature a front and rear access design with a hinged cover.

.3 Shall have a built in radius control.

.4 Shall be modular and in Keystone format opening to allow the possibility of changing connector types in the future without replacing the entire unit.

.5 Shall be sized to permit the termination of all fibres being installed and allow for future growth.

.6 Shall be tested after installation to verify that the system meets the loss limit from patch panel to patch panel.

.7 Panels shall be mounted in 483mm (19”) equipment racks.

.8 All equipment shall be certified as meeting the EIA technical specifications and must be installed as per the manufacture’s guidelines and recommended installation methods.

.9 Specified Product:
.1 Corning Closet Connector Housing (CCH). Number of rack units as indicated. Provide Corning Closet Connector Housing (CCH) panels complete with LC connectors and splicing hardware. Coordinate connector types on-site with the Owner during construction. Provide sufficient number of panels to terminate all strands of each cable terminated inside the panel housing.
.2 Allow for UPC (Ultra Physical Contact) connectors. Coordinate final type with the Owner during construction.

2.14 24-PORT COPPER PATCH PANEL (CAT6)

.1 Patch panel, 1 rack units high, 24 ports:
.1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-B.2.
.2 Patch panel to be the straight type (not angled).
.3 Keystone format.

.2 To be made of steel frame with black powder coat finish. To be modular and of keystone construction to allow the possibility of changing connector type in the future without replacing the entire unit. To be manufactured by an ISO 9001 certified manufacturer.

.3 Provide separate patch panels for STP and UTP cables. Dedicated patch panels for STP and UTP cables may not be shown on drawings. Provide sufficient numbers of patch panels to terminate all cables connected to the IT cabinet.

.4 Specified Manufacturer:
.1 Belden.

2.15 BONDING CONDUCTOR FOR TELECOMMUNICATIONS EQUIPMENT (G1)

.1 #6 AWG with 63/24 stranding Telco copper conductor, green insulated.

2.16 TERMINATION LUGS

.1 Termination lugs to be long barrel irreversible 2-hole compression type, complete with inspection window.

.2 Termination lugs to be sized for the bonding conductor and be suitable for the specified bonding conductors.

.3 Suitable for telecommunication applications.

.4 Termination lugs to facilitate a minimum of two crimps.

.5 Electro-tin plated.

.6 Acceptable Product:

.1 Burndy YAZ series two-hole Hylug code conductor long barrel with inspection window for telecommunications applications.

2.17 LABELS

.1 To meet the legibility, defacement, exposure and adhesion requirements of UL 969.

.2 To be preprinted or laser printed type.

.3 Where used for cable marking, provide Vinyl substrate with a white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable. If the cable jacket is white, provide a cable label with printing area that is any other colour than white, preferable orange or yellow so that the labels are easily distinguishable.

.4 Where insert type labels are used provide clear plastic cover over label.

.5 Labeling to meet the requirements of TIA/EIA-606-A.

2.18 TELECOMMUNICATIONS GROUND BUS (TGB)

.1 Predrilled commercially manufactured copper busbar, listed by NRTL, electrotin plated with holes sized for use with standard-sized lugs to: ANSI J-STD-607-A.

.2 Dimensions 6 mm thick, 50 mm wide, length sized as necessary to accommodate IT requirements plus 50% space. Minimum of 50mm insulation to: ANSI-J-STD-607-A.

2.19 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (BCT)

.1 3/0 AWG with 413/24 Stranding Telco copper conductor, green insulated.

2.20 SYSTEM CERTIFICATION AND WARRANTY

.1 A certification program provided by the manufacturer of the cabling infrastructure to cover the installed cabling system.

.2 The cabling system certification to provide the assurance that all present and future applications engineered for the performance level of the cabling system used will function over the cabling system.

.3 Prompt corrective action to be taken should the cabling system fail to support the application(s) designed to operate over it – whether at the time of cut over to the new cabling system, during subsequent use, or after upgrading to a new supported application during the construction and warranty periods.

.4 Certify that the installed cabling system conforms to all applicable local building and electrical codes.

2.21 FOUR-PAIR BALANCED UNSHIELDED TWISTED PAIR (UTP) CATEGORY 6 CABLE (RATED FOR UNDERGROUND APPLICATIONS)

.1 Gigabit Ethernet.

.2 Premise horizontal cable.

.3 Indoor/outdoor rated.

.4 Solid conductors.

.5 Gel-filled water blocking jacket. Suitable for burial applications.

.6 Operating temperature range: -20°C to 75°C.

.7 Third party verified to TIA/EIA-568-C.2, Category 6.

.8 Suitable for Ethernet/IP as well as PoE and PoE+ applications.

.9 Colours per drawings.

.10 Specified Product:

.1 Belden 2143A. Provide armoured version, where indicated.

2.22 HORIZONTAL CABLE MANAGER

.1 Constructed of 16 gauge steel.

.2 Continuous hinged door with magnetic closure strip.

.3 Four oblong openings top and bottom - allowing for cable exit top and/or bottom.

.4 Openings in the rear for cable entry.

.5 Designed to fit standard 19” rails.

.6 Finished in textured black powder paint.

.7 Acceptable product(s):
.1 Hammond PCMDD19001BK1 series 1U horizontal cable manager, or approved equivalent.

2.23 RACK MOUNT ETHERNET SWITCH

.1 Industrial grade, rack mountable, fully managed Ethernet switch.

.2 Twelve (12) 10/100/1000 Base TX ports complete with a minimum of sixteen (16) 10/100/1000 SFP fibre ports. Provide the required fibre transceiver on each SFP port. Fibre connectors to suit.

.3 Layer 2.

.4 Acceptable product(s):
.1 Cisco IE-4010-16S12P series c/w sixteen (16) GigE IND SFP fibre transceivers, plus one (1) spare SD-IE-1GB= Industrial Ethernet 1GB SD memory card.
.2 Provide a dedicated power supply for each switch, per Cisco PWR-RGD-AC-DC-H series 150W (minimum). Size power supply to suit.
.3 The final installation shall have a minimum of three (3) spare 10/100/1000 copper ports plus at least three (3) spare 10/100/1000 SFP fibre ports – provide the specified fibre transceivers for the spare SFP ports. Provide as many switches and expansion modules as required to meet this requirement.

2.24 RACK MOUNT FIREWALL ROUTER

.1 As indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Install termination and cross-connect hardware indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Install horizontal cables as indicated in conduits from control panels to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.

.2 Terminate horizontal cables in control panels and at individual work-area jacks.
.1 Identify and label as indicated to: TIA/EIA-606-A.

3.3 INSTALLATION OF BACKBONE CABLES

.1 Terminate backbone cables in control panels as indicated and according to manufacturers' instructions.
.1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 IMPLEMENT CROSS-CONNECTIONS

.1 Implement cross-connections using patch cords as specified.

3.5 FIELD QUALITY CONTROL

.1 Test horizontal UTP/STP cables as specified below and correct deficiencies, provide record of results as electronic copy.
  .1 Perform tests for Permanent Link on installed cables, including spares:
  .2 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
    .1 Perform tests for Channel on 100% of cross-connected data horizontal cabling installed from each control panel, including shortest and longest drops from each control panel.

.2 Test backbone UTP/STP cables as specified below and correct deficiencies: provide record of results as electronic copy.
  .1 Perform tests for Permanent Link on 4-pair cables:
    .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
    .2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568-B.1.

.3 Test Optical-fiber strands for attenuation to: TIA/EIA-568-B and correct deficiencies: provide record of results as electronic copy.
  .1 Test horizontal links at only one wavelength (850 nm or 1300 nm) and in one direction.
    .1 Attenuation to be less than 2.0 dB, unless consolidation point is used.
    .2 If consolidation point is used, attenuation test result to be less than 2.75 dB when testing between horizontal cross-connect and telecommunications outlet/connector.
  .2 Test backbone links in both directions. Backbone links:
    .1 Test multi-mode fiber at both applicable wavelengths (850 nm and 1300 nm).
    .2 Test single-mode fiber at both applicable wavelengths (1550 nm and 1310 m).
  .3 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.
    .1 Multi-mode-fiber attenuation coefficients:
      .1 3.5 db/km @ 850 nm; and
      .2 1.5 db km @ 1300 nm.
    .2 Single-mode fiber attenuation coefficients at both 1310 nm and 1550 nm:
      .1 1.0 db/km for inside plant cable; and
      .2 0.5 db/km for outside plant cables.
    .3 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.

.4 Perform additional Tier 2 tests using optical time domain reflectometer (OTDR) on backbone fiber pairs to: TSB-140.
  .1 Correct deficiencies.
  .2 Provide record of results as described in Division 1.

.5 Provide a record of the results as electronic copy to: TIA/TSB-140.

3.6 DISTRIBUTION CABLING

.1 Install distribution outlet drops in locations and with configurations as detailed in the drawings.

.2 Mount two-port faceplate using single gang adapter ring on double gang box by Division 16 at each point of service.

.3 Terminate each Category 6 permanent link on a RJ45 jack on one port of the common horizontal drop faceplate, and on a CAT 6 patch panel in control panel, or on male connection in control panel.

.4 All Category 6 modular jacks to be terminated in accordance with ANSI/TIA/EIA-568-B.1 Figure 6-1 (T568A configuration).

.5 Test each distribution drop. All cabling and terminations comprising each horizontal port link shall conform to the performance as detailed in paragraph 3.5.

3.7 IDENTIFICATION .1 AND LABELING

.1 Cable and termination identification requirements:

.1 The faceplate of each point of service to be labeled with the designation of the supporting control panel, e.g. CP-100', 'CP-400'.

.2 Individual Ports at each point of service: Are labeled using the format:

<Panel> <Port#>
where:
Panel corresponds to PLC panels or IT racks.

Port # is a two-digit number of the jack on the terminating jack panel. For panels terminating horizontal distribution, values range from '01 onwards'.

.3 Backbone Cables: each backbone cable shall be identified and labeled using the following format:
<Panel 1> <Panel 2>
where:
Panel 1/Panel 2 corresponds to PLC panel or IT rack.

.2 Labelling Application:

.1 Identification labels to be affixed to backbone cables with 15 cm of the following: each end of the cable, each side of a sleeve through floor slab; wall or other obstacle; entry and exit into a conduit; entry and exit points from a cable tray; and, any other location as needed to visually establish the identity of the cable.

.2 Horizontal distribution cables to be labeled on the termination faceplate at the point of service, the termination panel in the control panel and 5 cm from each end of the cable.

.3 Identification labels also to be affixed to distribution cables within 300 mm of the following: each end or termination, each side of a sleeve through floor slab; wall or other obstacle; entry and exit into a conduit; entry and exit points from a cable tray; and, other locations as needed to visually establish the identity of the cable.

3.8 GROUNDING AND BONDING

.1 As per ANSI J-STD-607-A, Section 16045 and the equipment manufacturers' recommendations.

3.9 CLEANING

.1 Upon completion of system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt and construction debris and repair damaged finish, including chips, scratches and abrasions.

3.10 DEMONSTRATION

.1 Operate control/signal systems to demonstrate proper functioning over the telecommunications infrastructure.

.2 Replace malfunctioning cable with new materials and then retest and re-commission until satisfactory performance is achieved.

3.11 ACCEPTANCE

.1 Acceptance with be withheld until the following have been completed successfully:
- .1 Acceptance of all submittals.
- .2 Delivery of final documentation.
- .3 Successful testing.
- .4 Successful demonstration, including operation of systems using the cable, training and manual review.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submissions: Section 16010 and Division 1.

.2 Shop Drawings: Provide a copy of the Table of Programmable Parameters for each applicable Component.

.3 Maintenance Manuals: Provide a copy of the Table of Programmable Parameters for each applicable Device. Reference Sections:

1.2 DEFINITIONS

.1 Commissioning: Verification of installation (mechanical, power and control wiring), energizing and calibrating of equipment.

.2 On drawings in Table of Devices, each device is defined by a component code. Component Codes are comprised of two parts a single digit Alpha Descriptor and two-digit Numeric Qualifier.

.3 Alpha Descriptor are as follows:

.1 A – Analysis.
.2 H – Hand.
.3 J – Power.
.4 L – Level.
.5 M – Motion.
.6 N – Miscellaneous.
.7 O – Output.
.8 P – Pressure.
.9 R – Relays.
.10 T – Temperature.
.11 U - Process Control.
.12 Z – Position.

.4 Table of Programmable Parameters: Manufacturer or Contractor created table listing all of the programmable parameters of a Device. Table is to contain separate columns for parameter codes, description, factory default values, commissioning, substantial performance review, and final inspection. Table is to be in electronic format for standard commercially available software or manufacturer's propriety software only if it is supplied as part of the contract. Programmable parameters include jumpers and dip switches as well as software selectable options. Table headers are to contain the JLR#, project name, Device Tag, Component Code, date, and column titles.

PART 2 - PRODUCTS

2.1 SHOP DRAWINGS

.1 Shop Drawings to outline options for each component. Include all components for a complete installation.

.2 Shop Drawings to include installation details including specific piping, valuing and mounting for all installation sensitive instruments. This will require co-ordination from the General, Mechanical, Electrical, and System Integrator.

.3 Provide a Table of Programmable parameters for each device.

2.2 CALIBRATION AND CERTIFICATION EQUIPMENT

.1 The MECP requires annual certification of certain process equipment.

.2 Include the supply of all cables, transmitters, software and any other device or testing equipment to meet the MECP requirements. One set per project for each type of device is required. Allow for eight (8) hours of operator training over two sessions one (1) month apart.

2.3 EQUIPMENT TAGGING

.1 Each instrument is to be provided with a stainless steel tag with the equipment tag imprinted on the tag. Connection to the instrument is via stainless steel chain or other approved method. Where the transmitter is remote to the sensor, provide a separate tag for each. Provide shop drawing of each tag for approval.

2.4 A01

.1 Gas Monitor:

.1 Transmitter:

.1 NEMA 4X, 316 Stainless Steel
.2 Zone 1, Group ABCD
.3 SIL-2 compliant universal gas detector (3rd party certification by TUV-Rheinland)
.4 Operating temperature: -40°C to 75°C
.5 5-95% RH (non-condensing)
.6 3-wire, 24VDC
.7 ¾" NPT conduit connections
.8 4-20mAq + HART
.9 3 programmable alarms with set and reset (adjustable deadband) plus 1 fail-safe system fault via four (4) Form C relays, each rated 5A at 30VDC, resistive loads.
.10 Graphical LCD display, visible in bright sunlight; displays fault, alarm status, trends, readings, settings, calibration instructions, etc. English.
.11 Non-volatile memory.

.2 Sensor:
- .1 Universal detector head that can accept all sensor types.
- .2 Select sensor type for combustible and toxic gases, as indicated.
- .3 Gas detection system to support up to 3 sensors per transmitter.
- .4 Automatic sensor voltage adjustment.
- .5 Plug and play sensor installation without the need to de-classify space.
- .6 Sensor can be bench calibrated and installed in field without additional calibration.
- .7 User selectable sensor range.
- .8 Sensor range can be changed without recalibration.
- .9 Note that the sensor is remote from the transmitter. Coordinate sensor placement and associated cable lengths with the manufacturer.
- .10 Provide the following accessories to suit installation:
  - .1 Calibration adapter
  - .2 Flow cell
  - .3 Duct mount kit (for ducted installations)
  - .4 Sensor simulator for each type of gas indicated
  - .5 Universal mounting kit
  - .6 End cap
  - .7 Magnetic wand
  - .8 Custom stainless steel tag
  - .9 Provide one calibration kit in a case for the site complete with tools, three (3) cylinders of each range of calibration gas (minimum of 103 litres per cylinder), regulators and tubing with fittings.
  - .10 Specified product:
    - .1 MSA or approved equivalent.

2.5 A02

.1 Dissolved Oxygen Analyzer:
- .1 Continuous measurement of dissolved oxygen (DO) concentration of process fluid in an open channel.
- .2 Type: Fluorescence
- .3 Element: Submersible dissolved oxygen probe
- .4 Range: 0-10 ppm
- .5 Repeatability: 0.02 ppm
- .6 Ambient temperature: -30 deg. C to 60 deg. C
- .7 Humidity: 0 to 95 percent, relative, noncondensing.
- .8 Temperature Compensation: Automatic, 0 to 30 degrees C.
- .9 Non-volatile memory backup.
- .10 Provide junction box and extension cables to suit
- .11 Sensor:
  - .1 Type: Fluorescence Quenching Method or vendor specific, automatic self-cleaning.
  - .2 Automatic compensation for ambient light, process colour changes and temperature variations. No consumables, not damaged by exposure to direct or indirect sunlight and no replacement cartridges.
  - .3 Process Temperature Range: 0 to 30 degrees C.
  - .4 Sensor Accuracy: ±0.05 ppm, ±1% of range
  - .5 Submersible DO probe

.6 Cable length to suit.

.12 Transmitter:
- .1 120VAC
- .2 CSA certified
- .3 4-20mA output
- .4 Minimum of two (2) form C dry contacts rated at 5A, 120VAC
- .5 NEMA 4X, industrial-grade, wall mount enclosure
- .6 Graphic LCD, LED backlit display
- .7 Compatible with specified sensor

.13 Acceptable product(s):
- .1 Hach
- .2 YSI
- .3 Endress and Hauser

2.6 A03

.1 UV Transmittance Analyser:
- .1 Continuous measurement of UV transmittance of process fluid in an open channel.
- .2 Sensor:
  - .1 Type: 2-beam
  - .2 Element: UV Absorbance/Transmittance Sensor
  - .3 Range: 0.01 - 60 1/m
  - .4 Ambient temperature: 2 - 40 °C
  - .5 Provide junction box and extension cables to suit
  - .6 Cable length to suit.
  - .7 Acceptable product(s):
    - .1 Hach UVAS,
    - .2 Approved Alternative
- .3 Transmitter:
  - .1 120VAC
  - .2 CSA certified
  - .3 4-20mA output
  - .4 Minimum of two (2) form C dry contacts rated at 5A, 120VAC
  - .5 NEMA 4X, industrial-grade, wall mount enclosure
  - .6 Graphic LCD, LED backlit display
  - .7 Compatible with specified sensor
  - .8 Acceptable product(s):
    - .1 Hach SC4500,
    - .2 Approved Alternative

2.7 F01

.1 Electromagnetic Flowmeter (Remote Sensor):
- .1 Sensor:
  - .1 Liner material: hard rubber or polyurethane, suitable for wastewater applications.
  - .2 Process connection: ASME B 16.5 CLASS 150 carbon steel flanges.
  - .3 Electrodes: 316L stainless steel.
  - .4 Cable length: specified by Contractor.
  - .5 CSA general purpose.

.6 NEMA 4X.

.2 Transmitter:
- .1 Cable entries: ½" NPT.
- .2 Programmable via keypad.
- .3 Illuminated LCD display.
- .4 Non-volatile memory.
- .5 User selectable units of measure.
- .6 CSA general purpose.
- .7 NEMA 4X.
- .8 4-20mA output.
- .9 4-wire.
- .10 24VDC power.
- .11 HART protocol.
- .12 Wall mount.

.3 3-point calibration.

.4 Size as indicated.

.5 Accuracy: +/- 0.5%.

.6 Acceptable Products:
- .1 Siemens MAG 3100W c/w MAG 6000.
- .2 Endress and Hauser equivalent

2.8 F02

.1 Thermal Flow switch:
- .1 Sensor:
  - .1 Suitable for ferric chloride applications.
  - .2 Cable length: specified by Contractor.
  - .3 Orientation to suit process.
  - .4 NO or NC contact
  - .5 12-36 Vdc
  - .6 SPST relay. 60 V ac/dc 1 A max
  - .7 0 to 60°C fluid temperature rating
- .2 Acceptable Products:
  - .1 OMEGA FST-200(model: FST-211-SPST or FST-211-R).
  - .2 Approved Alternative.

2.9 F03

.1 Open Channel Flowmeter:
- .1 Radar, ultrasonic and/or laser level measurement technologies.
- .2 Suitable for use in sewage pumping stations.
- .3 Not susceptible to foaming or fogging.
- .4 Deviation: ± 2 mm.
- .5 Ambient temperature: -20°C to 60°C.
- .6 Non-contact maintenance free measurement.
- .7 4-20 mA output.
- .8 24 VDC or 120 VAC power.
- .9 Rated for temporary submergence up to 6 m for 2 hours.

.10 Programmable.
.11 Flow Accuracy: ± 4% of reading.
.12 Suitable for accurate flow measurement in various level condition 0.3 m to 2.5 m; channel widths up to 2 m.
.13 Acceptable Products:
.1 Teledyne Isco LaserFlow.

2.10 L01

.1 Floats:
.1 Cable supported.
.2 Mercury-free tilting switch.
.3 Form C - contact rated for 120 Vac.
.4 Mark float cable every 300 mm and provide a means of securing the float at the set level.
.5 Select float to suit intended environment.
.6 Stainless steel sway control ring.
.7 Acceptable product(s):
.1 ITT Flygt - ENM-10.

2.11 L02

.1 Ultrasonic Level Measurement (Remote Sensor):
.1 Features:
.1 Single or dual points of measurement.
.2 User selectable units of measure.
.3 Programmable via keypad.
.4 Non-volatile memory.
.5 Pre-programmed tanks, flumes and weirs.
.6 Built-in temperature compensation.
.7 Modes of operation: level, differential level, volume, total volume and open channel flow.
.2 Transducer:
.1 Beam spread: 12° (max.).
.2 Process connection: 2” NPT.
.3 CSA general purpose.
.4 Maximum blocking distance: 0.3 m.
.5 Max range: 0 to 10m.
.6 Cable length: specified by Contractor.
.7 Class 1 Zone 1 rated, c/w all required appurtenances.
.8 Mounting Hardware per manufacturers recommendations
.9 Submergence shield per manufacturers recommendations
.10 Acceptable Products:
.1 Siemens XPS-15.
.2 Endress and Hauser equivalent.
.3 Transmitter:
.1 Field mount or as indicated.
.2 Illuminated LCD display.
.3 4-wire.
.4 Two (2) 4-20 mA outputs.

.5 24 VDC power
.6 NEMA 4X.
.7 CSA general purpose
.8 Accepts two (2) sensors
.9 Three (3) relays
.10 HART protocol
.11 Accuracy: +/- 6 mm; resolution of 1 mm.
.12 Acceptable Products:
.1 Siemens LT500
.2 Endress and Hauser equivalent.

2.12 L03

.1 Radar Level Measurement:
.1 Deviation: +/- 2 mm.
.2 Process Temperature: -40°C to 80°C.
.3 Voltage: 24 VDC.
.4 4-20 mA output with HART.
.5 Suitable for use in sewage plant application.
.6 NEMA 4X enclosure.
.7 LCD display.
.8 Non-volatile memory.
.9 CSA approvals.
.10 Class 1 Zone 1 rated, c/w all required appurtenances.
.11 Mounting Hardware per manufacturers recommendations
.12 Submergence shield per manufacturers recommendations
.13 Acceptable Products:
.1 Siemens LR120.
.2 Endress and Hauser equivalent.
.14 Transmitter:
.1 Field mount or as indicated.
.2 Illuminated LCD display.
.3 4-wire.
.4 Two (2) 4-20 mA outputs.
.5 24 VDC power
.6 NEMA 4X.
.7 CSA general purpose
.8 Accepts two (2) sensors
.9 Three (3) relays
.10 HART protocol
.11 Accuracy: +/- 6 mm; resolution of 1 mm.
.12 Acceptable Products:
.1 Siemens LT500
.2 Endress and Hauser equivalent.

2.13 L04

.1 Flood detection switch:
- .1 Cable supported.
- .2 Weighted compact-sized float switch.
- .3 Form C contact rated for 120 Vac.
- .4 Select float to suit intended environment.
- .5 Acceptable product(s):
  - .1 Gem Sensors LS-750 series

2.14 L05

.1 Radar Level Measurement:
- .1 Deviation: +/- 2 mm.
- .2 Process Temperature: -40°C to 80°C.
- .3 Voltage: 24 VDC.
- .4 4-20 mA output with HART.
- .5 Suitable for use in sewage plant application.
- .6 NEMA 4X enclosure.
- .7 LCD display.
- .8 Non-volatile memory.
- .9 CSA approvals.
- .10 Class 1 Zone 1 rated, c/w all required appurtenances.
- .11 Mounting Hardware per manufacturers recommendations
- .12 Acceptable Products:
  - .1 Siemens LR150.
  - .2 Endress and Hauser equivalent.

2.15 N01

.1 True on-line, double conversion, power line isolated UPS:
- .1 Input/Output voltages: 120 VAC/120 VA,.
- .2 VA Rating: 3000 VA/2700 W,
- .3 0.95 pF at full load,
- .4 Minimum of four (4) outlets at 120 VAC,
- .5 Power input via L5-15P line cord,
- .6 Power outputs via six (6) L5-15R receptacles,
- .7 Surge suppression,
- .8 Tower configuration,
- .9 Battery:
  - .1 Sealed lead-acid/maintenance free,
  - .2 Eight (8) minutes of protection at 80% of full loa,.
  - .3 Four (4)-hour charge time at 80% of full load,
  - .4 On-line automatic test without exposing load.
- .10 Acceptable product(s):
  - .1 Powerware PW9130L3000T-XL, complete with optional relay interface card.

2.16 O01

.1 Flashing Light:
- .1 LED rotating, stackable indictor.
- .2 120 VAC.
- .3 Mounting as indicated.
- .4 NEMA 4X rated. Suitable for outdoor installation.
- .5 cUL/CSA approved.
- .6 Minimum temperature range of -30°C to +55°C.
- .7 PLC compatible.
- .8 Provide colours as indicated.
- .9 Configurable.
- .10 Include integrated 100 dBA magnetodynamic sounder.
- .11 Acceptable product(s):
  - .1 Edwards Signaling 200 Class 70 mm Stacklight Series.

2.17 O02

.1 Flashing Light (Hazardous Location):
- .1 LED indictor.
- .2 120 Vac.
- .3 Mounting to suit.
- .4 NEMA 4X rated. Suitable for outdoor installation.
- .5 Zone 2.
- .6 Minimum temperature range of -30°C to +55°C.
- .7 PLC compatible.
- .8 Provide colours as indicated.
- .9 Configurable.
- .10 Acceptable product(s):
  - .1 Edwards Signaling 107 XBR XTRA-BRITE LED.

2.18 O03

.1 Alarm Horn (Hazardous Location):
- .1 100 dBA @ 10 feet.
- .2 120 Vac.
- .3 NEMA 4X. Outdoor weatherproof heavy–duty enclosure.
- .4 PLC compatible.
- .5 Surface mount indoors. Flush mount outdoors; coordinate with exterior cladding contractor.
- .6 Minimum temperature range of -30°C to +55°C.
- .7 Zone 2.
- .8 Acceptable product(s):
  - .1 Federal Signal 31X series.

2.19 P01

.1 Pressure Transmitter:
- .1 0.065% Accuracy Span adjustable to suit pressure range.
- .2 316 stainless steel, NEMA 4X. . Temperature rating of -40 deg. Celsius to +100 deg. Celsius.
- .3 Units in kPa.
- .4 ½" NPT, IP66 cable entry.
- .5 ½" NPT process connection.
- .6 SST Diaphram.
- .7 Class 1 Zone 1 as required for process.
- .8 LCD display.
- .9 24 VDC power supply, two wire (loop powered).
- .10 4 – 20 mA with HART.
- .11 Manufacturer's bracket for pipe and wall mounting.
- .12 Aluminum housing.
- .13 Acceptable products:
  - .1 Siemens P320I Series.
  - .2 Endress + Hauser equivalent.

2.20 T01

.1 Temperature Switch:
- .1 Industrial grade epoxy coated NEMA 4X enclosure.
- .2 SPDT contact rated for 10 amps at 250 VAC.
- .3 Stainless steel diaphragm, Viton O-ring.
- .4 cUL/CSA approval.
- .5 ½" NPT (female) plus knockouts + knockouts for electrical connections.
- .6 Set point repeatability: ±1% of the range.
- .7 Adjustable deadband.
- .8 Internal adjustment with reference scale.
- .9 Provide thermowells to suit application.
- .10 Acceptable product(s):
  - .1 United Electric Controls 100 Series.

2.21 T02

.1 Plant Indoor Ambient Temperature:
- .1 4-20 mA output, 2-wire operation.
- .2 HART protocol.
- .3 Configurable input and output.
- .4 CSA or equivalent approval.
- .5 Illuminated, rotatable display.
- .6 NEMA 4X, IP67 Die cast aluminum housing.
- .7 100 ohm platinum RTD element.
- .8 Zone 1 to suit environment.

.9 Acceptable product(s):
.1 Endress & Hauser TMT142 Series.

2.22 T03

.1 Process Area Temperature:
.1 4-20 mA output, 2-wire operation.
.2 HART protocol.
.3 Configurable input and output.
.4 CSA or equivalent approval.
.5 Illuminated, rotatable display.
.6 NEMA 4X, IP67 Die cast aluminum housing.
.7 100 ohm platinum RTD element.
.8 Provide thermowell to suit application.
.9 Zone 1 to suit environment.
.10 Acceptable product(s):
.1 Endress & Hauser TMT142 Series.

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Each device is to be installed in accordance with the manufacturer's recommendations.

3.2 ON-SITE START-UP AND COMMISSIONING

.1 Include as many visits as are necessary to start up and ensure trouble free and specified operation of the system. Be aware that various devices may be commissioned over a several week period.

.2 Provide Tables of Programmable Parameters for devices indicated. Have a copy of the tables available for the substantial performance review and final inspection. Update tables and distribute electronic (in format acceptable to the Consultant and Owner) or hard copies upon request. Provide updated copies of the tables in electronic format and hard copy for the maintenance manuals.

.3 Manufacturers representatives are to be on site with the Consultant for the substantial performance review and as required by the Contractor for commissioning. Consultant may request the presence of the manufacturer's representatives for final inspection based upon the performance of the system during the substantial performance review.

3.3 START-UP

.1 Start-up of the following equipment must be made by a manufacturer's representative. Include as many visits as are necessary by the manufacturer's representative to start up and ensure trouble free and specified operation of the system.
.1 All devices supplied.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 As per Section 17500.

.2 The Municipality of Brighton PLC standards.

1.2 PRODUCT DATA

.1 As per Instructions to Proponents.

1.3 OPERATION AND MAINTENANCE DATA

.1 As per Instructions to Proponents.

PART 2 - PRODUCTS

2.1 INTENT

.1 PLC programming is to be written in a clear organized fashion.

.2 Provide comments and descriptions as required to ensure that the program can be understood by a programmer not involved in the project.

.3 Logic should follow process.

.4 Group logic for each process loop in blocks.

.5 PLC programs must follow the Municipality of Brighton programming standards.

2.2 MEMORY BLOCK ASSIGNMENT

.1 Group like components (field devices, counters, timers) together.

.2 Allow space for future additions to components in each group.

.3 Provide a map or description of the memory assignments.

2.3 VARIABLE ASSIGNMENT

.1 Use descriptive names (tags) mapped to I/O addresses.

.2 Provide a description of each tag, including I/O address and field tag or operational description for internal variables.

.3 Provide variables that are mapped to an address for exchange with the SCADA for:
- .1 "Run-Time Metering" hours of operation for all specified equipment.
- .2 "Idle-Time Metering" hours of operation for all specified equipment.

2.4 DATA TRANSFER

.1 Preselected Equipment PLCs will require control of intelligent devices connected to Plant PLC via fieldbus. Treatment Process Equipment Supplier to ensure that control and status is available to preselected equipment PLCs.

.2 Preselected Equipment PLCs will collect analog values, generate alarm and status bits. Treatment Equipment Supplier to ensure that this information is available at the Plant PLCs and SCADA.

.3 The operators will control the preselected equipment via SCADA. SI to ensure that control data is available to Preselected Equipment PLCs.

2.5 OPERATOR SET POINTS

.1 Set point and ranges are to be mapped to an address for exchange with the SCADA or a field device.

.2 Use descriptive tags.

2.6 COMMON SOFTWARE FUNCTIONS

.1 Where practical, call functions and pass variables to reduce the length of program.

.2 List and describe functions in detail so that the function may be used by future programmers if additions or updates are required.

.3 Test functions thoroughly.

.4 Lead - Lag Duty:
- .1 Equipment will operate the Lead device until a specified condition or Operator Adjustable set point is reached, in which the Lag device will engage as well.
- .2 Timed Lead - Lag Duty:
  - .1 The operator will have the capability of adjusting a Lead operational time limit through SCADA.
  - .2 Once the Lead device has expired its operational time limit, it will become the Lag device on the next start up, and the Lag device will become Lead.
- .3 Operational Lead - Lag Duty:
  - .1 After every device operation, the duty is toggled between equipment. The Lag device becomes Lead, and the Lead device becomes Lag.

.5 Device Auto-Duty Rotation:

.1 Three (3) Device:

.1 The operator will have the capability of adjusting an operational time limit through SCADA before device duty rotation. Once the limit has expired, the roll of each device will rotate as follows:

.1 The Lag device will become the Lead device.

.2 The Lead device will become the Standby device.

.3 The Standby device will become the Lag device.

.2 Two (2) Device:

.1 The operator will have the capability of adjusting an operational time limit through SCADA before device duty rotation. Once the limit has expired, the roll of each device will toggle as follows:

.1 The Standby device will become the Lead device.

.2 The Lead device will become the Standby device.

.3 If one piece of equipment is taken out of rotation, the others are to continue to rotate.

.6 Tank Level Operation:

.1 Three (3) Pump / Four (4) Level Switch Method:

.1 The tank will have a Lead, Lag, and Standby pump.

.2 The tank will use an Analog Level to simulate four (4) discrete Level Switch depths in determining pump operation, as follows:

.1 Stop Level Switch (indicate a "Stop" all pumps).

.2 Start Lead Level Switch (indicate Start Lead pump).

.3 Start Lag Level Switch (indicate Start Additional Lag pump).

.4 High Alarm Level Switch (indicate an operator High Level Alarm).

.3 The Standby pump will take on the roll of either the Lead or Lag pump should a fault occur.

.2 Two (2) Pump / Three (3) Level Switch Method:

.1 The tank will have a Lead and a Standby pump.

.2 The tank will use an Analog Level to simulate three (3) discrete Level Switch depths in determining pump operation, as follows:

.1 Stop Level Switch (indicate "Stop" all pumps).

.2 Start Lead Level Switch (indicate Start Lead pump).

.3 High Alarm Level Switch (indicate an operator High Level Alarm).

.3 The Standby pump will take on the roll of the Lead pump should a fault occur.

2.7 FIELDBUS DEVICES

.1 When mapping to memory allow for addition of future points without the requirement to adjust the memory mapping for other devices.

.2 VFDs:

.1 Map the following points to memory and provide at SCADA:

.1	Fault	(Descriptive word)
.2	Run status	(Bit)
.3	Auto mode	(Bit)
.4	Phase loss	(Bit)
.5	Phase imbalance	(Bit)
.6	Average current	(Floating Point)
.7	Run control	(Bit)
.8	Fault reset	(Bit)

.9 Speed control (Floating Point)
.10 Speed feedback (Floating Point)
.11 Minimum speed (Floating Point)
.12 Maximum speed (Floating Point).

.3 FVNR (Full Voltage Non-Reversing) Starters:
.1 Map the following points to memory and provide at SCADA:
.1 Fault (Descriptive word)
.2 Run status (Bit)
.3 Auto mode (Bit)
.4 Phase loss (Bit)
.5 Phase imbalance (Bit)
.6 Average current (Floating Point)
.7 Run control (Bit)
.8 Fault reset (Bit).

.4 FVR (Full Voltage Reversing) Starter:
.1 Map the following points to memory and provide at SCADA:
.1 Fault (Descriptive word)
.2 Run status forward (Bit)
.3 Run status reverse (Bit)
.4 Auto mode (Bit)
.5 Phase loss (Bit)
.6 Phase imbalance (Bit)
.7 Average current (Floating Point)
.8 Run control forward (Bit)
.9 Run control reverse (Bit)
.10 Fault reset (Bit).

.5 FV2S (Full Voltage Two-Speed) Starter:
.1 Map the following points to memory and provide at SCADA:
.1 Fault (Descriptive word)
.2 Run status low (Bit)
.3 Run status high (Bit)
.4 Auto mode (Bit)
.5 Phase loss (Bit)
.6 Phase imbalance (Bit)
.7 Average current (Floating Point)
.8 Run control low (Bit)
.9 Run control high (Bit)
.10 Fault reset (Bit).

.6 Actuators:
.1 Discrete:
.1 If applicable, map the following points to memory and provide at SCADA:
.1 Fault
.2 Engage/Open actuator
.3 Disengage/Close actuator
.4 Fault reset
.5 Auto mode.

.2 Modulating:
.1 If applicable, map the following points to memory and provide at SCADA:
.1 Fault
.2 Actuator set point
.3 Actuator position
.4 Fault reset
.5 Auto mode.

.7 Miscellaneous I/O:
.1 Field I/O can be tied to the system via remote I/O and include but are not limited to :
.1 Manual switches
.2 Level, Flow, Pressure switches
.3 Level, Flow, Pressure transducers
.4 Analyzers
.5 Remote control from the PLC.

2.8 PID LOOPS

.1 List and describe PID loops.

.2 List and describe variables; provide functional ranges for each.

.3 Provide the Consultant the PID formulas used from the PLC manufacturer.

.4 Tune PID loops with the appropriate control method as specified below and turn over all field notes to the Consultant:
.1 Flow control:
.1 PI Control (proportional - integral).
.2 Liquid Pressure control:
.1 PI Control (proportional - integral).
.3 Temperature control:
.1 PID Control (proportional - integral - derivative).
.4 Level control:
.1 PID Control (proportional - integral - derivative). Use very little integral gain.
.5 Gas pressure:
.1 PID Control (proportional - integral - derivative). Use very little integral gain.
.6 Gains and other parameters are to be mapped with an address for exchange with the SCADA or a field device.

2.9 COMMUNICATIONS

.1 Set up program to reduce communication traffic.

.2 Arrange data transfer in words.

.3 List and describe transferable words.

2.10 TIME DELAYS

.1 Incorporate time delays where required to prevent nuisance alarms.

.2 Incorporate time delays for motor running alarms.

.3 Incorporate time delays for valve open/close confirmation.

PART 3 - INSTALLATION

3.1 FUNCTION DIAGRAMS

.1 Prior to starting programming, review drawings and specifications to establish function diagrams. Contact Consultant to clarify any concerns, omissions, or ambiguities.

.2 Submit function diagrams to Consultant for review prior to starting programming.

.3 Clearly indicate data transfers between the system and preselected equipment controllers.

.4 Update list as project progresses.

3.2 VARIABLE ASSIGNMENTS

.1 Provide a list of variables (tags) complete with descriptions. SI will be responsible for master list, including tags from preselected equipment PLCs.

.2 Submit list of variables to Consultant for review and written approval prior to starting programming.

.3 Update list as project progresses.

3.3 PRELIMINARY IMPLEMENTATION MEETING

.1 Once the function diagrams and list of variables have been reviewed by the Consultant, a meeting will be held:
- .1 The meeting will cover:
  - .1 Function diagrams for major loops.
  - .2 Alarms.
  - .3 Operator interfaces.
- .2 The meeting will be held in Brighton, Ontario.
- .3 Attending the meeting will be:
  - .1 System Integrator
  - .2 General Contractor
  - .3 Consultant
  - .4 Owner
  - .5 Operator.

3.4 INTERMEDIATE IMPLEMENTATION MEETING

.1 Once the programmer feels he has reached 80% completion a meeting will be held:
- .1 The meeting will cover:
  - .1 Review of the program to date.
  - .2 Changes to the proposed function diagrams for major loops.
  - .3 Alarms.
  - .4 Operator interfaces.
  - .5 Draft reports.
- .2 The meeting will be held in Brighton, Ontario.
- .3 Attending the meeting will be:
  - .1 System Integrator.
  - .2 General Contractor.
  - .3 Consultant.
  - .4 Owner.
  - .5 Operator.

3.5 FINAL IMPLEMENTATION MEETING

.1 Prior to final testing a meeting will be held:
- .1 The meeting will cover:
  - .1 Review of function diagrams for major loops.
  - .2 Review of alarms.
  - .3 Review of operator interfaces.
  - .4 Reports.
- .2 The meeting will be held in Brighton, Ontario.
- .3 Attending the meeting will be:
  - .1 System Integrator.
  - .2 General Contractor.
  - .3 Consultant.
  - .4 Owner.
  - .5 Operator.

3.6 TESTING / SIMULATIONS

.1 Once field-wiring tests have been completed and accepted, simulations can begin.

.2 Once the System Integrator has completed his preliminary testing and submitted a report to the Consultant, the Consultant will witness a complete simulation of the system operation.

.3 System Integrator is to provide all required testing equipment and simulate devices with switches and lights. Simulate analog signals with acceptable test equipment.

3.7 COMMISSIONING

.1 Once field-wiring tests have been completed and accepted, simulations can begin.

.2 Following successful equipment startup, in conjunction with the Operator manipulate the process to simulate variations including probable failures.

.3 Consultant and Owner to be present for final acceptance tests.

.4 For final acceptance prove:
- .1 Proper operation of control loops.
- .2 PID functions.
- .3 Alarm points.
- .4 Emergency shutdown.
- .5 Watch dog timers.

3.8 TRAINING

.1 Prepare instruction manual and train the Owners personnel to:
- .1 Resetting the PLC(s).
- .2 Interpreting indicators on the PLC modules.
- .3 Replacing a failed I/O card in the PLC.
- .4 Accessing and monitoring the program.

.2 Three training sessions are required, at least two to three weeks apart. Allow for each training session to be a minimum of three (3) hours.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 As per Section 17500.

.2 The Municipality of Brighton SCADA programming standard.

1.2 PRODUCT DATA

.1 As per Section 17051.

1.3 OPERATION AND MAINTENANCE DATA

.1 As per Division 1.

PART 2 - PRODUCTS

2.1 INTENT

.1 The SCADA programming is to be written in a clear organized fashion.

.2 Provide comments and descriptions as required to ensure that the program can be understood by a programmer not involved in the project.

.3 Process automation control is to be done at the PLC. SCADA is to act as an operator interface to provide maintenance control and handle data storage.

.4 Refer to Section 17051 for the specified SCADA software.

.5 Approval of draft screens and alarm list by the Consultant and Owner prior to installation.

.6 SCADA programs and screens must follow the Municipality of Brighton SCADA programming standards.

2.2 VARIABLE ASSIGNMENT/DATA TABLES

.1 Use descriptive names (tags) mapped to Data Tables.

.2 Provide a description of each tag, including address and field tag or operational description for internal variables.

2.3 ORDER INTERFACE

.1 General:

- .1 Use standard industry symbols, colours, and nomenclature.
- .2 Represent the general plant with an overall flow diagram.
- .3 Link detailed graphics pages to overall or general graphics pages.
- .4 Represent all data retrieved at the PLC on the graphics pages. Do not clutter screen and ensure that data is legible and clear.
- .5 Provide as many layers as required to properly represent the data.

.2 Status:

- .1 Use colours to represent on (green), off (red), maintenance/failed (yellow) status for pumps.
- .2 Use colours to represent open (green), close (red) status for valves.
- .3 For modulating valves, approximate position graphically and provide actual values.
- .4 For levels, approximate position graphically and provide actual values.
- .5 For RPM, approximate speed (%) graphically and provide actual values.
- .6 For totalizers and counters, provide a value.

.3 Control:

- .1 Operator is to have the capability of "start/stop" on equipment set in auto mode.
- .2 Operator is to have the capability to "open/close" valves/gates or adjust the position when applicable.
- .3 Provide safeguards and warnings to prevent an accidental change of state.
- .4 Operator is to have the capability of selecting manual mode operation on all motors and equipment.
- .5 Operator is to have the capability of adjusting all virtual float set points for each type of pump / float tank configurations as specified in Section 17210.
- .6 Operator is to have the capability of manually selecting pump device and resetting initial Auto-Duty assignments (Lead/Lag/Standby) manually or automatically.
- .7 Operator is to have the capability of adjusting a device Auto-Duty Rotation Timer for each uniquely indicated “Auto-Duty” system.
- .8 The operator is to have the capability to start or stop any device on screen “manual” mode selection. This control should be automatically reset on a timer (1 to 60 minutes). Any software interlocks are to override the SCADA “manual” mode. If the operator requires to run equipment in manual mode for an extended period of time, it should be done at the field equipment.

.4 Set points:

- .1 Operator is to have the capability to adjust set points within a fixed range.
- .2 Tags for set points are to be clear; provide a description where required.
- .3 Set points are to be adjusted from the process graphic screen. Show all data that can be affected by a change in set point on the screen where the set point adjustments are made.

.5 Alarms:

- .1 Alarms are to appear on screen regardless of the current display. Alarms are to remain on screen until acknowledged (field or SCADA).
- .2 Provide a 4 to 6-line alarm box that will remain on screen and indicate the latest alarms. Use colours to indicate alarm status.
- .3 Alarms are to remain on the alarm list until fault conditions are cleared.
- .4 Time/date stamp alarm activation, acknowledgment, and clear.

2.4 SCADA DEVICES

.1 VFDs:
- .1 Monitor (alarm) the following:
  - .1 Fault.
  - .2 Run status.
  - .3 Auto mode.
  - .4 Phase loss.
  - .5 Phase imbalance.
  - .6 Average current.
  - .7 Speed feedback.
- .2 Allow control or changing of the following:
  - .1 Run control (in SCADA “Hand” mode).
  - .2 Fault reset.
  - .3 Speed control.
  - .4 Minimum speed.
  - .5 Maximum speed.

.2 FVNR (Full Voltage Non-Reversing) starters:
- .1 Monitor (alarm) the following:
  - .1 Fault.
  - .2 Run status.
  - .3 Auto mode.
  - .4 Phase loss.
  - .5 Phase imbalance.
  - .6 Average current.
  - .7 Speed feedback.

.3 FVR (Full Voltage Reversing) Starters:
- .1 Monitor (alarm) the following:
  - .1 Fault.
  - .2 Run status forward.
  - .3 Run status reverse.
  - .4 Auto mode.
  - .5 Phase loss.
  - .6 Phase imbalance.
  - .7 Average current.
  - .8 Speed feedback.

.4 FV2S (Full Voltage Two-Speed) Starters:
- .1 Monitor (alarm) the following:
  - .1 Fault.
  - .2 Run status low.
  - .3 Run status high.
  - .4 Auto mode.
  - .5 Phase loss.
  - .6 Phase imbalance.
  - .7 Average current.
  - .8 Speed feedback.

.2 Allow control or changing of the following:
  .1 Run control (in SCADA “Hand” mode).
  .2 Fault reset.

2.5 PID LOOPS

.1 PID loop variables are to be made available for commissioning of the physical process at the SCADA.

.2 Software variables for PID loops are to be made available for trending for commissioning purposes. If used by a PID loop, trending should include:
  .1 Proportional Gain Set point (Kp).
  .2 Integral Gain Set Point (Ki).
  .3 Differential Gain Set Point (Kd).
  .4 Source input data value.
  .5 PID output data value.
  .6 Feedback error data value.

2.6 COMMUNICATION

.1 Set up program to reduce communication traffic.

.2 Arrange data transfer in words.

.3 Provide a data exchange table cross-referenced to the PLC(s).

2.7 TRENDING AND HISTORICAL DATA STORAGE

.1 Trend all analog signals. Trending data must clearly represent process variations. Data sample intervals to suit the process as follows:
  .1 Current : every 5.0 A.
  .2 Flow : every 50 m^3/day.
  .3 Level:
    .1 Tank depth : every 0.01 m
    .2 Storage : every 1% of volume.
  .4 Pressure : every 1% of measurement range.
  .5 Speed : every 5% of measurement range.
  .6 Totalizer : every 5 m^3.
  .7 Valve position : every 1% of actuator range.
  .8 Volts : every 5 V AC.

.2 Date/time stamp changes in discrete signals.

.3 Date/time stamp changes in operation set points.

.4 Trend motor starts and stops.

.5 SCADA to hold data only, totalizing and counting to be done at the PLC.

.6 Operator to have the ability to store trending data on a backup media to free storage space.

.7 Operator to have the ability to retrieve trending data from backup media.

.8 Trending is to be available for the commissioning of the physical process.

.9 Operator is to have the capability of selecting displayed trending data.

.10 Operator is to have the capability of adjusting x and y scales on displayed trend data.

.11 Where applicable, indicate set point on trend graphical display.

2.8 REPORTS

.1 Daily, weekly and monthly reports to be generated at the request of the operator. Single button selection for each type of report.

.2 Alarm report to print automatically when an alarm status changes.

.3 Reporting of trended values are to use both units and formatting as follows:

.1	Current	: 000 A.
.2	Flow	: 00,000 m^3/day.
.3	Level:	
	.1 Tank depth	: 0.00 m
	.2 Storage	: 0.00 %
.4	Pressure	: 0.00 %.
.5	Speed	: 00,000 rpm.
.6	Totalizer	: 00,000,000 m^3.
.7	Valve position	: 0.00 %.
.8	Volts	: 000 V AC.

PART 3 - INSTALLATION

3.1 OPERATING INTERFACES

.1 Prior to starting programming, review drawings and specifications to establish screen layouts, trending graphs, alarm screens and report formats. Contact Consultant to clarify any concerns, omissions, or ambiguities.

.2 Submit proposed operator interfaces to Consultant for review prior to starting programming.

3.2 VARIABLE ASSIGNMENTS

.1 Provide a data table complete with descriptions and cross-references to PLC(s).

.2 Submit proposed operator interfaces to Consultant for review prior to starting programming.

.3 Update list as project progresses.

3.3 PRELIMINARY IMPLEMENTATION MEETING

.1 Once the function diagrams and list of variables have been reviewed by the Consultant, a meeting will be held:
- .1 The meeting will cover:
  - .1 Function diagrams for major loops.
  - .2 Alarms.
  - .3 Operator interfaces.
- .2 The meeting will be held in Brighton, Ontario.
- .3 Attending the meeting will be:
  - .1 System Integrator.
  - .2 General Contractor.
  - .3 Consultant.
  - .4 Owner.
  - .5 Operator.

3.4 INTERMEDIATE IMPLEMENTATION MEETING

.1 Once the programmer feels he has reached 80% completion a meeting will be held:
- .1 The meeting will cover:
  - .1 Review of the program to date.
  - .2 Changes to the proposed function diagrams for major loops.
  - .3 Alarms.
  - .4 Operator interfaces.
  - .5 Draft reports.
- .2 The meeting will be held in Brighton, Ontario.
- .3 Attending the meeting will be:
  - .1 System Integrator.
  - .2 General Contractor.
  - .3 Consultant.
  - .4 Owner.
  - .5 Operator.

3.5 FINAL IMPLEMENTATION MEETING

.1 Prior to final testing a meeting will be held:
- .1 The meeting will cover:
  - .1 Review of function diagrams for major loops.
  - .2 Review of alarms.
  - .3 Review of operator interfaces.
  - .4 Reports.
- .2 The meeting will be held in Brighton, Ontario.
- .3 Attending the meeting will be:
  - .1 System Integrator.
  - .2 General Contractor.
  - .3 Consultant.
  - .4 Owner.
  - .5 Operator.

3.6 TESTING/ SIMULATIONS

.1 Once field-wiring tests have been completed and accepted, simulations can begin.

.2 Once the System Integrator has completed his preliminary testing and submitted a report to the Consultant, the Consultant will witness a complete simulation of the system operation.

.3 System Integrator is to provide all required testing equipment and simulate devices with switches and lights. Simulate analog signals with acceptable test equipment.

3.7 COMMISSIONING

.1 Once field-wiring tests have been completed and accepted, simulations can begin.

.2 Following successful equipment startup, in conjunction with the Operator manipulate the process to simulate variations including probable failures.

.3 Consultant and Owner to be present for final acceptance tests.

.4 For final acceptance prove:
- .1 Proper operation of control loops.
- .2 PID functions.
- .3 Alarm points and functionality (including alarm callouts).
- .4 Emergency shutdown.
- .5 Watch dog timers.

3.8 TRAINING

.1 Prepare instruction manual and train the Owner’s personnel to:
- .1 Navigate process screens.
- .2 Acknowledge alarms.
- .3 Request daily, weekly, and monthly reports.
- .4 Long-term data storage.
- .5 Long-term retrieval.
- .6 Software backup of PLC and SCADA programming.

.2 Three training sessions are required, at least two to three weeks apart. Allow for each training session to be a minimum of three (3) hours.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

.1 During the construction phase: Refer to Divisions 11, 15, 16, and 17 of the General Contract to establish requirements under other divisions for control and interface with the other plant PLCs.

.2 PLC programming as per Section 17210.

.3 SCADA programming as per Section 17310.

.4 During the construction phase: Control Narratives of the specifications for the General Contract.

.5 Brighton PLC and SCADA programming standards.

1.2 PRODUCT DATA

.1 Provide test procedures for each device and for control strategies prior to commissioning.

1.3 OPERATION AND MAINTENANCE DATA

.1 As per Division 1.

1.4 INTERLOCKS WITH PLANT PLCS

.1 Providing PLC and HMI logic to facilitate interlocking each piece of 600VAC equipment with the plant power system control logic. The interlock conditions include:

.1 Prior to transferring load from generator power to normal power the plant PLC will send a signal to shut down the process. Upon receipt of this signal the PLC respond accordingly. Process control shall resume once the signal has cleared.

.2 The startup of each piece of 600VAC equipment inside the plant will be sequenced based on the plant power system control logic. As such, provide logic to inhibit operation of each piece of 600VAC equipment in the process until permission has been granted by the power system logic.

PART 2 - PRODUCTS

2.1 INTENT

.1 To provide a seamless SCADA system that allows operators to control and monitor the process, extract historical data for trends or reports while maximizing treated water quality and minimizing operational (chemical, energy, etc.) costs.

2.2 PRESELECTED EQUIPMENT

.1 The System Integrator for the General Contract will be responsible for establishing a SCADA/PLC tag list, including data to be exchanged with preselected manufacturers.

.2 Preselected equipment programming will not be independent from system. Preselected manufacturers have been instructed that "black box" systems are not acceptable.

2.3 PLC OPERATION

.1 Prepare system configuration for use by MCC/PLC manufacturer at factory acceptance test.

.2 Once equipment is on site, start-up Ethernet communication between PLCs and intelligent MCCs, valves, and MIOs.

.3 Automated controls must be operational for the 14-day equipment acceptance tests.

2.4 SCADA

.1 SCADA system must be operational, including trending, reporting and event logging for startup of individual equipment. "Temporary" reports and trends may be discussed at time of construction.

PART 3 - EXECUTION

3.1 PROGRAMMING

.1 Program the PLC(s) to perform the functions described in Part 2.

.2 Provide appropriate documentation for the thorough understanding of the programming. Provide Table of Variables for the PLC(s) and SCADA software.

.3 Allow for alterations of scales and colours by the Owner during the Final Design Meeting.

3.2 COMMISSIONING

.1 Test each function individually. Provide the Consultant with a report prior to commissioning the system.

.2 Once loops have been tested and accepted, start up system. Consultant and Owner to be present for final acceptance tests.

.3 For final acceptance prove the general proper operation of:

- .1 Data exchange with Ethernet equipment.
- .2 Data exchange with PLC supplied with preselected equipment.
- .3 Data exchange over Ethernet network.
- .4 Data exchange with dialer and "fail safe" operation.
- .5 Proper operation of instruments.

.6 Proper SCADA manual control of devices (motors, valves, etc.).
.7 Monitoring of instruments and devices up to and including SCADA trending.
.8 Event logging, including changes to HMIs provided with preselected equipment.

.4 Final acceptance of specific reviews will be listed in Control Narratives for the General Contract for each specific process area.

3.3 TRAINING

.1 In the specified training period, provide the operators with a general understanding of:
.1 Tag structures
.2 System architecture
.3 Ethernet data transfer
.4 Ethernet data exchange
.5 SCADA system navigation in relation to HMI provided by preselected manufacturers
.6 Event logging and importance of operator Log In/Log Out; and
.7 Historian trending/reporting.

.2 Prepare "Help Files", including as a minimum the training guide and single-page instructions.

.3 In the specific sections of the Control Narrative, requirements for single-page instructions are outlined.

END OF SECTION

PART 1 - GENERAL

1.1 PROCESS CONTROL NARRATIVE

.1 Normal Operation: Raw sewage pumps' speed will modulate to maintain a normal liquid level in the raw sewage wet well.

.1 Pumps (P-1101, P-1102, P-1103 and P-1104) will operate in a lead/lag1/lag2/standby configuration.

.2 Lead and lag1 pumps are of the same capacity and performance. They are connected to a dedicated discharge header.

.3 Lag2 and standby pumps are of the same capacity and performance. They are connected to a dedicated discharge header.

.4 Influent raw sewage flow is measured on each pump header, by electromagnetic flow meters FIT-1101 and FIT-1102 respectively.

.5 If any of the pumps fail, the standby pump is to take its place in the duty chart.

.6 At low flows, only the lead pump will be activated.

.7 If at low flow the lead pump is at minimum speed set point, and liquid level in the wet well drops below the low liquid level set point, the lead pump will stop.

.8 When the liquid level in the wet well increases to high liquid level set point, the lead pump will activate and modulate speed to maintain normal liquid level set point in the wet well.

.9 When the liquid level in the tank increases to high liquid level with the lead pump operating, the lag1 pump is to activate and both pumps will modulate pump speeds to maintain normal liquid level set point in the wet well.

.10 If both the lead and lag1 pumps are modulating at low-speed set point, and the wet well level continues to drop, then the lag1 pump will deactivate and the lead pump will modulate to maintain normal liquid level set point.

.11 When the liquid level in the tank increases to high liquid level with both the lead and lag1 pumps activated, the lag2 pump is to activate and all three pumps will modulate pump speeds to maintain normal liquid level set point in the wet well.

.12 If the lead, lag1 and lag2 pumps are operating at low-speed set point, and the wet well level continues to drop, then the lag2 pump will deactivate and the lead and lag 1 pumps will modulate to maintain normal liquid level set point.

.13 If the liquid level in the wet well increases to the overflow level setpoint, with all three pumps operating, the raw sewage will pass over the overflow weir and a portion of flow will bypass to the equalization lagoon. The level sensor will measure the flow over the weir and determine the volume and flow rate of the bypass.

.14 If the liquid level in the wet well decreases to the low-low level setpoint, an alarm will be triggered, and all pumps will deactivate.

.2 Emergency Operation: If the liquid level in the wet well increases to the high-high level setpoint, an alarm will be triggered by float switch LSHH-1101 and a wet well draw down cycle will be initiated. All three duty pumps (lead, lag1 and lag2) will be activated for a set time that will be established during commissioning based on the time it takes to drain the wet well from the high-high to low liquid level. At the end of the set time, all pumps will deactivate.

.3 Level Sensor Operation: Ultrasonic level sensor LIT-1101 and radar level sensor LIT-1102 will operate in a lead/lag configuration. When the differential in level measurement between the two sensors increases above 50 mm, an alarm will be activated. In the event the duty sensor fails, the standby sensor is to take its place in controlling the pumps.

.4 Manual Operation: When the pump is in Manual Mode, Automatic Mode for that pump will be stopped. Manual mode will consist of an On/Off switch and a potentiometer for speed control.

Table 1: Raw Sewage Wet Well Operating Elevations

Operating Level	Relative Height from Tank Invert (m)	Elevation (m)	Action
Wet Well Invert		77.50	
Low-Low	0.78	78.28	Alarm from duty level sensor (LIT-1101 or LIT-1102). All pumps to deactivate.
Low	1.09	78.59	
Normal	1.66	79.16	
High	2.24	79.74	
High-High	2.54	80.04	Alarm from float switch LSHH-1101. All duty pumps to activate for a set time.
Overflow	3.10	80.60	Duty level sensor (LIT-1101 or LIT-1102) to measure bypass flow rate and volume.

1.1 PROCESS CONTROL NARRATIVES

.1 Equalization Lagoon:

.1 When level in the raw sewage maintenance hole exceeds the overflow level threshold, raw sewage will pass over the overflow weir and bypass to the Equalization Lagoon.

.2 Periodically, supernatant from the Aerated Solids Stabilization Cell will be decanted to the Equalization Lagoon. An operator will manually actuate a telescoping valve to separate, and gravity transfer the liquid fraction (supernatant) from the desired liquid level in the stabilization cell to the Equalization Lagoon.

.3 Supernatant and bypassed raw sewage will gravity flow from the Equalization Lagoon to the decant pumping station wet well based on liquid level.

.2 Decant Pumping Station:

.1 Normal Operation:

.1 Decant pumps (P-7301 and P-7302) will operate at fixed speed based on liquid level in the decant wet well.

.2 Decant pumps will operate in a duty/standby configuration.

.3 Pumps are all of the same capacity and performance.

.4 Liquid level in the decant wet well will be monitored by level sensor LIT-7301.

.5 When the liquid level in the wet well increases to high level setpoint, the duty pump will activate.

.6 When the liquid level in the wet well decreases to low level setpoint, the duty pump will deactivate.

.7 When the liquid level in the wet well decreases to the low-low level setpoint, alarm will be triggered for operator intervention.

.8 If the duty pump fails, the standby pump is to take its place in the duty chart.

.2 Emergency Operation: If the liquid level in the wet well increases to the high-high level setpoint, an alarm will be triggered by float switch LSHH-7301 and a wet well draw down cycle will be initiated. The duty pump will be activated for a set time that will be established during commissioning based on the time it takes to drain the wet well from the high-high to low liquid level. At the end of the set time, the duty pump will deactivate.

.3 Level Sensor Operation: Ultrasonic level sensor LIT-7301 and radar level sensor LIT-7302 will operate in a lead/lag configuration. When the differential in level measurement between the two sensors increases above 50 mm, an alarm will be activated. In the event the duty sensor fails, the standby sensor is to take its place in controlling the pumps.

.4 Manual Operation: When the pump is in Manual Mode, Automatic Mode for that pump will be stopped. Manual mode will consist of an On/Off switch.

Table 1: Decant Wet Well Operating Elevations

Operating Level	Relative Height from Tank Invert (m)	Elevation (m)	Action
Wet Well Invert		75.60	
Low-Low	0.26	75.86	Alarm from duty level sensor (LIT-7301 or LIT-7302). All pumps to deactivate.
Low	0.42	76.02	
High	1.05	76.65	
Inlet Pipe Invert	1.20	76.80	
High-High	3.80	79.40	Alarm from float switch LSHH-7301. Duty pump to activate for set time.

1.1 PROCESS CONTROL NARRATIVES

.1 Screening

.1 Normal Operation:

.1 The headworks treatment system, including grinder, grinder screen, auger screen and screenings conveyor, are controlled by the OEM control panels supplied with the equipment.

.2 The differential liquid level in the channel, upstream and downstream of the treatment system, will be measured by level sensor LIT-2102. This level sensor also provides an alarm if the channel inlet liquid level exceeds the high level setpoint.

.3 When the channel level differential exceeds the auger start setpoint, or the inlet liquid level exceeds the high liquid level setpoint, the grinder, grinder screen, auger screen and screenings conveyor will activate

.4 If the channel level differential decreases below the start level setpoint or the upstream and downstream levels are the same (no flow condition), the grinder, grinder screen, auger screen and screenings conveyor will deactivate.

.5 If liquid level in the channel upstream of the auger system remains above the high level setpoint, the system will run continuously.

.6 If the system has not automatically started within a preset adjustable period (60-minute factory setting), the backup timer will activate the grinder, auger screen and screw conveyor to run for a set period of time. If the backup timer is set to 0, the system will run continuously.

.7 If a level sensor failure is detected by the system PLC, an alarm will be triggered for operator intervention, the system will be activated and run continuously.

.8 When the PLC emergency stop pushbutton is pressed, power will be removed from the system. The emergency stop pushbutton actuator must be reset and the controller reset pushbutton pressed before the system can be reactivated.

.2 Reverse Operation:

.1 If the grinder cutter stack or screen jams, the system PLC will automatically initiate a reversal of the grinder for one-quarter turn to clear the blockage. If the obstruction clears, the grinder returns to normal forward rotation once the reversal sequence is complete. If the obstruction is not cleared, another reversal sequence will be initiated by the PLC. The system will deactivate and send an alarm to operators if there are three grinder cutter stack or screen reversals within a 30 second period.

.2 An auger reversal cycle will run automatically for 10 seconds (adjustable) after every 30 minutes of accumulated run time to break up and clear remaining solids.

.3 If the auger jams, the system PLC will initiate a reversal of the auger spiral for five seconds to clear the blockage. If the obstruction clears, the auger returns to normal forward rotation once the reversal sequence is complete. If the obstruction is not cleared, another reversal sequence will be initiated by the PLC. The system will deactivate and send an alarm to operators if two auger reversals are initiated within a 30 second period.

.4 If the screenings conveyor jams, the system PLC will initiate a reversal of the screw to clear the blockage. If the obstruction clears, the screw returns to normal forward rotation once the reversal sequence is complete. If the obstruction is not cleared, another reversal sequence will be initiated by the PLC. The system will deactivate and send an alarm to operators two reversals are initiated within a 30 second period.

.3 Manual Operation:

.1 When in Manual Mode, automatic level control will be stopped. The three-way selector switch on the grinder and auger screen units respectively will be adjusted from Level mode to the On or Off position. In Off mode, the grinder will deactivate. The auger screen will run until any in-progress cycle is completed and then deactivates. In On mode, the grinder and auger screen run continuously. When in On mode, either forward or reverse directions can be selected using manual selector switches.

.2 The screw conveyor is provided with an HOA selector. When in Manual Mode, automatic mode will be stopped. Manual mode will consist of an On/Off switch and a manual selector for forward and reverse directions.

.4 Spray Wash System: The spray wash solenoid valve will be turned On or Off by the PLC based on auger screen operation. When the auger screen is activated, the spray wash solenoid valve will be modulated to the On position and run continuously. When the auger screen deactivates, the spray wash solenoid will be returned to the Off position.

.5 Solids Collection: A bagging system will collect and contain solids discharged from the screw conveyor in a plastic bag inside the waste bin. Operators will visually monitor the bag until the desired capacity is reached. The top end of the plastic tube can then be tied off and the bag removed for disposal. The operator will then pull the desired length of plastic from the bagger cassette and tie off the end to form a new bag. Once the bagger cassette is out of material, the cassette will be manually replaced.

.6 Bypass:

.1 When the liquid level in the inlet channel exceeds the overflow level setpoint during peak flow conditions, raw sewage will flow over a bypass weir and through the manual screen in the bypass channel. Level sensor LS-2101 will trigger a high liquid level alarm to notify operators of the bypass.

.2 Level sensor LIT-2101 will measure the flow over the bypass weir and determine the volume and flow rate of the bypass.

.3 Gates on the inlet and outlet of each channel can also be manually positioned by operators to intentionally bypass the auger screen. Operators will manually close the auger screen channel inlet and outlet sluice gates to isolate the system and then open the bypass channel inlet and outlet hand gates. To return the system to normal operation, the bypass channel hand gates will be closed, and the auger screen channel sluice gates returned to their open position.

.2 Grit Removal

.1 Normal Operation:

.1 Two grit removal channels will operate continuously and have been designed for full redundancy.

.2 Flow through the grit channels will be controlled by a proportional weir on the discharge of each channel.

.2 Grit Disposal: When not operating at peak flows, accumulated grit can be removed for disposal. Inlet and outlet hand gates are manually closed by operators to isolate the selected channel. Only one channel can undergo grit removal at a time. Once grit has been removed, the hand gates will be manually returned to their open position to return the channel to normal operation.

1.1 PROCESS CONTROL NARRATIVES

.1 Aeration Tanks

.1 Blower Normal Operation:

.1 Blowers (BL-3301 and BL-3302) will operate in a duty/standby configuration. One blower will run continuously to provide air to the process.

.2 Duty and standby blowers are of the same capacity and performance.

.3 Pressure sensor PIT-3401 measures pressure in the discharge header and modulates blower speed to maintain constant pressure setpoint of 600 mbar.

.4 A minimum blower speed set point of 44.4 Nm3/min (estimated to occur at 640 rpm) will be set to achieve mixing within the aeration tanks and provide constant channel aeration.

.5 Analyzers AIT-3101 and AIT-3102 measure the DO concentration in each aeration tank.

.6 Motorized control valves VFC-3301, VFC-3302, VFC-3303 and VFC-3304 modulate air flow to each aeration tank fine bubble diffuser grid to maintain a dissolved oxygen (DO) set point in the tanks.

.7 If the motorized control valves are fully open and aeration tanks are below DO setpoint, an alarm will be sent to operators. At the operator's discretion, the blower pressure setpoint can be increased to provide additional air to the system.

.8 Operators can adjust manual values to control air flow to channel aeration.

.2 Manual: The system can be run in manual mode. When the blower is in Manual Mode, Automatic Mode for the blower will be stopped. Manual mode will consist of an HOA selector switch and a potentiometer for controlling the blower speed.

.2 Clarifier Tanks

.1 Chain and flight longitudinal sludge collectors (LC-3201, LC-3202 and LC-3203) will operate continuously.

.2 Chain and flight sludge cross collector s (CC-3201, CC-3202 and CC-3203) will operate continuously.

.3 Manual tipping troughs (SC-3201, SC-3202 and SC-3203) are used to collect scum and convey it to the scum pit.

.4 Chain and Flight Longitudinal Sludge Collector

.1 Automatic: A local control panel will display "RUNNING", "OFF", and "FAULT" and include a HOA selector switch for each chain and flight system. If torque pin breaks, chain and flight system will be stopped.

.2 Manual: When a sludge collector is in Manual Mode, Automatic Mode for that collector will be stopped. Manual mode will consist of an On/Off switch.

.5 Chain and Flight Sludge Cross Collector

.1 Automatic: A local control panel will display "RUNNING", "OFF", and "FAULT" and include a HOA selector switch for each chain and flight system. If torque pin breaks, chain and flight system will be stopped.

.2 Manual: When a sludge collector is in Manual Mode, Automatic Mode for that collector will be stopped. Manual mode will consist of an On/Off switch.

.3 Sludge Pumps

.1 Each sludge hopper will have a dedicated sludge transfer pump (P-5101, P-5102, and P-5103). A backup standby pump (P-5104) will be provided, connected to each tank suction pipe, discharging into the common header. Operators will need to manually switch over pumps in the event of a failure.

.2 Duty and standby pumps are all of the same capacity and performance.

.3 Duty sludge pumps will be automatically controlled and operate continuously.

.4 Each pump has a discharge electromagnetic flowmeter (FIT-5101, FIT-5102, FIT-5103 and FIT-5104) which measures flow from each pump and modulates pump speed to maintain flow setpoint of 35.5 L/s.

.5 When operating in RAS mode, sludge header three-way motorized control valve VFC-5101 is in recirculation position which discharges the sludge back into the aeration tanks.

.6 Operation in WAS Mode will be automatically initiated based on an operator adjustable wasting cycle duration and frequency. It is anticipated that a 30-minute wasting cycle will occur every 24 hours. When WAS Mode is initiated, the position of control valve VFC-5101 will switch to wasting position for the duration of the wasting cycle time.

.7 Manual: When the pump is in Manual Mode, Automatic Mode for that pump will be stopped. Manual mode will consist of an HOA selector switch and a potentiometer for speed control. Motorized control valve VFC-5101 can be operated in hand mode from the hand station near the valve.

.4 Scum Pump

.1 Scum pump (P-5201) will be automatically controlled, with the option of manually initiating a removal cycle.

.1 Liquid level will be measured by level sensor LIT-5021, with local level indication provided for operators.

.2 Clarifier tank tipping troughs are used to collect scum and convey it to the scum pit.

.3 When liquid level in the scum pit reaches the high-level set point of 2.153•m, the pump is to initiate a removal cycle.

.4 Three-way motorized control valve VFC-5201 to be placed in circulation mode.

.5 Pump is to be activated.

.6 After an operator adjustable set time (0-10 minutes), three-way valve VFC-5201 to be placed in discharge mode, so that scum is pumped to the stabilization lagoon.

.7 When liquid level in the scum pit reaches its low set point, the pump is to deactivate.

.8 When high liquid level setpoint of 2.458 m is reached, alarm will be provided to operators that scum pit is full.

.2 Manual: A manual button at the scum pit will allow operators to initiate a removal cycle prior to the scum pit reaching the high liquid level set point.

.5 Coagulant Dosing System (Ferric Chloride)

.1 Storage Tanks

.1 Bulk chemical delivery trucks will connect a discharge hose from the truck to the quick coupling connection in the chemical storage area.

.2 Ferric chloride will be pumped from the bulk delivery truck to Ferric Chloride Storage Tank No.1 (TH-7101) and No. 2 (TH-7102). Operator to monitor tank liquid level during unloading by observing the reverse float on each tank.

.3 Liquid level will be measured by ultrasonic level sensors LIT-7101 and LIT-7103 and radar level sensors LIT-7102 and LIT-7104, in Storage Tank No.1 and Storage Tank No.2 respectively. The sensors will operate in a lead/lag configuration in each tank.

.4 If the differential in level measurement between the two sensors in either tank increases above 50 mm, an alarm will be activated. In the event the duty sensor fails, the standby sensor is to take its place in controlling the pumps.

.5 When liquid level in the storage tank reaches high level set point, an alarm will be triggered to notify the delivery truck operator.

.6 When the liquid level in the storage tank reaches low level setpoint, an alarm will be triggered to notify operators that a chemical delivery is required.

.7 When the liquid level in the storage tank reaches low-low level setpoint, an alarm will be triggered and the ferric chloride pumps will deactivate.

.8 Precipitation will collect in the storage tank containment area.

.9 Operators to monitor liquid level in the containment area and manually open the drain valve periodically to empty accumulated precipitation.

.10 If a leak is detected in the containment area, motorized control valves on the discharge of each storage tank will close.

.11 Once the source of the leak is resolved and the spilled chemical properly disposed of, the motorized control valves can be returned to open position.

.2 Ferric Chloride Pumps

.1 Pumps (P-7101 and P-7102) will operate in a duty/standby configuration.

.2 Pumps are of the same capacity and performance.

.3 Duty pump will be automatically controlled and run continuously.

.4 Pump speed to be modulated based on totalized plant influent flow as measured by electromagnetic flowmeters FIT-1101 and FIT-1102. Operator can adjust concentration setpoint by manual input through the facility SCADA or pump local HMI.

.5 Pump suction piping, discharge piping and containment area are equipped with leak detection.

.6 If a leak is detected anywhere in the chemical dosing system, pump will deactivate and suction solenoid valve VFC-7103 will close.

.7 Once the leak has been resolved, pump needs to be manually activated by an operator from the local HMI. Solenoid valve VFC-7103 can be returned to open position.

.8 Manual: When the pump is in Manual Mode, Automatic Mode for that pump will be stopped. Manual mode will consist of an HOA selector switch and manual flow setpoint entry at the pump local HMI for speed control.

Table 1: Ferric Chloride Storage Tank Operating Elevations

Operating Level	Relative Height from Tank Invert (m)	Action
Tank Invert	0.000	N/A
Low-Low	0.100	Turn off Ferric Pumps Alarm
Low	0.300	Alarm
High	2.000	Warning
Overflow	2.312	Alarm

1.1 PROCESS CONTROL NARRATIVES

.1 Normal Operation:

.1 UV disinfection system is controlled by the OEM system control centre (SCC) supplied with the equipment.

.2 UV disinfection banks will operate in a duty/standby configuration, installed in a common channel in series.

.3 Minimum water level above the UV banks is maintained by a level control weir WSC-4001 on the channel discharge. Liquid level in the channel will also be monitored by level sensor LIT-4001.

.4 In Remote Mode, banks can be operated in Off, Hand or Auto operational modes.

.5 In Off operational mode, UV banks will deactivate and remain off while in this mode.

.6 In Hand operational mode, UV banks will activate for a set warm-up cycle and then power level will drop to a manually entered setpoint.

.7 In Auto operational mode, the UV banks will activate when liquid level in the channel meets or exceeds the low level setpoint.

.1 Bank power level will be modulated by the SCC to maintain the design UV dose of 30 mJ/cm2, determined based on the measured UV transmittance of the water. UV transmittance is measured by analyzers AIT-4002 and AIT-4002 for the duty and standby UV bank respectively.

.2 If there is a failure in a UV transmittance analyzer, an alarm will be triggered, and the UV bank will operate at full power.

.3 If liquid level in the channel drops below the low level setpoint, an alarm will be triggered by float switch LSL-4001, and the UV Bank will deactivate.

.4 If there is a multiple lamp failure in the duty UV bank, an alarm will be triggered. The duty bank will deactivate, and the standby UV bank will take its place in the duty chart.

.2 Manual Operation: When in Manual Mode, the three-way selector on each UV bank PDC will be switched from Remote to Local Off or Local On operational mode. In Local Off, the UV bank will be deactivated and remain off. In local On, the UV bank will activate and operate at full power level.

.3 Lamp Cleaning: When in Remote operating mode, a hydraulic wiper cleaning sequence for the UV bank lamps is automatically controlled by the HSC at pre-set intervals. A three-way selector mounted on the HSC can also be set to Local Off or Local On control modes for manual operation. Wiper cleaning will be disabled when the UV bank is deactivated.

.4 Bank Maintenance: If the duty UV bank must be removed from the channel for cleaning or routine maintenance, the standby bank will take its place in the duty chart. Operators will place the duty UV bank being removed into operational mode Remote Off and the standby UV bank will be switched to Remote Auto or Remote Hand mode. Once the duty UV Bank is reinstalled in the channel, operators will return the duty UV Bank to Remote Auto or Remote Hand operating mode and the standby UV bank to Remote Off.

.5 Bypass: Hand gates on the inlet and outlet of each channel can be manually positioned by operators to isolate and bypass the UV disinfection system to facilitate channel maintenance. Operators will close the UV disinfection channel inlet and outlet hand gates to isolate the disinfection system and then open the bypass channel inlet and outlet hand gates. When maintenance is complete, the bypass channel hand gates will be closed and the UV disinfection channel hand gates returned to their open position.

1.1 PROCESS CONTROL NARRATIVES

.1 Lagoon Aeration:

.1 Normal Operation:

.1 In Automatic Mode, all surface aspirators will be controlled as a system. Surface aspirators (MX-7201, MX-7202, MX-7203, MX-7204, MX-7205, MX-7206) will be activated and deactivated by the facility SCADA system.

.2 Manual Operation: When in Manual Mode, Automatic Mode for all aspirators will be stopped. Manual mode will consist of an On/Off switch on each aspirator unit.

.3 Peak Electrical Load Operation: Plant electrical load will be measured by the service entrance board's power monitor PM-0001B.

.1 If the total electrical load reaches 86% of the plant maximum, one surface aspirator in Aspirator Set No.1 (MX-7201 and MX-7202) will be automatically deactivated. If these conditions persist for more than 15 minutes, the surface aspirators will alternate which is energized and which is de-energized such that only one surface aspirator within Aspirator Set No.1 is activated at a time and for a maximum cycle time of 15 minutes at a time.

.2 Once the total electrical load reduces below the 86% setpoint less deadband for Aspirator Set No.1, both surface aspirators will be automatically activated.

.3 If the total electrical load reaches 88% of the plant maximum, one surface aspirator in Aspirator Set No.2 (MX-7203 and MX-7204) will be automatically deactivated. If these conditions persist for more than 15 minutes, the surface aspirators will alternate which is energized and which is de-energized such that only one surface aspirator within Aspirator Set No.2 is activated at once and for a maximum cycle time of 15 minutes at a time.

.4 Once the total electrical load reduces below the 88% setpoint less deadband for Aspirator Set No.2, both surface aspirators will be automatically activated.

.5 If the total electrical load reaches 90% of the plant maximum, one surface aspirator in Aspirator Set No.3 (MX-7205 and MX-7206) will be automatically deactivated. If these conditions persist for more than 15 minutes, the surface aspirators will alternate which is energized and which is de-energized such that only one surface aspirator within Aspirator Set No.3 is activated at once and for a maximum cycle time of 15 minutes at a time.

.6 Once the total electrical load reduces below the 90% setpoint for Aspirator Set No.3, both surface aspirators will be automatically activated.

.7 At least three surface aspirators must remain in operation at all times.

.2 Lagoon Decant:

.1 Normal Operation:

.1 Telescoping valve VTS-7301 will be manually operated to periodically transfer supernatant from the Aerated Solids Stabilization Cell to the Equalization Lagoon. It is anticipated that decanting will occur 2 to 3 times per year. At a minimum, this must be performed yearly prior to winter operation to maintain sufficient lagoon storage (3 months).

.2 An operator will adjust the telescoping valve to the desired liquid level in the Stabilization Cell and fully open the valve to transfer supernatant by gravity.

.3 When the liquid level in the Stabilization Cell decreases below the level of the telescoping valve, flow will stop and telescoping valveVTS-7301 will be manually closed.

.4 To reach lower liquid levels in the Stabilization Cell, manual valve VF-7303 will be manually opened by operators.

.5 Once Stabilization Cell liquid level decreases below the invert of the manual valve, flow will end, and valve VF-7303 will be manually closed.

1.1 PROCESS CONTROL NARRATIVES

.1 Effluent Water pumps speed will modulate to maintain normal pressure setpoint in the effluent water supply system.

- .1 Pumps (P-9903, P-9904 and P-9905) will operate in a lead/lag/standby configuration.
- .2 All pumps are of the same capacity and performance.
- .3 If any of the pumps fail, the standby pump is to take its place in the duty chart.
- .4 Effluent water system pressure will be measured by pressure sensor PIT-9901 on the inlet header to the pumps and by pressure sensor PIT-9902 on the discharge side of the pumps.
- .5 When pressure in the effluent water system at the discharge of the pumps decreases below the low pressure setpoint, the duty pump will activate, and pump speed will modulate to provide the pressure differential required maintain the normal system pressure setpoint.
- .6 If pressure downstream of the effluent water pumps increases to the high pressure setpoint with the lead pump in operation, the pump will deactivate.
- .7 If the effluent water system pressure downstream of the pumps decreases to the low pressure setpoint with the lead pump operating, the lag pump will activate, and the speed of both pumps will be modulated to provide the required pressure differential and maintain the normal pressure setpoint.
- .8 If system pressure downstream of the effluent water pumps increases to the high pressure setpoint with both the lead and lag pumps in operation, the lag pump will deactivate.

.2 Differential pressure will be measured across the duplex manual strainers by pressure sensors DPT-9902 and DPT-9903. When the pressure differential increases to meet or exceed the vendor recommended high pressure differential setpoint, operators will be notified that a manual cleanout is required. The manual strainers will remain in operation during cleaning.

.3 Automatic strainer will be backwashed periodically based on a user adjustable cycle timer for duration (2 to 4 minutes) and frequency.

.4 Differential pressure will be measured across the automatic by pressure sensor DPT-9901. When the pressure differential increases to meet or exceed the vendor recommended high pressure differential setpoint, the backwash cycle timer will override, and an additional backwash cycle will be initiated.

.5 If differential pressure continues to increase to the vendor recommended high-high pressure differential setpoint, an alarm will be triggered to notify operators, and an additional backwash cycle will be initiated.

Table 1: Effluent Water System Pressure Setpoints

Operating Level	Pressure Setpoint (m)
Low	40.0
Normal	45.0
High	50.0

Appendix A

Geotechnical and Hydrogeological Reports

Preliminary Geotechnical Investigation Report

Proposed Creek Relocation – 100 County Rd 64, Brighton

December 18, 2024

Prepared for:
J L Richards & Associates Limited

Cambium Reference: 19712-001

CAMBIUM INC.

866.217.7900

cambium-inc.com

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1.0 Introduction

Cambium Inc. (Cambium) was retained by the J L Richards & Associates Ltd. (The Client) on behalf of the Municipality of Brighton, to complete a geotechnical investigation for the proposed improvements of the Wastewater Treatment System (WWTS) located at 100 County Road 64, in Brighton, Ontario. The location of the Site is shown on the attached Figure 1. As part of the proposed upgrades, the Client has requested preliminary recommendations and commentary regarding the relocation of a section of Arena Creek located north of the WWTS.

The geotechnical investigation was conducted in accordance with Cambium's proposal 19712-P Rev1, dated February 20, 2024.

The purpose of the field work and testing was to obtain information on the general subsurface soil and groundwater conditions at the site by means of a limited number of boreholes and laboratory tests. Based on an interpretation of the data available for this site, this report provides engineering comments and preliminary recommendations in regard to the potential relocation of a section of Arena Creek.

Arena creek drains directly into Presqu-ile Bay of Lake Ontario. The fieldwork for the investigation of the relocation of the creek was completed concurrently with the fieldwork for the proposed upgrades.

It should be noted that this report addresses only the geotechnical (physical) aspects of the subsurface conditions at the site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are beyond the terms of reference for our assignment and are not addressed herein.

This report provides the results of the geotechnical exploration and testing and should be read in conjunction with the *"Standard Limitations"* in Section 7.0 which forms an integral part of this document. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. The data, interpretations and recommendations

contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location, or elevation, or if the project is not initiated within eighteen months of the date of the report, Cambium should be given an opportunity to confirm the recommendations in this report.

1.1 Reviewed Documents

The following project documents were received and reviewed during the drafting of this report:

[1] “Request for Proposal – Geotechnical and Hydrogeological” – Prepared by J.L. Richards, dated January 19, 2024, JLR No. 32296-001.

[2] “Brighton Wastewater Treatment System Municipal Class Environmental Assessment – Phase 2 Report – Final” – Prepared by J.L. Richards, dated August 2018, JLR No. 27271.

[3] “Class EA Addendum Report – Municipality of Brighton Wastewater Treatment System Class EA Addendum” – Prepared by J.L. Richards, dated December 22, 2022, JLR No. 31795-000.

[4] “A-045163-TOPO_V3-WB”, Topographic survey provided as CAD file via email by the Client, Dated 2024-01-24.

1.2 Standards and Guidelines

Applicable standards, guidelines and other normative documents utilized in preparing geotechnical engineering recommendations for this report are provided below.

[5] Canadian Foundation Engineering Manual – 5th Edition; Canadian Geotechnical Society; 2023.

[6] Technical Guide – River & Stream Systems: Erosion Hazard Limit; Ontario Ministry of Natural Resources.

[7] Geotechnical Principles for Stable Slopes; Prepared by Terraprobe Ltd. And Aqua Solutions; dated June 1998.

2.0 Background

2.1 Site Description

The property is a 68-acre parcel of land with access off of County Road 64 with the civic address of 100 County Road 64, Lot 33 and 34, Concession B, Municipality of Brighton, County of Northumberland, Ontario. The site is occupied by the current WWTS consisting of two lagoons: one large triangular shaped lagoon located on the southern side of the property, and one smaller rectangular lagoon located north of the larger lagoon. Arena Creek runs through a ravine north of the smaller rectangular lagoon. The creek meanders close to the lagoon on the north side. The creek measures about 2 to 3 m in width and is less than 1 m deep along this stretch. The area just north of the creek is an undeveloped, vegetated area with grass, shrubs, mature trees, and a grass clearing. A wire fence runs along the north side of the ravine at the top of the north embankment.

Publicly available geology maps the area as being covered in glaciolacustrine sand deposits. Localized areas of alluvial cohesive deposits may be encountered as well. The underlying bedrock is mapped as limestone of the Lindsay Formation.

2.1 Project Description

Based on RFP document provided by the Client [1], it is understood that the creek is potentially undercutting the north berm of the rectangular lagoon, and it is intended to relocate an approximate 100 m length of the creek to mitigate erosion the berm. It has been requested that Cambium provide preliminary recommendations regarding the creek relocation. The design of the creek embankments for the relocation work will be completed by Others using the preliminary recommendations provided.

3.0 Methodology

3.1 Borehole Investigation

Cambium completed the field investigation work at the site on February 20 to 23 and 27 to 28, 2024, to assess the subsurface conditions. A total of 20 boreholes were advanced across the site. Five of the boreholes (BH116-24 through BH120-24) were advanced as part of providing recommendations for the creek relocations. The other fifteen of the boreholes were advanced within the area of the proposed WWTS upgrades and are described in a separate report. Two boreholes (BH116-24 and BH117-24) were advanced through the top of the south embankment (the north berm of the lagoon), and the other three boreholes (BH118-24 through BH120-24) were advanced through the soils north of the creek.

The boreholes were advanced from depths ranging from approximately 5.0 to 8.0 metres below ground surface (mbgs). The approximate locations of the boreholes advanced are shown on the attached Figure 2.

Drilling and sampling were completed using a track mounted drill rig operating under the supervision of a Cambium geotechnical analyst. The boreholes were advanced to the sampling depths by means of continuous flight solid stem augers with 50 mm O.D. split spoon samplers. Standard Penetration Test (SPT) results (N-values) were recorded for the sampled intervals as the number of blows required to drive a split spoon sampler 305 mm into the soil, using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures. The SPT N-values were used in this report to estimate the relative density of the non-cohesive soil.

The encountered soil unit descriptions were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, future reference, laboratory testing, and storage. Open boreholes were checked for groundwater and general stability prior to backfilling. The boreholes were backfilled in accordance with O.Reg. 903, as amended.

Records of the Borehole Logs are provided in Appendix A.

The spatial locations and elevations of the boreholes were surveyed by Cambium personnel. The elevations are referenced to the benchmark provided by the Client noted on the topographic survey [4]: the manhole on a concrete pad located on the property. An elevation of 82.95 mASL was indicated for the benchmark.

3.2 Laboratory Testing

Laboratory soil testing included three Particle Size Distribution Analyses (LS 702), Natural Moisture Content Analyses (LS 701) on all samples, and Atterberg Limits testing (LS-703/704) on two samples. Results are presented in Appendix B and are summarized on the borehole logs and described in the subsequent sections of this report.

4.0 Subsurface Conditions

The subsurface soil and groundwater conditions encountered in the boreholes are presented on the attached Borehole Logs It is noted that the conditions indicated on the logs are for specific locations only and can vary between and beyond each location. The soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change. In addition, the descriptions provided on the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (drilling speed, shaking/grinding of the augers, etc.).

In general, the subsurface conditions of the berm (BH116-24 and BH117-24) are consistent between both borehole locations and the conditions encountered on the north side of the creek are generally consistent between the three boreholes advanced (BH118-24 through BH120-24).

4.1 Topsoil

Topsoil was encountered from the surface of 5 borehole locations. Topsoil thickness ranges from 50 mm on the berm to 100 mm in the area north of the creek.

Assessments of organic matter content or other topsoil quality tests were beyond the scope of this study.

4.2 Fill Material

Fill material was encountered underlying surficial topsoil in boreholes BH116-24 and BH117-24.

The fill material varies in composition with depth but is generally composed predominantly of sandy silt with trace to some gravel. The upper portions of the deposit are composed of a silty sand and gravel and the material transitions to sandy silt with depth.

The fill material thickness ranges from 1.5 to 2.3 m.

SPT N values measured in the fill material range from 7 to 21, indicative of the loose to compact relative density.

Laboratory particle size distribution analysis was completed on one sample of the fill material and the results are summarized in Table 1.

Table 1 Particle Size Distribution Results – Fill Material

Sample Location	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt and Clay
BH116-24 SS2	0.8 to 1.4	Sandy silt	0	26	74

The results are compared to Ontario Provincial Standard Specifications (OPSS.MUNI) 1010 gradation envelopes of Granular A and Granular B Type I for reference on the results diagram in Appendix B.

4.3 Sandy Silt

Sandy silt was encountered underlying the fill material in boreholes BH116-24 and BH117-24, underlying the topsoil in boreholes BH118-24 and BH120-24 and from the surface of BH119-24.

The sandy silt is brown in colour near the surface and transition to grey brown to grey with depth. The material contains trace gravel and trace to some clay. Organic material and rootlets were noted within he deposit, predominantly in in the upper portions, likely due to the overlying vegetation. The deposit also becomes cohesive in nature at some locations. Cohesive or slightly cohesive layers in the deposit were noted in boreholes BH117-24, BH118-24, and BH120-24 at depths ranging from 1.5 to 2.3 mbgs.

The thickness of the sandy silt deposit ranges from 2.2 to 4.5 m and the deposit extends to depths ranging from 3.1 to 4.6 mbgs.

SPT N values measured in the sandy silt range from 1 to 44. Lower values are due to cohesive layers within the deposit, indicative of a very soft to firm consistency. The silt is estimated to

have a compact to dense relative density. One value of over 50 was measured at the surface of BH120-24, likely due to a cobble.

Laboratory particle size distribution analysis was completed on one sample of the sandy silt and the results are summarized in Table 2.

Table 2 Particle Size Distribution Results – Sandy Silt

Sample Location	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay
BH116-24 SS5	3.0 to 3.5	Sandy silt, some clay, trace gravel	6	25	56	13

Atterberg Limits Testing was also completed on the above sample of the sandy silt to confirm the material's plasticity. The results of the testing are summarized in Table 3 below.

Table 3 Atterberg Limits Tests – Sandy Silt

Sample Location	Depth (mbgs)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Natural Moisture Content %
BH116-24 SS5	3.0 to 3.5	-	-	-	14.9

The results indicate that the sandy silt is non-cohesive at this location.

4.4 Glacial Till

Native deposits of glacial till were encountered underlying the sandy silt at all borehole locations. The glacial till was encountered at depths ranging from 3.1 to 4.6 mbgs. All boreholes terminated within the glacial till at depths ranging from 5.0 to 8.0 mbgs.

Glacial till is a heterogeneous mixture of all grain sizes due to the nature of deposition. At this location the glacial till varies in composition between borehole locations. The glacial till encountered in BH116-24 and BH117-24 is composed of a non-cohesive gravelly silty sand and the glacial till encountered in boreholes BH118-24 through BH124-24 is composed of a cohesive sandy clayey silt with some gravel. The glacial till at the latter locations transition to a non-cohesive sandy gravel with some silt at a depth of 4.6 to 6.1 mbgs. Cobbles and boulders

were also observed within the material. The upper portions of the glacial till deposit are cohesive in nature in boreholes BH101-24, BH104-24, BH106-24, BH112-24, and BH114-24.

SPT N values measured in the glacial till in the upper cohesive deposits range from 4 to 22, indicative of a firm to very stiff consistency. SPT N values measured in the non-cohesive layers of the deposit range from 20 to over 50, indicative of a relative density of compact to very dense.

Laboratory particle size distribution analysis was completed on one sample of the glacial till and the results are summarized in Table 4.

Table 4 Particle Size Distribution Results – Glacial Till

Sample Location	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay
BH119-24 SS6	4.6 to 5.0	Sandy silt, some clay, trace gravel	9	31	43	17

Atterberg Limits Testing was also completed on the above sample of the glacial till to confirm the material's plasticity. The results of the testing are summarized in Table 5 below.

Table 5 Atterberg Limits Tests – Glacial Till

Sample Location	Depth (mbgs)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Natural Moisture Content %
BH119-24 SS6	4.6 to 5.0	16.1	10.5	5.6	11.5

Based on the results of the Atterberg Limit tests, the upper portions of the glacial till can be considered cohesive silt.

4.5 Practical Refusal

Practical refusal was encountered at one borehole location: BH119-24, at a depth of 8.0 mbgs. Refusal may occur on cobbles and/or boulders, or due to very dense glacial till, and as such, refusal may not indicate the top of the bedrock. The refusal depth corresponds to 75.5 mASL, which is deeper than the bedrock elevations encountered in the boreholes advanced as part of

the investigation for the proposed WWTS upgrades. It is assumed that refusal was encountered on bedrock.

The bedrock beneath the site is of the Lindsay Formation, which is a deposit comprised predominantly of limestone bedrock of the Ordovician age. The limestone may contain thin layers of shale which are typically significant weaker in strength than the limestone.

4.6 Groundwater

Stabilized groundwater measurements were taken from the open boreholes following completion of drilling work. In addition, integrity of the open boreholes were also noted. Specific comments are provided on the respective borehole logs in Appendix A.

Groundwater observed within the overburden ranged from 3.0 to 4.6 mbgs.

Seasonal fluctuations and precipitation events may cause significant changes to the depth of the groundwater table over time.

5.0 Geotechnical Design Considerations

The following discussion and recommendations are based on factual data from this investigation and are intended to assist designers. These recommendations are for planning and design purposes only.

This report assumes that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards, and guidelines of practice. Recommendations should not be construed as providing instructions to contractors, who should form their own opinions about site conditions. It is possible that subsurface conditions beyond the borehole locations may vary from those observed. If significant variations are found before or during construction, or if there are significant changes to site development features, Cambium should be retained to review the implications of these changes with respect to the contents of this report.

5.1 Project Understanding & Assumptions

it is understood that Arena Creek located north of the north aeration lagoon, is undercutting the north berm of the lagoon. It is intended, as part of the upgrades to the WWTS, to relocate an approximate 100 m length of the creek to mitigate erosion the berm.

5.2 Inspection of Existing Site Conditions

A visual inspection of the area of the creek to be relocated was conducted on February 13, 2024. General observations pertaining to the existing site features including site drainage, vegetation cover, and conditions of the embankments were noted during the inspection. Photographs taken during the inspection are appended (Appendix C). A brief summary of the results of our visual inspection is presented below.

5.2.1 North Embankment

The table land of the north embankment is relatively flat and consists predominantly of a large grass covered clearing. There is dense vegetation around the clearing with tall mature trees. A wire fence runs east to west along the crest of the embankment.

The slope face is vegetated with several large shrubs and grass. Some small trees are sparsely spread out on the slope face. Some evidence of slope failure was noted in isolated locations on the slope face. The height of the north embankment measures about 3 m from the too to the crest and the angle of inclination varies from 2.4H:1V (23º) up to 1H:1V (45º).

The slope toe directly abuts the edge of Arena Creek forming a confined system with the south embankment: the north berm of the smaller aeration lagoon. The creak meanders slightly as it runs parallel to the lagoon. Water velocities also vary depending on the channel width and location.

5.2.2 South Embankment (Lagoon Berm)

The table land of the south embankment is the top of the lagoon berm, consisting of a dirt pathway/driveway and grass.

The slope face of the embankment is also grass covered. Isolated areas of exposed cobbles were also noted. The slope is approximately 1.7 to 2.2 m in height and has an angle of inclination ranging from 2.1H:1V (25º) up to 1.2H:1V (40º).

The slope toe abuts the edge of Arena Creek. Evidence of erosion was noted as isolated areas of steeper slopes of the berm created by the meandering of the creek.

5.3 Slope Stability Analysis – Existing Conditions

The Ontario Ministry of Natural Resources (MNR) publication titled “Technical Guide River & Stream Systems: Erosion Hazard Limit” [6] provides guidance for determining the erosion hazard limit for riverbanks based on the adequacy of the available maintenance access as well as the appropriate stable slope inclination, flooding, and toe erosion allowances. The furthest landward extent of the stable slope inclination, toe erosion allowance, and access delineates the total hazard land.

This provides indication on the required minimum slope for stable embankments to mitigate slope failure and therefore reduce the meander potential of the relocated creek section.

A detailed engineering analysis of the slope stability was carried out for two cross sections of the slope: Section A-A' along southern embankment (lagoon berm) and Section B-B', the northern embankment. The analyses were completed on the observed steepest sections to demonstrate the current level for potential instability of the embankments.

Additionally, an analysis was conducted for both sides of the creek at Section C-C' to demonstrate the existing potential for instability at a non-critical section.

Locations of the cross sections are shown on Figure 2.

Analyses were completed utilizing computer software SLOPE-W. The slope stability analysis is based on effective stress limit equilibrium method for analysing slope stability using the Morgenstern-Price method. These methods of analysis allow the calculation of Factors of Safety for hypothetical or assumed failure surfaces through the slope. The analysis method is used to assess potential for movements of large masses (greater than 1 m deep) of soil over a specific failure surface which is often curved or circular. The analysis involves dividing the sliding mass into many thin slices and calculating the force on each slice. The normal and shear forces acting on the sides and base of each slice are calculated. It is an iterative process that converges on a solution.

For a specific failure surface, the Factor of Safety is defined as the ratio of the available soil strength resisting movement to the gravitational forces that cause movement. The Factor of Safety of 1.0 represents a limiting equilibrium condition where the slope configuration is at the point of failure since the soil resistance is equal to the forces that cause movement. It is therefore usual to require a Factor of Safety of greater than 1.0 to ensure slope stability and incorporate external forces.

The analysis was carried out by preparing a model of the slope geometry and subsurface conditions; and analyzing numerous potential failure surfaces both through the overall slope, in search of the minimum or critical Factor of Safety for the site conditions. The pertinent data obtained from the topographic information, slope profile, slope mapping and the borehole information were input for the slope stability analysis. Based on the borehole results, the following Table 6 outlines the soil properties used for the soil stratigraphy.

Table 6 Physical Soil Properties

Stratum	Unit Weight (kN/m^3)	Angle of Friction (degrees)	Cohesion (kPa)
Fill Material – Sands and Silts	20.0	28	0
Sand/Sandy Silt	21.0	28	0
Glacial Till – Cohesive	22.0	35	5
Glacial Till – Cohesionless	22.0	35	0
Bedrock	n/a*		

**Bedrock is modelled as a material with infinite strength for practical slope stability analysis purposes.*

The above soil parameters are based on the effective stress analysis for the long-term slope stability. It is noted that the above parameters are relatively conservative for analysis purposes, and the site soils are, in actuality, likely somewhat stronger.

The Factors of the Safety of the cross sections and scenarios are summarized in Table 7 below.

Table 7 Calculated Factors of Safety

Cross Section	Existing Conditions
Section A-A’	0.7
Section B-B’	0.8
Section C-C’ south slope	1.0
Section C-C’ north slope	1.1

The results of the slope stability analysis are provided in Appendix D.

Based on the results of the analysis, the existing configuration of the slope should be considered unstable as is evident from the active ongoing erosion.

5.4 Stable Slope Inclination

Based on the MNR technical guide [6], for slopes within bush or forest, the land may be considered as passive land use and therefore, it is recommended that a 1.1 minimum Factor of Safety for slope stability be provided for the future embankments of the relocation of the proposed creek. Based on our analysis, it is recommended that the embankments measure an

angle of approximately **2H:1V** from the toe of the slope based on the existing subsurface conditions in the area north of the creek.

Elevated groundwater levels, such as immediately following precipitation events, cause a reduction in the Factor of Safety along the slope. To analyze the possible effects, simulated high groundwater conditions of a 1 m increase in the depth of the stream indicate that the factor of safety of 1.1 can be maintained at a 2H:1V angle. The results of the analysis are provided in Appendix D.

5.5 Toe Erosion

The regulatory erosion standard allowance recommendations are provided in Table 3 of the MNR technical guide. The table outlines determination of the toe erosion allowance based on type of material, bankful width, and evidence of active toe erosion for watercourses within 15 m of the slope toe. This section of Arena Creek show evidence of active erosion therefore, it is presumed that the bankful flow velocity exceeds the competent flow velocity. Based on the subsurface conditions and the likely composition of the slope, an additional erosion allowance of **8 m** should also be applied along this length of Arena Creek. If space is constrained, the toe erosion allowance can be reduced to a minimum of **5 m**.

5.6 Geomorphology and Vegetation Input

Vegetation cover on the slope face provides a major defence against soil erosion by reinforcing soil with a root system and reducing runoff flow velocity during precipitation events. The slope face and toe should be adequately and densely vegetated with native species of plants. It is recommended that large trees are planted within 1 m along the slope crest.

It is recommended that the Client retain the services of a specialist geomorphologist to provide additional input for the design of the slope toes and meander points to account for flow velocities and long-term scouring.

5.7 Design Review and Inspections

We should be contacted to review and approve design drawings, prior to tendering or commencing construction, to ensure that all pertinent geotechnical-related factors have been addressed.

6.0 Closing

Please note that this work program and report are governed by the attached Qualifications and Limitations. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (705) 742-7900.

Respectfully submitted,

Cambium Inc.

DS

2024-12-18

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Blasco Vijayabaskaran, P.Eng.
Project Manager - Geotechnical

DocuSigned by:
0B68D45279A94B7...

Stuart Baird, M.Eng., P.Eng.
Director of Technical Operations, Services

BV

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7.0 Standard Limitations

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Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

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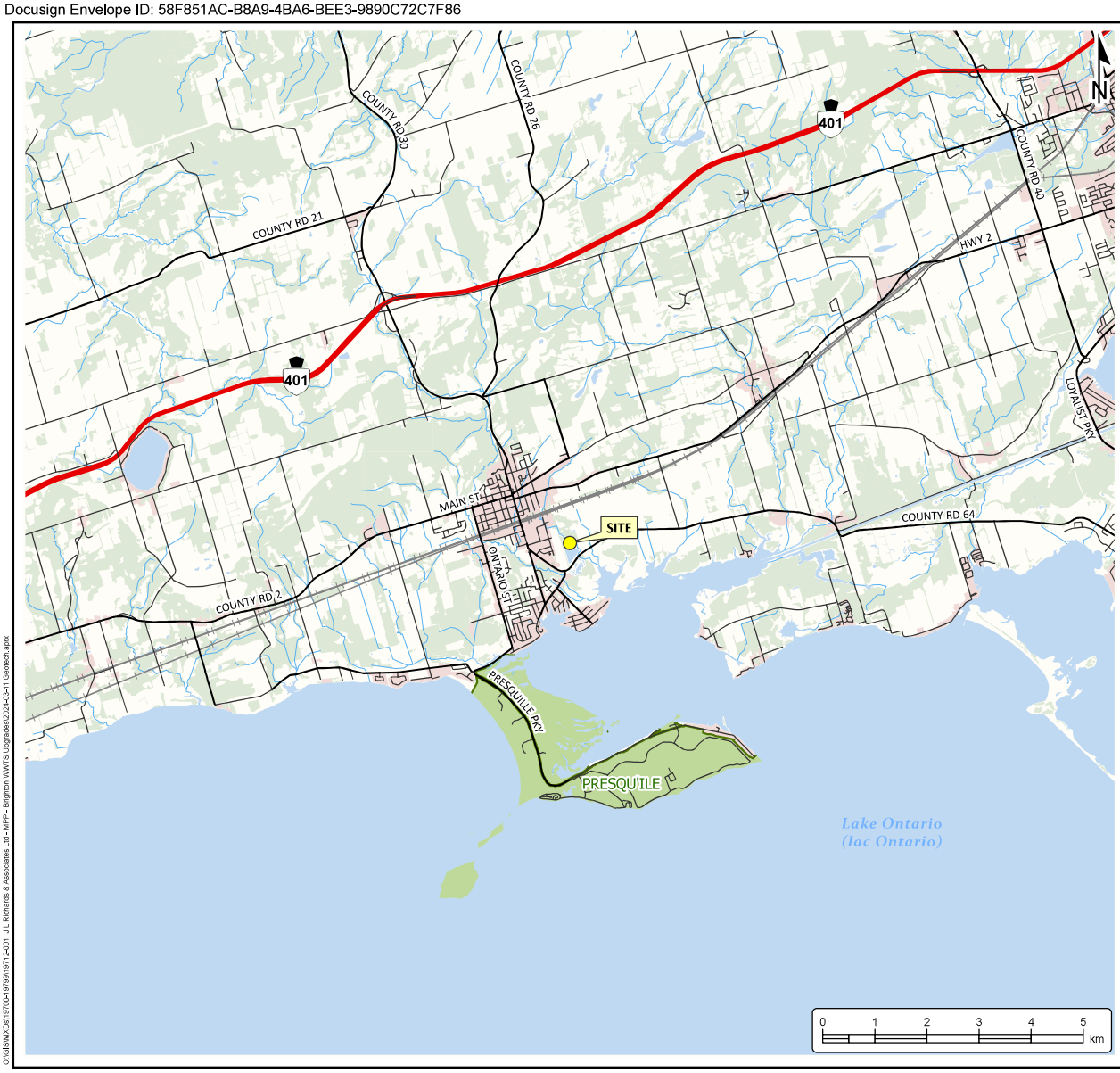
Appended Figures



GEOTECHNICAL INVESTIGATION

J L RICHARDS & ASSOCIATES LTD.
100 Concession Road 64
Brighton, Ontario

LEGEND

- Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Water Area
- First Nations Reserve
- Provincial Park
- Wooded Area
- Built Up Area

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CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

SITE LOCATION PLAN

Project No.: 19712-001		Date: March 2024	Rev.:
Scale: 1:100,000		Projection: NAD 1983 UTM Zone 18N	
Created by: DBB	Checked by: BVJ	Figure: 1	

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GEOTECHNICAL INVESTIGATION PROPOSED CREEK RELOCATION

J L RICHARDS & ASSOCIATES LTD.
100 Concession Road 64
Brighton, Ontario

LEGEND

- Benchmark
- Borehole
- Cross Section Location

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CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

BOREHOLE LOCATION PLAN

Project No.: 19712-001		Date: April 2024	
		Rev.:	
Scale: 1:1,500		Projection: NAD 1983 UTM Zone 18N	
Created by: DBB	Checked by: BVJ	Figure:	2

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Appendix A

Borehole Logs

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH116-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 82.32 mASL
Date Completed: February 27, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879297 **E:** 281901

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI / % Moisture	Shear Strength Cu, kPa (nat V., rem V.) / SPT (N)	Well Installation	Log Notes
82.3	0	**TOPSOIL:** 50 mm	82.27 / 0.05								
		FILL: (SM) SILTY SAND and GRAVEL: grey, moist, compact, with organics -(ML) sandy SILT: brown, no gravel		1	SS	50	10	6.6%	10		
81.8	0.5										
81.3	1			2	SS	56	12	11.2%	12		
80.8	1.5		80.80 / 1.52								
		(ML) sandy SILT: grey, wet, compact, trace gravel		3	SS	56	13	24.7%	13		
80.3	2										
79.8	2.5			4	SS	67	10	17.8%	10		
79.3	3										
				5	SS	100	14	14.9%	14		
78.8	3.5										
78.3	4										
77.8	4.5		77.75 / 4.57								
		(SM) gravelly SILTY SAND: grey-brown, moist, very dense, trace clay, with cobbles and boulders [GLACIAL TILL]	77.29 / 5.03	6	SS	100	75	5.6%	75		Groundwater encountered at 4.6 mbgs and borehole remained open upon completion.
77.3	5	Borehole terminated @ 5 mbgs within the glacial till.									
76.8	5.5										
76.3	6										
75.8	6.5										
75.3	7										
74.8											

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS 2	0	25	75	
SS 5	6	25	56	13

Logged By: SS
Input By: BV

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH117-24
Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1
Project No.: 19712-001
Elevation: 82.07 mASL
Date Completed: February 27, 2024
Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879291 **E:** 281916

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture 25 50 75	SPT (N) 20 40 60 80	Well Installation	Log Notes
82.1	0	**TOPSOIL:** 50 mm	82.02 / 0.05								
		FILL: (ML) SANDY SILT: grey brown, moist, compact, some gravel		1	SS	25	21	5.1%	21		
81.6	0.5	-no gravel									
81.1	1			2	SS	56	12	18.3%	12		
80.6	1.5	-loose, wet									
				3	SS	22	7	22.3%	7		
80.1	2		79.78 / 2.29								
79.6	2.5	**(ML) sandy SILT:** grey-brown, wet, compact		4	SS	100	10	31.7%	10		
79.1	3										
				5	SS	100	5	37.0%	5		
78.6	3.5	-auger grinding on cobbles and boulders, possible glacial till									
78.1	4										
77.6	4.5		77.50 / 4.57								
		(SM) gravelly SILTY SAND: grey, moist, compact, trace clay, with cobbles and boulders [GLACIAL TILL]		6	SS	100	20	7.9%	20		Groundwater encountered at 3.4 mbgs and borehole remained open upon completion.
77.1	5		77.04 / 5.03								
		Borehole terminated @ 5 mbgs within the glacial till.									
76.6	5.5										
76.1	6										
75.6	6.5										
75.1	7										
74.6											

Atterberg Limits (%) LL PL PI — Shear Strength Cu, kPa (nat V., rem V.)

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS **Input By:** BV

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH118-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 82.5 mASL
Date Completed: February 28, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879335 **E:** 281870

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (20 40 60 80)
82.40	0	**TOPSOIL:** 100 mm						
82.30	0.10	**(ML) sandy SILT:** brown, moist, loose, with organics and rootlets	1	SS	75	5	21.7%	5
			2	SS	33	6	22.7%	6
		-grey brown, some clay, slightly plastic	3	SS	56	10	28.1%	10
		-clayey, cohesive, grey, w > pl, very soft, trace sand	4	SS	89	1	29.9%	1
79.45	3							
79.35	3.05	**(ML) sandy CLAYEY SILT:** grey, w > pl, firm, some gravel [GLACIAL TILL]	5	SS	100	6	13.4%	6
		-(GP) sandy GRAVEL, wet, dense, some silt, non-cohesive	6	SS	100	47	7.7%	47
77.47	5							
77.37	5.03	Borehole terminated @ 5 mbgs within the glacial till.						

Well Installation: Groundwater encountered at 3.7 mbgs and remained open upon completion.

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS
Input By: BV

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH119-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 2

Project No.: 19712-001
Elevation: 83.39 mASL
Date Completed: February 28, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879315 **E:** 281905

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (20 40 60 80)
83.4	0	**(ML) sandy SILT:** grey brown, moist, very loose, some clay, with organics, slightly plastic	1	SS	42	3	18.1%	3
82.9	0.5	-brown, trace clay, non-cohesive						
82.4	1		2	SS	56	4	15.8%	4
81.9	1.5	-grey brown	3	SS	22	6	19.9%	6
81.4	2	-wet						
80.9	2.5		4	SS	56	9	23.4%	9
80.4	3	-no organics, some gravel						
79.9	3.5		5	SS	44	6	32.9%	6
79.4	4							
78.9	4.5	78.82						
		4.57 **(ML) sandy CLAYEY SILT:** grey, w > pl, firm, some gravel, with cobbles and boulders [GLACIAL TILL]	6	SS	56	4	11.5%	4
78.4	5							
77.9	5.5							
77.4	6	-(GP) sandy GRAVEL: very dense, some silt, non-cohesive						
			7	SS	100	50 / 125mm	8.1%	50
76.9	6.5							
76.4	7							
75.9		75.89 7.50						

Well Installation

Log Notes

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS 6	9	31	43	17

Logged By: SS
Input By: BV

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH119-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 2 of 2

Project No.: 19712-001
Elevation: 83.39 mASL
Date Completed: February 28, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879315 **E:** 281905

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
75.9	7.5	**(ML) sandy CLAYEY SILT:** grey, w > pl, firm, some gravel, with cobbles and boulders [GLACIAL TILL]	8	SS	80	50 / 100mm		50		Groundwater encountered at 3.0 mbgs and remained open upon completion.
75.39	8.00	Borehole terminated @ 8 mbgs within the glacial till due to practical refusal.								
75.4	8									
74.9	8.5									
74.4	9									
73.9	9.5									
73.4	10									
72.9	10.5									
72.4	11									
71.9	11.5									
71.4	12									
70.9	12.5									
70.4	13									
69.9	13.5									
69.4	14									
68.9	14.5									
68.4										

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS 6	9	31	43	17

Logged By: SS
Input By: BV

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH120-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 82.78 mASL
Date Completed: February 28, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879311 **E:** 281935

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (20 40 60 80)
82.8	0	**TOPSOIL:** 100 mm (82.68 / 0.10)	1	SS	33	50 / 150mm	10.4%	50
82.3	0.5	**(ML) sandy SILT:** grey brown, moist, dense to compact, trace gravel, with organics						
81.8	1		2	SS	89	10	19.4%	10
81.3	1.5	-wet, no organics	3	SS	22	12	22.1%	12
80.8	2	-some clay, slightly plastic						
80.3	2.5		4	SS	56	10	23.5%	10
79.8	3		5	SS	67	8	17.3%	8
79.3	3.5							
78.8	4							
78.3	4.5	(78.21 / 4.57) **(ML) sandy CLAYEY SILT:** grey, w > pl, very stiff, some gravel, with cobbles and boulders [GLACIAL TILL]	6	SS	67	22	14.9%	22
77.8	5							
77.3	5.5							
76.8	6	-(SM) sandy GRAVEL: very dense, some silt, some clay, non-cohesive						
76.3	6.5	(76.23)	7	SS	100	68	8.3%	68
75.8	7	(6.55) Borehole terminated @ 6.6 mbgs within the glacial till.						
75.3								

Well Installation: Groundwater encountered at 4.6 mbgs and borehole caved to 5.9 mbgs upon completion.

Log Notes:

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS **Input By:** BV

Appendix B

Soil Laboratory Testing Results

Grain Size Distribution Chart

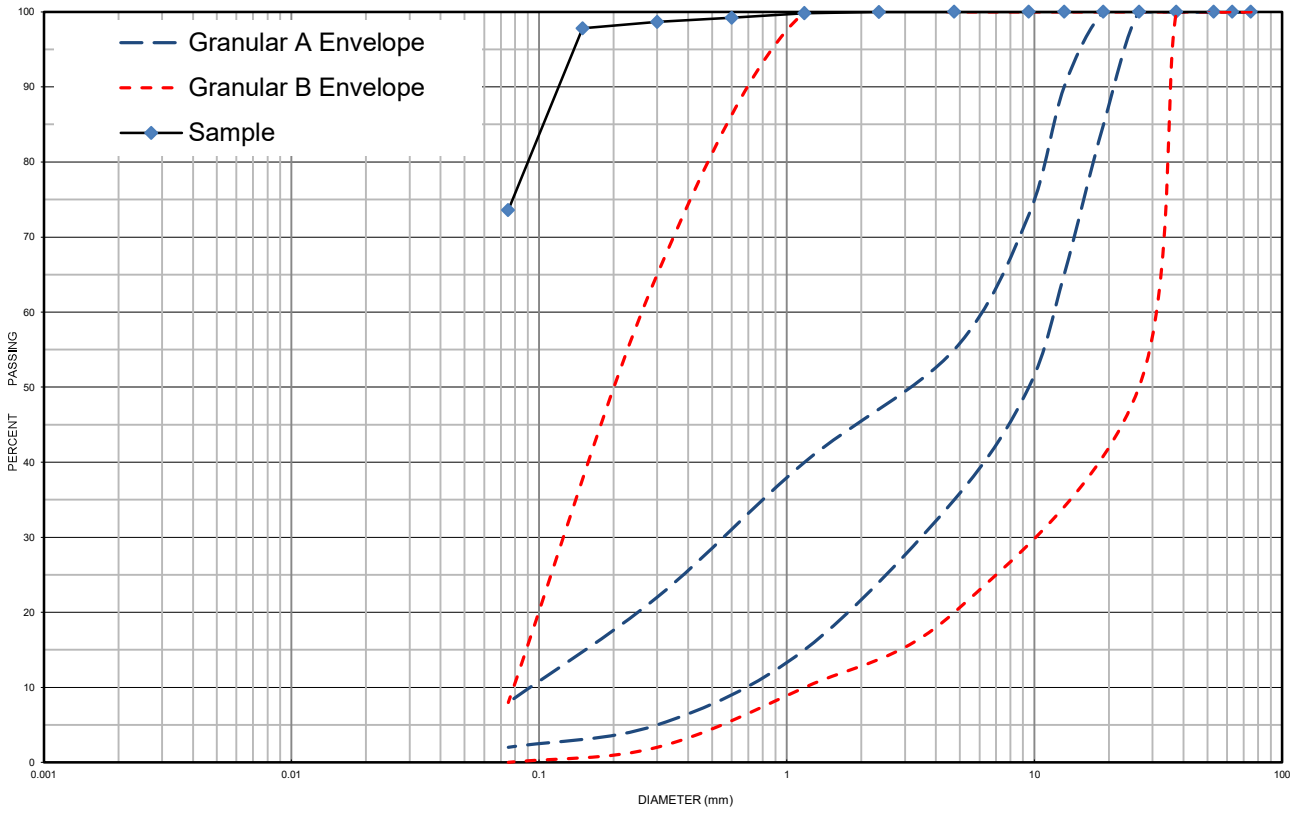
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 116-24 SS 2* **Depth:** *0.8 m to 1.4 m* **Lab Sample No:** *S-24-0425*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 116-24	SS 2	0.8 m to 1.4 m	0	26	74		11.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt	ML	-	-	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

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194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

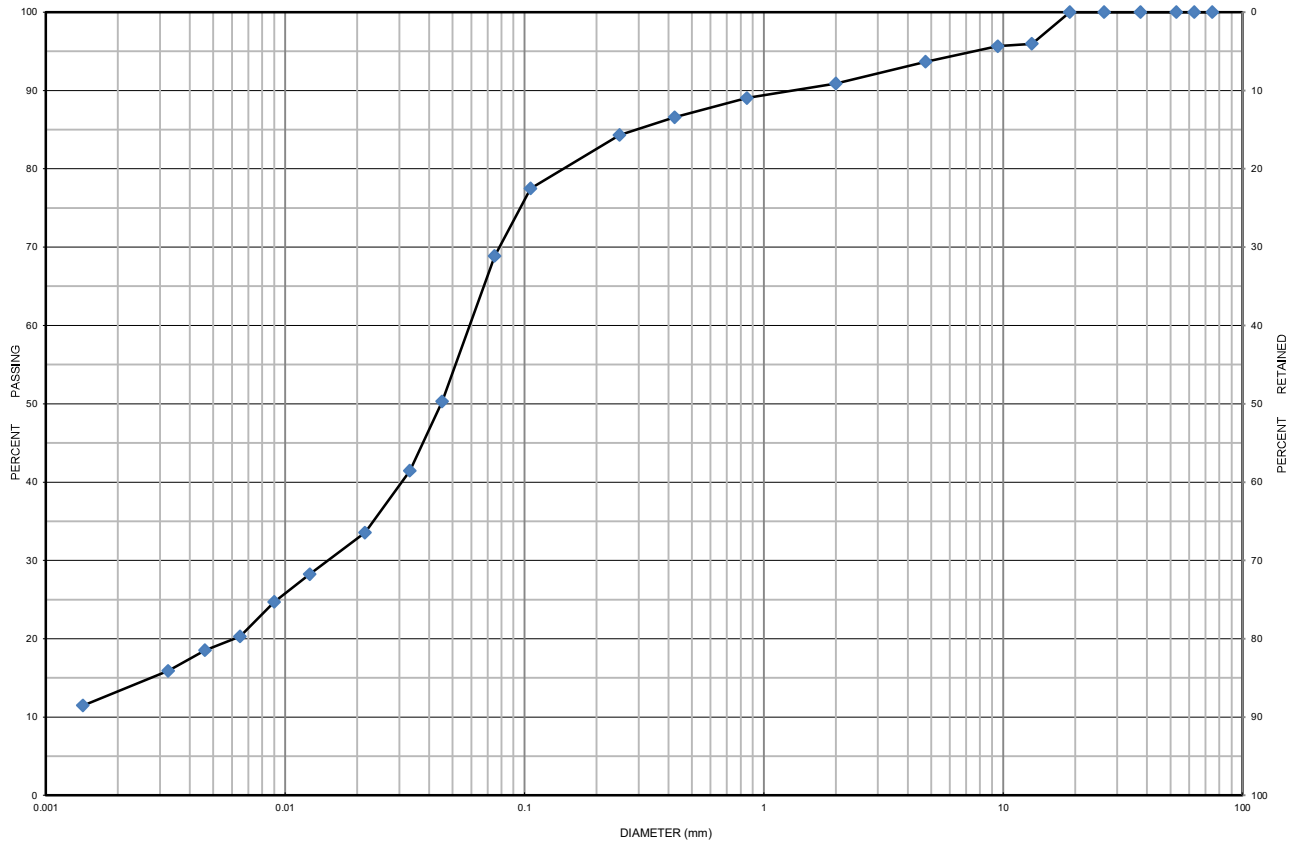
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 116-24 SS 5* **Depth:** *3 m to 3.5 m* **Lab Sample No:** *S-24-0426*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 116-24	SS 5	3 m to 3.5 m	6	25	56	13	14.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt some Clay trace Gravel	ML	0.059	0.016	-	-	-

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194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

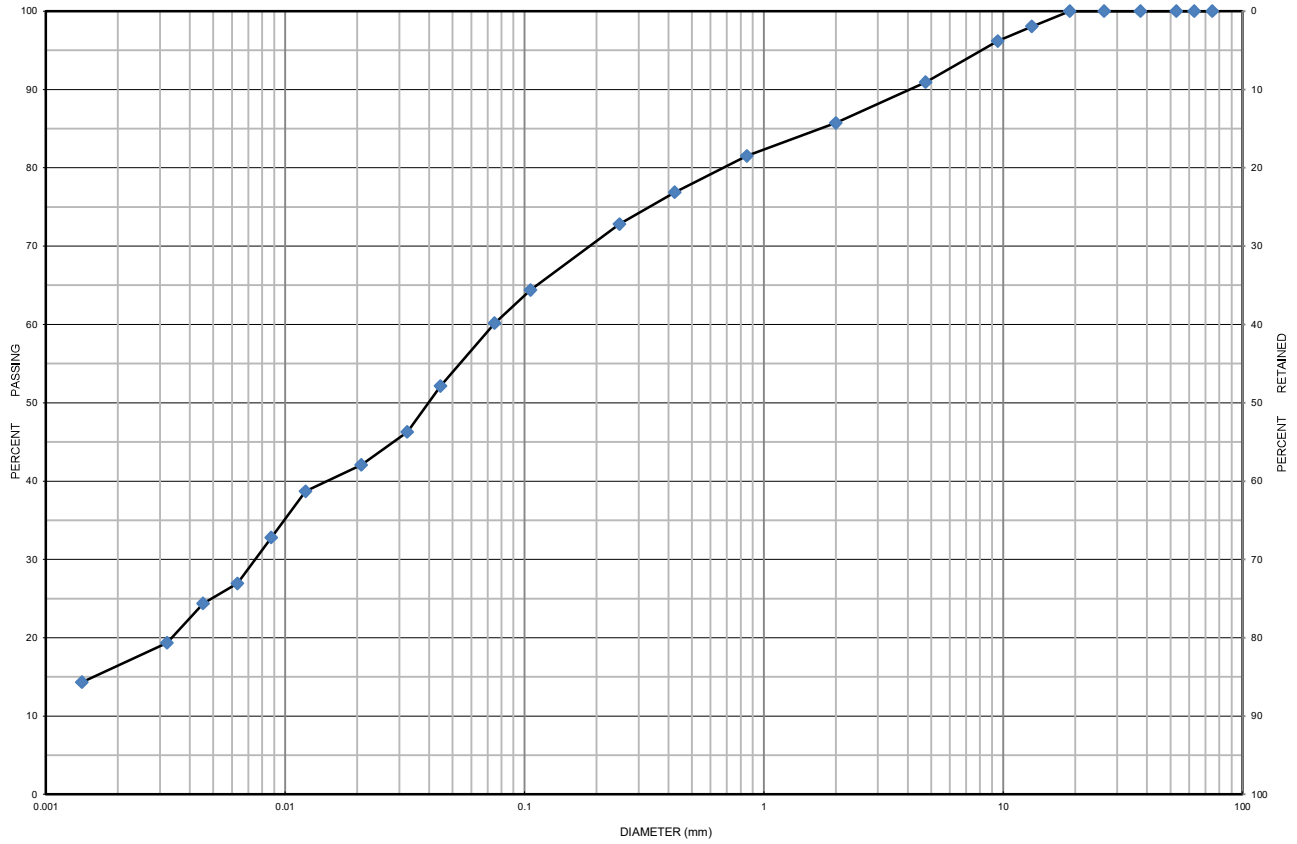
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 119-24 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-24-0427*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 119-24	SS 6	4.6 m to 5 m	9	31	43	17	11.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt some Clay trace Gravel	ML	0.0730	0.0076	-	-	-

Additional information available upon request

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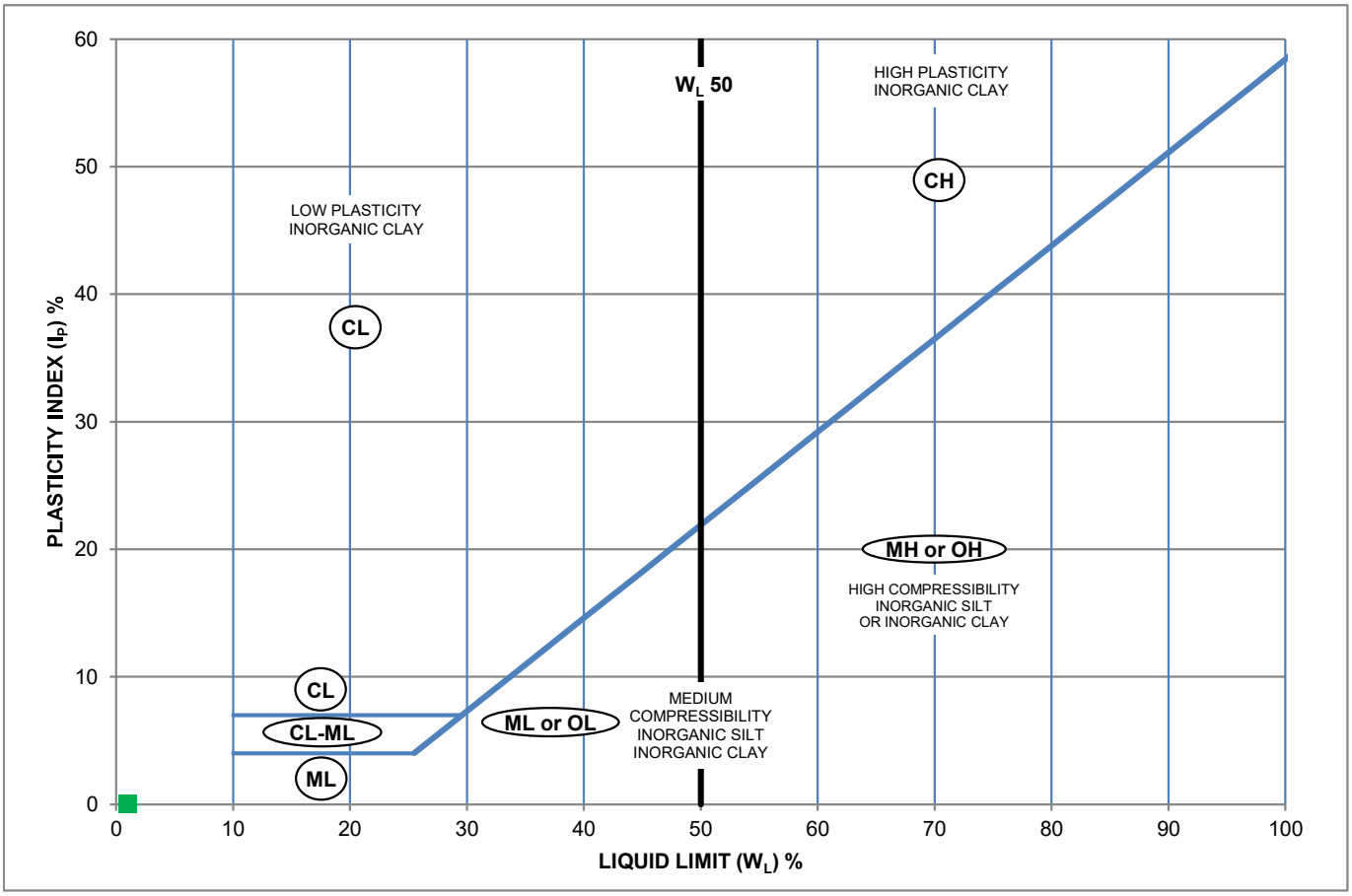
Plasticity Chart

Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sampled By: *Rory Ryan - Cambium Inc.* **Sample Date:** *January 12, 2024*

Hole No.: *BH 116-24 SS 5* **Depth:** *3 m to 3.5 m* **Lab Sample No:** *S-24-0426*



Symbol	Borehole	Sample	Depth	Description
■	BH 116-24	SS 5	3 m to 3.5 m	Material not plastic

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
Unable to complete	***Unable to complete***	***Unable to complete***

Additional information available upon request

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Plasticity Chart

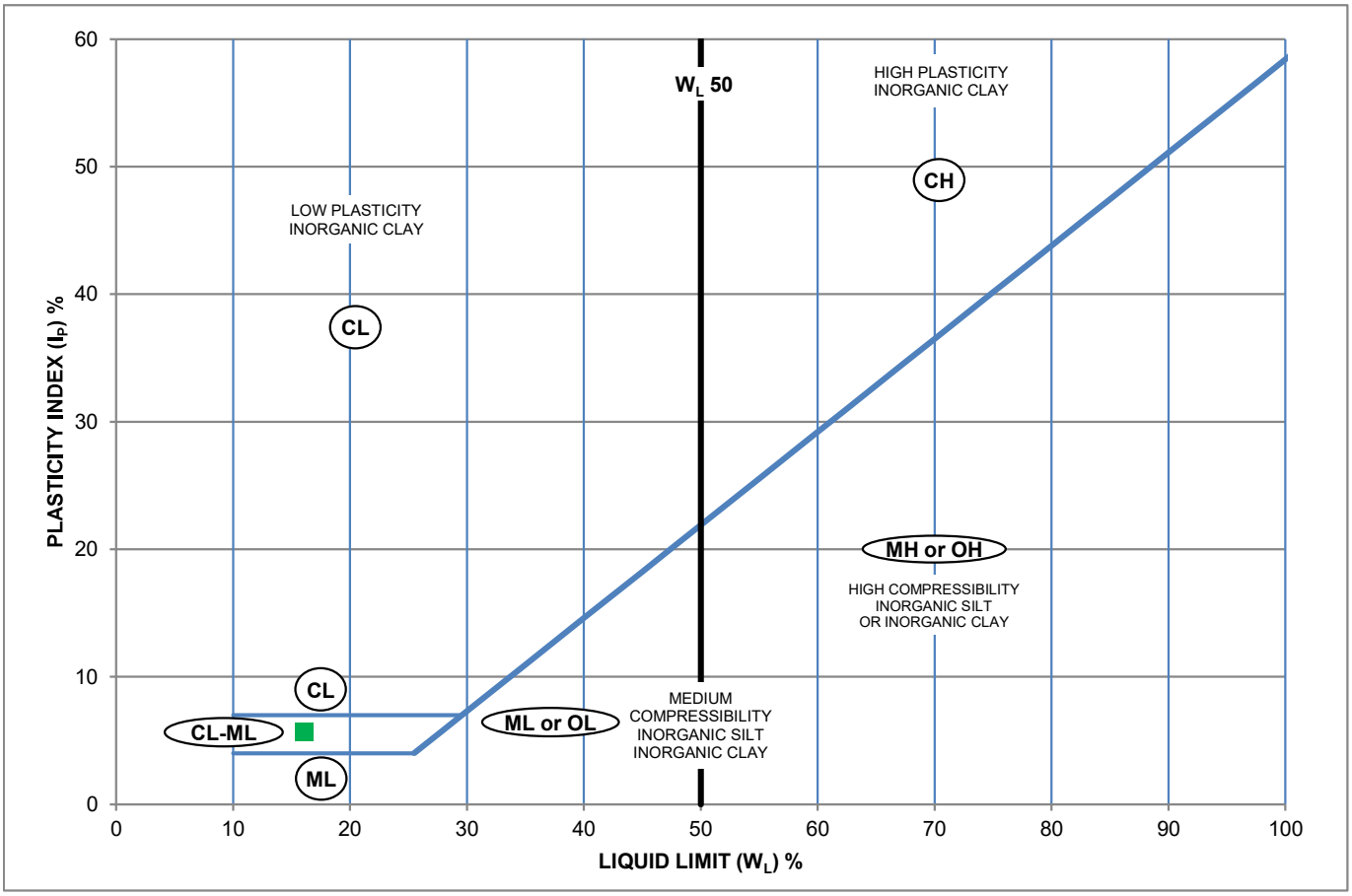
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sampled By: *Rory Ryan - Cambium Inc.* **Sample Date:** *January 12, 2024*

Hole No.: *BH 119-24 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-24-0427*

Low Plasticity	High Plasticity



Symbol	Borehole	Sample	Depth	Description
■	BH 119-24	SS 6	4.6 m to 5 m	CL-ML

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
16.1	***10.5***	***5.6***

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

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Appendix C

Preliminary Site Visit Photos

Photo 1 Viewing west along the northern berm of the lagoon. Berm is lightly vegetated.

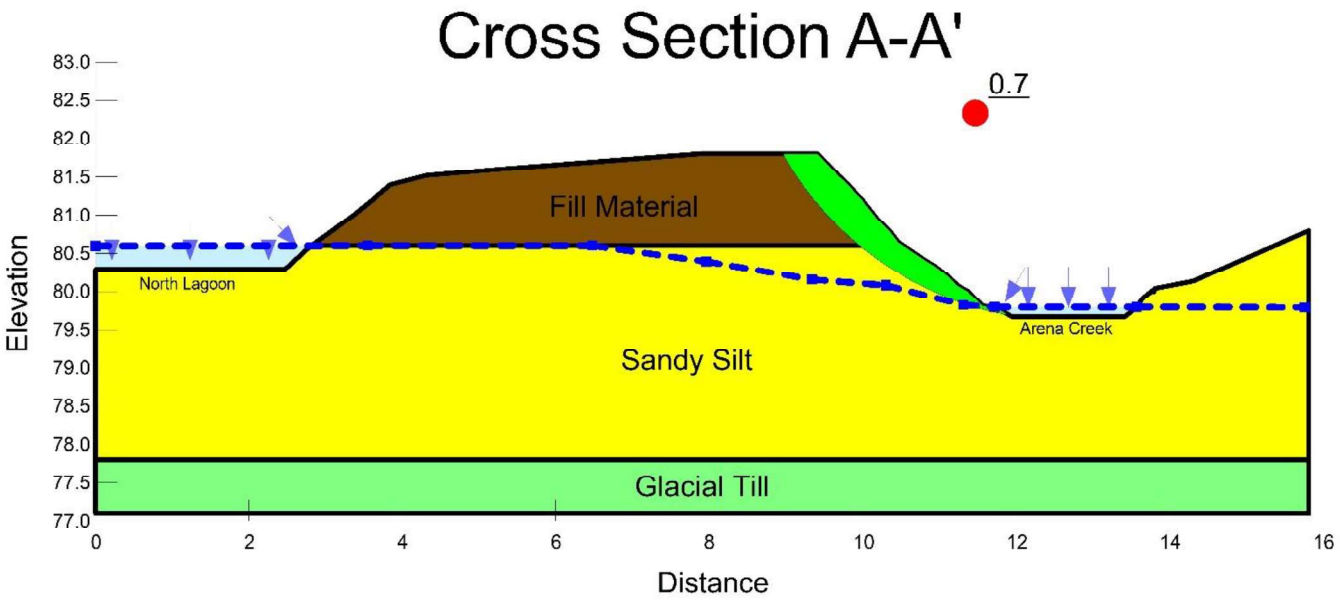
Photo 2 Viewing west along Arena Creek bed. North berm visible on right side. Evidence of toe erosion can be seen.

Photo 3 Table land north of Arena Creek. Likely area for the relocation work.

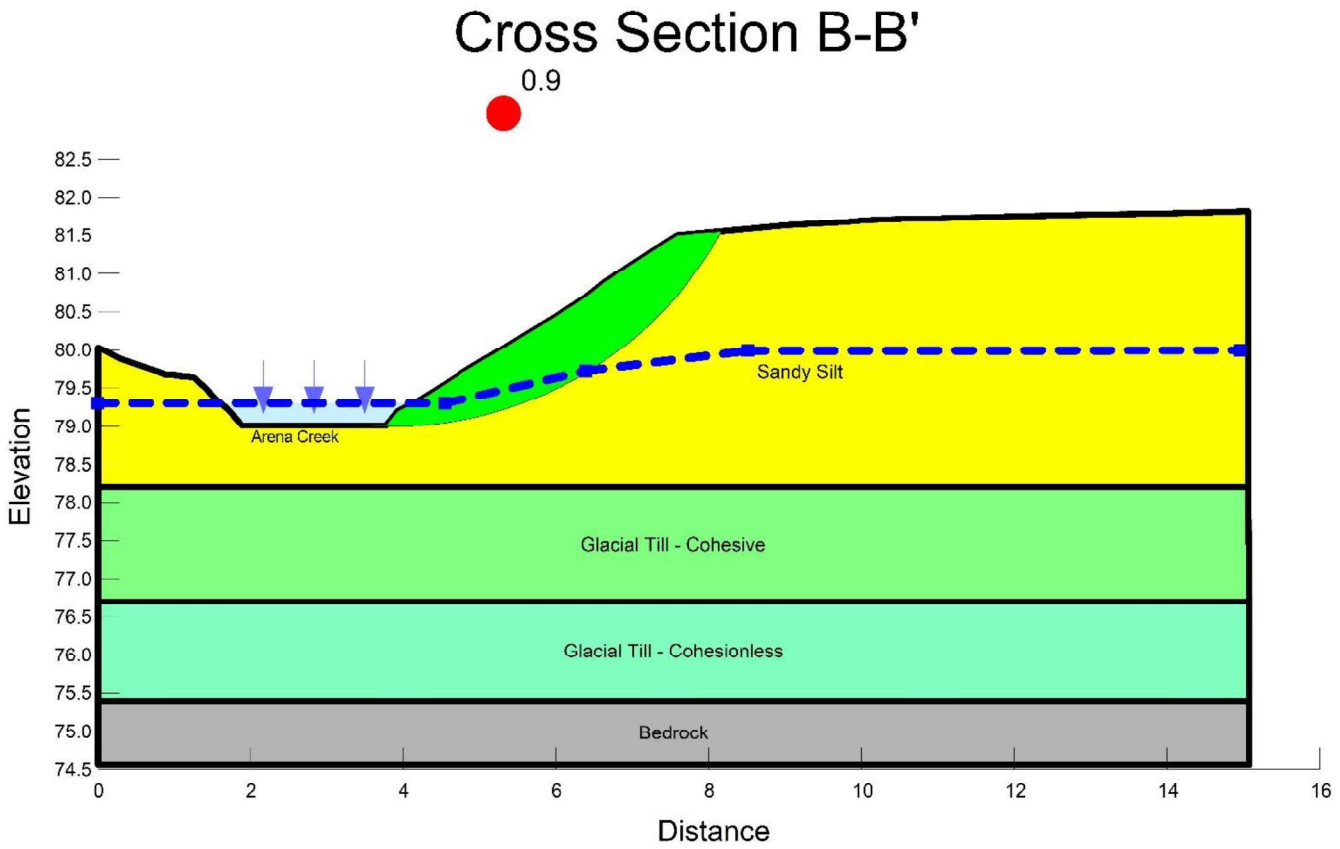
Photo 4 North embankment of Arena Creek. Active erosion visible in localized areas along slope.

Appendix D

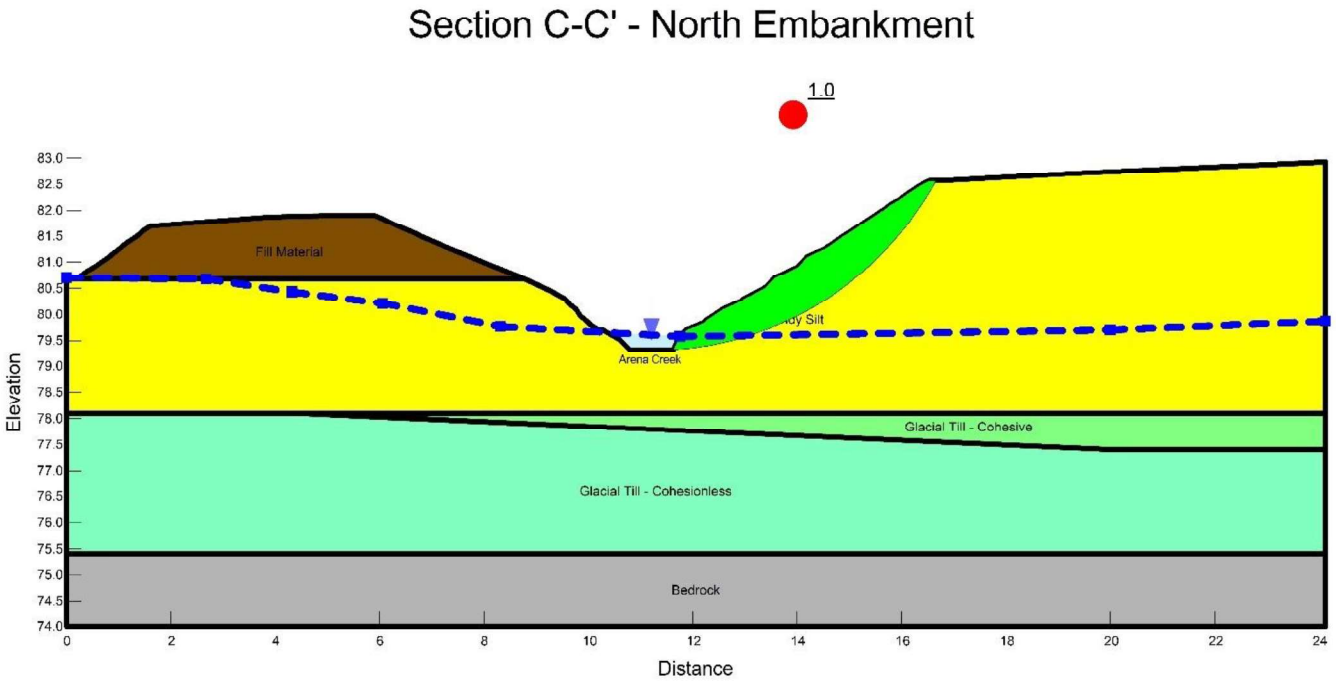
Slope Stability Analysis Results



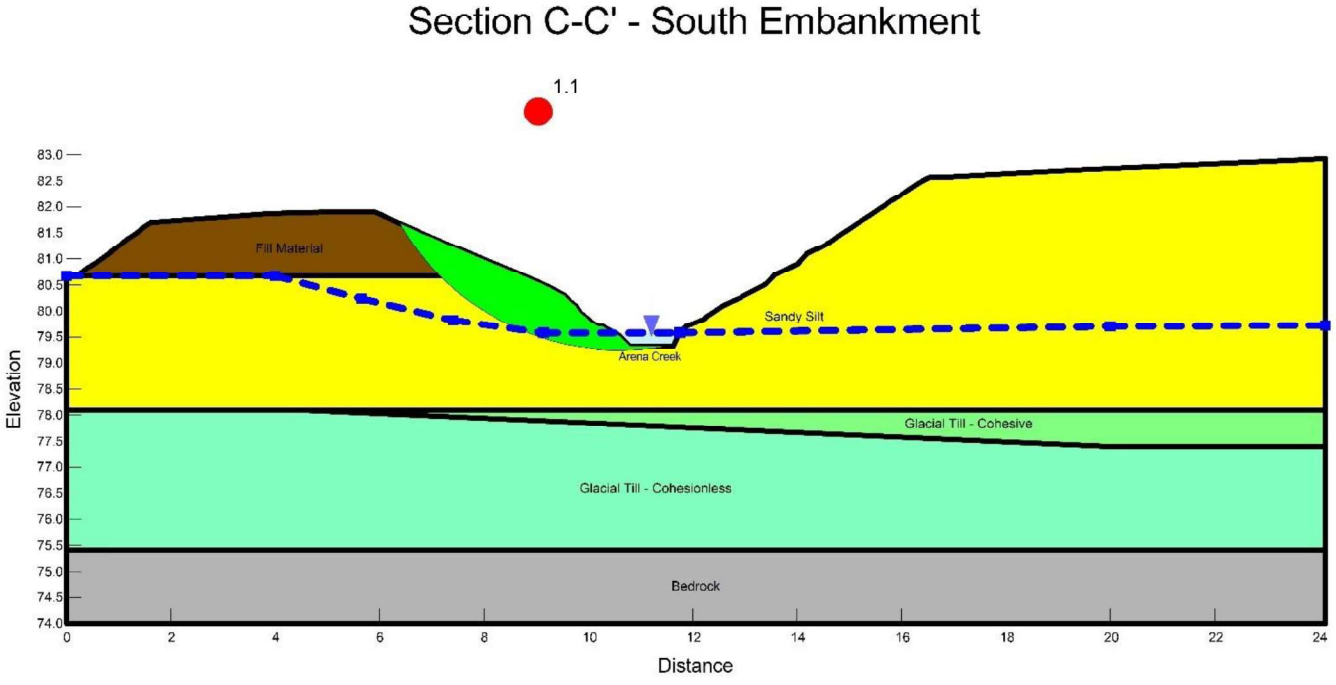
Analysis 1 North Lagoon Berm (South Embankment), location of significant erosion



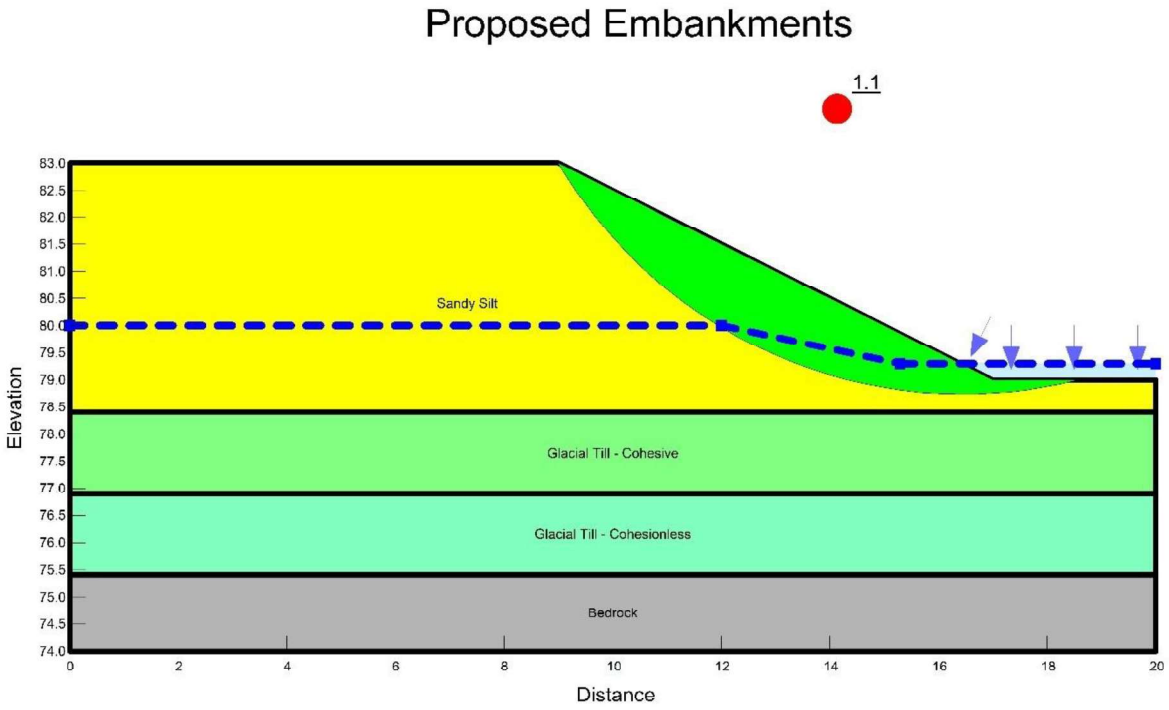
Analysis 2 North Embankment, locations of significant erosion



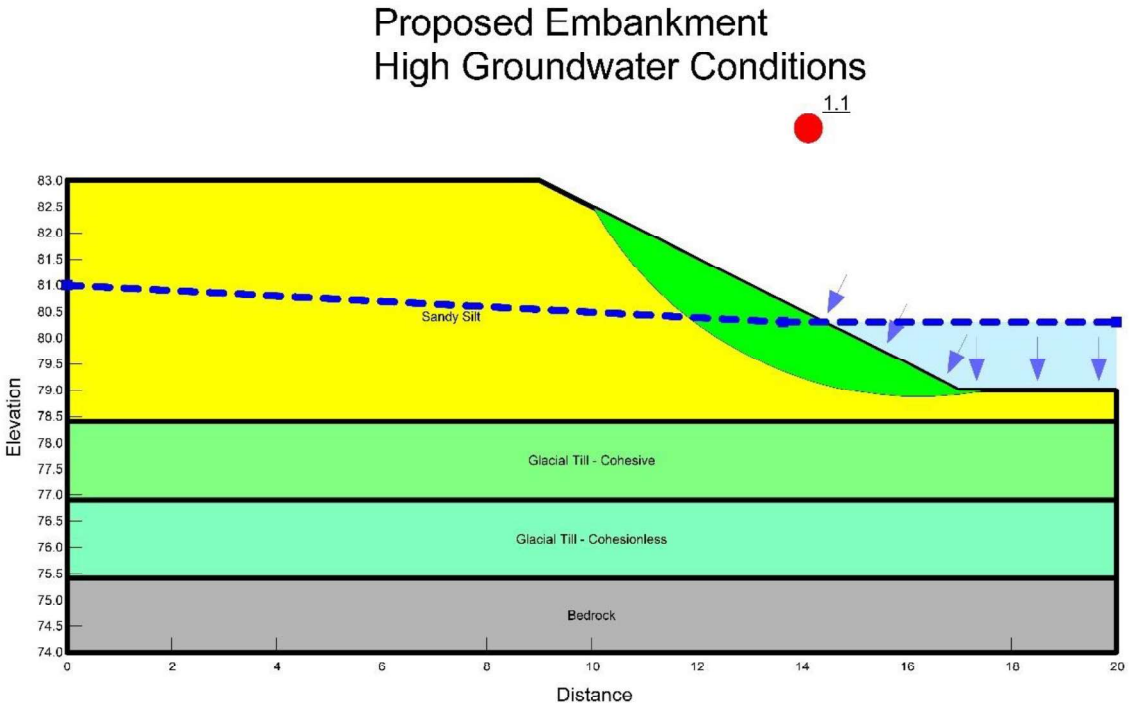
Analysis 3 North Lagoon Berm (South Embankment), located between BH116-24 and BH117-24



Analysis 4 South Embankment, located between BH116-24 and BH117-24



Analysis 5 Proposed Creek Embankment for Relocation



Analysis 6 South Embankment, located between BH116-24 and BH117-24

Hydrogeological Assessment Report – 100 County Rd 64, Brighton, ON

March 7, 2025

Prepared for:
J L Richards & Associates Ltd.

Cambium Reference: 19712-001

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1.0 Introduction

Cambium Inc. (Cambium) was retained by J L Richards & Associates Ltd. (the Client) on behalf of the Municipality of Brighton, to complete a hydrogeological assessment for proposed improvements of the Wastewater Treatment System (WWTS) located at 100 County Road 64, in Brighton, Ontario (the Site).

The purpose of the field work and testing was to obtain information on the general subsurface and groundwater conditions at the Site by means of groundwater monitoring well installations, as well as field and laboratory tests. This report addresses the hydrogeological aspects of the subsurface conditions at the Site. Cambium also completed geotechnical investigations concurrently with the hydrogeological assessment and relevant details of those investigations have been incorporated into this report. Detailed information from the geotechnical investigations is provided under separate cover (Cambium, 2024a; 2024b).

This report provides the results of the hydrogeological assessment and should be read in conjunction with the “Standard Limitations” in Section 9.0, which forms an integral part of this document. The reader’s attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. The data, interpretations, and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location, or elevation, or if the project is not initiated within eighteen months of the date of the report, Cambium should be given an opportunity to confirm that the recommendations in this report are still valid.

1.1 Site Description

The property is a 68-acre parcel of land which has a civic address of 100 County Road 64, Brighton, and a legal description of Lot 33 and 34, Concession B, Municipality of Brighton, County of Northumberland, Ontario. The site is occupied by the current WWTS and consists of two lagoons: one large triangular shaped lagoon located on the southern side of the property, and one smaller rectangular lagoon located north of the larger lagoon. The property is also

occupied by multiple Sea Can storage units and one single storey structure. Additionally, a decommissioned drying bed is located west of the rectangular lagoon. The bed is an open-air concrete structure with a concrete floor slab. A dirt road provides access to the site, including the area of the proposed construction. There is a small, forested grove located within the Site area as well.

Cambium understands that the proposed development will consist of the following structures which have subsurface components:

- Sanitary pumping station (SPS) with septic receiving tank
- Headworks building with two aeration tanks
- UV building and process building with three clarifier tanks
- Administration building
- New underground service lines to connect the treated wastewater to the outlet, and to connect the clarifier tanks to the smaller lagoon.

The regional location of the Site is identified on Figure 1, the property and surrounding areas are outlined on Figure 2, and Site plan drawings are included in Appendix A.

2.0 Physical Setting

2.1 Topography and Drainage

Based on regional topographic maps the Site area slopes to the south towards Lake Ontario. The Site has a topographic high located in the northwest corner with an elevation of 85.3 meters above sea level (masl) at BH105-24 and slopes towards the south-southeast with an elevation of 81.48 masl at BH117-24.

The Site is located within the Northeast Lake Ontario Shoreline tertiary watershed. The Site contains two lagoons, one large triangular shaped lagoon located on the southern side of the property, and one smaller rectangular lagoon located north of the larger lagoon. A stream runs from north to south within the Site and a provincially significant wetland is located less than 50 m to the south.

It is assumed that all local drainage will follow the local surficial topography and flow to the wetland and stream south of the Site, ultimately discharging into Lake Ontario.

2.2 Physiography

The Site is located in the physiographic region known as the Iroquois Plain. The region covers the border of Lake Ontario's shore extending from the City of Trenton in the east to the City of St. Catharines in the southwest. The Iroquois Plain refers to an area of lowlands that border the present-day Lake Ontario, which was formed within the basin of Glacial Lake Iroquois which was a larger and higher version of Lake Ontario. Lake Iroquois sediments consist both of granular soils (silt and sand) and finer-grained silt and clay soils (Chapman & Putnam, 1984).

2.3 Overburden Geology

According to Miscellaneous Release – Data 128 from the Ontario Geological Survey (2010) the predominant overburden of the Site consists of coarse-textured glaciolacustrine deposits

(sand, gravel, minor silt and clay) and modern alluvial deposits (clay, silt, sand, and gravel) (Appendix B).

2.4 Bedrock Geology

According to Miscellaneous Release – Data 219 from the Ontario Geological Survey (2007), the bedrock in the area of the Site consists of the Middle Ordovician Simcoe Group. The Simcoe Group consists of four formations that dip gently towards the southwest from oldest to youngest and consist of the Gull River, Bobcaygeon, Verulam, and the Lindsay Formations. The bedrock of the Site consists of the Lindsay Formation and is described as limestone (Appendix B).

2.5 Vulnerable and Regulated Areas

The Site is situated within the Lower Trent Source Protection Area (LTSPA), under jurisdiction of the Lower Trent Conservation Authority, as per the Ministry of the Environment, Conservation and Parks (MECP) Source Water Protection Information Atlas (SPIA) (Ministry of the Environment, Conservation and Parks, 2024). The Site is within the following areas:

- Significant Ground Water Recharge Area (SGRA) with a vulnerability score of 6
- Significant Ground Water Recharge Area (SGRA) with a vulnerability score of 4
- Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6

SGRAs are landscape surfaces which allow a high volume of water to infiltrate into the ground. A recharge area is classified as significant if the recharge rate for a particular area is greater than the average watershed recharge rate by 15% or more and the area has a hydrological connection to a surface water body or to an aquifer that is a source of groundwater for a drinking water system (Ministry of the Environment, Conservation and Parks, 2021). SGRAs are delineated using models which consider topography, surficial soil, land cover, and climate. Groundwater quantity and quality in SGRAs with a vulnerability of 6 or greater have a high risk of impact from surface activities, while risk of impact is moderate in SGRAs with a vulnerability score of 4.

HVAs are aquifers that are more sensitive to contamination as a result of the proximity to surface (shallow aquifers). Due to the prevalence of shallow bedrock across the region, approximately 90% of the LTSPA is classified as an HVA. By default, all HVA's have a vulnerability score of 6 because they are more sensitive to contamination.

A review of the Ministry of Natural Resources Natural Heritage System database indicates the Site is not located within any Areas of Natural and Scientific Interest (Ministry of Natural Resources, 2024).

The development area of the Site falls under a regulated area, as per the Lower Trent Conservation Authority (LTCA) and O.Reg. 41/24. Development restrictions may apply to the proposed development within the regulated portions of the Site. The Client should consult with LTCA to determine if any permits are required for the proposed development.

The SPIA and LTCA mapping is attached in Appendix B.

3.0 Subsurface Investigation

Cambium staff completed a borehole investigation at the Site on February 20 to 23, and 27 to 28, 2024, to assess subsurface conditions. A total of 20 boreholes, designated as BH101-24 through BH120-24, were advanced to depths ranging from approximately 1.5 to 9.2 meters below ground surface (mbgs). Borehole locations are shown in Figure 3 and borehole and rock core logs are included in Appendix C.

3.1 Subsurface Lithology

At a broad scale, the lithology at the Site is comprised of a downward sequence of fill material, glacial till, and limestone bedrock. Topsoil was additionally encountered from the surface at 9 borehole locations, with thickness ranging from 0.05 to 0.30 m. Further summary of general lithological details obtained from the subsurface investigation is presented below.

Fill Material

Fill material was encountered underlying surficial topsoil and asphaltic concrete or from the surface at all borehole locations.

The fill material varies in composition between borehole locations and with depth but is generally non cohesive across the site composed of silty sand and/or sandy silt with trace to some gravel and/or trace clay. The material is slightly plastic or cohesive at some locations, such as in BH106-24, BH107-24, BH109-24, and BH112-24. Additionally, fill material composed predominantly of sand and gravel was noted at the surface of some borehole locations such as in BH102-24, BH108-24, and BH111-24 through BH114-24. Organics and wood debris was also noted up to 2.0 and 2.5 mbgs in BH106-24 and BH112-24, respectively, which is indicative of possible buried topsoil. Asphaltic concrete was noted within the fill material in BH115-24. Further details on the composition of the fill material are provided on the respective borehole logs.

The fill material thickness where fully penetrated ranged from 0.7 to 3.1 m. BH111-24 and BH113-24 terminated within the fill material at 1.5 mbgs.

Glacial Till

Native deposits of glacial till were encountered underlying the fill material at all borehole locations with the exception of BH111-24 and BH113-24, where the boreholes were terminated within the fill material.

Glacial till is a heterogeneous mixture of all grain sizes due to the nature of deposition. At this location the glacial till is generally composed of silty sand, gravelly to some gravel, with trace to some clay. Cobbles and boulders were also observed within the material. The upper portions of the glacial till deposit are cohesive in nature in boreholes BH101-24, BH104-24, BH106-24, BH112-24, and BH114-24. The deposit transitions to non-cohesive material at depths ranging from 2.4 to 4.6 mbgs at these locations.

The top of the glacial till unit was encountered at depths ranging from 0.8 to 3.1 mbgs. Boreholes BH102-24, BH109-24, BH110-24, BH114-24, and BH115-24 terminated at depths ranging from 3.1 to 5.0 mbgs within the glacial till due to reaching target investigation depths. The remaining boreholes terminated due to practical refusal. Refusal does not necessarily indicate bedrock as refusal can also occur on cobbles or boulders within the glacial till. Refusal was also encountered in BH101-24, BH106-24, and BH107-24; however, rock coring was initiated following refusal in order to prove and qualify the bedrock.

Rock coring advanced in BH101-24 and BH106-24 encountered very dense glacial till overlying bedrock in the upper core recovery, measuring a thickness of 0.7 and 2.1 m, respectively.

Based on the results from BH101-24, BH106-24, and BH107-24, where bedrock was cored and proven, the glacial till is estimated to have a thickness measuring 4.0 to 4.7 m.

Bedrock/Practical Refusal

Practical refusal was encountered 5 borehole locations (BH103-24 through BH105-24, BH108-24, and BH112-24). As noted in the previous section, refusal may occur on cobbles and/or boulders, or due to very dense glacial till, and as such, refusal depths may not indicate the top of the bedrock. BH101-24, BH106-24, and BH107-24 were cored in order to prove bedrock. BH101-24 and BH106-24 encountered very dense glacial till in the rock core runs extending

deeper than the refusal depths. These very dense glacial till deposits extended 0.7 to 2.1 m deeper than the depth to refusal.

The depths and elevations to refusal and to the top of the bedrock surface are summarized in the Table below.

Table 1 Depths/Elevation to Refusal or Top of Bedrock

Borehole Location	Depth (mbgs)	Elevation (masl)
BH103-24	5.5	79.1
BH104-24	6.3	78.2
BH105-24	4.9	80.4
BH108-24	6.1	78.2
BH112-24	7.0	78.2
Cored and Proved Bedrock Depths		
BH101-24	6.5	78.6
BH106-24	7.8	77.5
BH107-24	5.0	79.8

There is typically a weathered zone at the contact between the top of the bedrock and the overlying overburden material. The subsurface conditions transition from glacial till to the bedrock and a zone of very dense glacial till was encountered in BH101-24 and BH106-24. Therefore, it should be anticipated that the upper portions of the limestone bedrock will be significantly weathered as the material transitions from deposition to sound bedrock.

3.2 Physical Laboratory Testing

Physical laboratory testing, including grain size distribution analysis, was completed on five soil samples to confirm textural classification identified during field logging and obtain percolation rate estimates. Analysis results are based on the Unified Soil Classification System scale. A summary of results is provided in Table 2 and complete laboratory analysis reports are provided in Appendix D.

Table 2 Grain Size Distribution Analysis Results

Borehole Location	Depth (mbgs)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH101-24 SS4B	2.5 – 2.9	Silty Gravelly Sand trace Clay	24	36	32	8
BH101-24 SS6	4.6 – 5	Silty Sand some Gravel some Clay	15	44	29	12
BH104-24 SS5	3 – 3.5	Gravelly Silty Sand trace Clay	31	36	27	6
BH108-24 SS1B	0.2 – 0.6	Silty Gravelly Sand	31	41	28	
BH116-24 SS2	0.8 – 1.4	Sandy Silt	0	26	74	
BH116-24 SS5	3 – 3.5	Sandy Silt some Clay trace Gravel	6	25	56	13
BH119-24 SS6	4.6 – 5	Sandy Silt some Clay trace Gravel	9	31	43	17

4.0 Groundwater Investigation

4.1 Monitoring Well Installation

Nested monitoring wells were installed at four locations across the Site, one deep (denoted with subscript D) and one shallow well (denoted with subscript S). Details of the installations are summarized in Table 3.

Table 3 Monitoring Well Construction

Well ID	Surface Elevation (masl)	Well Depth (mbgs)	Well Casing Stick-up (mags)	Screen Details	
				Top of Screen (mbgs)	Bottom of Screen (mbgs)
BH101-24-D	85.08	8.09	1.02	6.7	8.2
BH101-24-S	85.08	5.13	0.90	3.4	4.9
BH106-24-D	85.20	7.54	0.91	6.1	7.6
BH106-24-S	85.20	5.54	0.97	4.2	5.7
BH107-24-D	84.80	8.88	1.00	7.6	9.1
BH107-24-S	84.80	5.17	0.96	3.6	5.1
BH112-24-D	85.15	6.75	0.90	5.2	6.7
BH112-24-S	85.15	4.61	0.84	3.0	4.6

All monitoring wells with water were developed after installation. Development involved purging ten well volumes of groundwater or three times dry from the wells by hand pumping with Waterra tubing and a foot valve.

4.2 Groundwater Level Monitoring

Groundwater levels were measured monthly from March to June 2024, to determine the peak water level elevation at the Site. Water levels were measured manually in all monitoring wells using an electronic water level indicator, as well as automatically in BH107-S and BH107-D using an electronic transducer (datalogger) to allow continuous measurement of groundwater levels over the monitoring period. A barometric transducer was installed in BH107-D to compensate datalogger measurements for natural atmospheric pressure changes.

Manual water level measurements are summarized in Table 4 and a record of datalogger readings is provided in Appendix E. The lowest water level recorded manually during the monitoring period is 80.4 masl (5.38 mbgs) at BH10107-D on June 21, 2024. The highest water level measured is 83.3 masl (2.0 mbgs), measured at BH106-24-S on April 24, 2024.

Table 4 Monitoring Well Water Levels

Well ID		BH101-24-D	BH101-24-S	BH106-24-D	BH106-24-S	BH107-24-D	BH107-24-S	BH112-24-D	BH112-24-S
March 5th, 2024	Water Level (mbgs)	2.87	3.73	3.31	2.34	3.28	3.36	2.35	2.29
	Groundwater Elevation (masl)	82.21	81.35	81.89	82.86	81.52	81.44	82.8	82.86
March 28th, 2024	Water Level (mbgs)	2.83	2.65	2.37	3.14	3.91	3.31	2.26	2.25
	Groundwater Elevation (masl)	82.25	82.43	82.83	82.06	80.89	81.49	82.89	82.9
April 24th, 2024	Water Level (mbgs)	2.7	2.3	3.0	2.0	3.8	3.1	1.9	2.0
	Groundwater Elevation (masl)	82.4	82.8	82.2	83.3	81.0	81.7	83.2	83.2
May 24th, 2024	Water Level (mbgs)	4.10	3.77	4.40	3.62	5.37	4.40	3.28	3.28
	Groundwater Elevation (masl)	82.0	82.2	81.7	82.6	80.4	81.4	82.8	82.7
June 21st, 2024	Water Level (mbgs)	4.34	4.01	4.71	4.21	5.38	4.51	3.82	3.81
	Groundwater Elevation (masl)	81.8	82.0	81.4	82.0	80.4	81.3	82.2	82.2

4.3 Hydrostratigraphy and Hydraulic Gradients

The subsurface at the Site broadly consists of cohesive to non-cohesive glacial till (silty sand with variable amounts of cobbles, boulders, gravel, and clay) overlying limestone bedrock. Given the depths to bedrock listed in Table 1, the screen intervals summarized in Table 3, and the measured groundwater elevations reported in Table 4, it is interpreted that the aquifer within bedrock at depth is hydraulically isolated from the shallow aquifer in the overlying glacial till unit. The approximate elevation for hydraulic isolation is 77 masl. Connections likely exist between the overburden and the upper bedrock zone, however, due to the greater number of fractures and degree of weathering compared to bedrock at depth.

4.3.1 Vertical Groundwater Flow Direction

Downward vertical gradients were present between all shallow and deep monitoring well pairs where the shallow well was installed in overburden and the deep well was installed in bedrock. During the high water level monitoring event completed on April 24, 2024, the downward vertical gradient ranged from 0.14 m/m at BH101-24 to 0.55 m/m at BH106-24.

4.3.2 Horizontal Groundwater Flow Direction

Measured groundwater elevations within the shallow and deep monitoring wells across the Side indicate the groundwater flow direction within both the shallow and deeper aquifer is south-southwest (Figure 3 and Figure 4, respectively). This suggests that the creek present at the Site is potentially a losing stream, with water infiltrating into the subsurface and joining a general discharge direction towards Lake Ontario.

4.4 Groundwater Quality

Groundwater quality samples were collected from both the shallow and deep monitoring wells installed at BH106-24 and BH107-24 on March 5, 2024. Samples were submitted to Bureau Veritas in Mississauga (accredited by the Canadian Association for Laboratory Accreditation Inc.) for general organic and inorganic chemistry for both wells as well as for additional detailed chemical analyses for BH106-24 including semi-volatile and volatile organics,

pesticides, herbicides, and petroleum hydrocarbons. Samples were stored at a temperature between 0 °C and 10 °C prior to and during transport.

Water quality results were compared against Provincial Water Quality Objectives (PWQO) and Brighton Sanitary Sewer Bylaw 127-2016 guidelines. Certificates of Analysis for the samples are included in Appendix F. A summary of parameters exceeding the PWQO and Sewer By-law criteria is provided in Table 5 and Table 6, respectively.

Table 5 Results Exceeding PWQO Criteria

Parameter	Units	PWQO Criteria	Well ID	
			BH106-23-D	BH107-23-S
Total Arsenic (As)	ug/L	5	3.7	**28**
Total Cadmium (Cd)	ug/L	0.2	0.093	**0.51**
Total Cobalt (Co)	ug/L	0.9	**3.6**	**34**
Total Copper (Cu)	ug/L	5	**10**	**47**
Total Iron (Fe)	ug/L	300	**12,000**	**98,000**
Total Lead (Pb)	ug/L	5	**8.9**	**67**
Total Nickel (Ni)	ug/L	25	9.4	**75**
Total Silver (Ag)	ug/L	0.1	**0.61**	**0.21**
Total Uranium (U)	ug/L	5	0.95	**7.3**
Total Vanadium (V)	ug/L	6	**14**	**100**
Total Zinc (Zn)	ug/L	30	**40**	**280**
Total Zirconium (Zr)	ug/L	4	1.8	**15**

Bolded numbers indicate exceedance with respect to applicable guideline value

Table 6 Results Exceeding Sanitary Sewer By-law Criteria

Parameter	Units	Sanitary Sewer Criteria	Storm Sewer Criteria	Well ID	
				BH106-24-D	BH106-24-S
Total Suspended Solids	mg/L	350	15	**980**	**10,000**
Total Iron	ug/L	5,000	-	**12,000**	**98,000**

Bolded numbers indicate exceedance with respect to sanitary sewer criteria
Underlined numbers indicate exceedance with respect to storm sewer criteria

Based on the results of the chemical analysis, the following comments on groundwater quality are made.

- The unfiltered samples had numerous total metal parameters measured at concentrations in excess of PWQO criteria in samples from BH106-23-D and BH107-23-S. Treatment of excavation water would be required prior to discharge to surface receiving environments.
- Total suspended solids (TSS) and total iron concentrations exceeded Brighton Sanitary Sewer Discharge guidelines (Bylaw 127-2016, Table 1) in both monitoring wells tested. Treatment of excavation water would be required prior to discharge to this sewer system.
- TSS concentrations exceeded Brighton Storm Sewer guidelines (Bylaw 127-2016, Table 2) in both monitoring wells tested. Treatment of excavation water would be required to discharge to this sewer system.
- It is Cambium's opinion that TSS and metals concentrations may be treated to meet discharge criteria via cost-effective measures such as filtration or settling tanks.
- It is recommended that a filtered water quality sample be submitted for laboratory analysis prior to dewatering to confirm filtration will be an adequate water treatment technique. This may be collected from the monitoring wells on the Site or during the commissioning of the on-site dewatering system.
- Discharge water quality should be confirmed to be suitable for the selected receiver prior to the start of dewatering activities.

4.5 Single Well Hydraulic Tests

Cambium staff visited the Site on March 7th, 2024, to perform in-situ single well hydraulic tests (SWHTs) on select monitoring wells.

Rising head tests were conducted in each paired well by inducing an instantaneous change in head (water level) in the monitoring wells. Water level changes were achieved by either introducing/removing a solid slug (BH101-S, BH106-S, BH107-D, BH107-S, and BH112-S), or by purging the well dry with Waterra tubing and foot valve and monitoring well recovery (BH101-D, BH106-D, and BH112-D).

Water level recovery was monitored using a Solinst Levelogger pressure transducer data logger, with manual measurements collected simultaneously at regular intervals.

The hydraulic conductivity of the geological formations adjacent to the screened portion of each well was estimated via the AquiferTest Pro software using the Hvorslev method (Hvorslev, 1951). A summary of results is presented in Table 7. Detailed analytical reports are provided in Appendix G.

Table 7 Hydraulic Conductivity Estimates derived via SWHTs

Monitoring Well	Screened Stratigraphy	Hydraulic Conductivity, K (m/s)			
		Test 1	Test 2	Test 3	Geometric Mean
BH101-24-S	Gravelly Silty sand (glacial till)	2.8×10^{-6}	4.6×10^{-6}	-	3.6×10^{-7}
BH101-24-D	Bedrock	5.5×10^{-7}	4.5×10^{-7}	-	5.0×10^{-7}
BH106-24-S	Silty Sand (glacial till)	1.2×10^{-6}	-	-	1.2×10^{-6}
BH106-24-D	Bedrock	8.3×10^{-7}	9.1×10^{-7}	-	8.7×10^{-7}
BH107-24-S	Gravelly Silty Sand (glacial till)	9.9×10^{-6}	1.4×10^{-5}	1.5×10^{-5}	1.3×10^{-5}
BH107-24-D	Bedrock	7.8×10^{-7}	8.0×10^{-7}	9.0×10^{-7}	8.2×10^{-7}
BH112-24-S	Silty Sand (glacial till)	8.4×10^{-6}	9.3×10^{-6}	9.1×10^{-6}	8.9×10^{-6}
BH112-24-D	Silty Sand (glacial till)	$<4.0 \times 10^{-9}$	-	-	-
				Maximum	3.6×10^{-7}
				Minimum	1.3×10^{-5}
				Geometric Mean	1.5×10^{-6}

Estimated hydraulic conductivities for the shallow wells screened within the silty sand unit ranged between 3.6×10^{-7} m/s and 1.3×10^{-5} m/s, with an average value of 1.5×10^{-6} m/s. The estimated hydraulic conductivity for the deeper bedrock unit (excluding the value obtained for BH112-24-D) ranged between 8.7×10^{-7} m/s and 5.0×10^{-7} m/s, with an average value of 7.1×10^{-7} m/s. These values are consistent with published values for the tested materials (Freeze & Cherry, 1979).

For dewatering purposes, given fractured nature of the bedrock at the Site, the overburden and upper bedrock deposits are modeled as a single aquifer unit. Deeper bedrock is considered to be hydraulically distinct at elevations lower than 77 masl.

5.0 Dewatering Assessment

The requirements for construction dewatering generally depend on the Site's soil and groundwater conditions including soil type, soil permeability or hydraulic conductivity, local groundwater levels, and the design of the proposed works, such as the foundation/basement elevation or pipe invert level, as well as the size of proposed structure/excavation. The following subsections provide the specific excavation parameters and anticipated dewatering rates for the Site. Detailed dewatering calculations are included in Appendix H

5.1 Excavation Design Parameters

It is understood that the proposed improvements for the WWTS involve a number of individual components which require construction excavation, including a sanitary pumping station (SPS), septic receiving tank, headworks building and aeration tanks, UV building and clarifying tanks, administration building, and underground service lines (Appendix A). The dimensions for each component, including footprint area and anticipated excavation elevation, are:

- SPS (6.7 m x 5.8 m (38.9 m^2), with underside base slab elevation of 76.9 masl)
- Septic receiving tank (8.6 m x 4.6 m (39.5 m^2), with underside footing elevation of 80.1 masl)
- Headworks building (19.1 m x 13.4 m (256 m^2), with a top of tunnel base slab elevation of 78.9 masl)
- Aeration tanks (two tanks, total area 41.0 m x 24.0 m (984 m^2), with an underside base slab elevation of 78.3 masl)
- UV building (17.3 m x 12.9 m (223 m^2), with an underside tunnel slab elevation of 78.3 masl)
- Clarifier tanks (three tanks, total area 41.0 m x 17.0 m (697 m^2), with an underside sludge hopper lab elevation of 75.5 masl)

- Process building (23.9 m x 11.97 m (286 m^2), with an underside base slab elevation of 78.3 masl)
- Administration building (24.2 m x 12.2 m (295 m^2), with a maximum footing elevation of 82.5 masl, and base of building at grade)
- Underground service lines (pipe invert elevation of 79.6 masl in the vicinity of the Site investigation area and 78.1 masl in the vicinity of the decant pumping station)
- Decant pumping station (15.0 m radius (707 m^2), with an underside base slab elevation of 75.5 masl)

For short-term construction purposes, it is assumed that the target dewatering level is one meter below the maximum excavation depth for each component. For long-term operational dewatering, it is assumed that the maintenance of water levels at the base of each component will be required. For all calculations within the Site investigation area, the initial water level was taken to be the highest water level measured at the Site, which is 83.3 masl, measured at BH106-24-S on April 24, 2024. A water level in the vicinity of the decant pumping station is not currently available.

5.2 Dewatering Equations

5.2.1 Square Excavation

A modified Dupuit-Forchheimer equation was used to estimate the dewatering rate required for the approximately square excavations required for the buildings and tanks to be constructed at the Site (Powers, Corwin, Schmall, & Kaeck, 2007):

$$Q = \frac{\pi K(H^2 - h^2)}{\ln(R_0/r_s)}$$

$Where$:

$Q = dewatering\ rate\ (m^3/s)$

$K = hydraulic\ conductivity\ (m/s)$

$H = initial\ hydraulic\ head\ in\ aquifer\ (m)$

$h = target\ hydraulic\ head\ (initial\ hydraulic\ head - target\ drawdown)\ (m)$

$R_0 = zone\ of\ influence\ (from\ excavation\ center) = 3000(H-h)\sqrt{K}\ (m)$

$r_s = equivalent\ single\ well\ radius$

For square excavations, the equivalent radius (r_s) can be determined as the radius of a circle with the same area as the excavation, or with the same perimeter as the excavation. Here, the equivalent area method was used such that

$$r_s = \sqrt{\frac{ab}{\pi}}$$

5.2.2 Linear Trench

A modified Dupuit-Forchheimer equation was used to estimate the dewatering rate required for the proposed linear trench excavations required for the underground service lines to be installed at the Site (Powers, Corwin, Schmall, & Kaeck, 2007):

$$Q = \frac{\pi K(H^2 - h^2)}{\ln(R_0/r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

$Where$:

$Q = dewatering\ rate\ (m^3/s)$

$K = hydraulic\ conductivity\ (m/s)$

$H = initial\ hydraulic\ head\ in\ aquifer\ (m)$

$h = target\ hydraulic\ head\ (initial\ hydraulic\ head - target\ drawdown)\ (m)$

$R_0 = zone\ of\ influence\ (from\ excavation\ center) = 3000(H-h)\sqrt{K}\ (m)$

$r_s = equivalent\ single\ well\ radius = width\ of\ trench/2\ (m)$

$x = unit\ length\ of\ trench\ (m)$

$L = distance\ to\ line\ source\ = R_0/2(m)$

The radius of influence for each 50 m excavation was estimated from the measured hydraulic conductivity using the method of Sichardt (Kyrieleis & Sichardt, 1930). In conditions of low hydraulic conductivity, where R_0 is calculated to be less than r_s , the denominator of the first right hand term of the above equation is amended to be $\ln((R_0 + r_s)/r_s)$.

It is noted that the above equation is designed to represent steady state pumping conditions. In general, at the beginning of the pumping, the pumping rate required to lower Site water levels to acceptable levels may be greater than the rate estimated for steady state conditions as water stored in the unconfined aquifers is drained. Additionally, the calculations do not account for any precipitation that may occur during the construction process.

5.3 Estimated Dewatering Rates

5.3.1 Sanitary Pumping Station

Construction Dewatering

For the short-term construction phase of the project, the overall area of excavation is taken to be 20% greater than the footprint of the building, which is equivalent to an area of 8.0 m x 7.0 m. Given an initial water level of 83.3 masl and a target water level of 75.9 masl (1 m below the pumping station base), the target drawdown is 7.4 m. As the base of the SPS (76.9 masl) is located at the same elevation as competent bedrock in the vicinity of the excavation area (approximately 77 masl) same elevation of competent bedrock in BH106-24 and BH107-24, the vicinity of (77 masl), it is interpreted that dewatering will occur solely in the upper shallow groundwater aquifer.

For this scenario, the estimated construction dewatering rate ranges from 6 m^3/day (6,000 L/day, or 0.07 L/s) to 98 m^3/day (98,000 L/day, or 1.14 L/s), with an average rate of 17 m^3/day (17,000 L/day, or 0.20 L/s). The estimated radius for the zone of influence from pumping ranges from 18 m to 79 m, with an average value of 27 m (Table 8).

Table 8 Estimated Construction Dewatering Rates – SPS

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	18	6	0.07
Maximum	1.3×10^{-5}	79	98	1.14
Geom. Mean	1.5×10^{-6}	27	17	0.20

Employing a safety factor of 2, the estimated short-term construction dewatering rate for the SPS ranges from 12 m^3/day (12,000 L/day, or 0.14 L/s) to 196 m^3/day (196,000 L/day, or 2.28 L/s), with an average rate of 34 m^3/day (34,000 L/day, or 0.40 L/s).

Operational Dewatering

For the long-term operational phase of the project, the dewatering area is taken to be equivalent to the footprint of the building (6.7 m x 5.8 m). Given an initial water level of 83.3 masl and a target water level of 76.9 masl (pumping station base), the target drawdown is 5.8 m.

For this scenario, the estimated operational dewatering rate ranges from 4 m^3/day (4,000 L/day, or 0.05 L/s) to 77 m^3/day (77,000 L/day, or 0.89 L/s), with an average rate of 13 m^3/day (13,000 L/day, or 0.13 L/s). The estimated radius for the zone of influence due to pumping from the center of the excavation ranges from 15 m to 72 m, with an average value of 27 m (Table 9).

Table 9 Estimated Operational Dewatering Rates – SPS

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	15	4	0.05
Maximum	1.3×10^{-5}	72	77	0.89
Geom. Mean	1.5×10^{-6}	27	13	0.13

Employing a safety factor of 2, the estimated long-term operational dewatering rate for the SPS ranges from 8 m^3/day (8,000 L/day, or 0.10 L/s) to 154 m^3/day (154,000 L/day, or 1.78 L/s), with an average rate of 26 m^3/day (26,000 L/day, or 0.26 L/s).

5.3.2 Septic Receiving Tank

Construction Dewatering

For the short-term construction phase of the project, the overall area of excavation is taken to be 20% greater than the footprint of the tank, which is equivalent to an area of 10.3 m x 5.5 m.

Given an initial water level of 83.3 masl and a target water level of 79.1 masl (1 m below the underside of the footing), the target drawdown is 4.2 m. As the elevation of competent bedrock in the vicinity of the receiving tank area is approximately 77 masl, it is interpreted that dewatering will occur solely in the upper shallow groundwater aquifer.

For this scenario, the estimated construction dewatering rate ranges from 3 m^3/day (3,000 L/day, or 0.04 L/s) to 49 m^3/day (49,000 L/day, or 0.57 L/s), with an average rate of 9 m^3/day (9,000 L/day, or 0.11 L/s). The estimated radius for the zone of influence due to pumping from the center of the excavation ranges from 12 m to 49 m, with an average value of 20 m (Table 10).

Table 10 Estimated Construction Dewatering Rates – Septic Receiving Tank

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	12	3	0.04
Maximum	1.3×10^{-5}	49	49	0.57
Geom. Mean	1.5×10^{-6}	20	9	0.11

Employing a safety factor of 2, the estimated short-term construction dewatering rate for the SPS ranges from 6 m^3/day (6,000 L/day, or 0.08 L/s) to 98 m^3/day (98,000 L/day, or 1.14 L/s), with an average rate of 18 m^3/day (18,000 L/day, or 0.22 L/s).

Operational Dewatering

For the long-term operational phase of the project, the dewatering area is taken to be equivalent to the footprint of the tank (8.6 m x 4.6 m). Given an initial water level of 83.3 masl and a target water level of 80.1 masl (underside of the footing), the target drawdown is 2.9 m.

For this scenario, the estimated operational dewatering rate ranges from 2 m^3/day (2,000 L/day, or 0.03 L/s) to 31 m^3/day (31,000 L/day, or 0.35 L/s), with an average rate of 6 m^3/day (6,000 L/day, or 0.07 L/s). The estimated radius for the zone of influence due to pumping from the center of the excavation ranges from 9 m to 35 m, with an average value of 14 m (Table 11).

Table 11 Estimated Operational Dewatering Rates – Septic Receiving Tank

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	9	2	0.03
Maximum	1.3×10^{-5}	35	34	0.39
Geom. Mean	1.5×10^{-6}	14	6	0.07

Employing a safety factor of 2, the estimated long-term operational dewatering rate for the septic receiving tank ranges from 4 m^3/day (4,000 L/day, or 0.06 L/s) to 68 m^3/day (68,000 L/day, or 0.78 L/s), with an average rate of 12 m^3/day (12,000 L/day, or 0.14 L/s).

5.3.3 Main Processing Area

The main processing area is defined as the portion of the Site which includes the headworks building and aeration tanks, the UV building and clarifier tanks, and the process building. All together, the footprint of these components is approximately 3,350 m^2, which is modeled with dimensions of 67 m x 50 m. The elevation for the base of the majority of components in this area is 78.3 masl, with the exception of the clarifier tanks, which have an underside sludge hopper slab elevation of 75.5 masl.

Construction Dewatering – Main Processing Area

For the short-term construction phase of the project, the overall area of excavation is taken to be 20% greater than the footprint of the main processing area, which is equivalent to an area of 80.4 m x 60.0 m. Given an initial water level of 83.3 masl and a target water level of 77.3 masl (1 m below the underside of the majority of building bases), the target drawdown is 6.0 m. As the elevation of competent bedrock in the vicinity of the receiving tank excavation area is approximately 77 masl, it is interpreted that dewatering will occur solely in the upper shallow groundwater aquifer (overburden and weathered bedrock).

For this scenario, the estimated construction dewatering rate ranges from 24 m^3/day (24,000 L/day, or 0.28 L/s) to 215 m^3/day (215,000 L/day, or 2.48 L/s), with an average rate of 55 m^3/day (55,000 L/day, or 0.64 L/s). The estimated radius for the zone of influence due to

pumping from the center of the excavation ranges from 50 m to 104 m, with an average value of 61 m (Table 12).

Table 12 Estimated Construction Dewatering Rates – Main Processing Area

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	50	24	0.28
Maximum	1.3×10^{-5}	104	215	2.48
Geom. Mean	1.5×10^{-6}	61	55	0.64

Employing a safety factor of 2, the estimated short-term construction dewatering rate for the main processing area ranges from 48 m^3/day (48,000 L/day, or 0.56 L/s) to 430 m^3/day (430,000 L/day, or 4.96 L/s), with an average rate of 110 m^3/day (110,000 L/day, or 1.28 L/s).

Construction Dewatering – Additional Depth of Clarifier Tanks

Additional dewatering will be required for placement of the clarifier tanks. Employing a starting water level elevation of 77.3 masl (the target water level for the overall excavation area) and a target water level of 74.5 masl (1 m below the sludge hopper slab elevation), the additional target drawdown is 2.8 m. As the elevation of competent bedrock in the vicinity of the clarifying tank area is approximately 77 masl, it is interpreted that dewatering for this component of construction will occur within the deeper bedrock aquifer.

The estimated additional dewatering rate required during clarifier tank construction ranges from 8 m^3/day (8,000 L/day, or 0.10 L/s) to 12 m^3/day (12,000 L/day, or 0.13 L/s), with an average rate of 10 m^3/day (10,000 L/day, or 0.12 L/s). The estimated radius for the zone of influence due to pumping from the center of the excavation ranges from 23 m to 24 m, with an average value of 20 m (Table 13).

Table 13 Estimated Construction Dewatering Rates – Additional Depth of Clarifier Tanks

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	5.0×10^{-7}	23	8	0.10
Maximum	8.7×10^{-7}	24	12	0.13
Geom. Mean	7.1×10^{-7}	24	10	0.12

Employing a safety factor of 2, the estimated short-term construction dewatering rate for the additional excavation depth required for the clarifier tanks ranges from 16 m^3/day (16,000 L/day, or 0.20 L/s) to 24 m^3/day (24,000 L/day, or 0.26 L/s), with an average rate of 20 m^3/day (20,000 L/day, or 0.24 L/s).

In a scenario where excavation for the clarifier tanks is occurring at the same time as excavation of the overall main processing area, the dewatering rates will be cumulative (main processing area + clarifier dewatering rates). This would result in an estimated combined dewatering rate ranging from 64 m^3/day (64,000 L/day, or 0.76 L/s) to 454 m^3/day (454,000 L/day, or 5.32 L/s), with an average rate of 130 m^3/day (130,000 L/day, or 1.52 L/s).

Operational Dewatering

For the long-term operational phase of the project, the dewatering area is taken to be equivalent to the footprint of the components (approximately 67 m x 50 m). Given an initial water level of 83.3 masl and a target water level equivalent to the base of the majority of the components (78.3 masl), the target drawdown is 5.0 m. It is noted that these assumptions require the additional depth of clarifier tanks to be waterproofed (dewatering the entire footprint area an additional 2.8 m to reach the depth of the clarifier slab was not calculated).

For this scenario, the estimated operational dewatering rate ranges from 18 m^3/day (18,000 L/day, or 0.21 L/s) to 161 m^3/day (161,000 L/day, or 1.86 L/s), with an average rate of 41 m^3/day (41,000 L/day, or 0.48 L/s). The estimated radius for the zone of influence due to

pumping from the center of the excavation (R_0) ranges from 42 m to 86 m, with an average value of 51 m (Table 14).

Table 14 Estimated Operational Dewatering Rates – Main Processing Area

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	42	18	0.21
Maximum	1.3×10^{-5}	86	161	1.86
Geom. Mean	1.5×10^{-6}	51	41	0.48

Employing a safety factor of 2, the estimated long-term operational dewatering rate for the septic receiving tank ranges from 36 m^3/day (36,000 L/day, or 0.42 L/s) to 322 m^3/day (322,000 L/day, or 3.72 L/s), with an average rate of 82 m^3/day (82,000 L/day, or 0.96 L/s).

5.3.4 Administration Building

Construction Dewatering

For the short-term construction phase of the project, the overall area of excavation is taken to be 20% greater than the footprint of the building, which is equivalent to an area of 29.0 m x 14.6 m. Given an initial water level of 83.3 masl and a target water level of 81.5 masl (1 m below the base of footings), the target drawdown is 1.8 m. As the elevation of competent bedrock in the vicinity of the administrative building area is approximately 77 masl, it is interpreted that dewatering for this component of construction will occur solely in the upper shallow groundwater aquifer.

For this scenario, the estimated construction dewatering rate ranges from 4 m^3/day (4,000 L/day, or 0.05 L/s) to 37 m^3/day (37,000 L/day, or 0.43 L/s), with an average rate of 9 m^3/day (9,000 L/day, or 0.11 L/s). The estimated radius for the zone of influence from pumping ranges from 15 m to 31 m, with an average value of 18 m (Table 15).

Table 15 Estimated Construction Dewatering Rates – Administration Building

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	15	4	0.05
Maximum	1.3×10^{-5}	31	37	0.43
Geom. Mean	1.5×10^{-6}	18	9	0.11

Employing a safety factor of 2, the estimated short-term construction dewatering rate for the administration building ranges from 8 m^3/day (8,000 L/day, or 0.10 L/s) to 74 m^3/day (74,000 L/day, or 0.86 L/s), with an average rate of 18 m^3/day (18,000 L/day, or 0.22 L/s).

Operational Dewatering

As the base of the administration building will be constructed at grade, long-term operational dewatering for this component will not be required. This is based on an assumption that the annual high-water level at the site, approximately 2 mbgs, is equivalent to the maximum footing depth plus a safety margin of 0.5 m.

5.3.5 Underground Service Lines

Construction Dewatering

For the short-term construction phase of the project, the overall area of excavation is taken to be 2 m wide, with construction occurring in 50 m segments. Based on depths to bedrock identified by boreholes across the site, it is interpreted that dewatering for this component of construction will occur solely in the upper shallow groundwater aquifer (Section 4.3).

Main Processing Area

Within the vicinity of the main processing, pipe invert elevations for service lines are approximately 79.6 masl. Given an initial water level of 83.3 masl and a target water level of 78.6 masl (1 m below pipe invert), the target drawdown is 4.7 m. The estimated construction dewatering rate for this scenario for each 50 m segment ranges from 14 m^3/day (14,000 L/day, or 0.16 L/s) to 37 m^3/day (122,000 L/day, or 1.42 L/s), with an average rate of 33 m^3/day

(33,000 L/day, or 0.39 L/s). The estimated radius for the zone of influence from pumping ranges from 9 m to 51 m, with an average value of 18 m (Table 16).

Table 16 Estimated Construction Dewatering Rates – Underground Service Lines

	Hydraulic Conductivity (K)	Zone of Influence (R_0)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	3.6×10^{-7}	9	14	0.16
Maximum	1.3×10^{-5}	51	122	1.42
Geom. Mean	1.5×10^{-6}	18	33	0.39

Employing a safety factor of 2, the estimated short-term construction dewatering for each 50 m segment of excavation for service lines ranges from 28 m^3/day (28,000 L/day, or 0.32 L/s) to 244 m^3/day (244,000 L/day, or 2.84 L/s), with an average rate of 66 m^3/day (66,000 L/day, or 0.78 L/s).

Decant Pumping Station

Within the vicinity of the decant pumping station, pipe invert elevations for service lines are approximately 78.1 masl. As this portion of the Site is outside the investigation area, there is currently insufficient information about subsurface conditions to enable dewatering calculations for this component of the development.

Operational Dewatering

It is understood that the underground service lines will be waterproofed such that no long-term operational dewatering for this component will be required.

5.3.6 Decant Pumping Station

For the short-term construction phase of the project, the overall area of excavation is taken to be 20% greater than the footprint of the decant pumping station, which is equivalent to a radius of 18 m, or 1,018 m^2. Given an underside base slab elevation of 75.5 masl, the target water level for construction dewatering is 74.5 masl (1 m below the base slab).

For the long-term operational phase of the project, the dewatering area is taken to be equivalent to the pumping station footprint, which is equivalent to a radius of 15 m, or 707 m^2. The target water level for operational dewatering is 75.5 masl.

As the decant pumping station is located within the eastern portion of the development, which is outside the scope of the current investigation area, there is currently insufficient information about subsurface conditions to enable dewatering calculations for this component of the development.

5.4 Required Regulatory Permits or Registrations

Any construction dewatering or other water taking in Ontario is governed by the Ontario Water Resources Act (Ontario Regulation 387/04 and/or Ontario Regulation 63/16) and/or the Environmental Protection Act (Registrations under Part II.2).

A Permit to Take Water (PTTW) must be obtained for water takings in excess of 50,000 L/day, except for certain specified activities for which only registration through the Environmental Activity and Sector Registry (EASR) is required. must be obtained. One such activity is temporary construction dewatering greater than 50,000 L/day but less than 400,000 L/day.

For short-term dewatering, it is assumed that construction at the Site will occur in stages, with excavation for only one component of the development occurring at a time. Given this scenario, based on the dewatering rates summarized in Table 17, EASR registration may be required during excavation for construction of the main processing area and installation of service lines. For long-term dewatering, based on an average estimated combined dewatering rate of 120 m^3/day (120,000 L/day, or 1.36 L/s), a PTTW will be required for permanent operations at the Site.

Regardless of the potentially lower dewatering rates estimated for construction, it is recommended that a PTTW application be submitted for both the construction and permanent operation phases. EASR registration may be preferable if construction plans commence quickly, however the most cost-effective approach would be to combine the two phases into one application.

Table 17 Dewatering Rates (including safety factor) and Mean Zone of Influence

Development Component	Construction (L/day)			Long-term (L/day)			Mean Zone of Influence (m*)
	Min	Max	Mean	Min	Max	Mean	
SPS	12,000	196,000	34,000	8,000	154,000	26,000	27
Septic Receiving Tank	6,000	98,000	18,000	4,000	68,000	12,000	20
Main Processing Area	48,000	430,000	110,000	36,000	322,000	82,000	61
Additional depth for Clarifier	16,000	24,000	20,000	n/a (assumes clarifier is waterproofed)			-
Admin Building	8,000	74,000	18,000	-	-	-	18
Underground Service Lines (primary area)	28,000	244,000	66,000	-	-	-	18

**meters from the centre of the excavation.*

5.5 Zone of Influence

The dewatering calculations include estimates of the horizontal distance from the center of each excavation to the point where the influence of water withdrawal will be negligible (i.e., the distance to zero drawdown (Kyrieleis & Sichardt, 1930). The area included within the distance to zero drawdown from the excavation is the zone of influence. As summarized in Table 17, the mean estimated zone of influence radii range from the center of each excavation area is 18 m to 61 m.

In the context of the creek that is present at the Site, the most significant excavation will be for the main processing area and clarifier. As the creek is anticipated to be located at a distance of approximately equal to or greater than 50 m from the outer edge of the processing area, it is expected that the zone of influence induced from dewatering may approach but not intercept the creek. It is additionally noted that groundwater at the Site is inferred to flow south-southwest with the creek potentially a losing stream (Section 4.3.2). This scenario results in the excavations at the Site being downgradient of the creek, which additionally minimizes the risk of impact from dewatering on water flow within the creek.

In the context of the wetland area located south of the Site, the outer edge of the processing area is located approximately 600 m downgradient and 300 m cross -gradient from the wetland boundaries, which is greater than the mean estimated zone of influence. As such, no direct impact to wetland ecology is anticipated due to dewatering at the Site.

6.0 Conclusions and Recommendations

Cambium was retained by the Client to complete a hydrogeological assessment for proposed improvements of the Wastewater Treatment System in Brighton, Ontario. The purpose of the assessment was to provide information on the general subsurface and groundwater conditions at the Site, characterize groundwater quality, and provide estimates for dewatering volumes for both the construction phase and long-term operations at the Site.

Hydrogeological Conditions

- At a broad scale, the lithology at the Site is comprised of a downward sequence of topsoil, fill material, glacial till, and limestone bedrock.
- Nested monitoring wells (one deep, one shallow) were installed at four locations across the Site. Groundwater levels measured monthly from March to June, 2024, identified the lowest water level was 80.4 masl (5.38 mbgs) at BH10107-D on June 21, 2024, and the highest water level was 83.3 masl (2.0 mbgs), measured at BH106-24-S on April 24, 2024.
- Downward vertical gradients ranged from 0.14 m/m at BH101-24 to 0.55 m/m at BH106-24 during the high water level monitoring event completed on April 24, 2024.
- Measured groundwater elevations indicate the groundwater flow direction within both the shallow and deeper aquifer is south-southwest, which suggests that the creek present at the Site is potentially a losing stream, with water infiltrating into the subsurface and joining a general discharge direction towards Lake Ontario.

Groundwater Quality

- PWQO criteria: Numerous total metal parameters were measured at concentrations in excess of PWQO criteria for both the shallow and deep monitoring wells. It is Cambium's opinion that treatment via filtration or settling tanks may be sufficient to reduce metal concentrations to within acceptable thresholds, however confirmational water quality testing would be required prior to discharge.

- Brighton Sanitary Sewer criteria: Total suspended solids (TSS) and total iron exceeded guidelines in both the shallow and deep monitoring wells and total xylenes exceeded guidelines in the deep monitoring well. it is Cambium's opinion that treatment via filtration or settling tanks may be sufficient to reduce TSS and metals concentrations to within acceptable thresholds, but additional testing is recommended to confirm whether total xylene would be similarly reduced with this treatment technique.
- Brighton Storm Sewer criteria: No measured parameters exceeded guidelines in either monitoring well tested. No treatment of excavation water would be required to discharge to this sewer system.
- Cambium recommends that discharge water quality should be confirmed to be suitable for the selected receiver prior to the start of dewatering activities.

Estimated Dewatering Rates

- Sanitary pumping station: 34,000 L/day (construction); 26,000 L/day (long-term)
- Septic receiving tank: 18,000 L/day (construction); 12,000 L/day (long-term)
- Main processing area: 110,000 L/day (construction); 82,000 L/day (long-term)
- Additional depth for clarifier: 20,000 L/day (construction); no long-term dewatering required if clarifier is waterproofed.
- Administration building: 18,000 L/day (construction); no long-term dewatering required (slab on grade construction).
- Underground service lines (per 50 m): 66,000 L/day (construction); no long-term dewatering required (service lines insensitive to groundwater levels).
- For short-term dewatering, it is assumed that construction at the Site will occur in stages, with excavation for one component of the development occurring at a time. Given this scenario, an EASR registration will potentially only be required during excavation for construction of the main processing area/clarifier and installation of underground service lines (estimated dewatering rates 130,000 L/day and 66 L/day, respectively).

- For long-term dewatering, based on an average estimated combined dewatering rate of 120 m^3/day (120,000 L/day, or 1.36 L/s), a PTTW will be required for permanent operations at the Site.
- It is recommended that a PTTW application be submitted for both the construction and permanent operation phases at the Site. EASR registration may be preferable if construction plans commence quickly, however the most cost-effective approach would be to combine the two phases into one application.

Zone of Influence

- The mean estimated zone of influences from the center of each excavation area are estimated to range from 18 m to 66 m.
- In the context of the creek that is present at the Site, the creek is anticipated to be located at a distance greater than 50 m from the outer edge of the most significant excavation area, and as such, it is anticipated that dewatering activities may approach but not impact the creek. It is noted that the excavations are downgradient of the creek, which additionally minimizes the risk of impact on the water body.
- In the context of the wetland area located south of the Site, the outer edge of the most significant excavation area is located approximately 600 m downgradient and 300 m cross-gradient from the wetland boundaries. Due to this distance, no direct impact to wetland ecology is anticipated due to dewatering at the Site.

7.0 Closing

We trust that the information in this submission meets your current requirements. If you have any questions regarding the contents of this report, please contact the undersigned.

Respectfully submitted,

Cambium Inc.

Maren Catt
Technician – Junior Hydrogeologist

Natasha Augustine, M.Sc.
Coordinator – Environmental Scientist

Kyle Horner, Ph.D., P.Geo.
Senior Project Manager – Senior Hydrogeologist

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9.0 Standard Limitations

Limited Warranty

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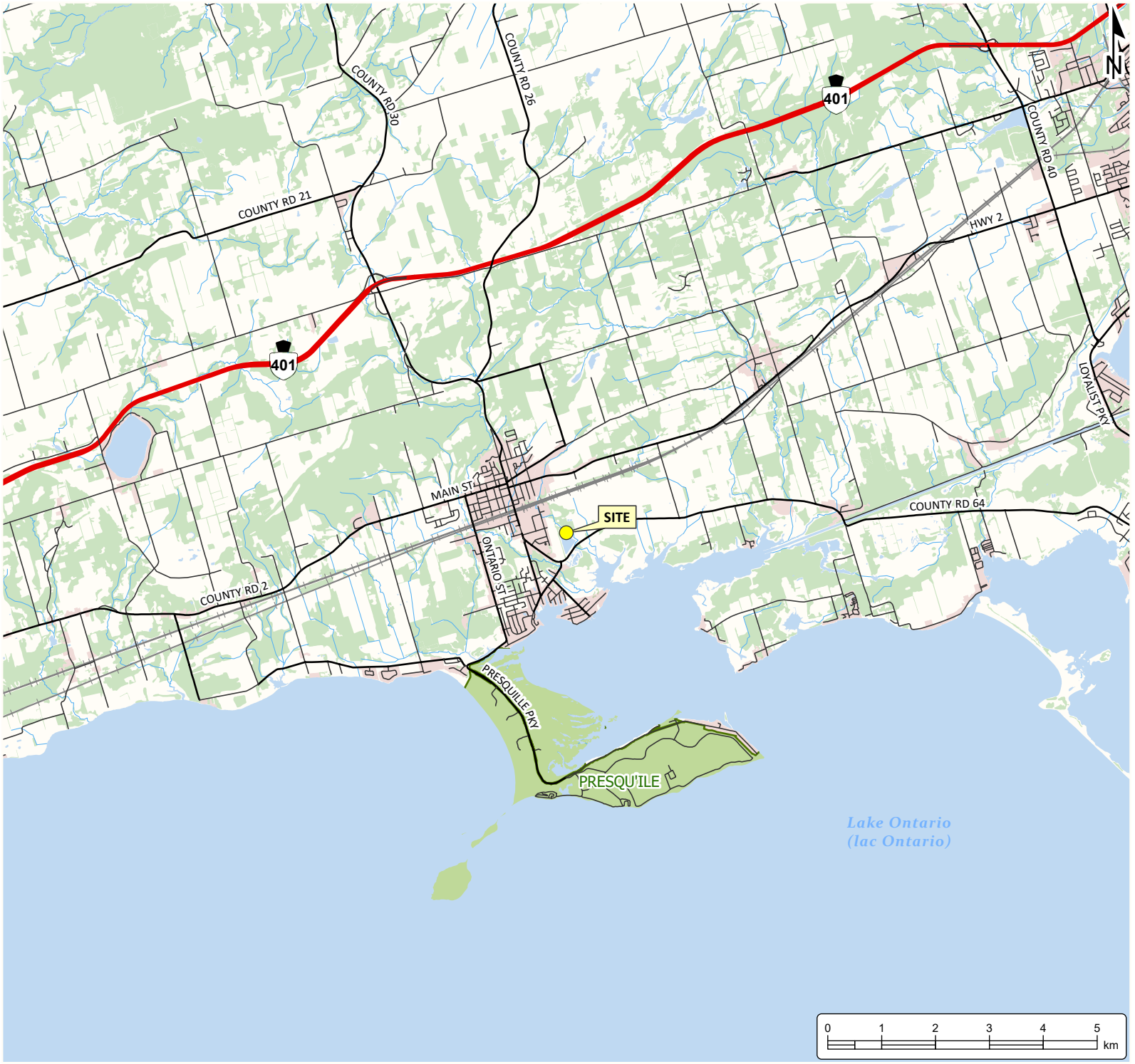
Appended Figures

HYDROGEOLOGICAL ASSESSMENT

J L RICHARDS & ASSOCIATES LTD.
100 Concession Road 64
Brighton, Ontario



LEGEND

- Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Water Area
- First Nations Reserve
- Provincial Park
- Wooded Area
- Built Up Area

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Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

SITE LOCATION PLAN

Project No.: 19712-001		Date: August 2024 Rev.:	
Scale: 1:100,000		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: KH	Figure:	1

O:\GIS\MXDs\19700-19799\19712-001 J L Richards & Associates Ltd - MPP - Brighton WWTS Upgrades\2024-08-29 Hydro G.aprx

HYDROGEOLOGICAL ASSESSMENT

J L RICHARDS & ASSOCIATES LTD.
100 Concession Road 64
Brighton, Ontario

LEGEND

- Benchmark
- Borehole
- Monitoring Well
- Watercourse
- Site (approximate)

Notes:
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- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
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BOREHOLE LOCATION PLAN

Project No.: 19712-001		Date: August 2024	Rev.:
Scale: 1:1,500		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: KH	Figure: 2	

O:\GIS\MXDs\19700-19799\19712-001 J L Richards & Associates Ltd - MPP - Brighton WWTS Upgrades\2024-08-29 Hydro G.aprx

HYDROGEOLOGICAL ASSESSMENT

J L RICHARDS & ASSOCIATES LTD.
100 Concession Road 64
Brighton, Ontario

LEGEND

- (82.5) Shallow Groundwater Elevation April 24, 2024
- Monitoring Well
- Watercourse
- Site (approximate)
- Shallow Groundwater Contours April 24, 2024
- Shallow Groundwater Flow Direction April 24, 2024

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SHALLOW GROUNDWATER CONTOURS

Project No.: 19712-001		Date: August 2024 Rev.:	
Scale: 1:1,500		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: KH	Figure:	3

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HYDROGEOLOGICAL ASSESSMENT

J L RICHARDS & ASSOCIATES LTD.
100 Concession Road 64
Brighton, Ontario

LEGEND

- (82.5) Deep Groundwater Elevation April 24, 2024
- Monitoring Well
- Watercourse
- Deep Groundwater Contours April 24, 2024
- Site (approximate)
- Deep Groundwater Flow Direction April 24, 2024

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DEEP GROUNDWATER CONTOURS

Project No.: 19712-001		Date: August 2024 Rev.:	
Scale: 1:1,500		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: KH	Figure:	4

O:\GIS\MXDs\19700-19799\19712-001 J L Richards & Associates Ltd - MPP - Brighton WWTS Upgrades\2024-08-29 Hydro G.aprx

Appendix A

Site Plan Drawings

REFER TO DRAWING C002 AND C004

OUTDOOR ODOUR CONTROL

NEW GRANULAR DRIVEWAY

CONCRETE PAD FOR SEPTAGE RECEIVING

NEW 1200mm Ø CB01
W INV. 82.58
S INV. 82.60

4.3m 100mm Ø PVC DR 35 SAN @ 1.0%

4.7m 100mm Ø PVC DR 35 SAN @ 1.0%

SEPTAGE PRE-TREATMENT BUILDING

NEW 1200mm Ø MH19
E INV. 81.54
S INV. 81.52

3.3m 100mm Ø PVC DR 35 SAN @ 1.0%

BELOW GRADE SEPTAGE RECEIVING TANK

LOADING AREA

HEADWORKS BUILDING

HEADWORKS COURTYARD

8.2m 75mm Ø PVC DR 35 SAN @ 2.0%

NEW 1200mmØ MH 15
E INV. 82.54
S INV. 82.52

75mm Ø EW FM

50mm Ø EW FM

75mm Ø EW FM

450mm Ø SAN

INV. 81.29

UV DISINFECTION BUILDING

FUTURE AERATION TANK #3

AERATION TANK #2

AERATION TANK #1

TUNNEL BELOW

CLARIFIER TANK #1

CLARIFIER TANK #2

CLARIFIER TANK #3

FUTURE CLARIFIER TANK #4

OUTDOOR FERRIC TANK

PROCESS BUILDING

64.2m 300mm Ø PVC DR 26 SAN FM

INV. 78.73

INV. 80.23

AERATED SOLIDS STABILIZATION CELL (FMR AERATED LAGOON)
BASE INV. 77.420

INV. 78.73

23.2 100mm Ø PVC DR 35 SAN @ 8.0%

7.2m 100mm Ø PVC DR 35 SAN @ 8.0%

NEW 1200mm Ø MH18
W INV. 81.82
E INV. 81.80

450mm Ø TEMPORARY SAN BYPASS @0.1%

100mm Ø SAN FM PVC DR 26

REFER TO DRAWING C004 FOR CONTINUATION

RW SPS
SW INV. 80.500
OF INV. 80.800

400mm Ø SAN FM PVC SDR 26

400mm Ø SAN FM PVC SDR 26

59m 50mm Ø WM PEX SDR 9 @690PSI

NEW 2400mm X 1800mm MH 02
N INV. 80.530
E INV. 80.530
W INV. 80.730
S INV. 81.58

5.5m 1050mm Ø PVC DR 35 SAN @ 0.5%

1.7m 1050mm Ø PVC DR 35 SAN @ 0.5%

EX. 1200mm Ø MH 131
SW INV. 80.790m
E INV. 80.740m

NEW 1500mmØ MH 04
NW INV. 79.33
SW INV. 79.30

12.5m 600mm Ø PVC DR35 SANITARY OVERFLOW @ 0.4%

2.6m 600mm Ø PVC DR 35 SAN @ 0.6%

16.7m 900mm Ø PVC DR35 TEMPORARY SANITARY BYPASS @0.1%

40.2m 100mm Ø PVC DR 35 SAN @ 1.3%

20.1m 450mm Ø PVC DR 35 SAN @ 1.3%

NEW 1200mmØ MH01
E INV. 81.23
S INV. 81.17

NEW 1200mmØ MH07
N INV. 80.91
E INV. 80.87

GENSET

150mm BOLLARDS

NEW 1200mmØ MH08
E INV. 79.75
W INV. 79.97

69.14m 450mm Ø PVC DR 35 SAN @ 1.3%

88.6m 450mm Ø PVC DR 35 SAN @ 0.4%

90m 450mm

NEW 2400mm X 1800mm MH 03
W INV. 79.47
E INV. 79.26
N INV. 79.29

10.1m 100mm Ø PVC DR 35 SAN @ 1.0%

NEW 1200mm Ø MH 17
E INV. 81.70
N INV. 81.68
S INV. 82.21

21.0m 100mm Ø PVC DR 35 SAN @ 1.3%

NEW 1200mmØ MH16.
INV (N) = 82.00
INV (E) = 81.98

NEW 1200mmØ MH05 AS PER OPSD 701.010
WITH TYPE A FRAME AND
COVER AS PER OPSD 401.010
S INV. = 78.75
W INV. = 78.82
N INV. = 78.75

SAN 900mmØ HDPE PR 4710 DR 32.5 @0.5%

INV. 78.72

CONCRETE PIPE

ADMIN BUILDING

GRAVEL PARKING LOT

GRAVEL PARKING LOT EXTENSION

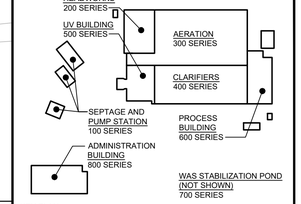
PORT

HATCH

VENT

54,000 L BURIED FIRE WATER RESERVOIR
54,000 L UNDERGROUND COMPOSITE FIRE WATER STORAGE TANK C/W STRAPS TO DEADMAN ANCHORS (APPROXIMATE SIZE 3.8 x 13.3 m)
EXAMPLE GRANBY MODEL
NN08260518FP

EQUALIZATION LAGOON (FMR FACULTATIVE LAGOON)
BERM ELEV. 80.500
H.W.L. 79.400
OUTLET. INV. 77.720



KEY PLAN
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B	ISSUED FOR 30% CLIENT REVIEW	07/06/24
A	ISSUED FOR 15% CLIENT REVIEW	20/03/24

VERIFY SHEET SIZE AND SCALES. THE BAR TO THE RIGHT IS 25MM IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE:

CLIENT:
MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca
J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:
BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:
CIVIL
SITE-WIDE
SERVICING PLAN - PLANT & ADMIN AREA

DESIGN:	RC
DRAWN:	DT
CHECKED:	SS
JLR #:	32296-001

DRAWING #: C002

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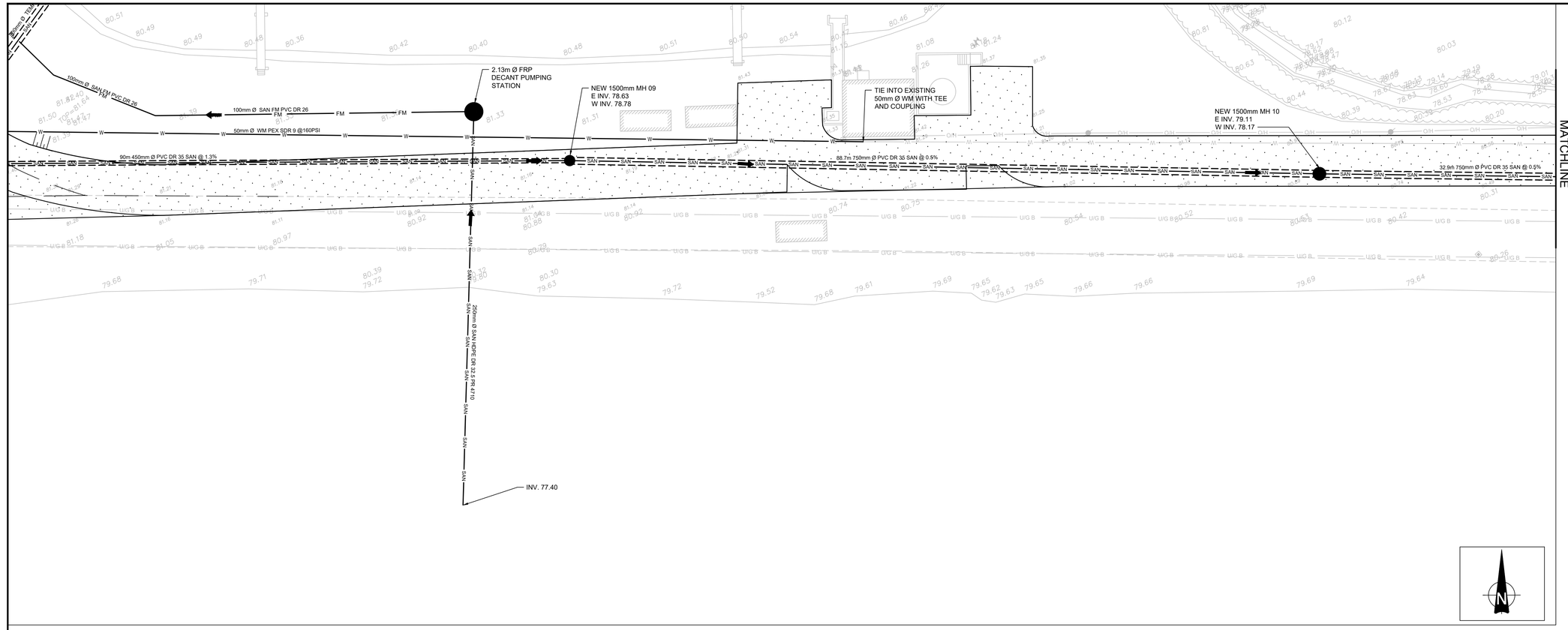
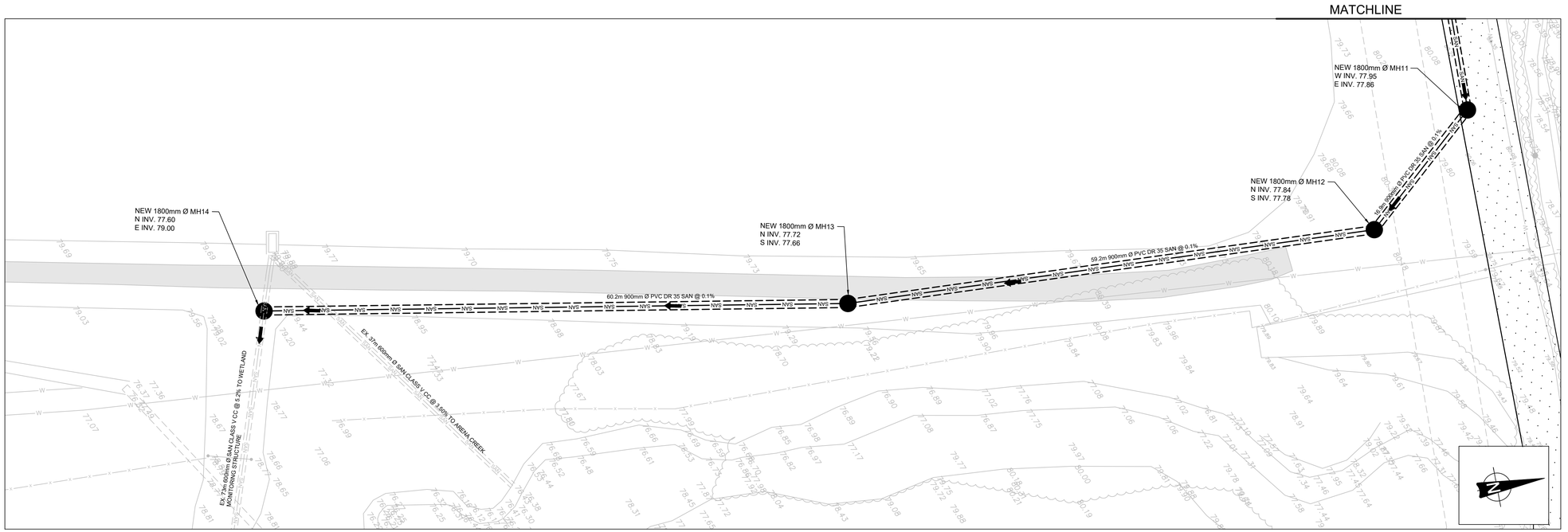
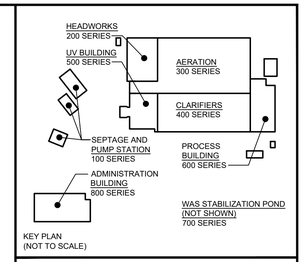

2.13m Ø FRP
DECANT PUMPING
STATION
NEW 1500mm MH 09
E INV. 78.63
W INV. 78.78
TIE INTO EXISTING
50mm Ø WM WITH TEE
AND COUPLING
NEW 1500mm MH 10
E INV. 79.11
W INV. 78.17
100mm Ø SAN FM PVC DR 26
100mm Ø SAN FM PVC DR 26
50mm Ø WM PEX SDR 9 @160PSI
90m 450mm Ø PVC DR 35 SAN @ 1.3%
88.7m 750mm Ø PVC DR 35 SAN @ 0.5%
32.9m 750mm Ø PVC DR 35 SAN @ 0.5%
250mm Ø SAN HDPE DR 32.5 PR 4710
INV. 77.40
MATCHLINE
MATCHLINE


NEW 1800mm Ø MH14
N INV. 77.60
E INV. 79.00
NEW 1800mm Ø MH13
N INV. 77.72
S INV. 77.66
NEW 1800mm Ø MH12
N INV. 77.84
S INV. 77.78
NEW 1800mm Ø MH11
W INV. 77.95
E INV. 77.86
60.2m 900mm Ø PVC DR 35 SAN @ 0.1%
59.2m 900mm Ø PVC DR 35 SAN @ 0.1%
15.8m 900mm Ø PVC DR 35 SAN @ 0.1%
Ex. 37m 600mm Ø SAN CLASS V CC @ 3.58% TO ARENA CREEK
Ex. 7m 600mm Ø SAN CLASS V CC @ 5.2% TO WETLAND
MONITORING STRUCTURE

BENCHMARK 1: SURVEY SPIKE
ELEV = 79.61 (NORTH SIDE OF DRIVEWAY ENTRANCE)

BENCHMARK 1: SURVEY SPIKE
ELEV = 79.12 (NORTH SIDE OF DRIVEWAY ENTRANCE)



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SCALE: 1:250

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CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS • ARCHITECTS • PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

CIVIL
SITE-WIDE
OUTFALL PIPING PLAN & OUTFALL STRUCTURE

DESIGN:	RC
DRAWN:	DT
CHECKED:	SS
JLR #:	32296-001

DRAWING #: C003

PLOT DATE: Monday, January 27, 2025 5:51:45 PM

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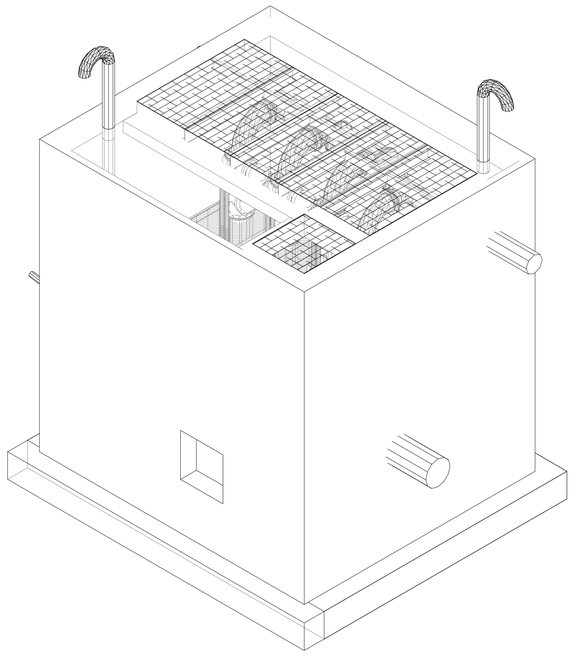


11
S110

ISOMETRIC VIEW

NOT TO SCALE

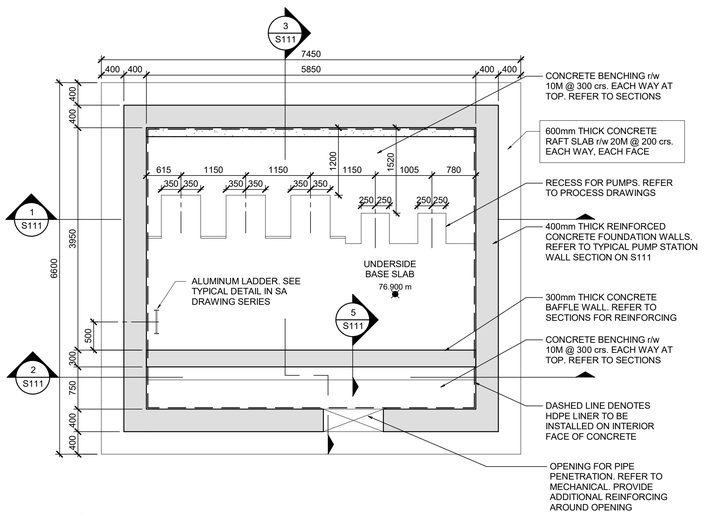
DRAWING NOTES

1. REFER TO SD000 DRAWING SERIES FOR STRUCTURAL GENERAL NOES, LEGEND TO STRUCTURAL MATERIALS AND LIST OF STRUCTURAL ABBREVIATIONS.
2. PROVIDE ADDITIONAL REINFORCING AROUND ALL SLAB AND WALL OPENINGS THAT EXCEED 150mm IN DIAMETER (OR WIDTH / LENGTH) AS PER STANDARD DETAILS IN S000 DRAWING SERIES. WHERE (2) TWO OR MORE OPENINGS LESS THAN 150mm IN DIAMETER (OR WIDTH / LENGTH) ARE SPACED CLOSER THAN 150mm, ADDITIONAL REINFORCING SHALL BE PROVIDED AS PER THE STANDARD DETAILS IN S000 DRAWING SERIES.
3. COORDINATE ALL MECHANICAL, PROCESS AND ELECTRICAL OPENINGS WITH THE RESPECTIVE DISCIPLINE.
4. REFER TO FOUNDATION AND BACKFILL DRAWINGS FOR FOUNDATION SUBGRADE AND PREPARATION, AND BACKFILL REQUIREMENTS.
5. THE FOLLOWING DESIGN LOADS ARE CONSIDERED FOR THE PUMPING STATION AND RELATED WORKS:

DESIGN LOADS

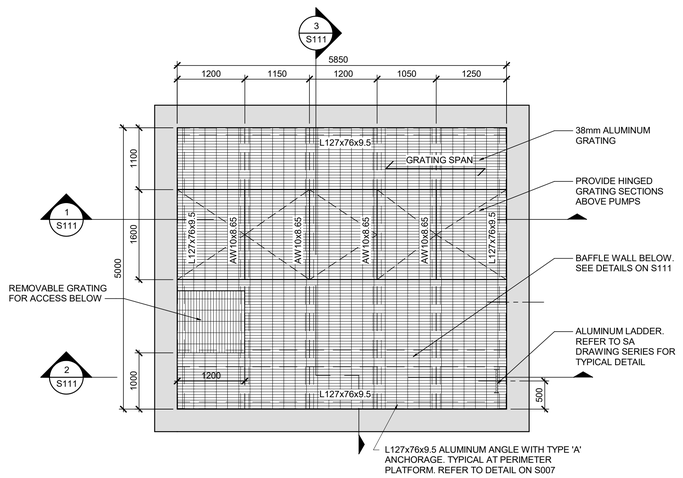
LIVE LOAD ON TOP SLAB: 7.2 kPa

LIVE LOAD ON PLATFORM LEVEL: 4.8 kPa OR A CONCENTRATED LOAD OF 6 kN (WEIGHT OF ONE LARGE PUMP)



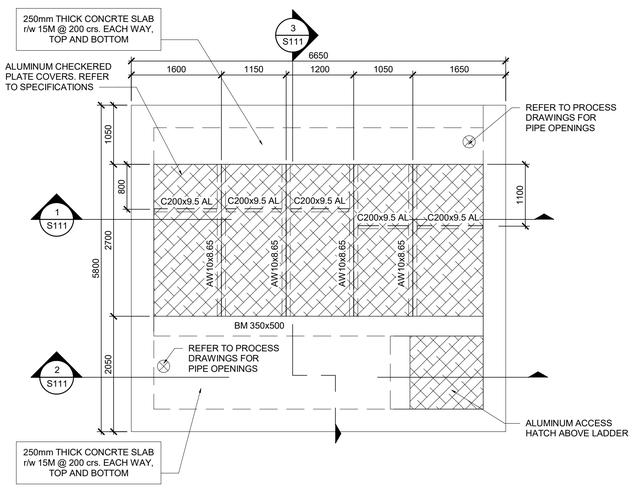
1 S110 — PUMP STATION - FOUNDATION PLAN

SCALE : 1 : 50



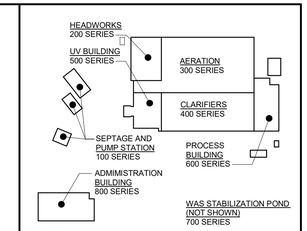
2 S110 — PUMP STATION - PLATFORM LEVEL PLAN

SCALE : 1 : 50



3 S110 — PUMP STATION - GROUND LEVEL PLAN

SCALE : 1 : 50



KEY PLAN
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SCALE: 1 : 50

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

STRUCTURAL
SEPTAGE AND PUMP STATION

PUMP STATION ISOMETRIC VIEW, PLANS AND NOTES

DESIGN:	CWD
DRAWN:	SWW/JIC
CHECKED:	JMO
JLR #:	32296

DRAWING #: S110

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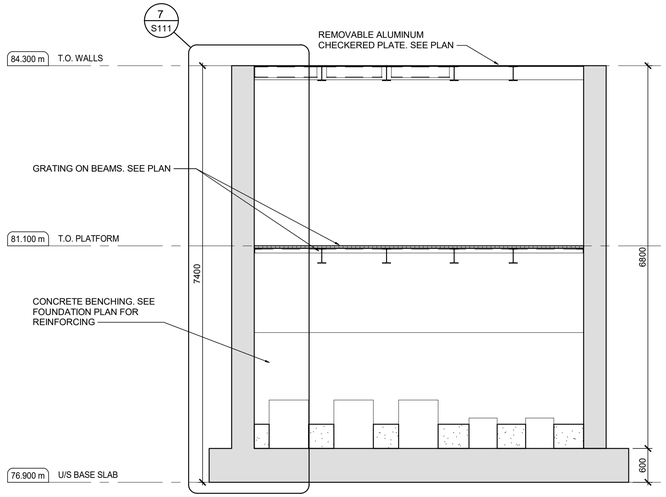
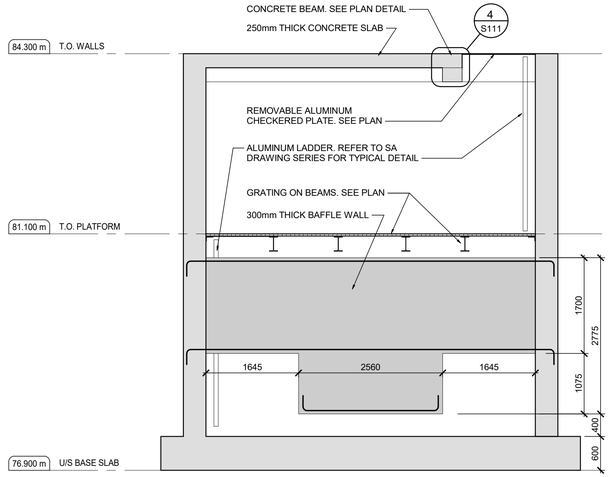
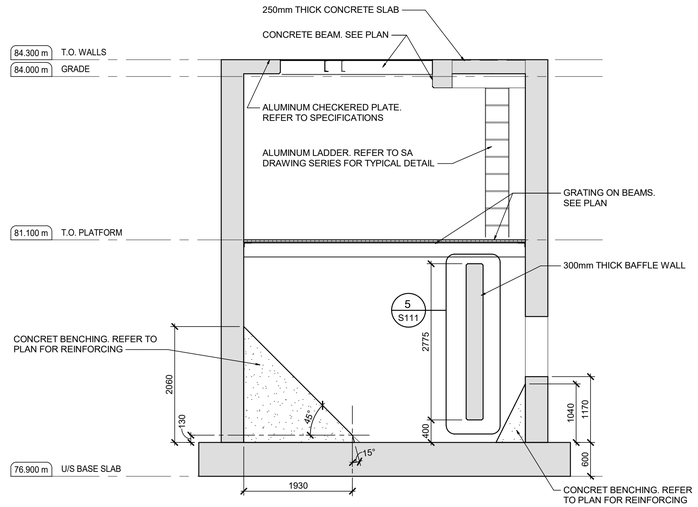
PLOT DATE: 2025-01-15 2:40:31 PM



1 S111 SECTION
SCALE : 1 : 50



2 S111 SECTION
SCALE : 1 : 50



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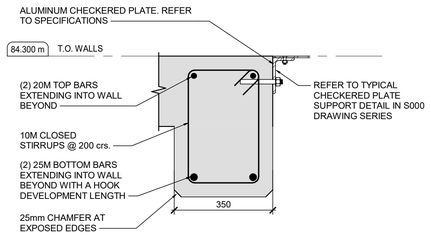
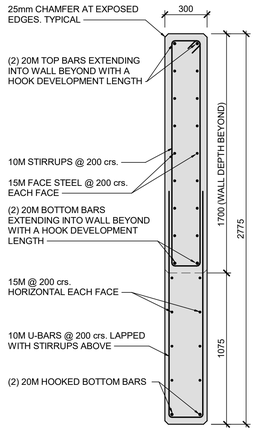
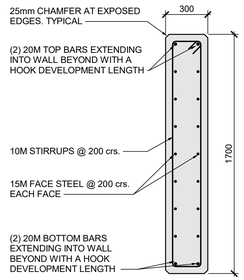


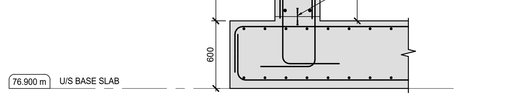
4 S111 CONCRETE BEAM DETAIL
SCALE : 1 : 10



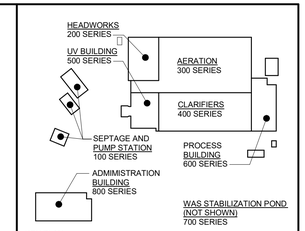
5 S111 SECTION AT BAFFLE WALL
SCALE : 1 : 20



6 S111 SECTON AT BAFFLE WALL
SCALE : 1 : 20



TYPICAL PUMP STATION WALL SECTION
7 S111
SCALE : 1 : 25



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A	ISSUED FOR 66% CLIENT REVIEW	01/11/24

VERIFY SHEET SIZE AND SCALES. THE BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE: As indicated

CLIENT:
MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca
J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:
BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO

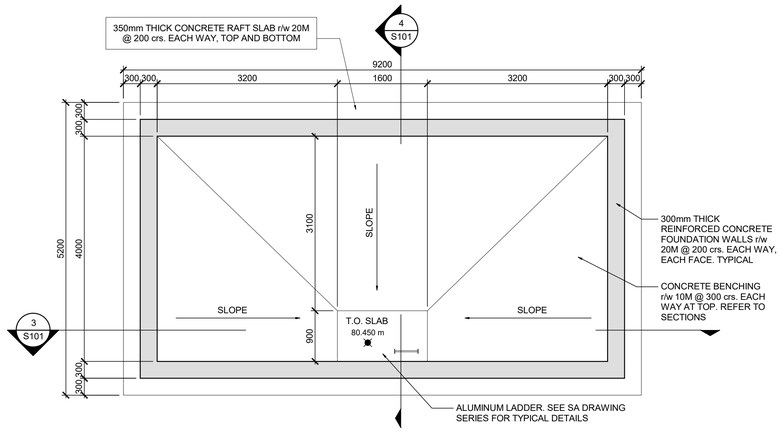
DRAWING:
STRUCTURAL
SEPTAGE AND PUMP STATION
PUMP STATION SECTION DETAILS

DESIGN:	CWD
DRAWN:	SWW/JIC
CHECKED:	JMO
JLR #:	32296

DRAWING #: S111

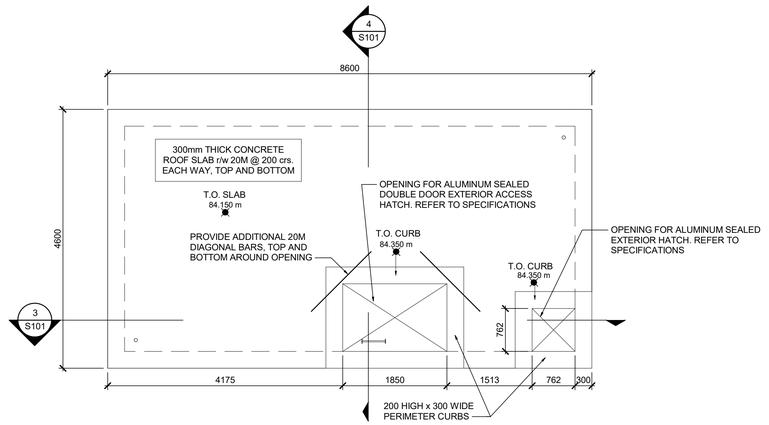
File Location: C:\Users\jcale\Desktop\Brighton LOCAL\32296 SS-Pump Station LOCAL.rvt

PLOT DATE: 2025-01-15 2:40:31 PM



1 S101 — SEPTAGE TANK - FOUNDATION PLAN

SCALE : 1 : 50



2 S101 — SEPTAGE TANK - GROUND LEVEL PLAN

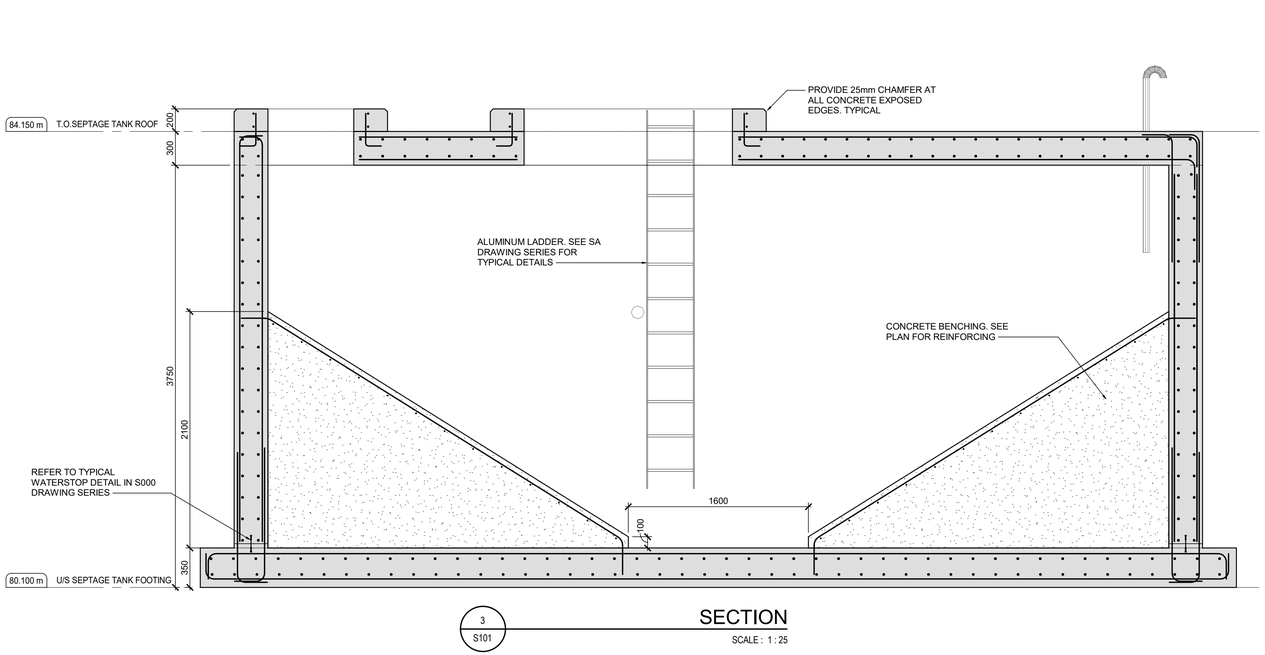
SCALE : 1 : 50

DRAWING NOTES

1. REFER TO SD000 DRAWING SERIES FOR STRUCTURAL GENERAL NOES, LEGEND TO STRUCTURAL MATERIALS AND LIST OF STRUCTURAL ABBREVIATIONS.
2. PROVIDE ADDITIONAL REINFORCING AROUND ALL SLAB AND WALL OPENINGS THAT EXCEED 150mm IN DIAMETER (OR WIDTH / LENGTH) AS PER STANDARD DETAILS IN S000 DRAWING SERIES. WHERE (2) TWO OR MORE OPENINGS LESS THAN 150mm IN DIAMETER (OR WIDTH / LENGTH) ARE SPACED CLOSER THAN 150mm, ADDITIONAL REINFORCING SHALL BE PROVIDED AS PER THE STANDARD DETAILS IN S000 DRAWING SERIES.
3. COORDINATE ALL MECHANICAL, PROCESS AND ELECTRICAL OPENINGS WITH THE RESPECTIVE DISCIPLINE.
4. REFER TO FOUNDATION AND BACKFILL DRAWINGS FOR FOUNDATION SUBGRADE AND PREPARATION, AND BACKFILL REQUIREMENTS.
5. THE FOLLOWING DESIGN LOADS ARE CONSIDERED FOR THE SEPTAGE TANK AND RELATED WORKS:

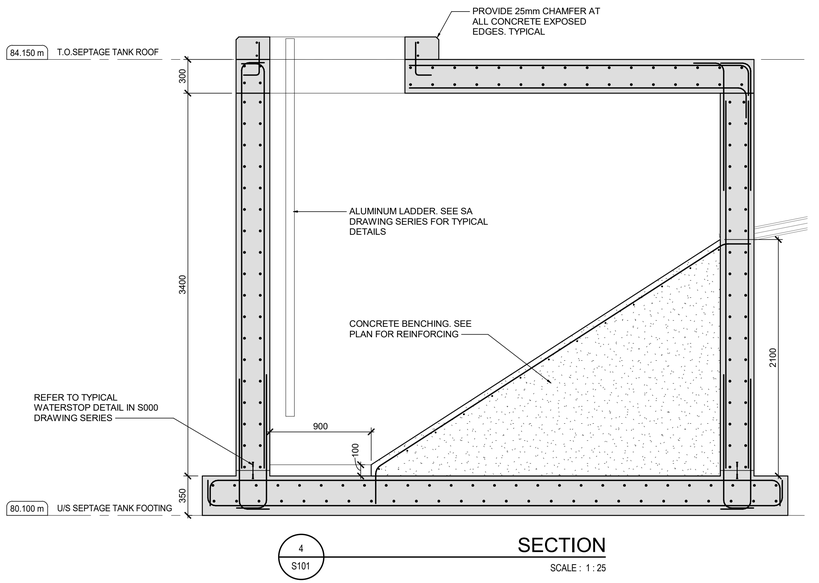
DESIGN GROUND LEVEL LOADS

LIVE LOAD ON TOP SLAB AND HATCHES: 7.2 kPa



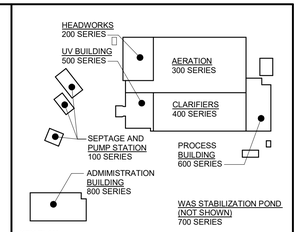
3 S101 — SECTION

SCALE : 1 : 25



4 S101 — SECTION

SCALE : 1 : 25



KEY PLAN
(NOT TO SCALE)

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A	ISSUED FOR 30% CLIENT REVIEW	07/06/24

VERIFY SHEET SIZE AND SCALES. THE BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE: As indicated

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

STRUCTURAL
SEPTAGE AND PUMP STATION

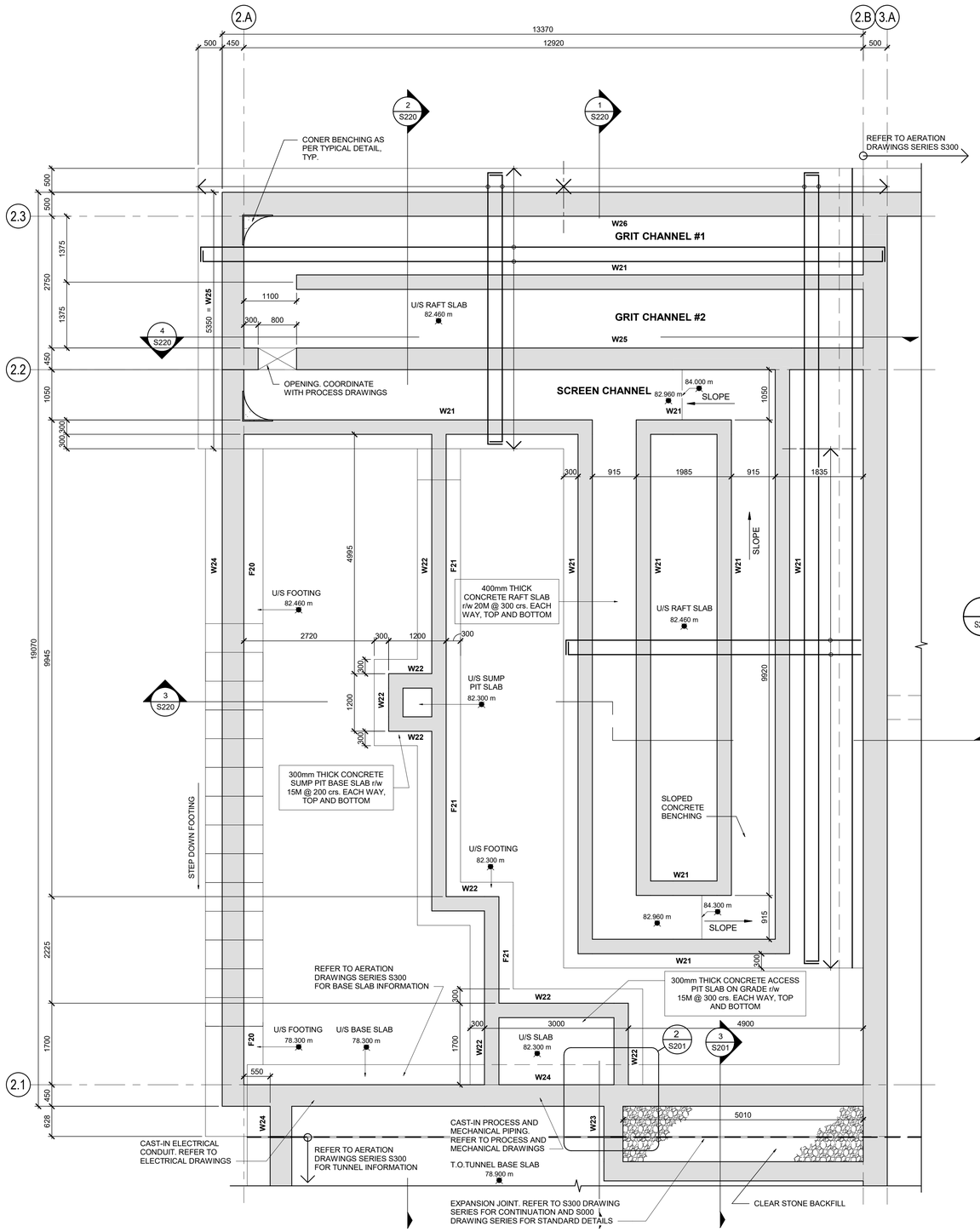
SEPTAGE TANK PLAN AND SECTIONS

DESIGN:	CWD
DRAWN:	SWW/JIC
CHECKED:	JMO
JLR #:	32296

DRAWING #: S101

File Location: C:\Users\jcalet\Desktop\Brighton LOCAL\32296 S-Septage_LOCAL.rvt

PLOT DATE: 2025-01-15 3:03:03 PM



1 S201 FOUNDATION PLAN

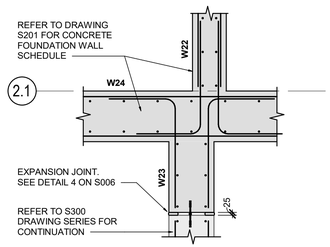
SCALE : 1 : 50

DRAWING NOTES:

1. REFER TO S000 DRAWING SERIES FOR STRUCTURAL GENERAL NOTES, LEGEND TO STRUCTURAL MATERIALS AND A LIST OF STRUCTURAL ABBREVIATIONS.
2. COORDINATE ALL OPENINGS WITH THE ASSOCIATED RESPONSIBLE DISCIPLINE AS NOTED ON PLAN AND IN THE REMAINDER OF THE DRAWING SET . PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS AS PER TYPICAL DETAIL IN S000 DRAWING SERIES.
3. REFER TO TYPICAL DETAILS IN S000 DRAWING SERIES FOR DOWELS, HORIZONTAL AND VERTICAL REINFORCING OF WALLS AND LINTELS.
4. ALL LIQUID RETAINING STRUCTURES INCLUDING CONCRETE WALLS AND SLABS ARE TO HAVE CRYSTALLINE WATERPROOFING ENTRAINED WITHIN THE MIX DESIGN ON THESE PLANS. ALL BELOW GRADE WALLS AND SLABS THAT ENCLOSE OCCUPIED SPACES SHALL HAVE CRYSTALLINE WATERPROOFING ENTRAINED IN THE MIX DESIGN. REFER TO CAST-IN-PLACE CONCRETE SPECIFICATION FOR FURTHER DETAILS.
5. REFER TO SA DRAWING SERIES FOR STAIR, PLATFORM, GUARDRAIL / HANDRAIL AND LADDER INFORMATION.

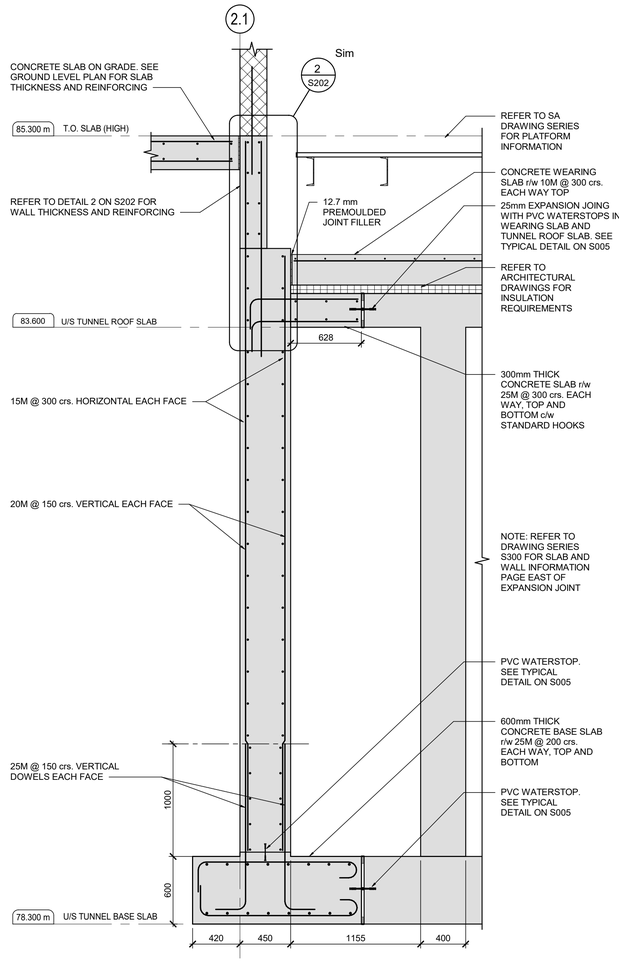
CONCRETE FOUNDATION WALL SCHEDULE		
MARK	DESCRIPTION	REINFORCING
W20	240mm THICK CONCRETE WALL	15M @ 300 crs. EACH WAY, EACH FACE
W21	300mm THICK CONCRETE WALL	15M @ 150 crs. HORIZONTAL EACH FACE, 15M @ 200 crs. VERTICAL EACH FACE
W22	300mm THICK CONCRETE WALL	15M @ 300 crs. EACH WAY, EACH FACE
W23	400mm THICK CONCRETE WALL	20M @ 300 crs. EACH WAY, EACH FACE
W24	450mm THICK CONCRETE WALL	SEE SECTION 3 ON S201
W25	450mm THICK CONCRETE WALL	15M @ 150 crs. HORIZONTAL EACH FACE, 20M @ 200 crs. VERTICAL EACH FACE
W26	500mm THICK CONCRETE WALL	15M @ 150 crs. HORIZONTAL EACH FACE, 20M @ 200 crs. VERTICAL EACH FACE

CONCRETE FOOTING SCHEDULE		
MARK	SIZE	REINFORCING
F20	1200 x 400 STRIP FOOTING	(4) 15 LONGITUDINAL AND 15M @ 300 crs. HOOKED TRANSVERSE, TOP AND BOTTOM
F21	900 x 400 STRIP FOOTING	(4) 15 LONGITUDINAL AND 15M @ 300 crs. HOOKED TRANSVERSE, TOP AND BOTTOM



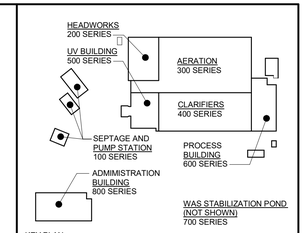
2 S201 PLAN DETAIL AT WALL END

SCALE : 1 : 25



3 S201 TYPICAL FOUNDATION WALL W24 AT CANTILEVERED BASE SLAB

SCALE : 1 : 25



KEY PLAN
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SCALE: As indicated

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CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

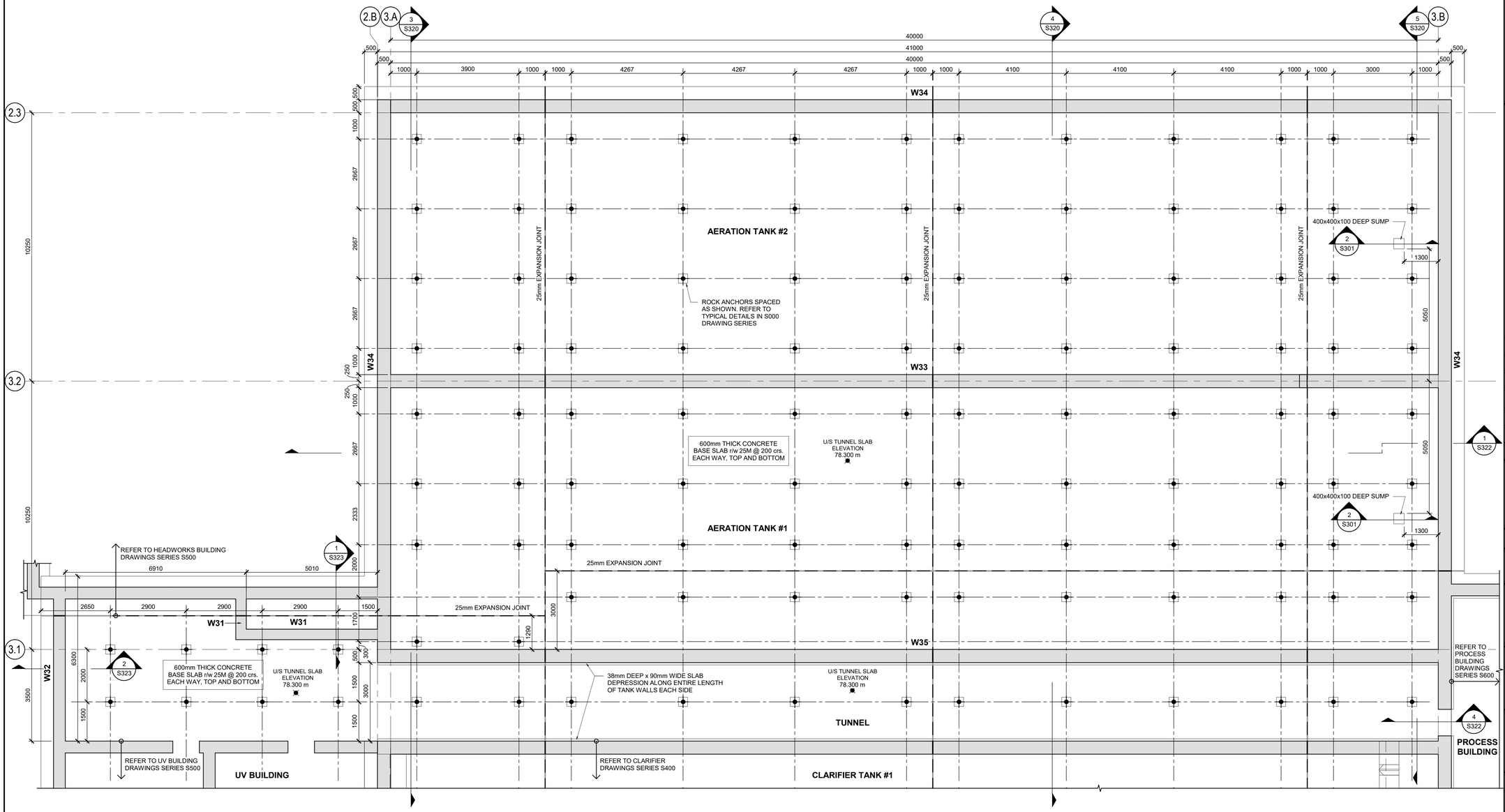
DRAWING:

STRUCTURAL
HEADWORKS

FOUNDATION PLAN

DESIGN: CWD	
DRAWN: JIC	DRAWING #:
CHECKED: JMO	S201
JLR #: 32296	

PLOT DATE: 2025-01-15 8:39:11 PM File Location: C:\Users\jcain\Desktop\Brighton LOCAL\32296 S-Headworks LOCAL.rvt

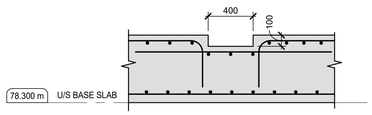


BASE SLAB PLAN

1 / S301

SCALE : 1 : 75

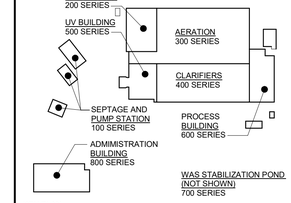
CONCRETE FOUNDATION WALL SCHEDULE		
MARK	DESCRIPTION	REINFORCING
W30	300mm THICK CONCRETE WALL	SEE SECTION 3 ON S322
W31	400mm THICK CONCRETE WALL	SEE SECTION 1 ON S322
W32	450mm THICK CONCRETE WALL	SEE SECTION 2 ON S322
W33	500mm THICK CONCRETE WALL	SEE SECTION 1 ON S321
W34	500mm THICK CONCRETE WALL	SEE SECTION 2 ON S321
W35	500mm THICK CONCRETE WALL	SEE SECTION 2 ON S321



SECTION AT SUMP

2 / S301

SCALE : 1 : 25



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SCALE: As indicated

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

STRUCTURAL
AERATION

BASE SLAB LEVEL PLAN

DESIGN: CWD	
DRAWN: JIC/SWW	DRAWING #: S301
CHECKED: JMO	
JLR #: 32296	

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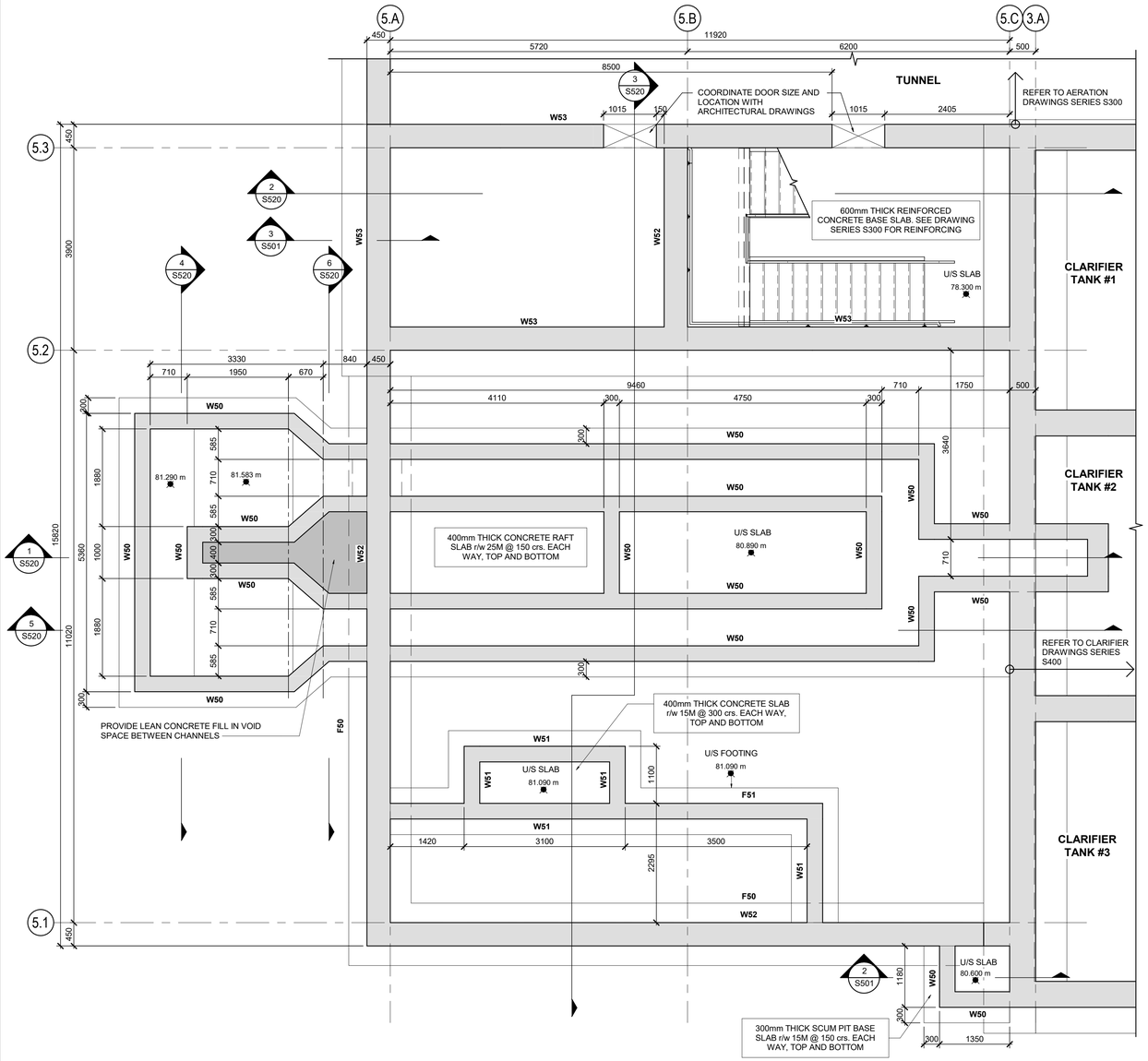

1 S501 FOUNDATION PLAN

SCALE : 1 : 50

CONCRETE FOUNDATION WALL SCHEDULE		
MARK	DESCRIPTION	REINFORCING
W50	300mm THICK CONCRETE WALL	15M @ 150 crs. EACH WAY, EACH FACE
W51	300mm THICK CONCRETE WALL	15M @ 300 crs. EACH WAY, EACH FACE
W52	450mm THICK CONCRETE WALL	20M @ 300 crs. EACH WAY, EACH FACE
W53	450mm THICK CONCRETE WALL	SEE SECTION 3 ON S501

CONCRETE FOOTING SCHEDULE		
MARK	WIDTH x DEPTH	REINFORCING
F50	1200 x 400 STRIP FOOTING	(4) 15M LONGITUDINAL AND 15M @ 300 crs.HOOKED TRANSVERSE TOP AND BOTTOM
F51	900 x 400 STRIP FOOTING	(4) 15M LONGITUDINAL AND 15M @ 300 crs.HOOKED TRANSVERSE TOP AND BOTTOM

DRAWING NOTES:

1. REFER TO S000 DRAWING SERIES FOR STRUCTURAL GENERAL NOTES, LEGEND TO STRUCTURAL MATERIALS AND A LIST OF STRUCTURAL ABBREVIATIONS.
2. COORDINATE ALL OPENINGS WITH THE ASSOCIATED RESPONSIBLE DISCIPLINE AS NOTED ON PLAN AND IN THE REMAINDER OF THE DRAWING SET . PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS AS PER TYPICAL DETAIL IN S000 DRAWING SERIES.
3. REFER TO TYPICAL DETAILS IN S000 DRAWING SERIES FOR DOWELS, HORIZONTAL AND VERTICAL REINFORCING OF WALLS AND LINTELS.
4. ALL LIQUID RETAINING STRUCTURES INCLUDING CONCRETE WALLS AND SLABS ARE TO HAVE CRYSTALLINE WATERPROOFING ENTRAINED WITHIN THE MIX DESIGN ON THESE PLANS. ALL BELOW GRADE WALLS AND SLABS THAT ENCLOSE OCCUPIED SPACES SHALL HAVE CRYSTALLINE WATERPROOFING ENTRAINED IN THE MIX DESIGN. REFER TO CAST-IN-PLACE CONCRETE SPECIFICATION FOR FURTHER DETAILS.
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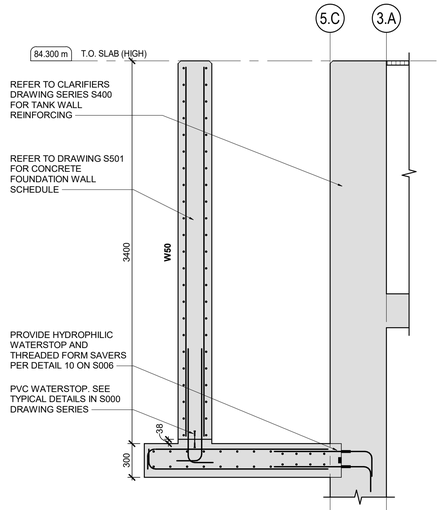
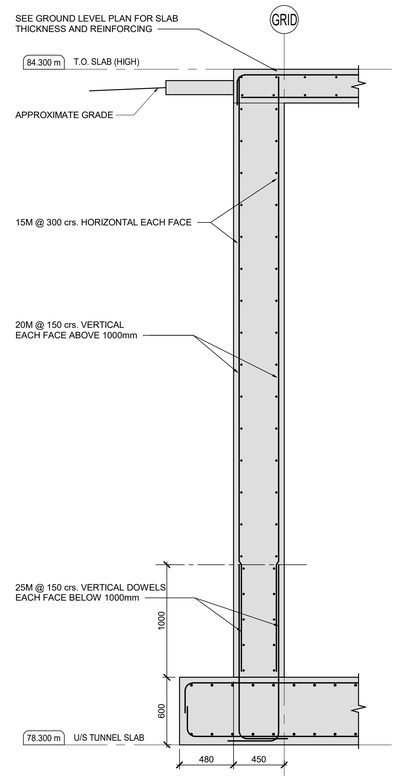


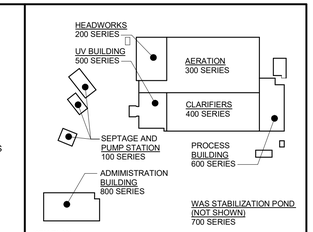
2 S501 SECTION AT SCUM PIT

SCALE : 1 : 25



3 S501 FOUNDATION WALL SECTION W53

SCALE : 1 : 25



KEY PLAN (NOT TO SCALE)

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VERIFY SHEET SIZE AND SCALES. THE BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE: As indicated

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

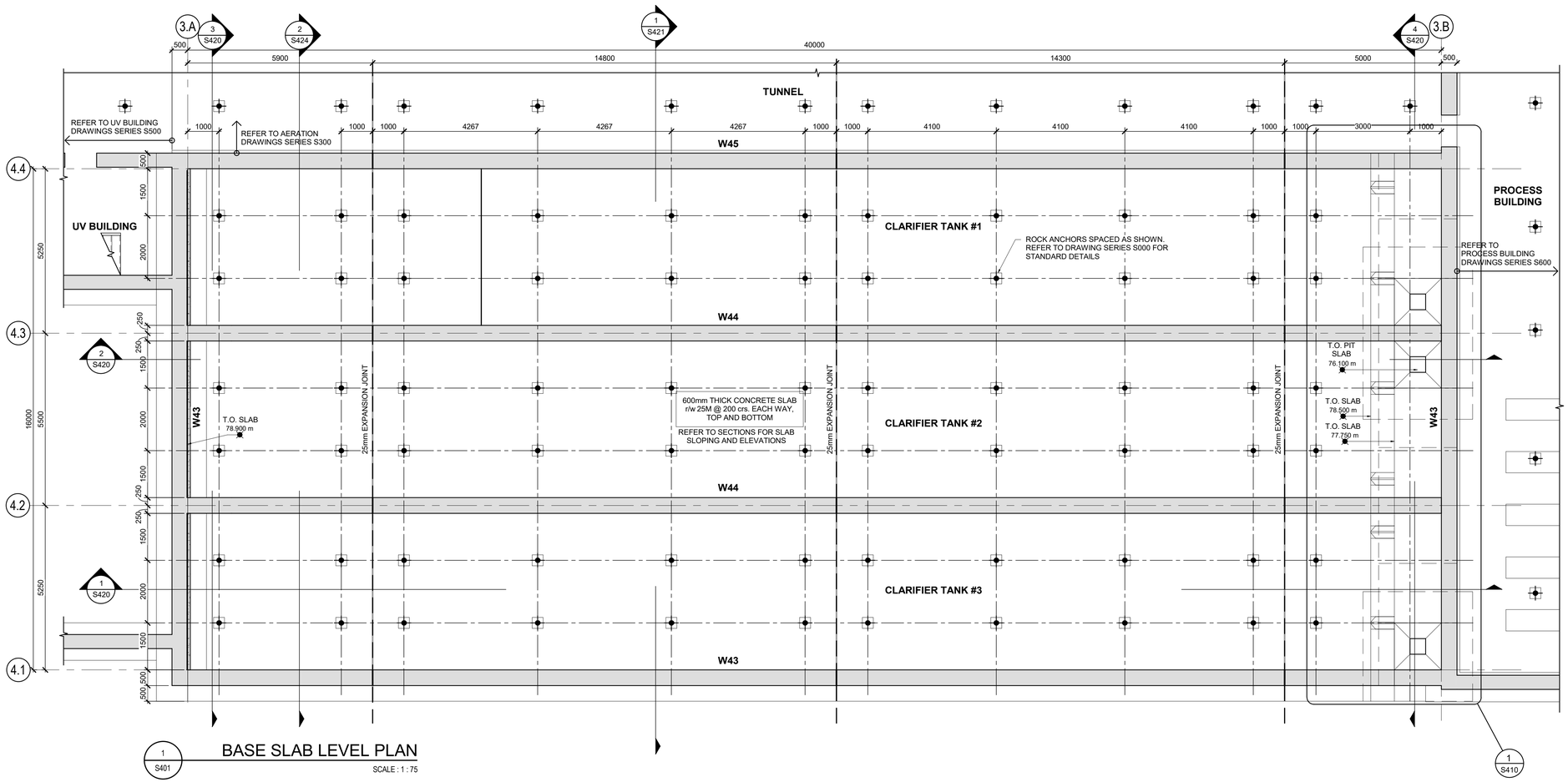
DRAWING:

STRUCTURAL
UV BUILDING

FOUNDATION PLAN

DESIGN: CWD	
DRAWN: JIC	DRAWING #: S501
CHECKED: JMO	
JLR #: 32296	

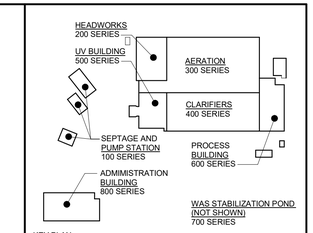
PLOT DATE: 2025-01-15 8:28:21 PM File Location: C:\Users\jcate\Desktop\Brighton LOCAL\32296 S-UV Bldg LOCAL.rvt



1 S401 BASE SLAB LEVEL PLAN

SCALE : 1 : 75

CONCRETE FOUNDATION WALL SCHEDULE		
MARK	DESCRIPTION	REINFORCING
W40	300mm THICK CONCRETE WALL	<varies>
W41	350mm THICK CONCRETE WALL	SEE SECTION 4 ON S422
W42	400mm THICK CONCRETE WALL	<varies>
W43	500mm THICK CONCRETE WALL	SEE SECTION 1 ON S421
W44	500mm THICK CONCRETE WALL	SEE SECTION 2 ON S421
W45	500mm THICK CONCRETE WALL	SEE SECTION 3 ON S421



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SCALE: 1 : 75

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

STRUCTURAL
CLARIFIERS

BASE SLAB LEVEL PLAN

DESIGN: CWD	
DRAWN: JIC/SWW	DRAWING #:
CHECKED: JMO	S401
JLR #: 32296	

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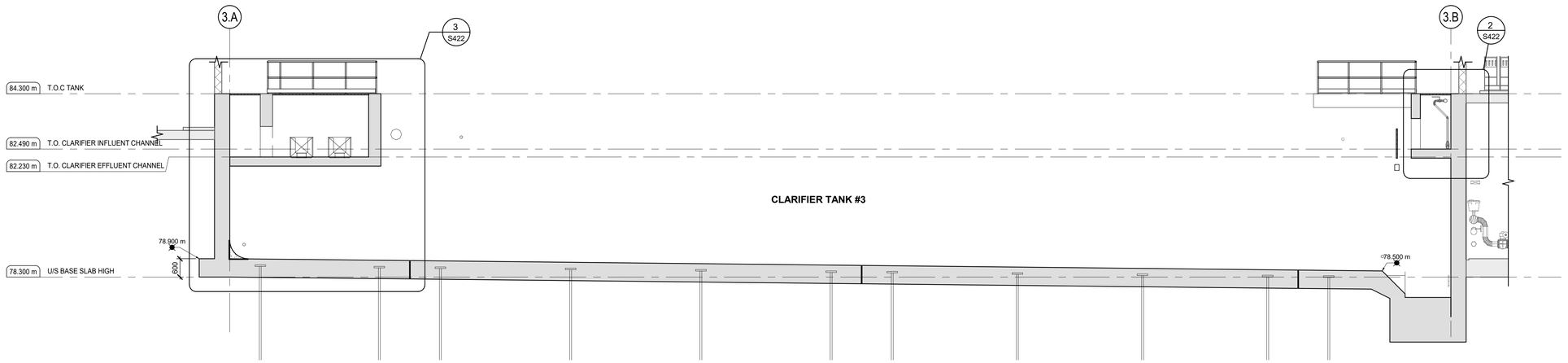
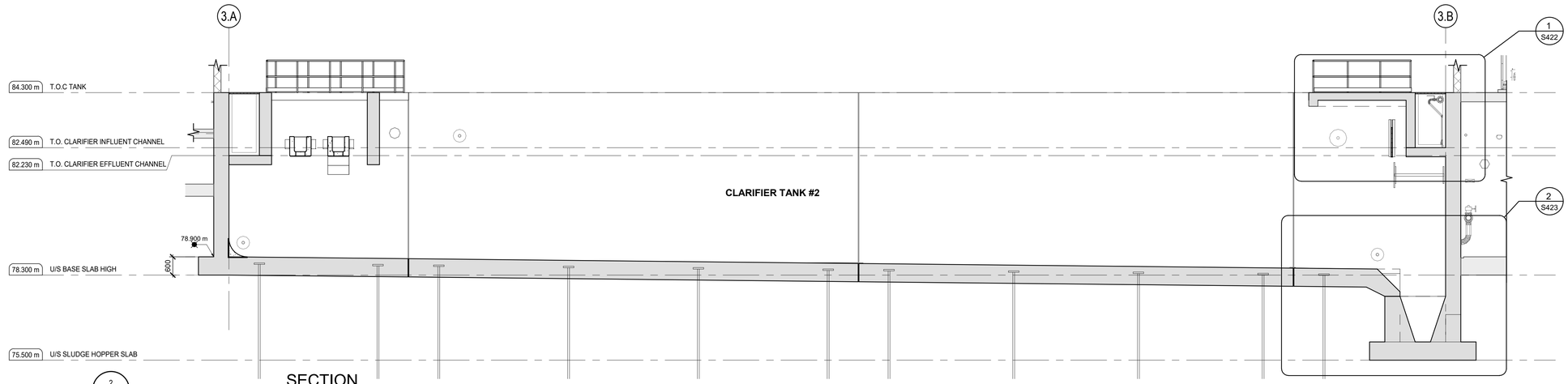


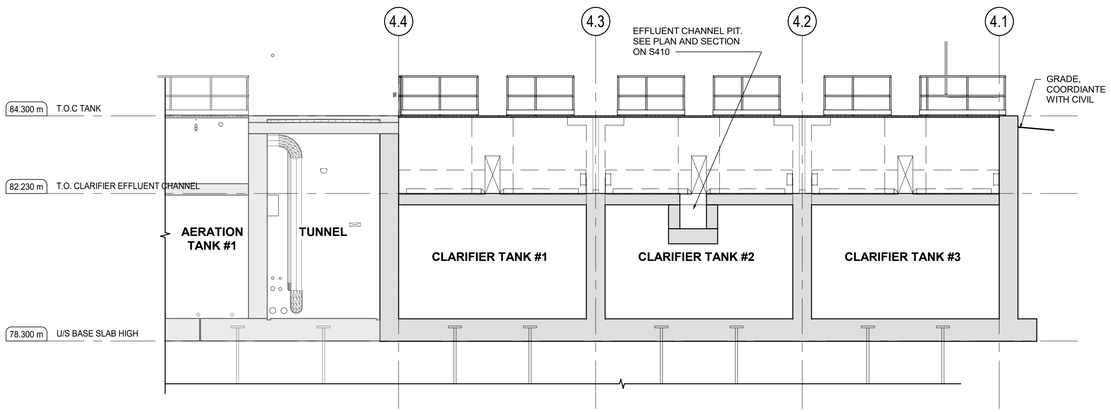
1 S420 SECTION

SCALE : 1 : 75



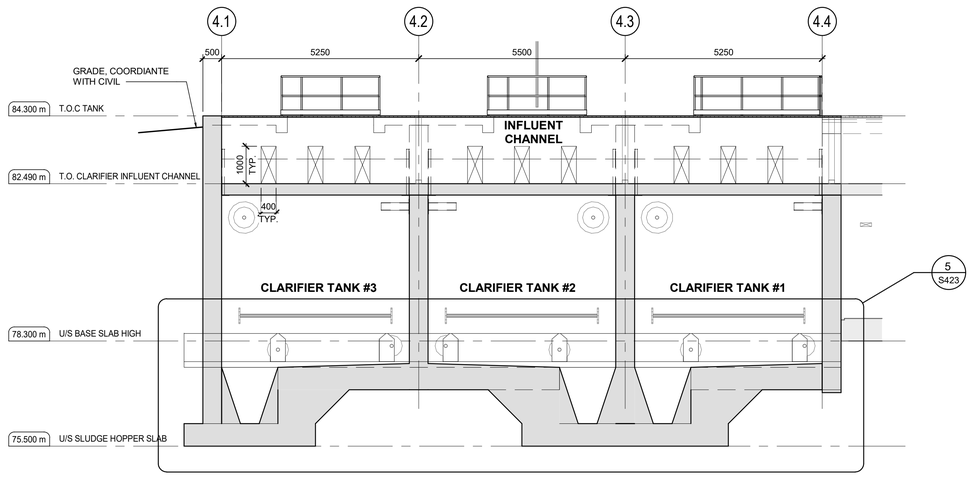
2 S420 SECTION

SCALE : 1 : 75



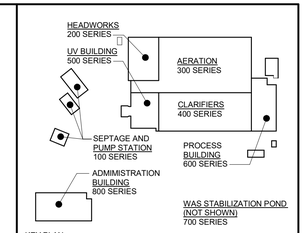
3 S420 SECTION AT EFFLUENT CHANNEL

SCALE : 1 : 75



4 S420 SECTION AT INFLUENT CHANNEL

SCALE : 1 : 75



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SCALE: 1 : 75

CLIENT:

MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

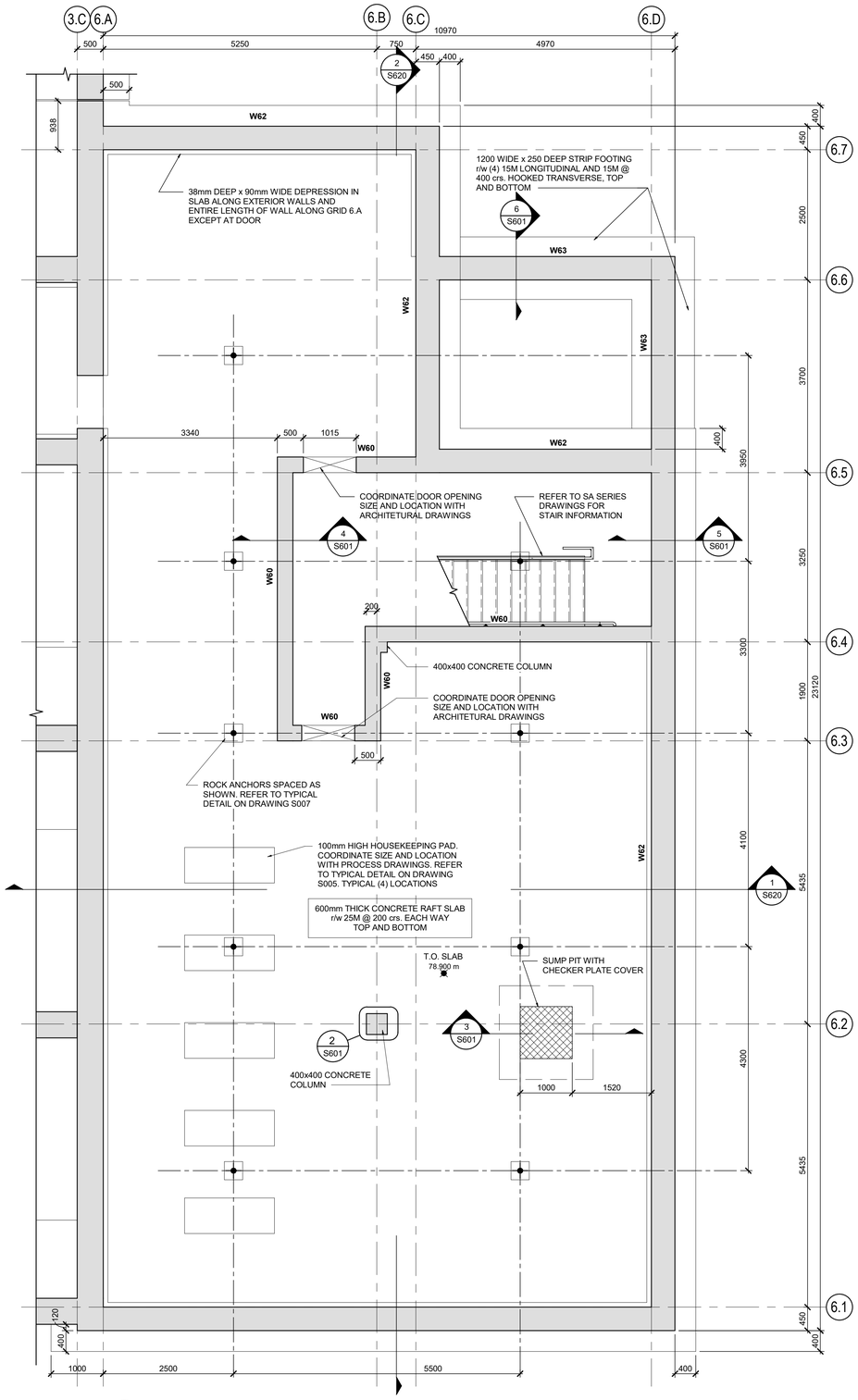
DRAWING:

STRUCTURAL
CLARIFIERS

SECTIONS AND DETAILS

DESIGN: CWD	DRAWING #: S420
DRAWN: JIC/SWW	
CHECKED: JMO	
JLR #: 32296	

PLOT DATE: 2025-01-15 7:38:22 PM File Location: C:\Users\jcale\Desktop\Brighton LOCAL\32296 S-Clarifiers LOCAL.rvt



1 S601 BASEMENT LEVEL PLAN

SCALE : 1 : 50

CONCRETE FOUNDATION WALL SCHEDULE		
MARK	DESCRIPTION	REINFORCING
W60	300mm THICK CONCRETE WALL	SEE SECTION 4 ON S601
W61	400mm THICK CONCRETE WALL	SEE SUMP PIT SECTION 3 ON S601
W62	450mm THICK CONCRETE WALL	SEE SECTION 5 ON S601
W63	450mm THICK CONCRETE WALL	SEE SECTION 6 ON S601

DRAWING NOTES:

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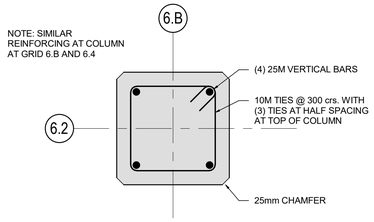
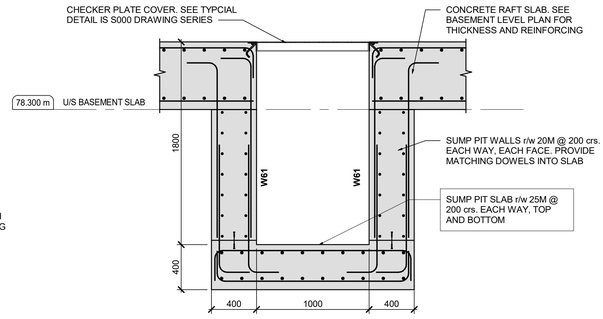
4. ALL LIQUID RETAINING STRUCTURES INCLUDING CONCRETE WALLS AND SLABS ARE TO HAVE CRYSTALLINE WATERPROOFING ENTRAINED WITHIN THE MIX DESIGN ON THESE PLANS. ALL BELOW GRADE WALLS AND SLABS THAT ENCLOSE OCCUPIED SPACES SHALL HAVE CRYSTALLINE WATERPROOFING ENTRAINED IN THE MIX DESIGN. REFER TO CAST-IN-PLACE CONCRETE SPECIFICATION FOR FURTHER DETAILS.
5. REFER TO SA DRAWINGS SERIES FOR STAIR, PLATFORM, GUARDRAIL / HANDRAIL AND LADDER INFORMATION.



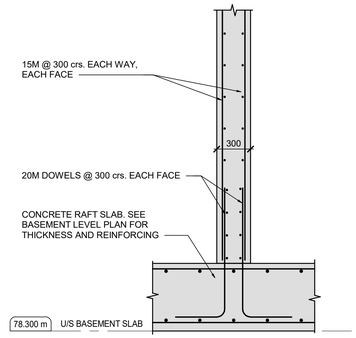
2 S601 400 x 400 COLUMN DETAIL

SCALE : 1 : 10



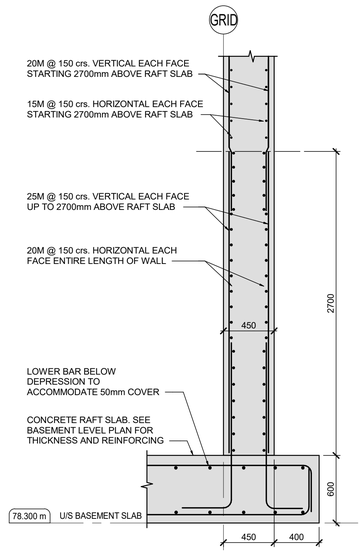
3 S601 SECTION AT SUMP PIT

SCALE : 1 : 25



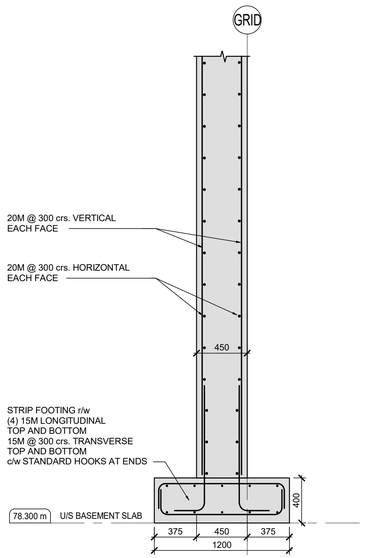
4 S601 TYPICAL FOUNDATION WALL - W60

SCALE : 1 : 25



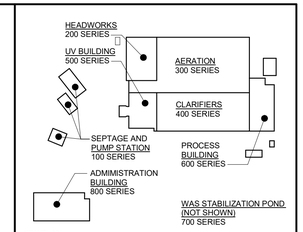
5 S601 TYPICAL FOUNDATION WALL - W62

SCALE : 1 : 25



6 S601 TYPICAL FOUNDATION WALL - W63

SCALE : 1 : 25



KEY PLAN
(NOT TO SCALE)

DESIGN DOCUMENTS HEREIN HAVE BEEN DESIGNED UNDER THE ONTARIO BUILDING CODE 2012.

NOT FOR CONSTRUCTION

No.	ISSUE / REVISION	DD/MM/YY
D	ISSUED FOR ECA APPLICATION	16/01/25
C	ISSUED FOR BUILDING PERMIT	20/12/24
B	ISSUED FOR 66% CLIENT REVIEW	01/11/24
A	ISSUED FOR 30% CLIENT REVIEW	07/06/24

VERIFY SHEET SIZE AND SCALES. THE BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE: As indicated

CLIENT:

MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

STRUCTURAL
PROCESS BUILDING

BASEMENT LEVEL PLAN

DESIGN:	CWD
DRAWN:	JIC
CHECKED:	JMO
JLR #:	32296

DRAWING #: S601

File Location: C:\Users\jcain\Desktop\Brighton LOCAL\32296-S-Process Bldg LOCAL.rvt

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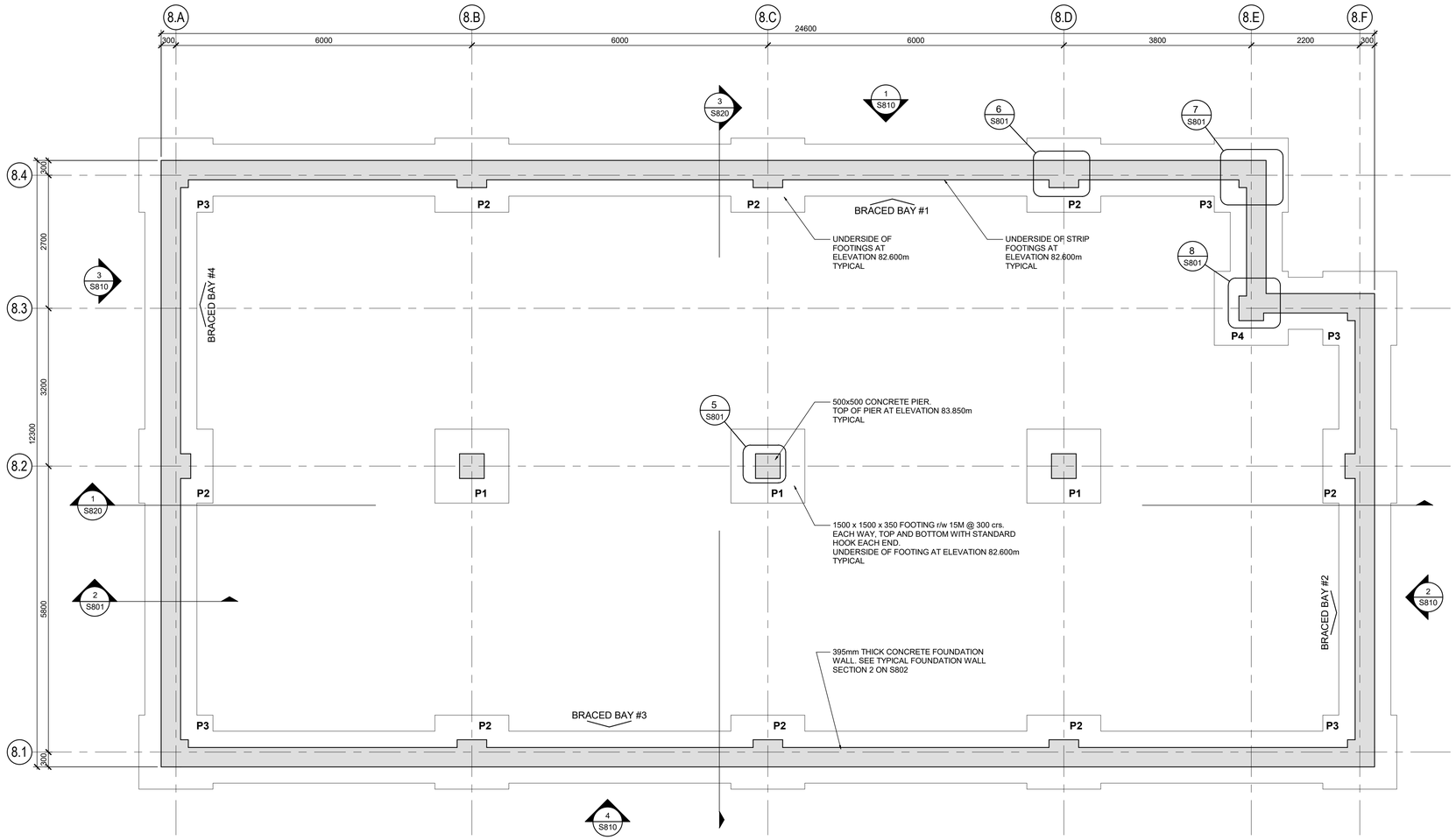
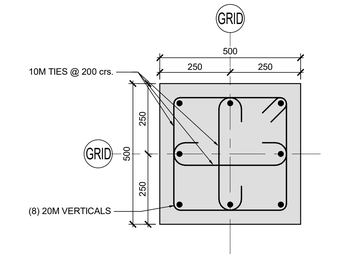
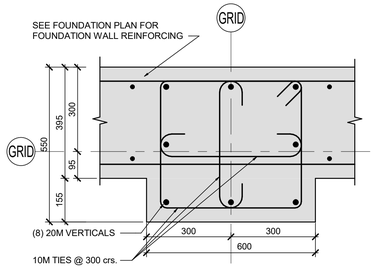


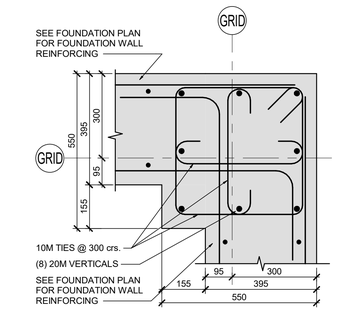
1 S801 — FOUNDATION PLAN
SCALE : 1 : 50



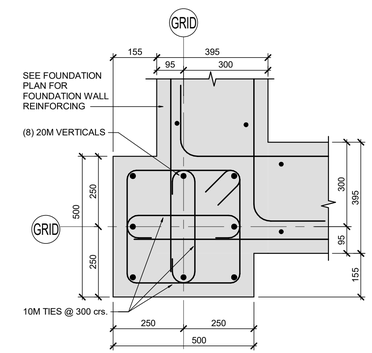
5 S801 — P1 PIER DETAIL
SCALE : 1 : 10



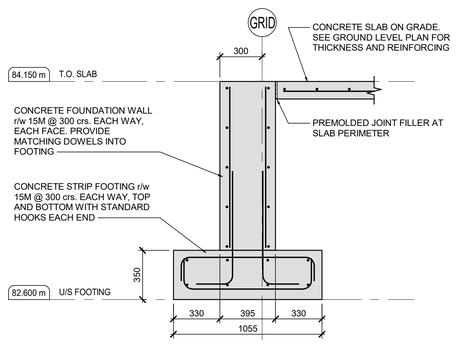
6 S801 — P2 PIER DETAIL AT EXTERIOR WALL
SCALE : 1 : 10



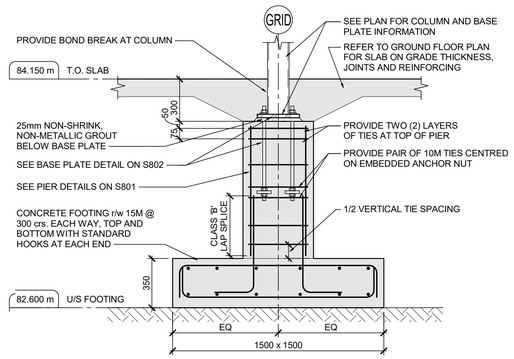
7 S801 — P3 PIER DETAIL AT EXTERIOR CORNER
SCALE : 1 : 10



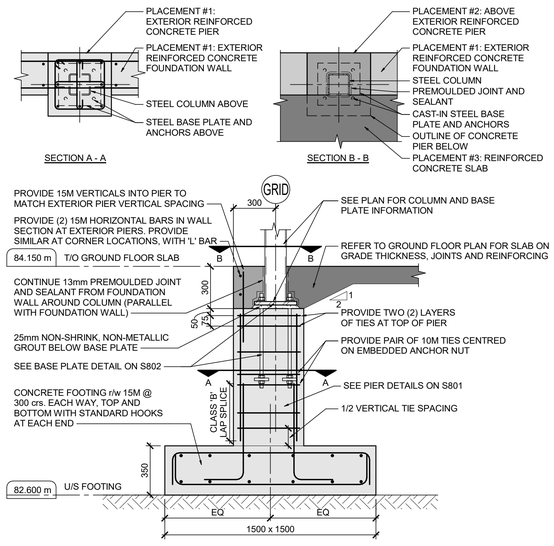
8 S801 — P4 PIER DETAIL AT INTERIOR CORNER
SCALE : 1 : 10



2 S801 — TYPICAL FOUNDATION WALL SECTION
SCALE : 1 : 20



3 S801 — TYPICAL CONCRETE PIER SECTION AT INTERIOR GRAVITY COLUMN AND CONCEALED BRACED BAY LOCATIONS
SCALE : 1 : 20



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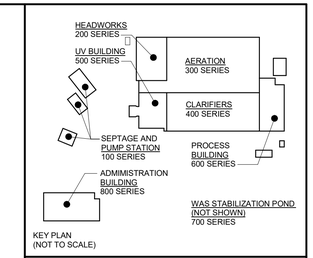

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NOT FOR CONSTRUCTION

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D	ISSUED FOR ECA APPLICATION	16/01/25
C	ISSUED FOR BUILDING PERMIT	20/12/24
B	ISSUED FOR 66% CLIENT REVIEW	01/11/24
A	ISSUED FOR 30% CLIENT REVIEW	07/06/24

VERIFY SHEET SIZE AND SCALES. THE BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE: As indicated

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca
J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:
BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES
100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:
STRUCTURAL
ADMININSTRATION BUILDING
FOUNDATION PLAN

DESIGN: CWD	
DRAWN: JIC	DRAWING #: S801
CHECKED: JMO	
JLR #: 32296	

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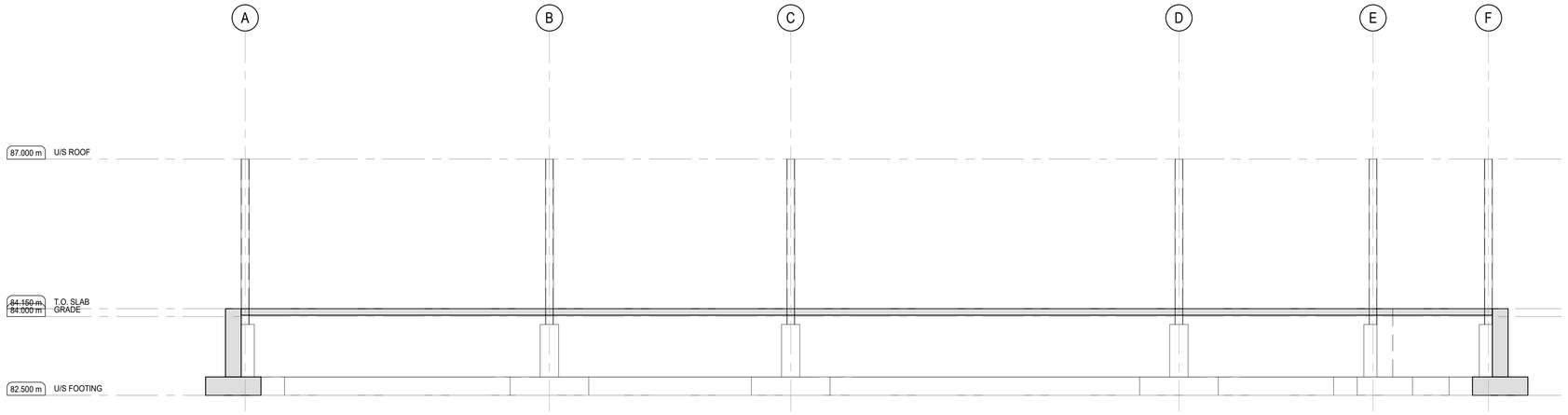

1 / S802 — Section 1

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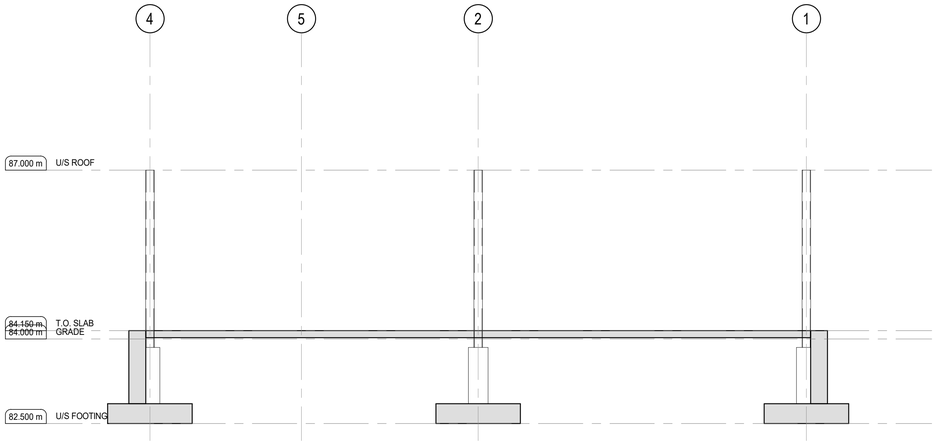

2 / S802 — Section 2

SCALE : 1 : 50

KEY PLAN
(NOT TO SCALE)

PRELIMINARY DESIGN

THESE DOCUMENTS ARE NOT COMPLETE IN ALL DETAILS AND MAY BE SUBJECT TO CHANGE AS DESIGN DEVELOPMENT AND CODE REVIEW IS ADVANCED.

No.	ISSUE / REVISION	DD/MM/YY

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SCALE: 1 : 50

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

STRUCTURAL
ADMININSTRATION BUILDING

BUILDING SECTIONS

DESIGN:	Designer
DRAWN:	Author
CHECKED:	Checker
JLR #:	32296

DRAWING #: S802

File Location: P:\32000\32296-001 - Brighton WWT System Upgrades\03-Production\10-Revit Shared\Structural models\32296 S-Admin R23.rvt

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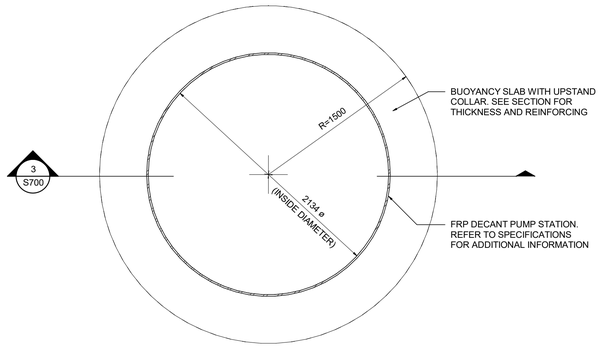
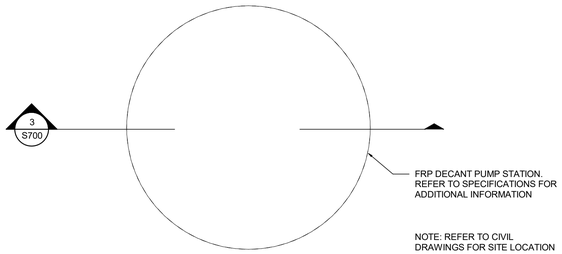


3 S700

1 S700 PLAN AT BASE SLAB LEVEL

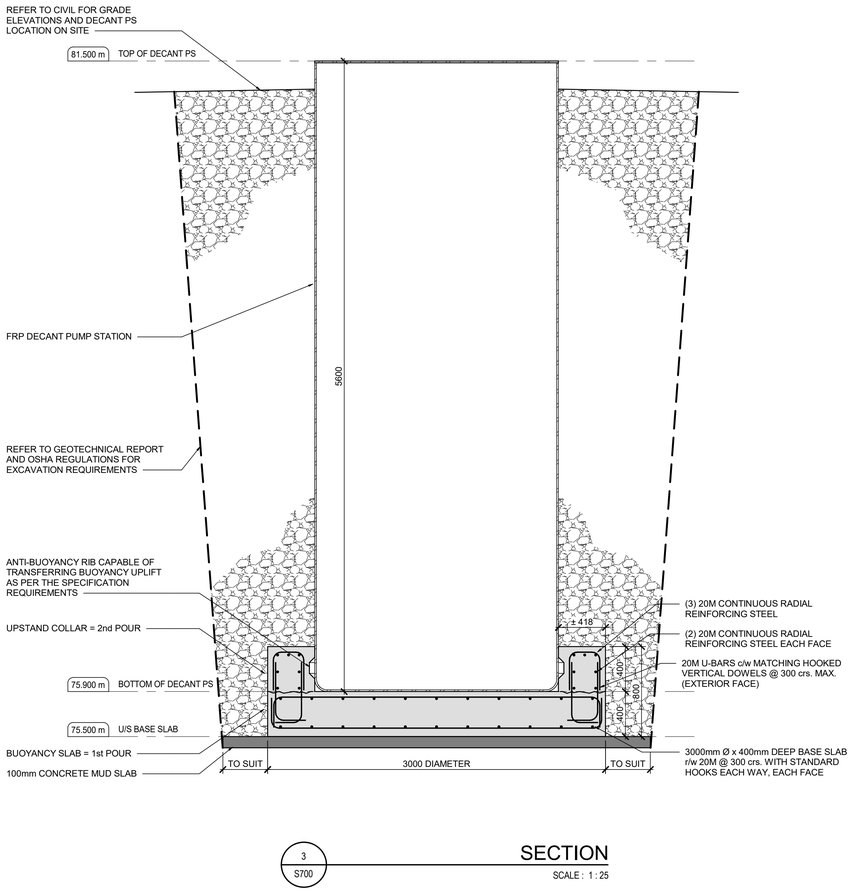
SCALE : 1 : 25



3 S700

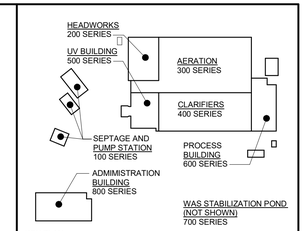
2 S700 PLAN AT GRADE LEVEL

SCALE : 1 : 25



3 S700 SECTION

SCALE : 1 : 25



KEY PLAN
(NOT TO SCALE)

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No.	ISSUE / REVISION	DD/MM/YY
A	ISSUED FOR ECA APPLICATION	16/01/25

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SCALE: 1 : 25

CLIENT: MUNICIPALITY OF BRIGHTON

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

PROJECT NORTH

PROJECT:

BRIGHTON WASTEWATER TREATMENT SYSTEM UPGRADES

100 COUNTY ROAD 64, BRIGHTON ONTARIO

DRAWING:

STRUCTURAL
WAS STABILIZATION POND

DECANT PS PLAN AND SECTION DETAILS

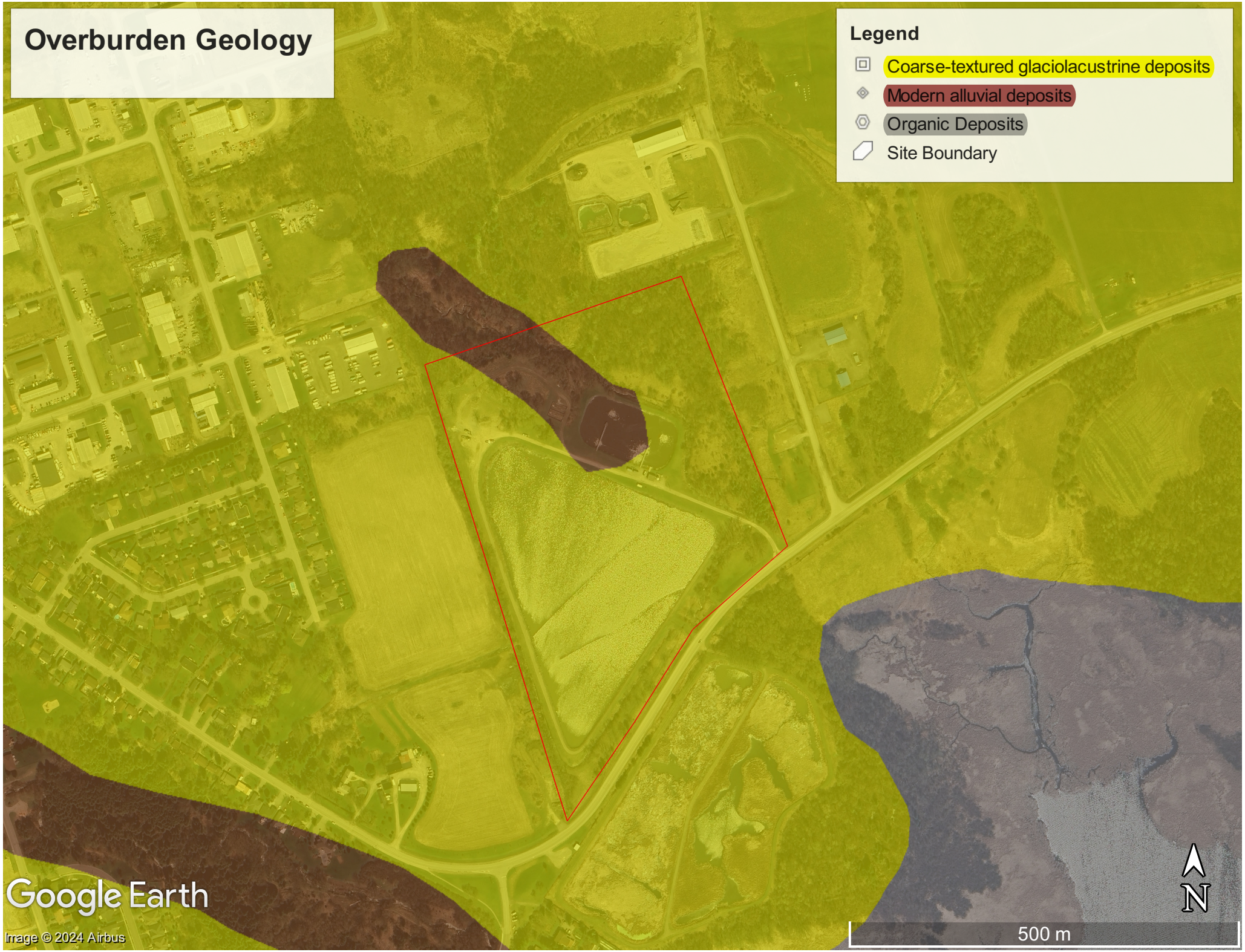
DESIGN:	CWD
DRAWN:	JIC
CHECKED:	MJB
JLR #:	32296

DRAWING #: S700

PLOT DATE: 2025-01-15 8:26:52 PM File Location: P:\32000\32296-001 - Brighton WWT System Upgrades\03-Production\10-Revit Shared\Structural models\32296 S-Decant PS R23.rvt

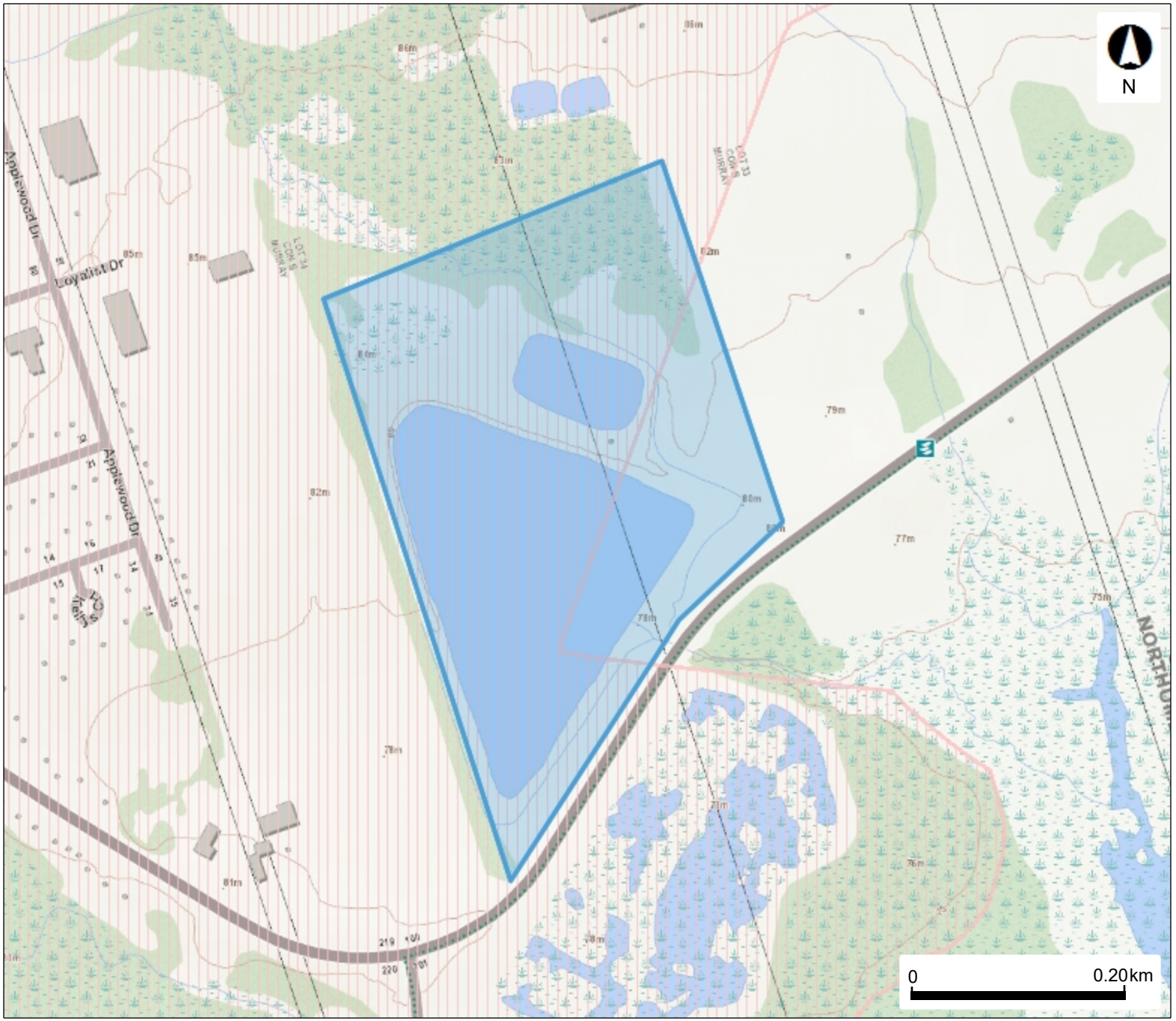
Appendix B

Background Information for Physical Setting


Overburden Geology
Legend
Coarse-textured glaciolacustrine deposits
Modern alluvial deposits
Organic Deposits
Site Boundary
Google Earth
Image © 2024 Airbus
N
500 m


Bedrock Geology
Legend
Lindsay Formation
Site Boundary
Google Earth
Image © 2024 Airbus
N
500 m

Source Protection Information Atlas - HVA Map



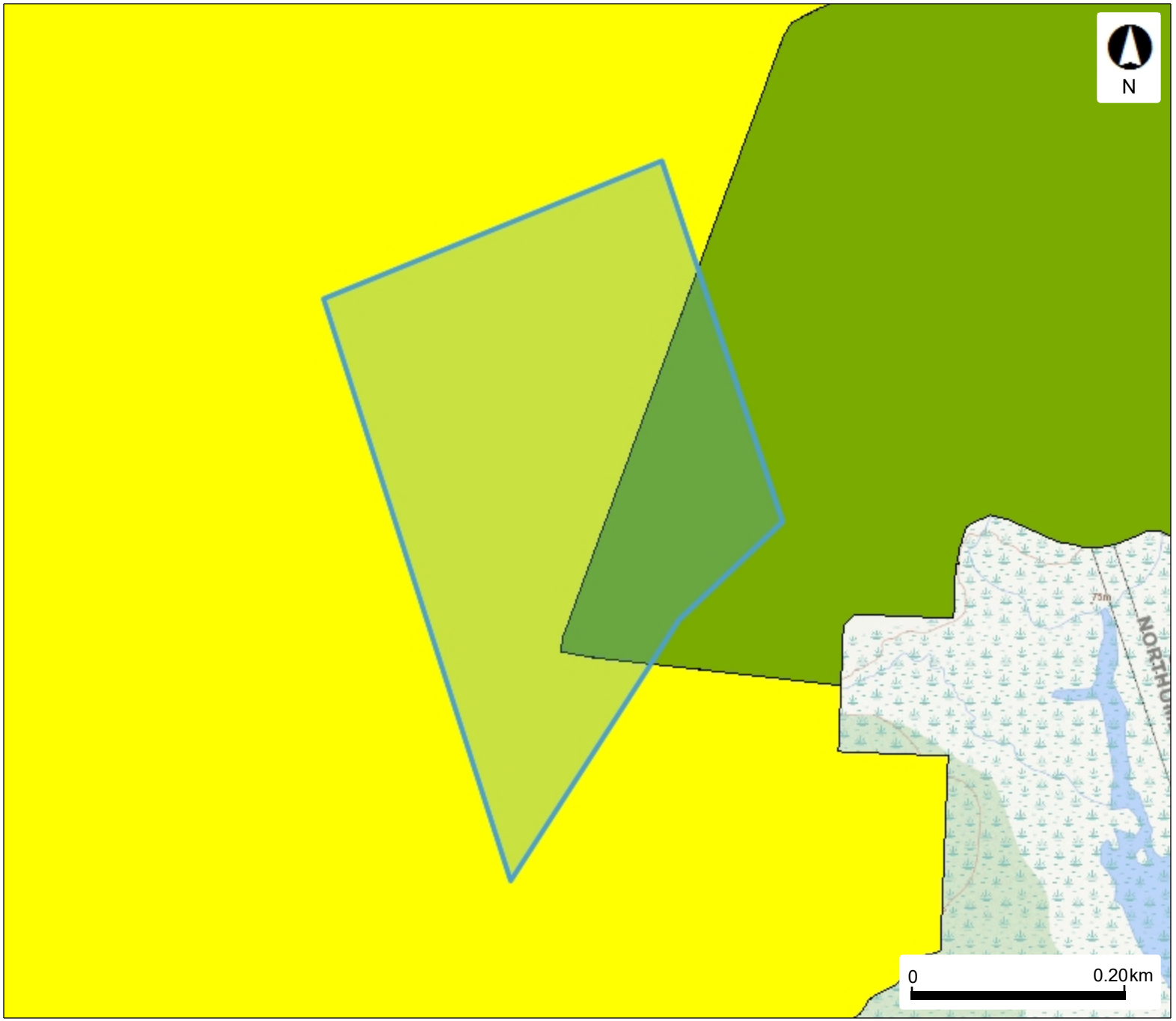
Legend

Highly Vulnerable Aquifers

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Map Created: 4/30/2024
Map Center: 44.03308 N, -77.72193 W

Source Protection Information Atlas - SGRA Map



Legend

Significant Groundwater Recharge Area

- N/A
- 0
- 2
- 4
- 6

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Map Created: 4/30/2024
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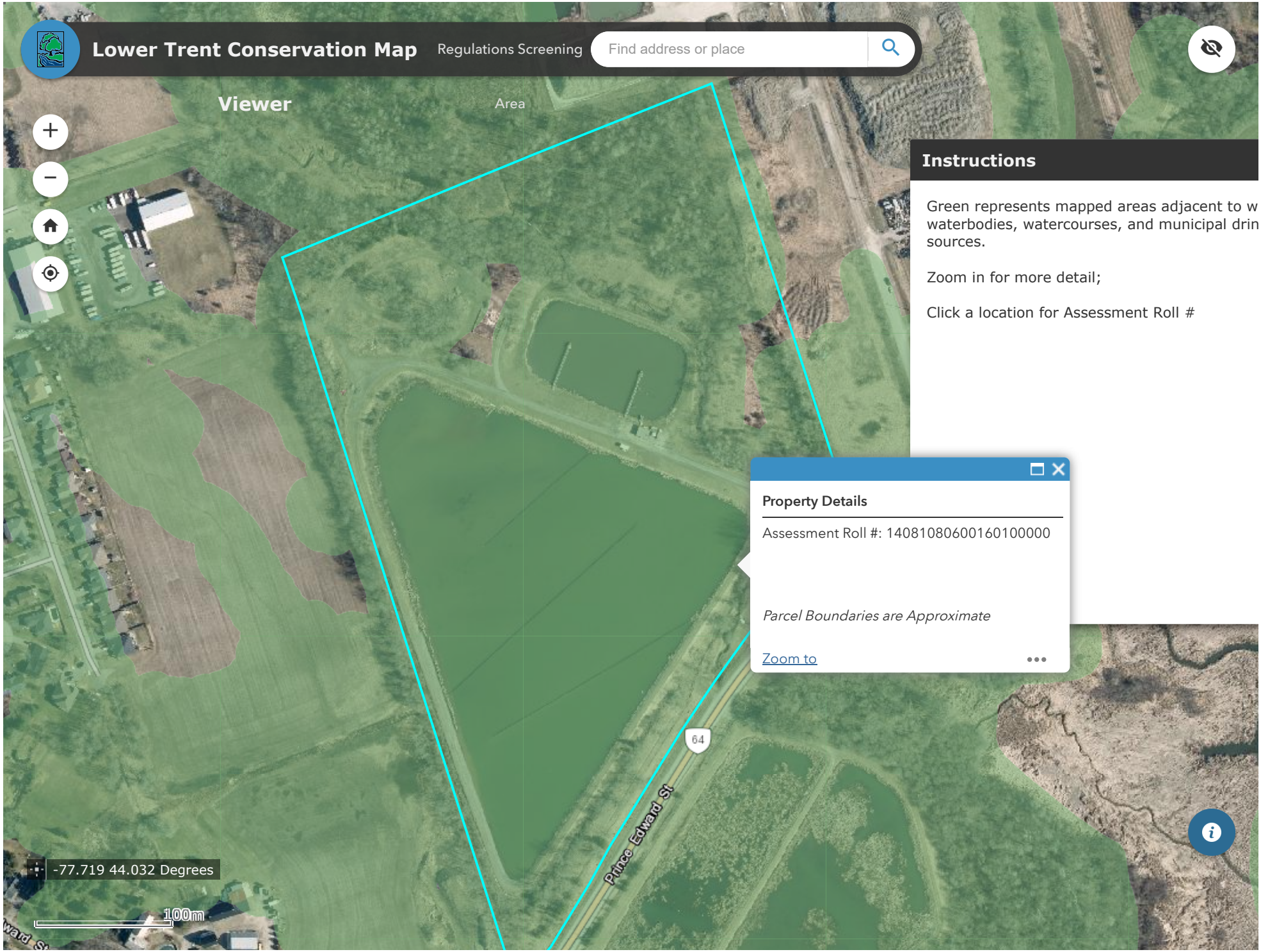

Lower Trent Conservation Map
Regulations Screening
Find address or place
Viewer
Area
Instructions
Green represents mapped areas adjacent to w
waterbodies, watercourses, and municipal drin
sources.
Zoom in for more detail;
Click a location for Assessment Roll #
Property Details
Assessment Roll #: 14081080600160100000
Parcel Boundaries are Approximate
Zoom to
64
Prince Edward St
-77.719 44.032 Degrees
100m

Appendix C

Borehole and Rock Core Logs

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH101-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 2
Project No.:	19712-001	**Elevation:**	85.08 mASL	**Date Completed:**	February 20, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879279 **E:** 281792		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
85.1	0	**TOPSOIL:** 150 mm	84.93	1A	SS			27.2%		Cap	
			0.15								
84.6	0.5	**FILL:** (SM) SILTY SAND: brown, moist, compact, some clay, some gravel		1B	SS	46	11	10.2%	11		
		-loose below									
84.1	1			2	SS	0	8	9.6%	8		
83.6	1.5	-with organics, wood debris								Bentonite Plug	
				3	SS	50	8	18.8%	8	Riser	
83.1	2										
		-clayey, cohesive									
82.6	2.5		82.59	4A	SS			35.3%			
		(SM) gravelly SILTY SAND: grey-brown, cohesive, w > pl, stiff, some clay, with cobbles and boulders [GLACIAL TILL]	2.49	4B	SS	100	9	42.3%	9		
82.1	3										
				5	SS	21	10	11.1%	10		
81.6	3.5										
81.1	4									Sand Pack	
		-non-cohesive, wet, very dense, some gravel								PVC Screen	
80.6	4.5			6	SS	100	50 / 75mm	9.6%	50		
80.1	5										
79.6	5.5		79.29								
		: Refer to rock core log BH101-24	5.79							Cap	
79.1	6										
78.6	6.5										
78.1	7										
77.6											

Groundwater measured on March 5th, 2024 at 2.9 mbgs and 3.7 mbgs.

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS 4B	24	36	32	8
SS 6	15	44	29	12

1m = 24 units

Logged By: RR **Input By:** BV

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH101-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	2 of 2
Project No.:	19712-001	**Elevation:**	85.08 mASL	**Date Completed:**	February 20, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879279 **E:** 281792		

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description (Elevation / Depth)	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI; 25 50 75; % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.); 20 40 60 80; SPT (N) 20 40 60 80	Well Installation	Log Notes
77.6 / 7.5		7.5 : Refer to rock core log BH101-24								
77.1 / 8										
76.6 / 8.5		Borehole terminated @ 8.3 mbgs within the bedrock.								
76.1 / 9										
75.6 / 9.5										
75.1 / 10										
74.6 / 10.5										
74.1 / 11										
73.6 / 11.5										
73.1 / 12										
72.6 / 12.5										
72.1 / 13										
71.6 / 13.5										
71.1 / 14										
70.6 / 14.5										
70.1										

1m = 24 units

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS 4B	24	36	32	8
SS 6	15	44	29	12

Logged By: RR **Input By:** BV

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH102-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	84.65 mASL	**Date Completed:**	February 23, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879300 **E:** 281792		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
84.6	0	**TOPSOIL:** 100 mm	84.55 / 0.1								
		FILL: (SP) SAND and GRAVEL: brown, moist, loose, trace silt		1	SS	42	9	2.2%	9		
84.2	0.5	-(SM) SILTY SAND: with organics									
83.6	1			2	SS	44	8	20.4%	8		
83.2	1.5	-compact, no organics									
				3	SS	56	10	14.5%	10		
82.6	2										
82.2	2.5			4	SS	0	19		19		
81.6	3		81.6 / 3.05								
		(SM) gravelly SILTY SAND: grey brown, moist, compact, some clay, with cobbles and boulders [GLACIAL TILL]		5	SS	22	13	9%	13		
81.2	3.5										
80.6	4										
80.2	4.5	-dense, some gravel		6	SS	100	31	7.4%	31		Borehole remained open and dry upon completion.
79.6	5		79.62 / 5.03								
		Borehole terminated @ 5 mbgs within the glacial till.									
79.2	5.5										
78.6	6										
78.2	6.5										
77.6	7										
77.2											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH103-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 84.54 mASL
Date Completed: February 23, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879292 **E:** 281781

SUBSURFACE PROFILE				SAMPLE							
Elevation (m) / Depth	Lithology	Description (Elevation / Depth)		Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI; 25 50 75; % Moisture 25 50 75	Shear Strength Cu, kPa (nat V. rem V.); 20 40 60 80; SPT (N) 20 40 60 80	Well Installation	Log Notes
84.5 / 0		**TOPSOIL:** 125mm	84.41								0.1m: 75 mm gravel layer underlying topsoil.
84 / 0.5		**FILL:** (ML) SANDY SILT: brown, moist, compact, some gravel	0.13	1	SS	42	11	11.2%	11		
		-some clay, with organics, slightly plastic									
83.5 / 1				2	SS	44	11	16.3%	11		
83 / 1.5		-wet		3	SS	33	10	9.9%	10		
82.5 / 2			82.25								
82 / 2.5		**(SM) gravelly SILTY SAND:** grey brown, cohesive, w < pl, stiff, some clay, with cobbles and boulders [GLACIAL TILL]	2.29	4	SS	56	16	8.2%	16		
81.5 / 3				5	SS	67	12	8.4%	12		
81 / 3.5											
80.5 / 4											
80 / 4.5		-grey, non-cohesive, very dense, some gravel		6	SS	67	50 / 150mm	6.7%	50		
79.5 / 5											
79 / 5.5			79.05								Borehole remained dry and caved to 5.4 mbgs upon completion
		Borehole terminated @ 5.5 mbgs within the glacial till due to practical refusal.	5.49								
78.5 / 6											
78 / 6.5											
77.5 / 7											
77											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: SS
Input By: BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH104-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	83.91 mASL	**Date Completed:**	February 23, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879292 **E:** 281761		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75	% Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80	SPT (N) 20 40 60 80	Well Installation	Log Notes
83.9	0	**TOPSOIL:** 100mm	83.81 / 0.1										
		FILL: (ML) SANDY SILT: dark brown, moist, very loose to loose, trace gravel, with organics		1	SS	42	3		19.3%		3		
83.4	0.5												
82.9	1			2	SS	42	7		19.6%		7		
82.4	1.5			3	SS	44	10		21.7%		10		
81.9	2		81.62 / 2.29										
81.4	2.5	**(SM) gravelly SILTY SAND:** grey-brown, cohesive, w < pl, stiff, some clay, with cobbles and boulders [GLACIAL TILL]		4	SS	100	9		9.5%		9		
80.9	3	-non-cohesive, compact		5	SS	100	14		61.8%		14		
80.4	3.5												
79.9	4												
79.4	4.5	-(GP) sandy GRAVEL: very dense		6	SS	100	50 / 100mm		7.7%		50		
78.9	5												
78.4	5.5												
77.9	6	-grey		7	SS	100	50 / 50mm		9.5%		50		Groundwater encountered at 3.4 mbgs and caved to 4.3 mbgs upon completion.
			77.61 / 6.3										
77.4	6.5	Borehole terminated @ 6.3 mbgs within the glacial till due to practical refusal.											
76.9	7												
76.4													

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS 5	31	36	27	6

1m = 24 units

Logged By: SS **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH105-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 85.3 mASL
Date Completed: February 23, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879311 **E:** 281766

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V. — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
85.3	0	**TOPSOIL:** 125 mm	85.17 / 0.13								
		FILL: (SM) SILTY SAND: dark brown, moist, loose, some gravel, with organics		1	SS	50	8	7.6%	8		
84.8	0.5										
84.3	1			2	SS	22	5	9.1%	5		
83.8	1.5										
				3	SS	56	9	19.5%	9		
83.3	2										
		-dark grey		4	SS	56	7	22%	7		
82.8	2.5										
82.3	3		82.25 / 3.05								
		(SM) SILTY SAND: grey brown, moist, dense, some gravel, trace clay, with cobbles and boulders [GLACIAL TILL]		5	SS	100	30	12.2%	30		
81.8	3.5										
81.3	4										
		-very dense									
80.8	4.5			6	SS	33	50 / 150mm	4.3%	50		Groundwater observed at 3.0 mbgs upon completion.
			80.42 / 4.88								
80.3	5	Borehole terminated @ 4.9 mbgs within the glacial till due to practical refusal.									
79.8	5.5										
79.3	6										
78.8	6.5										
78.3	7										
77.8											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS
Input By: BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH106-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 2
Project No.:	19712-001	**Elevation:**	85.2 mASL	**Date Completed:**	February 20, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879316 **E:** 281786		

Elevation (m) / Depth	Description	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
85.2 / 0	**FILL:** (SM) SILTY SAND: brown, moist, loose, some gravel	1	SS	17	5	13.4%	5	Cap	
84.7 / 0.5	-dark brown, with organics and rootlets								
84.2 / 1		2	SS	46	10	10.6%	10		
83.7 / 1.5	-clayey, grey brown, firm, cohesive								
83.2 / 2		3	SS	50	5	18.4%	5	Bentonite Plug	
82.7 / 2.5	-trace clay, dark brown, non-cohesive, with organics and rootlets	4	SS	38	11	18.3%	11	Riser	
82.2 / 3	82.15 / 3.05 **(SM) gravelly SILTY SAND:** grey-brown, cohesive, w < pl, stiff, some clay, with cobbles and boulders [GLACIAL TILL]	5	SS	67	13	9.4%	13		Groundwater measured on March 5th, 2024 at 3.3 mbgs and 2.3 mbgs.
81.7 / 3.5									
81.2 / 4									
80.7 / 4.5	-non-cohesive, compact, some gravel	6	SS	100	26	7.5%	26	Sand Pack	
80.2 / 5								PVC Screen	
79.7 / 5.5	79.46 / 5.74 : Refer to rock core log BH106-24							Cap	
79.2 / 6									
78.7 / 6.5									
78.2 / 7									
77.7									

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: RR **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH106-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	2 of 2
Project No.:	19712-001	**Elevation:**	85.2 mASL	**Date Completed:**	February 20, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879316 **E:** 281786		

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description (Elevation / Depth)	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI; 25 50 75; % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.); 20 40 60 80; SPT (N) 20 40 60 80	Well Installation	Log Notes
77.7 / 7.5		7.5 : Refer to rock core log BH106-24								
77.2 / 8										
76.7 / 8.5										
76.2 / 9										
75.7 / 9.5		Borehole terminated @ 9.3 mbgs within the bedrock.								
75.2 / 10										
74.7 / 10.5										
74.2 / 11										
73.7 / 11.5										
73.2 / 12										
72.7 / 12.5										
72.2 / 13										
71.7 / 13.5										
71.2 / 14										
70.7 / 14.5										
70.2										

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: RR **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH107-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 2

Project No.: 19712-001
Elevation: 84.8 mASL
Date Completed: February 21, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879301 **E:** 281704

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI	% Moisture	Shear Strength Cu, kPa (nat V., rem V.)	SPT (N)	Well Installation	Log Notes
84.8	0	**TOPSOIL:** 300 mm	84.5	1A	SS	75	11	15.4%		11		Cap	
			0.3	1B	SS			15.5%					
84.3	0.5	**FILL:** (MH) sandy CLAYEY SILT: grey, w > pl, with organics											
		-dark brown		2A	SS			14.7%		15			
83.8	1		83.73			83	15						
		(SM) gravelly SILTY SAND: grey-brown, moist, compact, trace clay, with cobbles and boulders [GLACIAL TILL]	1.07	2B	SS			10.1%					
83.3	1.5											Bentonite Plug	
				3	SS	63	24	6.9%		24		Riser	
82.8	2	-very dense											
				4	SS	100	55	6.1%		55			
82.3	2.5												
81.8	3	-compact, some gravel											
				5	SS	100	25	6.4%		25			Groundwater measured on March 5th, 2024 at 3.3 mbgs and 3.4 mbgs.
81.3	3.5												
80.8	4											Sand Pack	
80.3	4.5	-(GP) sandy GRAVEL: wet, very dense										PVC Screen	
				6	SS	100	50 / 125mm	7.8%		50			
79.8	5		79.77									Cap	
		: Refer to rock core log BH107-24	5.03										
79.3	5.5												
78.8	6												
78.3	6.5												
77.8	7												
77.3													

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH107-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	2 of 2
Project No.:	19712-001	**Elevation:**	84.8 mASL	**Date Completed:**	February 21, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879301 **E:** 281704		

SUBSURFACE PROFILE				SAMPLE							
Elevation (m) / Depth	Lithology	Description (Elevation / Depth)	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI; 25 50 75; % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.); 20 40 60 80; SPT (N) 20 40 60 80	Well Installation	Log Notes
77.3 / 7.5		7.5 : Refer to rock core log BH107-24								
76.8 / 8										
76.3 / 8.5										
75.8 / 9										
75.3 / 9.5		Borehole terminated @ 9.2 mbgs within the bedrock.								
74.8 / 10										
74.3 / 10.5										
73.8 / 11										
73.3 / 11.5										
72.8 / 12										
72.3 / 12.5										
71.8 / 13										
71.3 / 13.5										
70.8 / 14										
70.3 / 14.5										
69.8										

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** BV

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH108-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 84.27 mASL
Date Completed: February 22, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879277 **E:** 281716

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V. 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
84.3	0	**FILL:** (SM) gravelly SILTY SAND: dark brown, moist, with organics	84.09 / 0.18	1A	SS			10.9%			
				1B	SS	67	36	7.3%	36		
83.8	0.5	**FILL:** gravelly SILTY SAND: brown, moist, dense	83.51 / 0.76								
83.3	1	**(SM) gravelly SILTY SAND:** grey-brown, moist, dense, trace clay, with cobbles and boulders [GLACIAL TILL]		2	SS	88	34	8.2%	34		
82.8	1.5	-grey below		3	SS	75	46	5.7%	46		
82.3	2	-very dense									
81.8	2.5			4	SS	100	58	6.3%	58		
81.3	3			5	SS	100	50 / 75mm	5.7%	50		
80.8	3.5										
80.3	4										
79.8	4.5			6	SS	71	93	7.3%	93		
79.3	5										
78.8	5.5	-(GP) sandy GRAVEL, wet, some silt		7	SS	73	72	5.4%	72		
78.3	6		78.22 / 6.05								
77.8	6.5	Borehole terminated @ 6 mbgs within the glacial till due to practical refusal.									Groundwater observed at 4.6 mbgs upon completion. Borehole caved to 5.2 mbgs.
77.3	7										
76.8											

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS1B	31	41	28	

Logged By: FI
Input By: BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH109-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	83.95 mASL	**Date Completed:**	February 22, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879266 **E:** 281696		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V. 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
84	0	**FILL:** (SM) gravelly SILTY SAND: dark brown, wet, compact, some clay, with organics, slightly plastic	83.19	1A	SS	67	21	15.8%	21		
83.4	0.5			1B	SS			19.0%			
			0.76								
83	1	**(SM) gravelly SILTY SAND:** grey-brown, moist, dense, trace clay, with cobbles and boulders [GLACIAL TILL]		2	SS	63	14	5.8%	14		
82.4	1.5	-dense		3	SS	83	37	6.4%	37		
82	2										
81.4	2.5	-wet, very dense, some gravel		4	SS	92	67	9.0%	67		
81	3		80.9								Groundwater observed a 1.8 mbgs upon completion. Borehole caved to 2.3 mbgs.
		Borehole terminated @ 3 mbgs within the glacial till.	3.05								
80.4	3.5										
80	4										
79.4	4.5										
79	5										
78.4	5.5										
78	6										
77.4	6.5										
77	7										
76.4											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH110-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	83.72 mASL	**Date Completed:**	February 22, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879259 **E:** 281716		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V. — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
83.7	0	**ASPHALT:** 75 mm, Rubblized	83.64	1A	SS			5.9%			
		FILL: (SM) gravelly SILTY SAND: brown, moist, compact	0.08	1B	SS	58	15	7.9%	15		
83.2	0.5		82.96								
		(SM) gravelly SILTY SAND: grey brown, moist, dense, trace clay, with cobbles and boulders [GLACIAL TILL]	0.76	2	SS	67	39	4.6%	39		
82.7	1										
		-very dense		3	SS	100	50 / 0mm	6.4%	50		
82.2	1.5										
81.7	2										
		-dense		4	SS	75	48	6.3%	48		
81.2	2.5										
80.7	3		80.67								Borehole remained dry and open upon completion.
		Borehole terminated @ 3 mbgs within the glacial till.	3.05								
80.2	3.5										
79.7	4										
79.2	4.5										
78.7	5										
78.2	5.5										
77.7	6										
77.2	6.5										
76.7	7										
76.2											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH111-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	84.86 mASL	**Date Completed:**	February 22, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879323 **E:** 281711		

SUBSURFACE PROFILE				SAMPLE							
Elevation (m) / Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI; % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V.; SPT (N) 20 40 60 80	Well Installation	Log Notes
84.9 — 0		**TOPSOIL:** 50mm	84.81 / 0.05	1A	SS			10.4%			
		FILL: (SM) gravelly SILTY SAND: grey brown, moist, with cobbles		1B	SS			47.1%			
84.4 — 0.5				1C	SS	75	27	4.3%	27		
83.9 — 1				2A	SS			8.0%			
83.4 — 1.5			83.34	2B	SS	33	6	13.2%	6		Borehole remained dry and open upon completion.
		Borehole terminated @ 1.5 mbgs within the fill material.	1.52								
82.9 — 2											
82.4 — 2.5											
81.9 — 3											
81.4 — 3.5											
80.9 — 4											
80.4 — 4.5											
79.9 — 5											
79.4 — 5.5											
78.9 — 6											
78.4 — 6.5											
77.9 — 7											
77.4											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH112-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	85.15 mASL	**Date Completed:**	February 22, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879342 **E:** 281748		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI / % Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. rem V.) (20 40 60 80) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
85.2	0	**TOPSOIL:** 125 mm	85.02	1A	SS			22.3%		Cap	
			0.13								
84.6	0.5	**FILL:** (SM) gravelly SAND and SILT: grey brown, moist, compact, some clay, with wood debris		1B	SS	58	12	6.6%	12		
		-clayey, w > pl, firm, cohesive									
84.2	1			2	SS	42	5	12.6%	5		
83.6	1.5	-trace gravel, non-cohesive								Bentonite Plug	
				3	SS	63	8	13.4%	8	Riser	
83.2	2										
82.6	2.5	-dark brown, with organics and rootlets		4A	SS	100	13	16.0%	13		Groundwater measured on March 5th, 2024 at 2.4 mbgs and 2.3 mbgs.
				4B	SS			32.4%			
82.2	3		82.1								
			3.05								
81.6	3.5	**(SM) gravelly SILTY SAND:** grey, cohesive, w < pl, firm, some clay, with cobbles and boulders [GLACIAL TILL]		5	SS	17	5	9.7%	5	Sand Pack	
81.2	4									PVC Screen	
80.6	4.5	-non-cohesive, very dense									
				6	SS	75	67	7.8%	67	Cap	
80.2	5										
79.6	5.5										
79.2	6	-(GP) sandy GRAVEL: moist									
				7	SS	67	88	5.2%	88		Groundwater observed at 3.1 mbgs upon completion.
78.6	6.5										
78.2	7		78.19								
		Borehole terminated @ 7 mbgs within the glacial till due to practical refusal.	6.96								
77.6											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH113-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	84.69 mASL	**Date Completed:**	February 23, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879300 **E:** 281813		

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) / % Moisture	Shear Strength Cu, kPa / SPT (N)	Well Installation	Log Notes
84.7	0	**FILL:** (SP) SAND and GRAVEL: grey, moist, compact	1	SS	100	11	5.3%	11		
84.2	0.5									
83.7	1	-very dense	2	SS	100	53	6.7%	53		
83.2	1.5	83.17								Borehole remained dry and open upon completion.
82.7	2	Borehole terminated @ 1.5 mbgs within the fill material. 1.52								
82.2	2.5									
81.7	3									
81.2	3.5									
80.7	4									
80.2	4.5									
79.7	5									
79.2	5.5									
78.7	6									
78.2	6.5									
77.7	7									
77.2										

Atterberg Limits (%): LL, PL, PI — 25 50 75
Shear Strength Cu, kPa: nat V., rem V. — 20 40 60 80
% Moisture: 25 50 75
SPT (N): 20 40 60 80

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH114-23

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 81.85 mASL
Date Completed: February 23, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879269 **E:** 281819

SUBSURFACE PROFILE				SAMPLE							
Elevation (m) / Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI; % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.); SPT (N) 20 40 60 80	Well Installation	Log Notes
81.8 / 0		**TOPSOIL:** 150 mm	81.7 / 0.15								
81.4 / 0.5		**FILL:** (SP) SAND and GRAVEL: grey, moist, dense, trace silt -silty, dark brown, compact, with organics, trace gravel		1	SS	42	43	3.0%	43		
80.8 / 1				2	SS	50	10	19.7%	10		
80.4 / 1.5			80.33 / 1.52								
79.8 / 2		**(SM) SILTY SAND:** grey-brown, cohesive, w < pl, stiff, some gravel, some clay, with cobbles and boulders [GLACIAL TILL] -non-cohesive, very dense		3	SS	63	10	9.1%	10		
79.4 / 2.5				4	SS	100	50 / 125mm	9.0%	50		
78.8 / 3			78.8 / 3.05								Borehole encountered groundwater at 2.3 mbgs and remained open upon completion.
78.4 / 3.5		Borehole terminated @ 3 mbgs within the glacial till.									
77.8 / 4											
77.4 / 4.5											
76.8 / 5											
76.4 / 5.5											
75.8 / 6											
75.4 / 6.5											
74.8 / 7											
74.4											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: SS
Input By: BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH115-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Elevation: 82.1 mASL
Date Completed: February 22, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879249 **E:** 281784

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI (25 50 75) / % Moisture (25 50 75)	Shear Strength Cu, kPa nat V. rem V. (20 40 60 80) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
82.1	0	**FILL:** (SM) SILTY SAND: black, moist, loose, some gravel, with asphaltic concrete and organics		1A	SS			16.4%			
				1B	SS	67	8	16.1%	8		
81.6	0.5	-no asphaltic concrete									
81.1	1		81.03	2	SS	54	15	8.3%	15		
		(SM) gravelly SILTY SAND: brown, moist, dense, trace clay, with cobbles and boulders [GLACIAL TILL]	1.07								
80.6	1.5			3	SS	79	40	6.9%	40		
80.1	2										
		-wet, very dense									
79.6	2.5			4	SS	67	54	10.7%	54		
79.1	3		79.05								Groundwater observed at 2.1 mbgs upon completed. Borehole remained open.
		Borehole terminated @ 3 mbgs within the glacial till.	3.05								
78.6	3.5										
78.1	4										
77.6	4.5										
77.1	5										
76.6	5.5										
76.1	6										
75.6	6.5										
75.1	7										
74.6											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH116-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	82.32 mASL	**Date Completed:**	February 27, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879297 **E:** 281901		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V. rem V.) — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
82.3	0	**TOPSOIL:** 50 mm	82.27 / 0.05	1	SS	50	10	6.6%	10		
81.8	0.5	**FILL:** (SP) SAND and GRAVEL: grey, moist, compact, with organics -silty, brown, trace gravel	81.56 / 0.76	2	SS	56	12	11.2%	12		
81.3	1	**(ML) sandy SILT:** grey, moist, compact, some clay, some gravel -grey brown, compact, some clay, slightly plastic		3	SS	56	13	24.7%	13		
80.8	1.5										
80.3	2			4	SS	67	10	17.8%	10		
79.8	2.5										
79.3	3			5	SS	100	14	14.9%	14		
78.8	3.5										
78.3	4										
77.8	4.5	**(SM) gravelly SILTY SAND:** grey-brown, moist, very dense, trace clay, with cobbles and boulders [GLACIAL TILL]	77.75 / 4.57	6	SS	100	75	5.6%	75		Groundwater encountered at 4.6 mbgs and borehole remained open upon completion.
77.3	5	Borehole terminated @ 5 mbgs within the glacial till.	77.29 / 5.03								
76.8	5.5										
76.3	6										
75.8	6.5										
75.3	7										
74.8											

1m = 24 units

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS 2	0	26	75	
SS 5	6	25	56	13

Logged By: SS **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH117-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	82.07 mASL	**Date Completed:**	February 27, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879291 **E:** 281916		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
82.1	0	**TOPSOIL:** 50 mm	82.02 / 0.05								
		FILL: (SM) SILTY SAND: grey brown, moist, compact, some gravel		1	SS	25	21	5.1%	21		
81.6	0.5	-trace gravel									
81.1	1			2	SS	56	12	18.3%	12		
80.6	1.5	-loose									
				3	SS	22	7	22.3%	7		
80.1	2		79.78 / 2.29								
79.6	2.5	**(ML) sandy SILT:** grey-brown, moist, compact		4	SS	100	10	31.7%	10		
79.1	3	-w > pl									
				5	SS	100	5	37.0%	5		
78.6	3.5	-auger grinding on cobbles and boulders, possible glacial till									
78.1	4										
77.6	4.5		77.5 / 4.57								
		(SM) gravelly SILTY SAND: grey, moist, compact, trace clay, with cobbles and boulders [GLACIAL TILL]		6	SS	100	20	7.9%	20		Groundwater encountered at 3.4 mbgs and borehole remained open upon completion.
77.1	5		77.04 / 5.03								
		Borehole terminated @ 5 mbgs within the glacial till.									
76.6	5.5										
76.1	6										
75.6	6.5										
75.1	7										
74.6											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH118-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	82.5 mASL	**Date Completed:**	February 28, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879335 **E:** 281870		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
82.5	0	**TOPSOIL:** 100 mm	82.4 / 0.1								
82	0.5	**(SM) SILTY SAND:** brown, moist, loose, with organics and rootlets		1	SS	75	5	21.7%	5		
81.5	1	-grey brown, some clay, slightly plastic		2	SS	33	6	22.7%	6		
81	1.5			3	SS	56	10	28.1%	10		
80.5	2		80.21 / 2.29								
80	2.5	**(CL) SILTY CLAY:** grey, w > pl, very soft, trace sand		4	SS	89	1	29.9%	1		
79.5	3		79.45 / 3.05								
79	3.5	**(ML) sandy CLAYEY SILT:** grey, w > pl, firm, some gravel [GLACIAL TILL]		5	SS	100	6	13.4%	6		
78.5	4										
78	4.5	-(GP) sandy GRAVEL, wet, dense, some silt, non-cohesive		6	SS	100	47	7.7%	47		Groundwater encountered at 3.7 mbgs and remained open upon completion.
77.5	5		77.47 / 5.03								
77	5.5	Borehole terminated @ 5 mbgs within the glacial till.									
76.5	6										
76	6.5										
75.5	7										
75											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH119-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 2

Project No.: 19712-001
Elevation: 83.39 mASL
Date Completed: February 28, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879315 **E:** 281905

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V. — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
83.4	0	**(SM) SILTY SAND:** grey brown, moist, very loose, some clay, with organics, slightly plastic		1	SS	42	3	18.1%	3		
82.9	0.5	-brown, trace clay, non-cohesive		2	SS	56	4	15.8%	4		
82.4	1										
81.9	1.5	-grey brown		3	SS	22	6	19.9%	6		
81.4	2										
80.9	2.5	-wet		4	SS	56	9	23.4%	9		
80.4	3		80.34 / 3.05								
79.9	3.5	**(ML) sandy SILT:** grey-brown, moist, loose, some clay, some gravel		5	SS	44	6	32.9%	6		
79.4	4										
78.9	4.5		78.82 / 4.57								
78.4	5	**(ML) sandy CLAYEY SILT:** grey, w > pl, firm, some gravel, with cobbles and boulders [GLACIAL TILL]		6	SS	56	4	11.5%	4		
77.9	5.5										
77.4	6	-(GP) sandy GRAVEL: very dense, some silt, non-cohesive		7	SS	100	50 / 125mm	8.1%	50		
76.9	6.5										
76.4	7										
75.9			75.89 / 7.5								

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS 6	9	31	43	17

Logged By: SS
Input By: BV

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH119-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	2 of 2
Project No.:	19712-001	**Elevation:**	83.39 mASL	**Date Completed:**	February 28, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879315 **E:** 281905		

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V. 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
75.9	7.5		**(ML) sandy CLAYEY SILT:** grey, w > pl, firm, some gravel, with cobbles and boulders [GLACIAL TILL]	75.39	8	SS	80	50 / 100mm		50		Groundwater encountered at 3.0 mbgs and remained open upon completion.
75.4	8		Borehole terminated @ 8 mbgs within the glacial till due to practical refusal.	8								
74.9	8.5											
74.4	9											
73.9	9.5											
73.4	10											
72.9	10.5											
72.4	11											
71.9	11.5											
71.4	12											
70.9	12.5											
70.4	13											
69.9	13.5											
69.4	14											
68.9	14.5											
68.4												

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS 6	9	31	43	17

Logged By: SS **Input By:** BV

Client:	J L Richards & Associates Limited	**Project Name:**	Brighton WWTS Upgrades	**Log of Borehole:**	BH120-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	19712-001	**Elevation:**	82.78 mASL	**Date Completed:**	February 28, 2024
Location:	100 County Rd 64, Brighton ON	**UTM:**	18 T **N:** 4879311 **E:** 281935		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V. / rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
82.8	0	**TOPSOIL:** 100 mm	82.68 / 0.1	1	SS	33	50 / 150mm	10.4%	50		
82.3	0.5	**(SM) SILTY SAND:** grey brown, moist, dense to compact, trace gravel, with organics		2	SS	89	10	19.4%	10		
81.8	1										
81.3	1.5	-wet, no organics		3	SS	22	12	22.1%	12		
80.8	2										
80.3	2.5	-some clay, slightly plastic		4	SS	56	10	23.5%	10		
79.8	3										
79.3	3.5			5	SS	67	8	17.3%	8		
78.8	4										
78.3	4.5		78.21								
77.8	5	**(ML) sandy CLAYEY SILT:** grey, w > pl, very stiff, some gravel, with cobbles and boulders [GLACIAL TILL]	4.57	6	SS	67	22	14.9%	22		
77.3	5.5										
76.8	6	-(SM) sandy GRAVEL: very dense, some silt, some clay, non-cohesive		7	SS	100	68	8.3%	68		Groundwater encountered at 4.6 mbgs and borehole caved to 5.9 mbgs upon completion.
76.3	6.5		76.23								
75.8	7	Borehole terminated @ 6.6 mbgs within the glacial till.	6.55								
75.3											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: SS **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH101-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Ground Elevation: 85.08 mASL
Date Completed: February 20, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879279 **E:** 281792

SUBSURFACE PROFILE

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Core Run	UCS (MPa) 10 50 100 250	Natural Fractures	Lab Notes	Log Notes
79.3	5.8		: (SP) gravelly SAND: with cobbles and boulders [GLACIAL TILL]		Run 1 TCR = **100%** SCR = **20%** RQD = **0%**		20		
78.8	6.3						20		
				78.58 / 6.5			4		
78.3	6.8		**Limestone:** [Lindsay Formation] grey, strong, fresh, slightly disintigrated, intensely to moderately fractured, poor RQD		Run 2 TCR = **100%** SCR = **93%** RQD = **48%**		4		
77.8	7.3						2		
							2		
77.3	7.8				Run 3 TCR = **100%** SCR = **96%** RQD = **35%**		2		
				76.8 / 8.28			3		
76.8	8.3		Rock core terminated @ 8.3m due to due to target depth achieved.						
76.3	8.8								
75.8	9.3								
75.3	9.8								
74.8	10.3								
74.3	10.8								
73.8	11.3								
73.3	11.8								
72.8	12.3								
72.3									

1m = 26 units

Logged By: RR
Input By: BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH106-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Ground Elevation: 85.2 mASL
Date Completed: February 20, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879316 **E:** 281786

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Core Run	UCS (MPa) 10 50 100 250	Natural Fractures	Lab Notes	Log Notes
79.5	5.7		: (SP) sandy GRAVEL: with cobbles and boulders [GLACIAL TILL]		Run 1 TCR = **0%** SCR = **0%** RQD = **0%**		20		
79	6.2						20		
					Run 2 TCR = **0%** SCR = **0%** RQD = **0%**		20		
78.5	6.7						20		
							20		
78	7.2				Run 3 TCR = **0%** SCR = **0%** RQD = **0%**		20		
				77.45					
77.5	7.7		**Limestone:** [Lindsay Formation] grey, strong, fresh, competent, moderately fractured, fair RQD	7.75			2		
							3		
77	8.2				Run 4 TCR = **95%** SCR = **95%** RQD = **65%**		1		
							1		
76.5	8.7						3		
				75.98					
76	9.2		Rock core terminated @ 9.2m due to due to target depth achieved.	9.22					
75.5	9.7								
75	10.2								
74.5	10.7								
74	11.2								
73.5	11.7								
73	12.2								
72.5									

1m = 26 units

Logged By: RR
Input By: BV

Client: J L Richards & Associates Limited
Project Name: Brighton WWTS Upgrades
Log of Borehole: BH107-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 19712-001
Ground Elevation: 84.8 mASL
Date Completed: February 21, 2024

Location: 100 County Rd 64, Brighton ON
UTM: 18 T **N:** 4879301 **E:** 281704

SUBSURFACE PROFILE

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Core Run	UCS (MPa) 10 50 100 250	Natural Fractures	Lab Notes	Log Notes
79.8	5		**Limestone:** [Lindsay Formation], grey, strong, fresh, slightly decomposed to competent, intensely fractured, poor to very poor RQD		Run 1 TCR = **100%** SCR = **58%** RQD = **50%**		20		
79.3	5.5						1		
					Run 2 TCR = **50%** SCR = **44%** RQD = **0%**		20		
78.8	6						4		
							5		
78.3	6.5						4		
					Run 3 TCR = **90%** SCR = **79%** RQD = **35%**		3		
77.8	7						20		
77.3	7.5		-slightly fractured, good RQD				3		
							3		
76.8	8						2		
					Run 4 TCR = **100%** SCR = **100%** RQD = **78%**		0		
76.3	8.5						1		
75.8	9			75.63			7		
			Rock core terminated @ 9.2m due to due to target depth achieved.	9.17					
75.3	9.5								
74.8	10								
74.3	10.5								
73.8	11								
73.3	11.5								
72.8									

Logged By: RR
Input By: BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Appendix D

Grain Size Analysis Results

Grain Size Distribution Chart

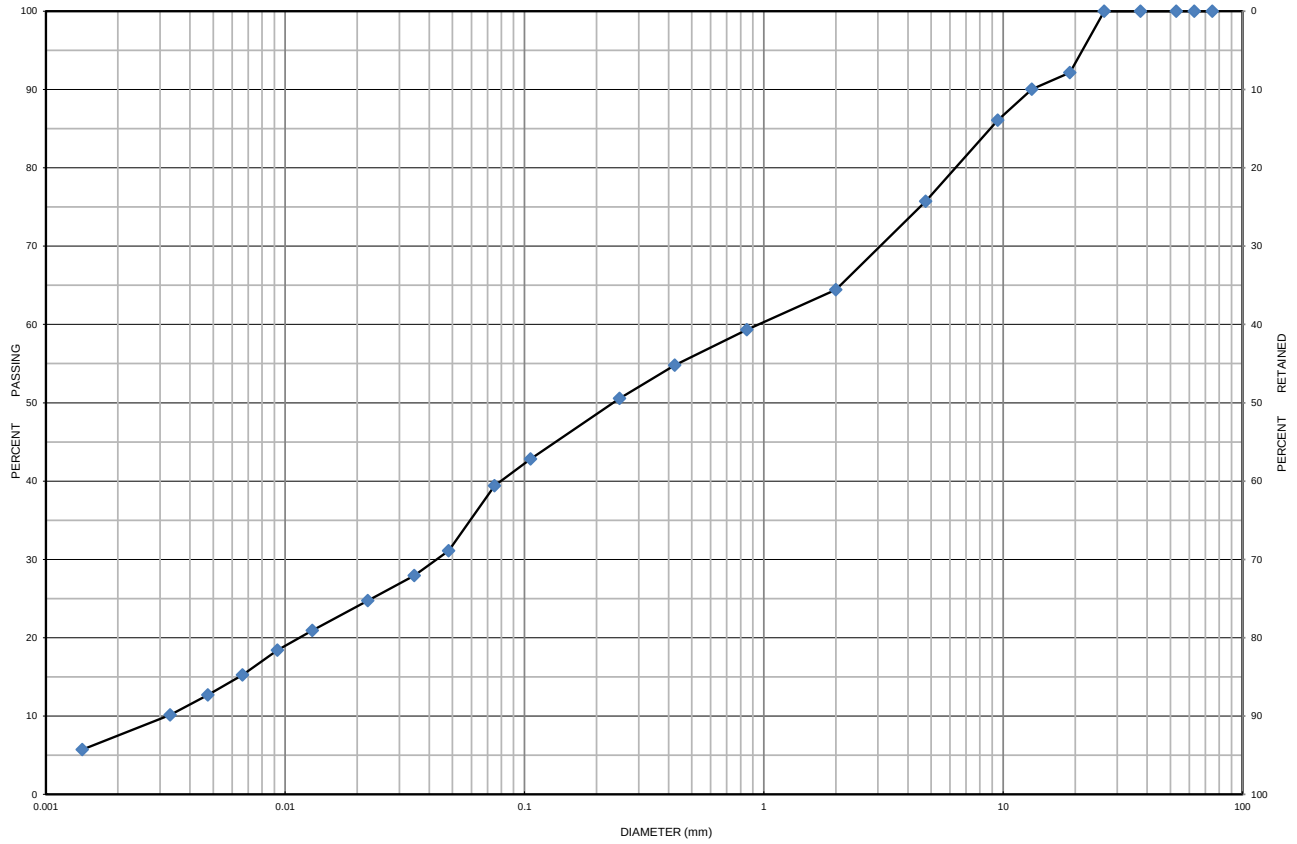
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 101-24 SS 4B* **Depth:** *2.5 m to 2.9 m* **Lab Sample No:** *S-24-0421*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-24	SS 4B	2.5 m to 2.9 m	24	36	32	8	42.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Gravelly Sand trace Clay	SM	0.9500	0.0440	0.0032	296.88	0.64

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

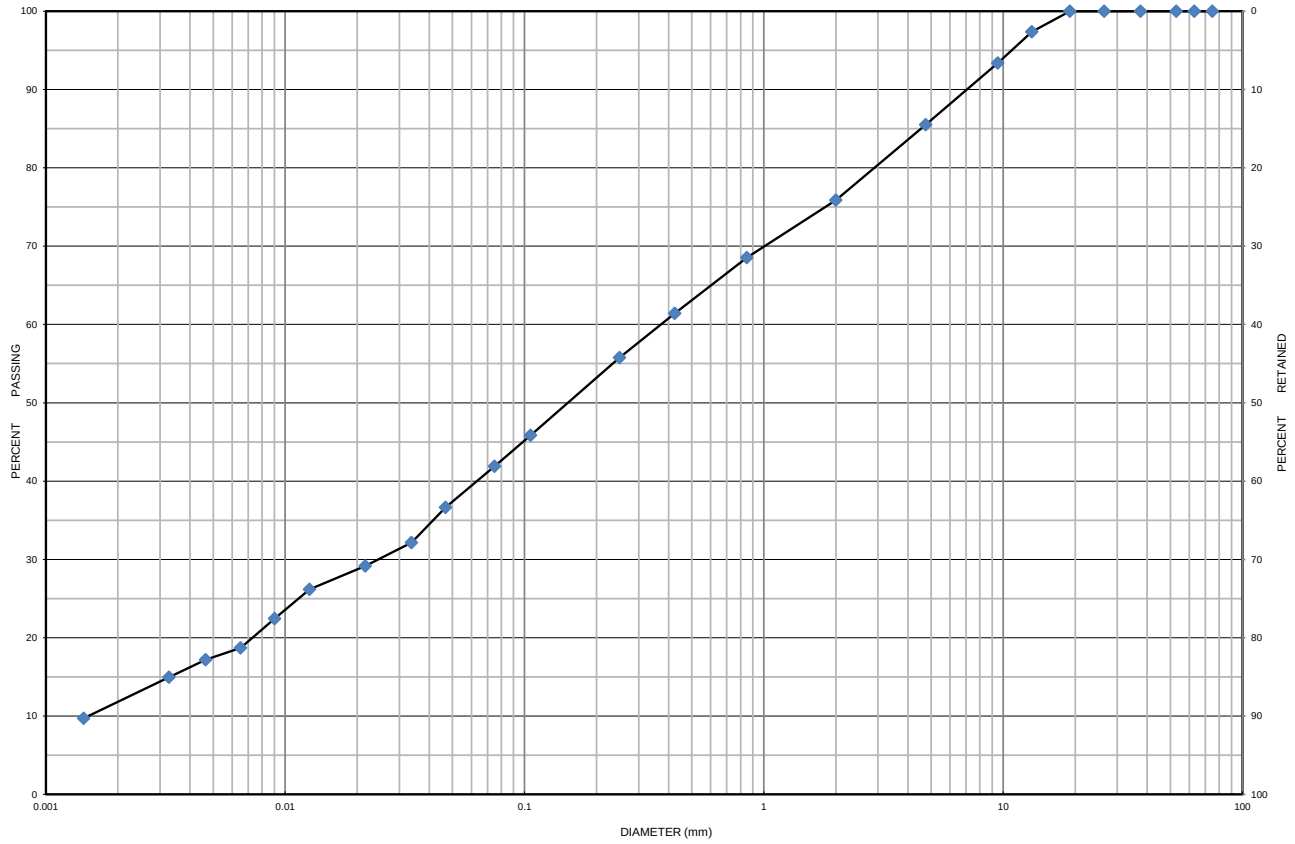
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 101-24 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-24-0422*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-24	SS 6	4.6 m to 5 m	15	44	29	12	9.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Gravel some Clay	SM	0.3700	0.0240	0.0016	231.25	0.97

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

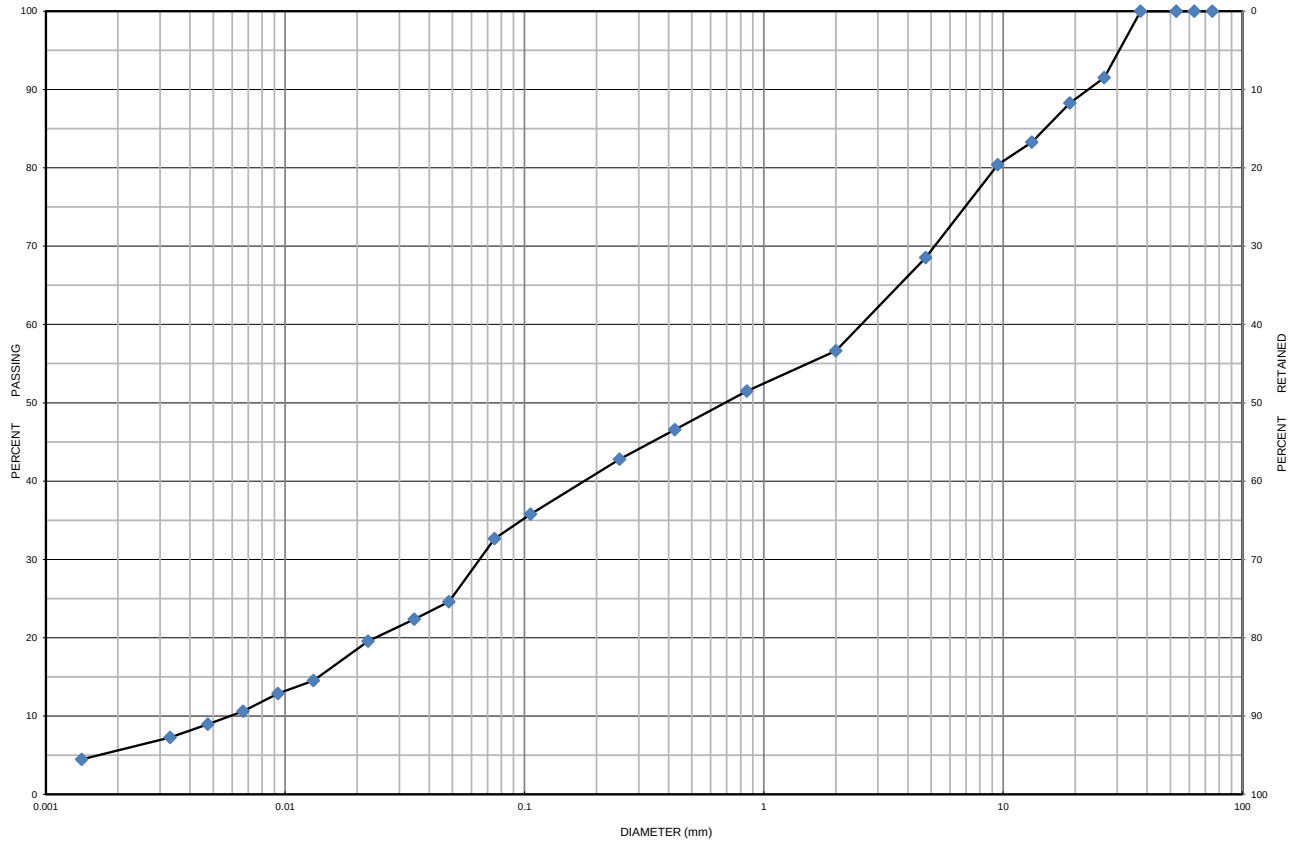
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 104-24 SS 5* **Depth:** *3 m to 3.5 m* **Lab Sample No:** *S-24-0424*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 104-24	SS 5	3 m to 3.5 m	31	36	27	6	61.8

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravelly Silty Sand trace Clay	SM	2.6000	0.0650	0.0059	440.68	0.28

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

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Grain Size Distribution Chart

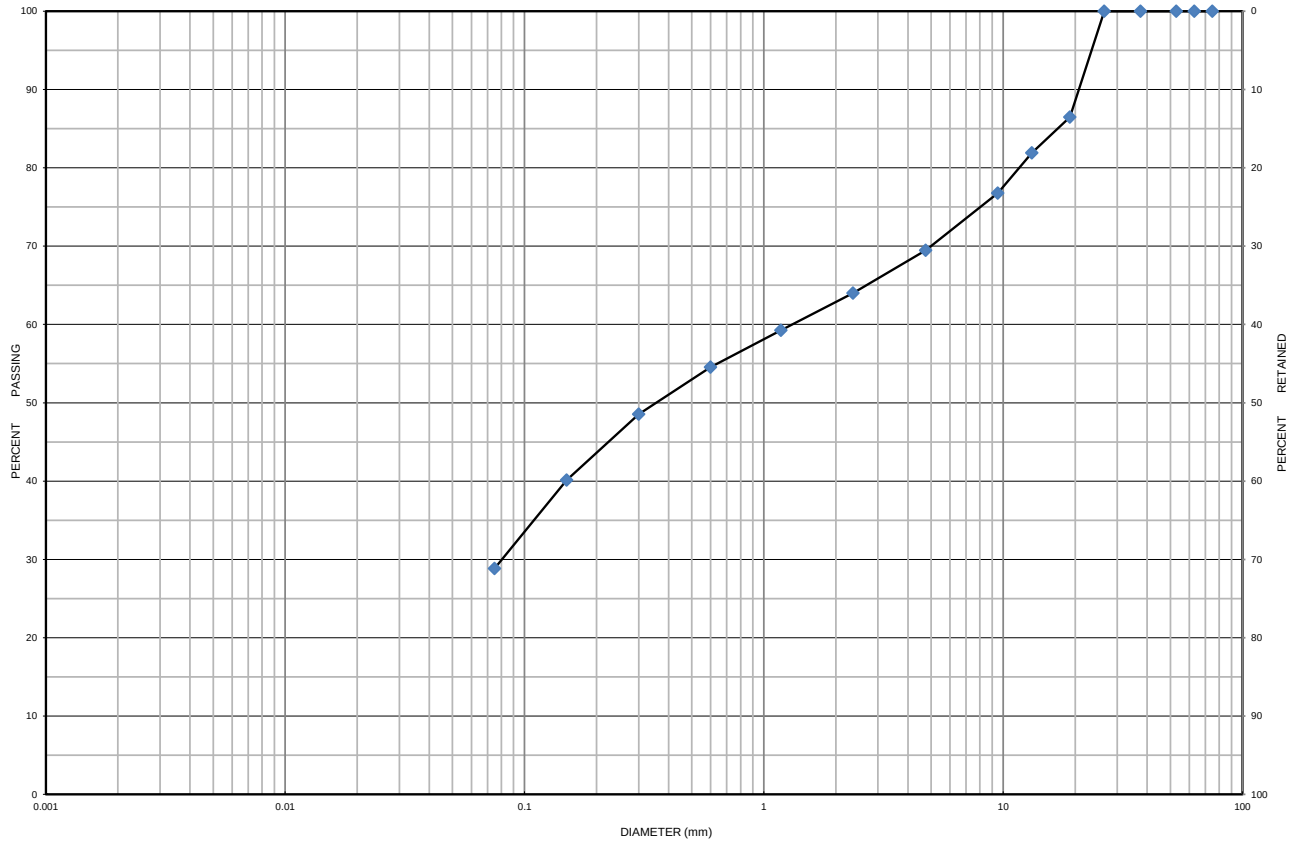
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 108-24 SS 1B* **Depth:** *0.2 m to 0.6 m* **Lab Sample No:** *S-24-0423*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 108-24	SS 1B	0.2 m to 0.6 m	31	41	28		7.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Gravelly Sand	SM	1.400	0.080	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

Cambium Inc. (Laboratory)
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Grain Size Distribution Chart

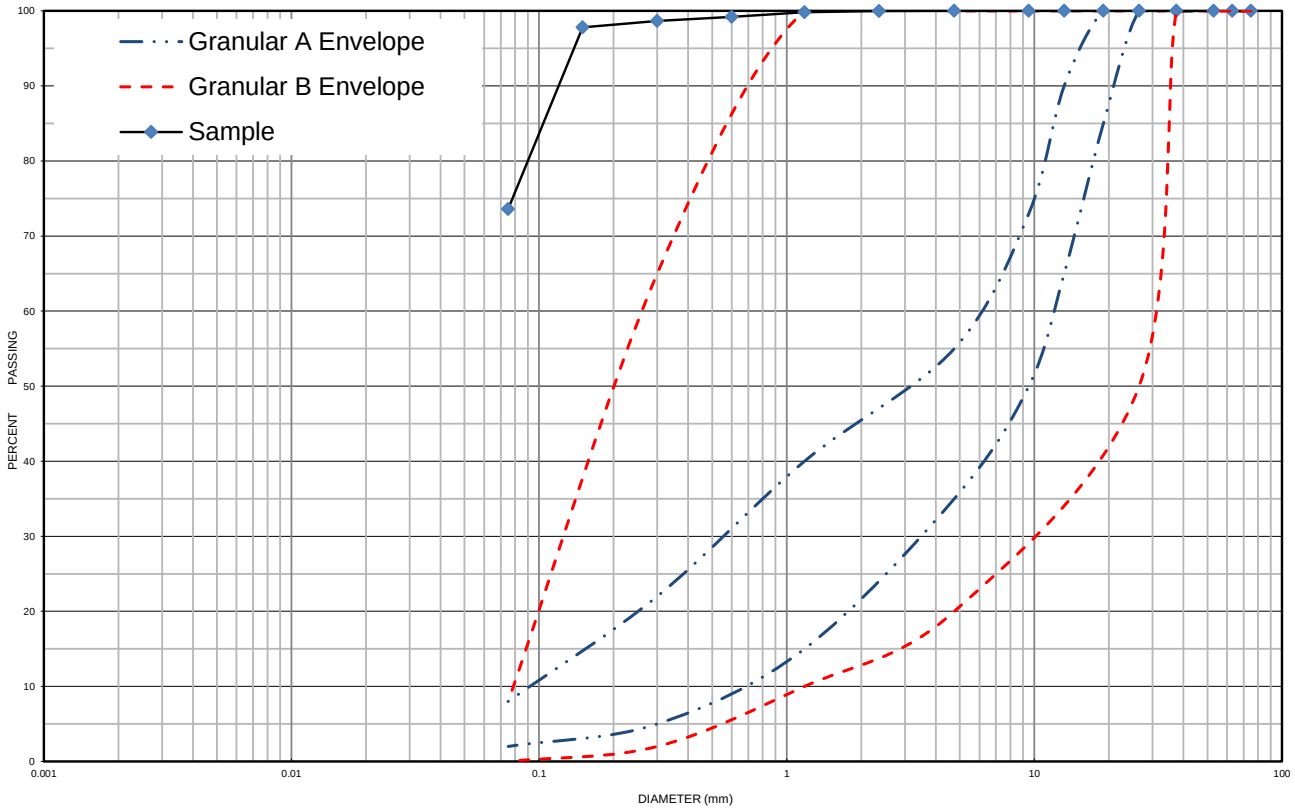
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 116-24 SS 2* **Depth:** *0.8 m to 1.4 m* **Lab Sample No:** *S-24-0425*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 116-24	SS 2	0.8 m to 1.4 m	0	26	74		11.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt	ML	-	-	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

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Grain Size Distribution Chart

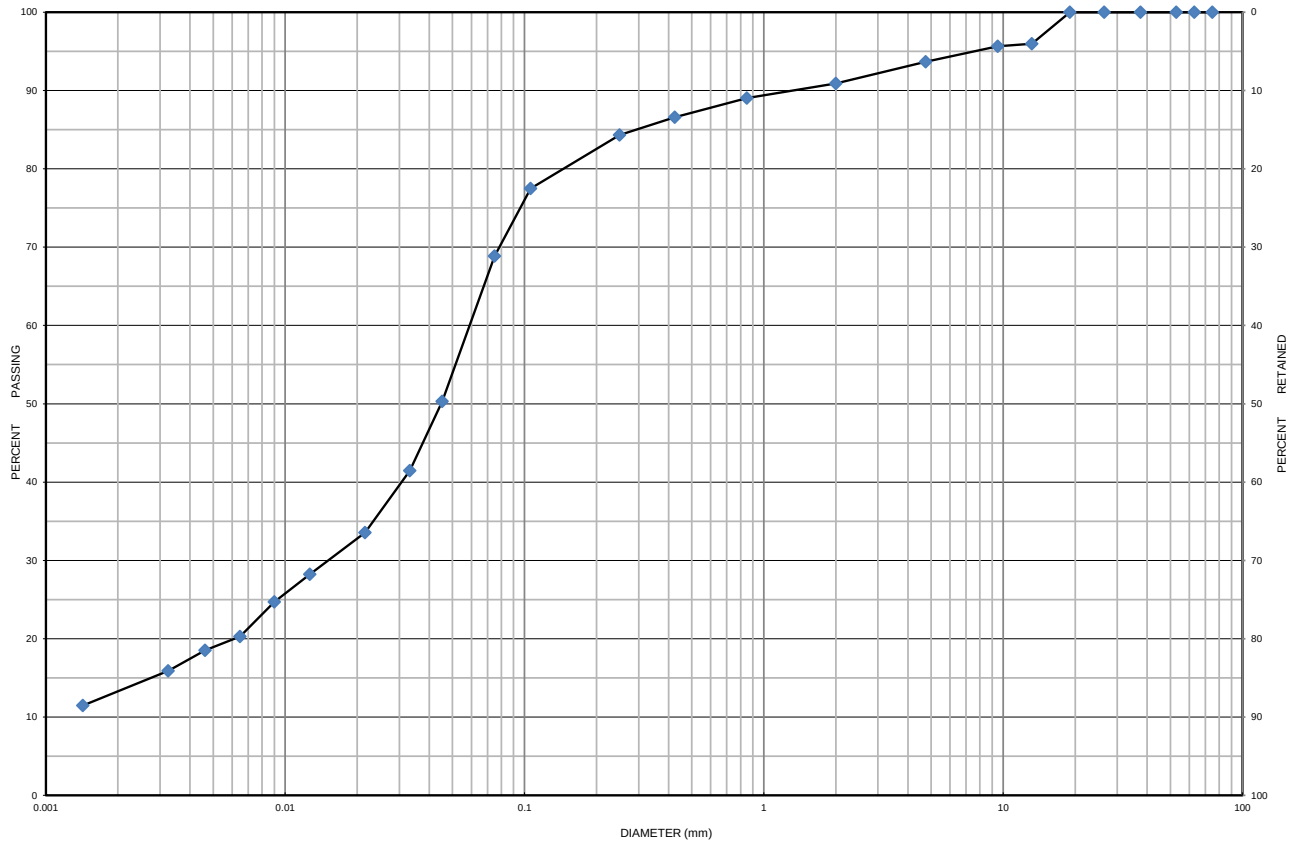
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 116-24 SS 5* **Depth:** *3 m to 3.5 m* **Lab Sample No:** *S-24-0426*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 116-24	SS 5	3 m to 3.5 m	6	25	56	13	14.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt some Clay trace Gravel	ML	0.059	0.016	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

Cambium Inc. (Laboratory)
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194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

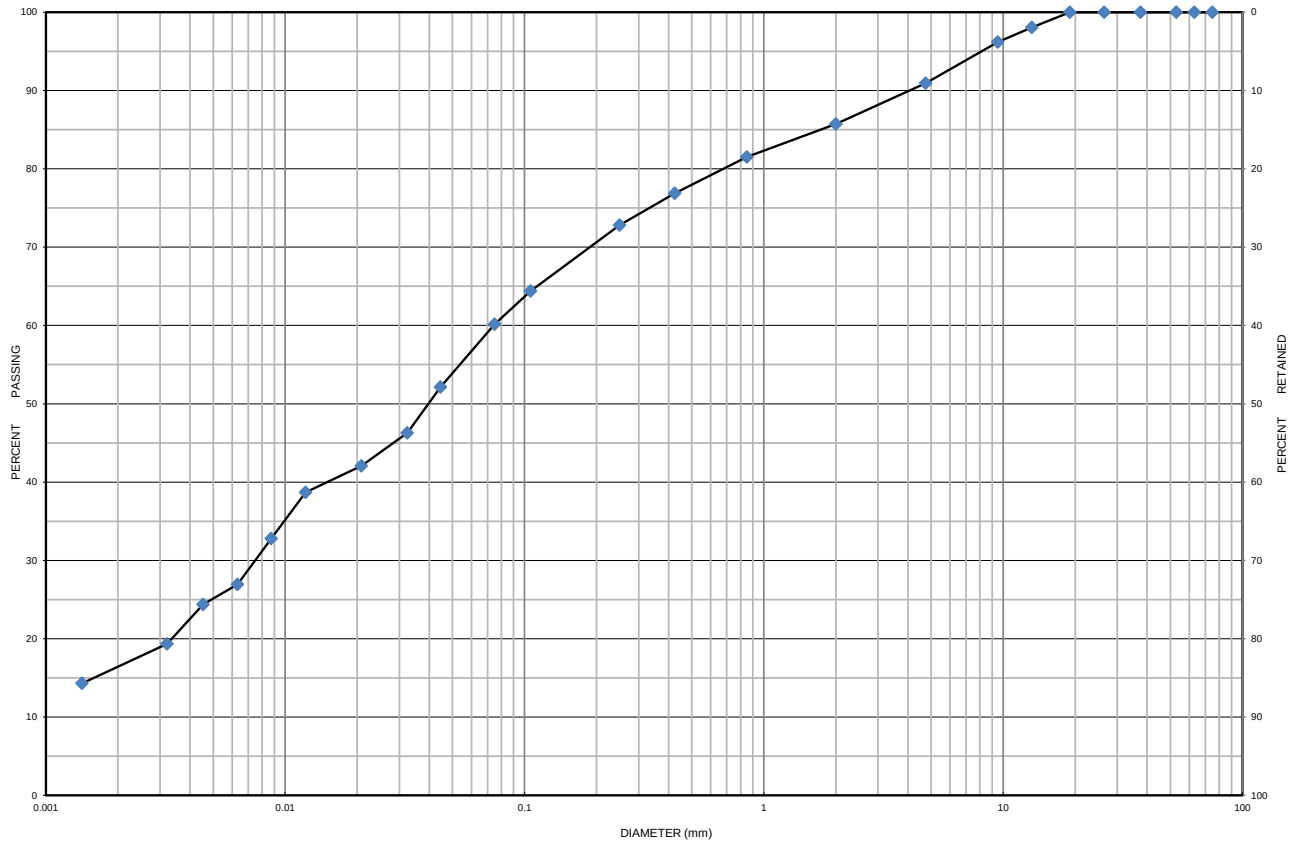
Project Number: *19712-001* **Client:** *J L Richards & Associates Limited*

Project Name: *Brighton WWTS Upgrades*

Sample Date: *January 12, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 119-24 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-24-0427*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 119-24	SS 6	4.6 m to 5 m	9	31	43	17	11.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt some Clay trace Gravel	ML	0.0730	0.0076	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *March 25, 2024*

(Senior Project Manager)

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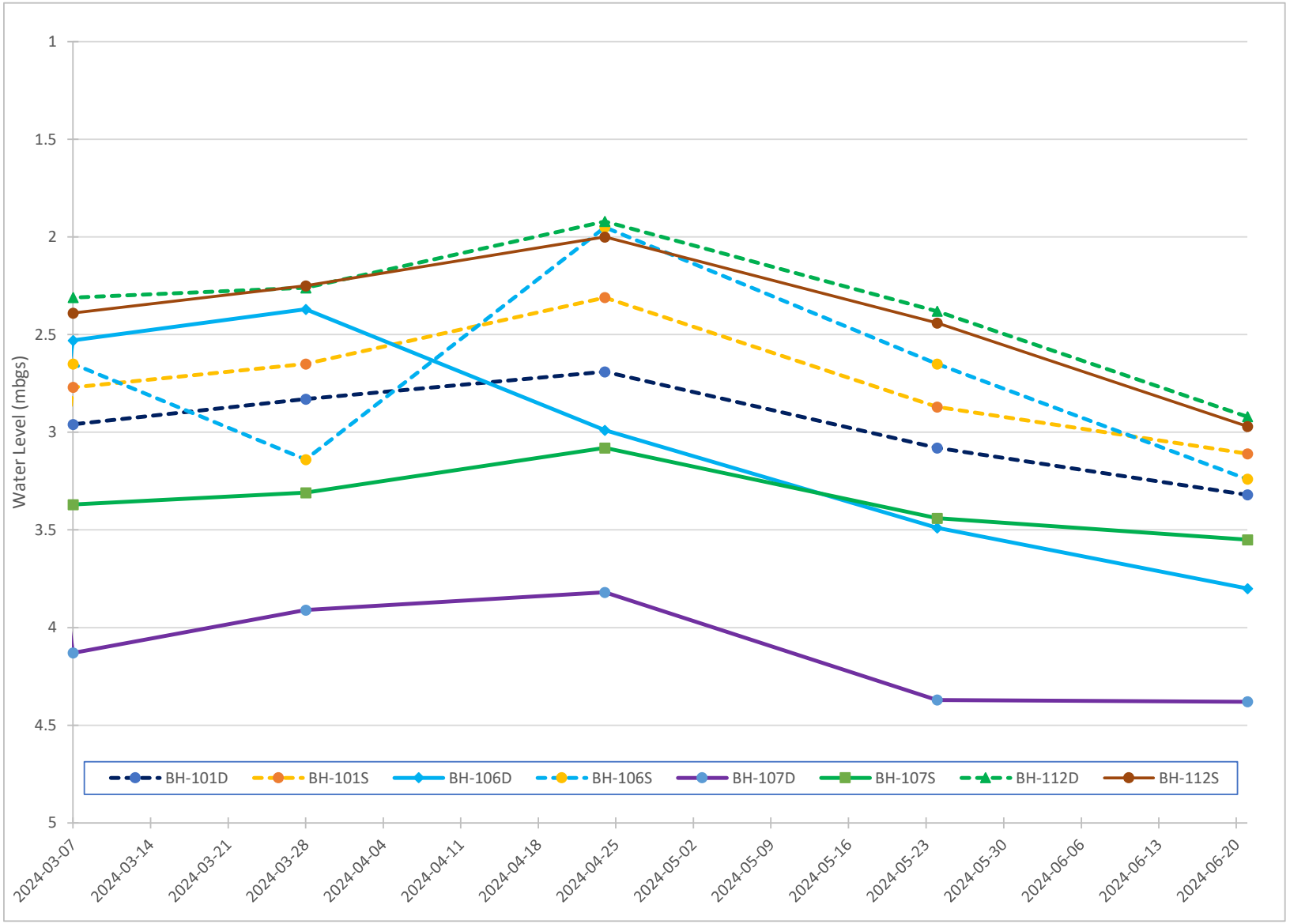
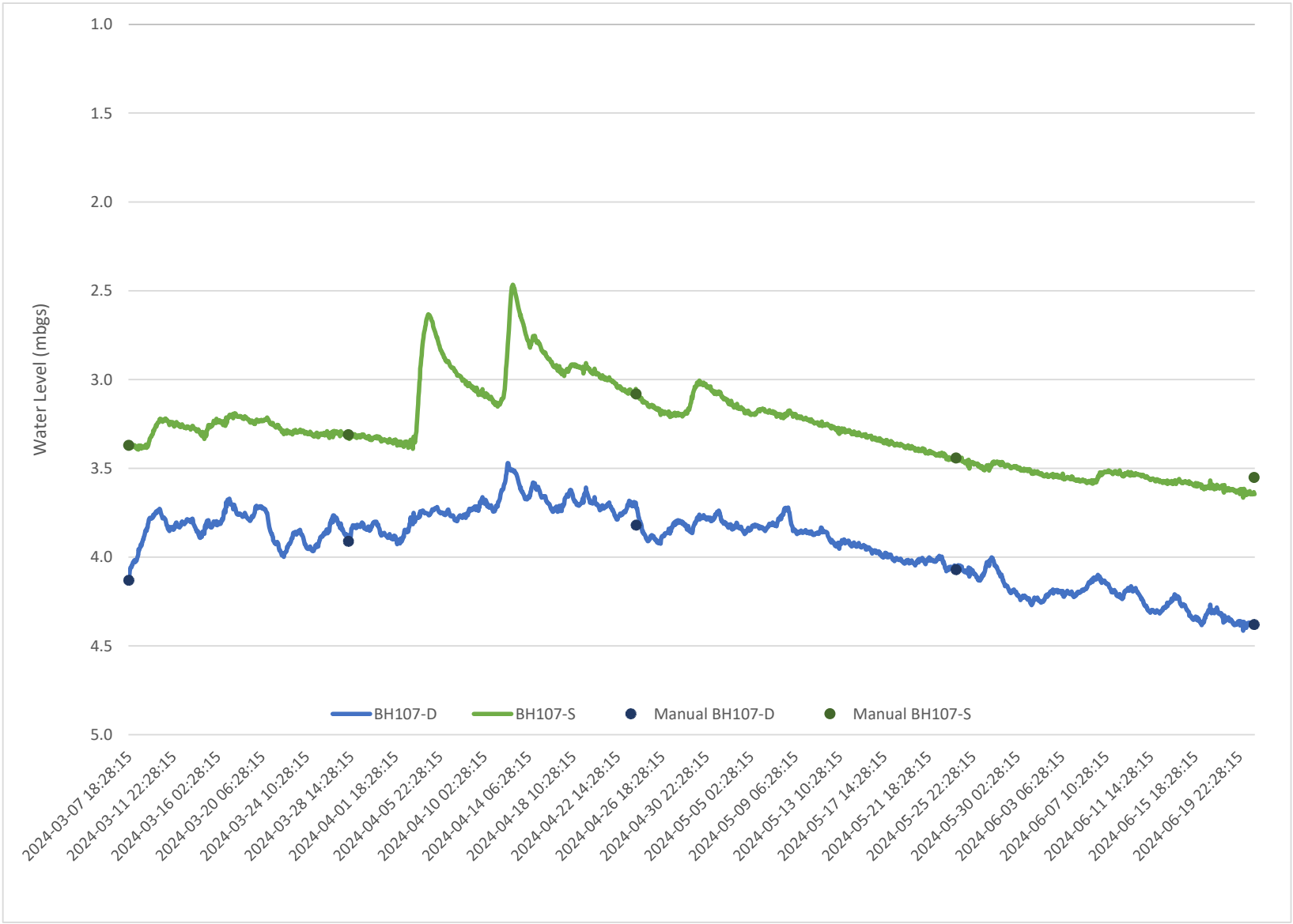
Appendix E

Long-term Water Level Records



Long-term water levels - All Wells (manual measurements)



Long-term Water Levels - BH107-S and BH107-D (logger data)

Appendix F

Water Quality Analysis Results

Your Project #: 19712-001
Your C.O.C. #: C#978961-01-01

Attention: Kyle Horner

Cambium Environmental Inc
31 Hyperion Court, Suite 102
Kingston, ON
Canada K7P 7G3

Report Date: 2024/03/14
Report #: R8066220
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C466842
Received: 2024/03/06, 08:36

Sample Matrix: Ground Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sewer Use By-Law Semivolatile Organics	2	2024/03/07	2024/03/07	CAM SOP 00301	EPA 8270 m
Dissolved Aluminum (0.2 u, clay free)	4	N/A	2024/03/12	CAM SOP-00447	EPA 6020B m
Alkalinity	4	N/A	2024/03/07	CAM SOP-00448	SM 24 2320 B m
Biochemical Oxygen Demand (BOD)	2	2024/03/08	2024/03/13	CAM SOP-00427	SM 24 5210B m
Free Residual Chlorine	2	2024/03/06	2024/03/06	CAM SOP 00425	SM 24 4500-CL G m
Chloride by Automated Colourimetry	2	N/A	2024/03/07	CAM SOP-00463	SM 24 4500-Cl E m
Chromium (VI) in Water	4	N/A	2024/03/07	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	4	N/A	2024/03/07	CAM SOP-00457	OMOE E3015 m
Total Cyanide	2	2024/03/07	2024/03/07	CAM SOP-00457	OMOE E3015 5 m
Dissolved Oxygen	4	2024/03/06	2024/03/06	CAM SOP-00427	SM 24 4500 O G m
Fluoride	2	2024/03/06	2024/03/07	CAM SOP-00449	SM 24 4500-F C m
Formaldehyde (HPLC)	2	2024/03/06	2024/03/07	CAM SOP-00310	EPA 8315A m
Hardness (calculated as CaCO3)	4	N/A	2024/03/12	CAM SOP 00102/00408/00447	SM 2340 B
Mercury	4	2024/03/08	2024/03/08	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS	1	2024/03/11	2024/03/11	CAM SOP-00447	EPA 6020B m
Total Metals Analysis by ICPMS	3	2024/03/11	2024/03/12	CAM SOP-00447	EPA 6020B m
Sulphide (as H2S) (1)	4	N/A	2024/03/09	AB WI-00065	Auto Calc
Total Sulphide (1)	4	N/A	2024/03/09	AB SOP-00080	SM 24 4500 S2-A D Fm
E.coli, (CFU/100mL)	2	N/A	2024/03/06	CAM SOP-00552	MECP E3371
Total Ammonia-N	4	N/A	2024/03/08	CAM SOP-00441	USGS I-2522-90 m
Total Nonylphenol in Liquids by HPLC	2	2024/03/07	2024/03/07	CAM SOP-00313	In-house Method
Nonylphenol Ethoxylates in Liquids: HPLC	2	2024/03/07	2024/03/07	CAM SOP-00313	Bureau Veritas
Animal and Vegetable Oil and Grease	2	N/A	2024/03/09	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	2	2024/03/09	2024/03/09	CAM SOP-00326	EPA1664B m,SM5520B m
OC Pesticides (Selected) & PCB (2)	2	2024/03/08	2024/03/11	CAM SOP-00307	EPA 8081B/ 8082A
OC Pesticides Summed Parameters	2	N/A	2024/03/06	CAM SOP-00307	EPA 8081B/ 8082A
pH (3)	4	2024/03/06	2024/03/07	CAM SOP-00413	SM 24th - 4500H+ B
Phenols (4AAP)	4	N/A	2024/03/07	CAM SOP-00444	OMOE E3179 m
Field Measured pH (4)	4	N/A	2024/03/13		Field pH Meter
Sulphate by Automated Turbidimetry	2	N/A	2024/03/07	CAM SOP-00464	SM 24 4500-SO42- E m

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Your Project #: 19712-001
Your C.O.C. #: C#978961-01-01

Attention: Kyle Horner

Cambium Environmental Inc
31 Hyperion Court, Suite 102
Kingston, ON
Canada K7P 7G3

Report Date: 2024/03/14
Report #: R8066220
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C466842
Received: 2024/03/06, 08:36

Sample Matrix: Ground Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Field Temperature (4)	4	N/A	2024/03/13		Field Thermometer
Total Kjeldahl Nitrogen in Water	1	2024/03/07	2024/03/11	CAM SOP-00938	OMOE E3516 m
Total Kjeldahl Nitrogen in Water	1	2024/03/07	2024/03/08	CAM SOP-00938	OMOE E3516 m
Total PAHs (5)	2	N/A	2024/03/08	CAM SOP - 00301	
Total Phosphorus (Colourimetric)	4	2024/03/07	2024/03/07	CAM SOP-00407	SM 24 4500-P I
Mineral/Synthetic O & G (TPH Heavy Oil) (6)	2	2024/03/09	2024/03/09	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	2	2024/03/08	2024/03/09	CAM SOP-00428	SM 24 2540D m
Turbidity	4	N/A	2024/03/07	CAM SOP-00417	SM 24 2130 B
Un-ionized Ammonia (7)	4	2024/03/06	2024/03/13	Auto Calc.	PWQO
Volatile Organic Compounds in Water	2	N/A	2024/03/08	CAM SOP-00228	EPA 8260D

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 19712-001
Your C.O.C. #: C#978961-01-01

Attention: Kyle Horner

Cambium Environmental Inc
31 Hyperion Court, Suite 102
Kingston, ON
Canada K7P 7G3

Report Date: 2024/03/14
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Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C466842

Received: 2024/03/06, 08:36

(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE , Calgary, AB, T2E 6P8
(2) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane
(3) "The CCME method and Analytical Protocol (O. Reg 153/04, O. Reg. 406/19) requires pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME and Analytical Protocol (O. Reg 153/04, O. Reg. 406/19) holding time. Bureau Veritas endeavors to analyze samples as soon as possible after receipt."

(4) This is a field test, therefore, the results relate to items that were not analysed at Bureau Veritas.
(5) Total PAHs include only those PAHs specified in the sewer use by-by-law.
(6) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease
(7) Un-ionized ammonia is calculated using the total ammonia result and field data provided by the client for pH and temperature.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bureauveritas.com
Phone# (519)652-9444

==========

This report has been generated and distributed using a secure automated process.
Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

BRIGHTON SANITARY SEWER BYLAW (127-2016)

Bureau Veritas ID		YNY785			YNY785		
Sampling Date		2024/03/05 15:30			2024/03/05 15:30		
COC Number		C#978961-01-01			C#978961-01-01		
	UNITS	BH106-D	RDL	QC Batch	BH106-D Lab-Dup	RDL	QC Batch
Calculated Parameters							
Total Animal/Vegetable Oil and Grease	mg/L	<0.50	0.50	9259127			
Inorganics							
Total BOD	mg/L	<2	2	9262848			
Fluoride (F-)	mg/L	0.17	0.10	9259904	0.15	0.10	9259904
Total Kjeldahl Nitrogen (TKN)	mg/L	0.76	0.10	9261020			
Total Suspended Solids	mg/L	980	25	9260533			
Dissolved Sulphate (SO4)	mg/L	78	1.0	9259366			
Total Cyanide (CN)	mg/L	<0.0050	0.0050	9260284			
Dissolved Chloride (Cl-)	mg/L	25	1.0	9259384			
Miscellaneous Parameters							
Formaldehyde	ug/L	<10	10	9259739	<10	10	9259739
Petroleum Hydrocarbons							
Total Oil & Grease	mg/L	<0.50	0.50	9265784			
Total Oil & Grease Mineral/Synthetic	mg/L	<0.50	0.50	9265786			
Miscellaneous Parameters							
Nonylphenol Ethoxylate (Total)	mg/L	<0.025	0.025	9260259			
Nonylphenol (Total)	mg/L	<0.001	0.001	9260251			
Semivolatile Organics							
Di-N-butyl phthalate	ug/L	<8	8	9260314	<8	8	9260314
Bis(2-ethylhexyl)phthalate	ug/L	<8	8	9260314	<8	8	9260314
3,3'-Dichlorobenzidine	ug/L	<3	3	9260314	<3	3	9260314
Pentachlorophenol	ug/L	<4	4	9260314	<4	4	9260314
Phenanthrene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Anthracene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Fluoranthene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Pyrene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Benzo(a)anthracene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Chrysene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Benzo(b/j)fluoranthene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Benzo(k)fluoranthene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Benzo(a)pyrene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

BRIGHTON SANITARY SEWER BYLAW (127-2016)

Bureau Veritas ID		YNY785			YNY785		
Sampling Date		2024/03/05 15:30			2024/03/05 15:30		
COC Number		C#978961-01-01			C#978961-01-01		
	UNITS	BH106-D	RDL	QC Batch	BH106-D Lab-Dup	RDL	QC Batch
Indeno(1,2,3-cd)pyrene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Dibenzo(a,h)anthracene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Benzo(g,h,i)perylene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Dibenzo(a,i)pyrene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Benzo(e)pyrene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Perylene	ug/L	<0.8	0.8	9260314	<0.8	0.8	9260314
Dibenzo(a,j) acridine	ug/L	<2	2	9260314	<2	2	9260314
7H-Dibenzo(c,g) Carbazole	ug/L	<2	2	9260314	<2	2	9260314
1,6-Dinitropyrene	ug/L	<2	2	9260314	<2	2	9260314
1,3-Dinitropyrene	ug/L	<2	2	9260314	<2	2	9260314
1,8-Dinitropyrene	ug/L	<2	2	9260314	<2	2	9260314
Calculated Parameters							
Total PAHs (18 PAHs)	ug/L	<5	5	9259174			
Volatile Organics							
Benzene	ug/L	<0.20	0.20	9260755			
Chloroform	ug/L	<0.20	0.20	9260755			
1,2-Dichlorobenzene	ug/L	<0.40	0.40	9260755			
1,4-Dichlorobenzene	ug/L	<0.40	0.40	9260755			
cis-1,2-Dichloroethylene	ug/L	<0.50	0.50	9260755			
trans-1,3-Dichloropropene	ug/L	<0.40	0.40	9260755			
Ethylbenzene	ug/L	<0.20	0.20	9260755			
Methylene Chloride(Dichloromethane)	ug/L	<2.0	2.0	9260755			
1,1,2,2-Tetrachloroethane	ug/L	<0.40	0.40	9260755			
Tetrachloroethylene	ug/L	<0.20	0.20	9260755			
Toluene	ug/L	<0.20	0.20	9260755			
Trichloroethylene	ug/L	<0.20	0.20	9260755			
Vinyl Chloride	ug/L	<0.20	0.20	9260755			
p+m-Xylene	ug/L	<0.20	0.20	9260755			
o-Xylene	ug/L	<0.20	0.20	9260755			
Total Xylenes	ug/L	<0.20	0.20	9260755			
Calculated Parameters							
Aldrin + Dieldrin	ug/L	<0.005	0.005	9258305			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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BRIGHTON SANITARY SEWER BYLAW (127-2016)

Bureau Veritas ID		YNY785			YNY785		
Sampling Date		2024/03/05 15:30			2024/03/05 15:30		
COC Number		C#978961-01-01			C#978961-01-01		
	UNITS	BH106-D	RDL	QC Batch	BH106-D Lab-Dup	RDL	QC Batch
Chlordane (Total)	ug/L	<0.005	0.005	9258305			
DDT+ Metabolites	ug/L	<0.005	0.005	9258305			
Pesticides & Herbicides							
a-Chlordane	ug/L	<0.005	0.005	9264041	<0.005	0.005	9264041
g-Chlordane	ug/L	<0.005	0.005	9264041	<0.005	0.005	9264041
o,p-DDT	ug/L	<0.005	0.005	9264041	<0.005	0.005	9264041
p,p-DDT	ug/L	<0.005	0.005	9264041	<0.005	0.005	9264041
Lindane	ug/L	<0.003	0.003	9264041	<0.003	0.003	9264041
Hexachlorobenzene	ug/L	<0.005	0.005	9264041	<0.005	0.005	9264041
Mirex	ug/L	<0.005	0.005	9264041	<0.005	0.005	9264041
Surrogate Recovery (%)							
2,4,6-Tribromophenol	%	76		9260314	76		9260314
2-Fluorobiphenyl	%	69		9260314	74		9260314
D14-Terphenyl (FS)	%	99		9260314	98		9260314
D5-Nitrobenzene	%	85		9260314	88		9260314
D8-Acenaphthylene	%	77		9260314	80		9260314
2,4,5,6-Tetrachloro-m-xylene	%	52		9264041	46 (1)		9264041
Decachlorobiphenyl	%	72		9264041	77		9264041
4-Bromofluorobenzene	%	97		9260755			
D4-1,2-Dichloroethane	%	104		9260755			
D8-Toluene	%	98		9260755			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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BRIGHTON SANITARY SEWER BYLAW (127-2016)

Bureau Veritas ID		YNY786		
Sampling Date		2024/03/05 16:15		
COC Number		C#978961-01-01		
	UNITS	BH106-S	RDL	QC Batch
Calculated Parameters				
Total Animal/Vegetable Oil and Grease	mg/L	<0.50	0.50	9259127
Inorganics				
Total BOD	mg/L	2	2	9262848
Fluoride (F-)	mg/L	<0.10	0.10	9259904
Total Kjeldahl Nitrogen (TKN)	mg/L	1.5	0.20	9261020
Total Suspended Solids	mg/L	10000	100	9260533
Dissolved Sulphate (SO4)	mg/L	180	1.0	9259366
Total Cyanide (CN)	mg/L	<0.0050	0.0050	9260284
Dissolved Chloride (Cl-)	mg/L	31	1.0	9259384
Miscellaneous Parameters				
Formaldehyde	ug/L	<10	10	9259739
Petroleum Hydrocarbons				
Total Oil & Grease	mg/L	<0.50	0.50	9265784
Total Oil & Grease Mineral/Synthetic	mg/L	<0.50	0.50	9265786
Miscellaneous Parameters				
Nonylphenol Ethoxylate (Total)	mg/L	<0.025	0.025	9260259
Nonylphenol (Total)	mg/L	<0.001	0.001	9260251
Semivolatile Organics				
Di-N-butyl phthalate	ug/L	<8	8	9260314
Bis(2-ethylhexyl)phthalate	ug/L	<8	8	9260314
3,3'-Dichlorobenzidine	ug/L	<3	3	9260314
Pentachlorophenol	ug/L	<4	4	9260314
Phenanthrene	ug/L	<0.8	0.8	9260314
Anthracene	ug/L	<0.8	0.8	9260314
Fluoranthene	ug/L	<0.8	0.8	9260314
Pyrene	ug/L	<0.8	0.8	9260314
Benzo(a)anthracene	ug/L	<0.8	0.8	9260314
Chrysene	ug/L	<0.8	0.8	9260314
Benzo(b/j)fluoranthene	ug/L	<0.8	0.8	9260314
Benzo(k)fluoranthene	ug/L	<0.8	0.8	9260314
Benzo(a)pyrene	ug/L	<0.8	0.8	9260314

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BRIGHTON SANITARY SEWER BYLAW (127-2016)

Bureau Veritas ID		YNY786		
Sampling Date		2024/03/05 16:15		
COC Number		C#978961-01-01		
	UNITS	**BH106-S**	**RDL**	**QC Batch**
Indeno(1,2,3-cd)pyrene	ug/L	<0.8	0.8	9260314
Dibenzo(a,h)anthracene	ug/L	<0.8	0.8	9260314
Benzo(g,h,i)perylene	ug/L	<0.8	0.8	9260314
Dibenzo(a,i)pyrene	ug/L	<0.8	0.8	9260314
Benzo(e)pyrene	ug/L	<0.8	0.8	9260314
Perylene	ug/L	<0.8	0.8	9260314
Dibenzo(a,j) acridine	ug/L	<2	2	9260314
7H-Dibenzo(c,g) Carbazole	ug/L	<2	2	9260314
1,6-Dinitropyrene	ug/L	<2	2	9260314
1,3-Dinitropyrene	ug/L	<2	2	9260314
1,8-Dinitropyrene	ug/L	<2	2	9260314
Calculated Parameters				
Total PAHs (18 PAHs)	ug/L	<5	5	9259176
Volatile Organics				
Benzene	ug/L	<0.20	0.20	9260755
Chloroform	ug/L	<0.20	0.20	9260755
1,2-Dichlorobenzene	ug/L	<0.40	0.40	9260755
1,4-Dichlorobenzene	ug/L	<0.40	0.40	9260755
cis-1,2-Dichloroethylene	ug/L	<0.50	0.50	9260755
trans-1,3-Dichloropropene	ug/L	<0.40	0.40	9260755
Ethylbenzene	ug/L	<0.20	0.20	9260755
Methylene Chloride(Dichloromethane)	ug/L	<2.0	2.0	9260755
1,1,2,2-Tetrachloroethane	ug/L	<0.40	0.40	9260755
Tetrachloroethylene	ug/L	<0.20	0.20	9260755
Toluene	ug/L	0.33	0.20	9260755
Trichloroethylene	ug/L	<0.20	0.20	9260755
Vinyl Chloride	ug/L	<0.20	0.20	9260755
p+m-Xylene	ug/L	0.42	0.20	9260755
o-Xylene	ug/L	<0.20	0.20	9260755
Total Xylenes	ug/L	0.42	0.20	9260755
Calculated Parameters				
Aldrin + Dieldrin	ug/L	<0.005	0.005	9258305

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BRIGHTON SANITARY SEWER BYLAW (127-2016)

Bureau Veritas ID		YNY786		
Sampling Date		2024/03/05 16:15		
COC Number		C#978961-01-01		
	UNITS	**BH106-S**	**RDL**	**QC Batch**
Chlordane (Total)	ug/L	<0.005	0.005	9258305
DDT+ Metabolites	ug/L	<0.01	0.01	9258305
Pesticides & Herbicides				
a-Chlordane	ug/L	<0.005	0.005	9264041
g-Chlordane	ug/L	<0.005	0.005	9264041
o,p-DDT	ug/L	<0.005	0.005	9264041
p,p-DDT	ug/L	<0.01 (1)	0.01	9264041
Lindane	ug/L	<0.003	0.003	9264041
Hexachlorobenzene	ug/L	<0.005	0.005	9264041
Mirex	ug/L	<0.005	0.005	9264041
Surrogate Recovery (%)				
2,4,6-Tribromophenol	%	91		9260314
2-Fluorobiphenyl	%	79		9260314
D14-Terphenyl (FS)	%	101		9260314
D5-Nitrobenzene	%	93		9260314
D8-Acenaphthylene	%	85		9260314
2,4,5,6-Tetrachloro-m-xylene	%	49 (2)		9264041
Decachlorobiphenyl	%	73		9264041
4-Bromofluorobenzene	%	95		9260755
D4-1,2-Dichloroethane	%	108		9260755
D8-Toluene	%	96		9260755

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection Limit was raised due to matrix interferences.
(2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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PWQO METALS AND INORGANICS (GROUND WATER)

Bureau Veritas ID		YNY785			YNY785			YNY786		
Sampling Date		2024/03/05 15:30			2024/03/05 15:30			2024/03/05 16:15		
COC Number		C#978961-01-01			C#978961-01-01			C#978961-01-01		
	UNITS	BH106-D	RDL	QC Batch	BH106-D Lab-Dup	RDL	QC Batch	BH106-S	RDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	610	1.0	9258324				860	1.0	9258324
Sulphide (as H2S)	mg/L	0.046	0.0020	9267084				0.38	0.038	9267084
Total Un-ionized Ammonia	mg/L	<0.00061	0.00061	9258068				<0.00061	0.00061	9258068
Field Measurements										
Field Temperature	Celsius	12.3	N/A	ONSITE				12.8	N/A	ONSITE
Field Measured pH	pH	6.48		ONSITE				6.70		ONSITE
Inorganics										
Total Ammonia-N	mg/L	0.32	0.050	9259401				0.19	0.050	9259401
Dissolved Oxygen	mg/L	8.43	0.050	9259295				8.10	0.050	9259295
pH	pH	7.43		9259905	7.53		9259905	7.13		9259905
Phenols-4AAP	mg/L	0.0011	0.0010	9260625				<0.0010	0.0010	9260625
Total Phosphorus	mg/L	0.49	0.004	9260440				0.078	0.004	9260440
Total Sulphide	mg/L	0.044	0.0018	9267085				0.35 (1)	0.036	9267085
Turbidity	NTU	420	0.5	9259832	410	0.5	9259832	2400	1	9259832
WAD Cyanide (Free)	ug/L	<1	1	9260283	<1	1	9260283	<1	1	9260283
Alkalinity (Total as CaCO3)	mg/L	470	1.0	9259902	470	1.0	9259902	640	1.0	9259902
Metals										
Dissolved (0.2u) Aluminum (Al)	ug/L	<5	5	9260721				<5	5	9260721
Chromium (VI)	ug/L	<0.50	0.50	9260463				<0.50	0.50	9260463
Mercury (Hg)	ug/L	<0.10	0.10	9263386				<1.5	1.5	9263386
Total Antimony (Sb)	ug/L	<0.50	0.50	9266357				<0.50	0.50	9266357
Total Arsenic (As)	ug/L	3.7	1.0	9266357				63	1.0	9266357
Total Beryllium (Be)	ug/L	0.45	0.40	9266357				4.0	0.40	9266357
Total Boron (B)	ug/L	90	10	9266357				110	10	9266357
Total Cadmium (Cd)	ug/L	0.093	0.090	9266357				1.4	0.090	9266357
Total Chromium (Cr)	ug/L	13	5.0	9266357				130	5.0	9266357
Total Cobalt (Co)	ug/L	3.6	0.50	9266357				54	0.50	9266357
Total Copper (Cu)	ug/L	10	0.90	9266357				75	0.90	9266357

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Sample pH <9, preservation incomplete. Due to volatility of analyte, a low bias in the results is likely.
Detection limits raised due to sample matrix.

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PWQO METALS AND INORGANICS (GROUND WATER)

Bureau Veritas ID		YNY785			YNY785			YNY786		
Sampling Date		2024/03/05 15:30			2024/03/05 15:30			2024/03/05 16:15		
COC Number		C#978961-01-01			C#978961-01-01			C#978961-01-01		
	UNITS	BH106-D	RDL	QC Batch	BH106-D Lab-Dup	RDL	QC Batch	BH106-S	RDL	QC Batch
Total Iron (Fe)	ug/L	12000	100	9266357				150000	1000	9266357
Total Lead (Pb)	ug/L	8.9	0.50	9266357				130	0.50	9266357
Total Molybdenum (Mo)	ug/L	1.5	0.50	9266357				6.1	0.50	9266357
Total Nickel (Ni)	ug/L	9.4	1.0	9266357				110	1.0	9266357
Total Selenium (Se)	ug/L	<2.0	2.0	9266357				<2.0	2.0	9266357
Total Silver (Ag)	ug/L	0.61	0.090	9266357				0.28	0.090	9266357
Total Thallium (Tl)	ug/L	0.11	0.050	9266357				1.3	0.050	9266357
Total Tungsten (W)	ug/L	4.9	1.0	9266357				<1.0	1.0	9266357
Total Uranium (U)	ug/L	0.95	0.10	9266357				9.8	0.10	9266357
Total Vanadium (V)	ug/L	14	0.50	9266357				140	0.50	9266357
Total Zinc (Zn)	ug/L	40	5.0	9266357				560	5.0	9266357
Total Zirconium (Zr)	ug/L	1.8	1.0	9266357				21	1.0	9266357

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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PWQO METALS AND INORGANICS (GROUND WATER)

Bureau Veritas ID		YNY787			YNY787			YNY788		
Sampling Date		2024/03/05			2024/03/05			2024/03/05		
COC Number		C#978961-01-01			C#978961-01-01			C#978961-01-01		
	UNITS	BH107-D	RDL	QC Batch	BH107-D Lab-Dup	RDL	QC Batch	BH107-S	RDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	280	1.0	9258324				600	1.0	9258324
Sulphide (as H2S)	mg/L	0.0085	0.0020	9267084				0.44	0.038	9267084
Total Un-ionized Ammonia	mg/L	0.0033	0.00061	9258068				<0.00061	0.00061	9258068
Field Measurements										
Field Temperature	Celsius	11.9	N/A	ONSITE				12.3	N/A	ONSITE
Field Measured pH	pH	7.10		ONSITE				7.02		ONSITE
Inorganics										
Total Ammonia-N	mg/L	0.99	0.050	9259401				0.11	0.050	9259401
Dissolved Oxygen	mg/L	9.04	0.050	9259295				8.42	0.050	9259295
pH	pH	7.83		9259897				7.41		9259897
Phenols-4AAP	mg/L	<0.0010	0.0010	9260625				<0.0010	0.0010	9260625
Total Phosphorus	mg/L	0.23	0.004	9260440				0.10	0.004	9260440
Total Sulphide	mg/L	0.0080	0.0018	9267085				0.41 (1)	0.036	9267085
Turbidity	NTU	130	0.1	9259832				3700	2	9259832
WAD Cyanide (Free)	ug/L	<1	1	9260283				<1	1	9260283
Alkalinity (Total as CaCO3)	mg/L	330	1.0	9259895				520	1.0	9259895
Metals										
Dissolved (0.2u) Aluminum (Al)	ug/L	<5	5	9260721	<5	5	9260721	<5	5	9260721
Chromium (VI)	ug/L	<0.50	0.50	9260463				<0.50	0.50	9260463
Mercury (Hg)	ug/L	<0.10	0.10	9263386				<1.5	1.5	9263386
Total Antimony (Sb)	ug/L	<0.50	0.50	9266357				<0.50	0.50	9266357
Total Arsenic (As)	ug/L	1.1	1.0	9266357				28	1.0	9266357
Total Beryllium (Be)	ug/L	<0.40	0.40	9266357				2.9	0.40	9266357
Total Boron (B)	ug/L	550	10	9266357				120	10	9266357
Total Cadmium (Cd)	ug/L	<0.090	0.090	9266357				0.51	0.090	9266357
Total Chromium (Cr)	ug/L	<5.0	5.0	9266357				120	5.0	9266357
Total Cobalt (Co)	ug/L	1.3	0.50	9266357				34	0.50	9266357
Total Copper (Cu)	ug/L	1.9	0.90	9266357				47	0.90	9266357
Total Iron (Fe)	ug/L	3400	100	9266357				98000	1000	9266357

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limits raised due to sample matrix.

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PWQO METALS AND INORGANICS (GROUND WATER)

Bureau Veritas ID		YNY787			YNY787			YNY788		
Sampling Date		2024/03/05			2024/03/05			2024/03/05		
COC Number		C#978961-01-01			C#978961-01-01			C#978961-01-01		
	UNITS	BH107-D	RDL	QC Batch	BH107-D Lab-Dup	RDL	QC Batch	BH107-S	RDL	QC Batch
Total Lead (Pb)	ug/L	3.3	0.50	9266357				67	0.50	9266357
Total Molybdenum (Mo)	ug/L	<0.50	0.50	9266357				5.2	0.50	9266357
Total Nickel (Ni)	ug/L	3.4	1.0	9266357				75	1.0	9266357
Total Selenium (Se)	ug/L	<2.0	2.0	9266357				<2.0	2.0	9266357
Total Silver (Ag)	ug/L	<0.090	0.090	9266357				0.21	0.090	9266357
Total Thallium (Tl)	ug/L	<0.050	0.050	9266357				0.61	0.050	9266357
Total Tungsten (W)	ug/L	<1.0	1.0	9266357				2.1	1.0	9266357
Total Uranium (U)	ug/L	0.27	0.10	9266357				7.3	0.10	9266357
Total Vanadium (V)	ug/L	4.9	0.50	9266357				100	0.50	9266357
Total Zinc (Zn)	ug/L	10	5.0	9266357				280	5.0	9266357
Total Zirconium (Zr)	ug/L	1.6	1.0	9266357				15	1.0	9266357

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Bureau Veritas Job #: C466842
Report Date: 2024/03/14

Cambium Environmental Inc
Client Project #: 19712-001
Sampler Initials: MC

RESULTS OF ANALYSES OF GROUND WATER

Bureau Veritas ID		YNY785	YNY785	YNY786		
Sampling Date		2024/03/05 15:30	2024/03/05 15:30	2024/03/05 16:15		
COC Number		C#978961-01-01	C#978961-01-01	C#978961-01-01		
	UNITS	BH106-D	BH106-D Lab-Dup	BH106-S	RDL	QC Batch
Inorganics						
Free Chlorine	mg/L	<0.1	<0.1	<0.1	0.1	9259310

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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MICROBIOLOGY (GROUND WATER)

Bureau Veritas ID		YNY785	YNY786		
Sampling Date		2024/03/05 15:30	2024/03/05 16:15		
COC Number		C#978961-01-01	C#978961-01-01		
	UNITS	BH106-D	BH106-S	RDL	QC Batch
Microbiological					
Escherichia coli	CFU/100mL	<10	<10	10	9259388

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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TEST SUMMARY

Bureau Veritas ID: YNY785
Sample ID: BH106-D
Matrix: Ground Water

Collected: 2024/03/05
Shipped:
Received: 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sewer Use By-Law Semivolatile Organics	GC/MS	9260314	2024/03/07	2024/03/07	Adriana Zurita
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	9260721	N/A	2024/03/12	Thuy Linh Nguyen
Alkalinity	AT	9259902	N/A	2024/03/07	Nachiketa Gohil
Biochemical Oxygen Demand (BOD)	DO	9262848	2024/03/08	2024/03/13	Amrutha Anilkumar
Free Residual Chlorine	SPEC	9259310	2024/03/06	2024/03/06	Taslima Aktar
Chloride by Automated Colourimetry	SKAL	9259384	N/A	2024/03/07	Alina Dobreanu
Chromium (VI) in Water	IC	9260463	N/A	2024/03/07	Surleen Kaur Romana
Free (WAD) Cyanide	SKAL/CN	9260283	N/A	2024/03/07	Prgya Panchal
Total Cyanide	SKAL/CN	9260284	2024/03/07	2024/03/07	Prgya Panchal
Dissolved Oxygen	DO	9259295	2024/03/06	2024/03/06	Nusrat Naz
Fluoride	ISE	9259904	2024/03/06	2024/03/07	Nachiketa Gohil
Formaldehyde (HPLC)	LC/UV	9259739	2024/03/06	2024/03/07	Kimberley Linde
Hardness (calculated as CaCO3)		9258324	N/A	2024/03/12	Automated Statchk
Mercury	CV/AA	9263386	2024/03/08	2024/03/08	Aswathy Neduveli Suresh
Total Metals Analysis by ICPMS	ICP/MS	9266357	2024/03/11	2024/03/12	Prempal Bhatti
Sulphide (as H2S)	CALC	9267084	N/A	2024/03/09	Automated Statchk
Total Sulphide	SPEC	9267085	N/A	2024/03/09	Ly Vu
E.coli, (CFU/100mL)	PL	9259388	N/A	2024/03/06	Paramjit Paramjit
Total Ammonia-N	LACH/NH4	9259401	N/A	2024/03/08	Prabhjot Kaur
Total Nonylphenol in Liquids by HPLC	LC/FLU	9260251	2024/03/07	2024/03/07	Dennis Boodram
Nonylphenol Ethoxylates in Liquids: HPLC	LC/FLU	9260259	2024/03/07	2024/03/07	Dennis Boodram
Animal and Vegetable Oil and Grease	BAL	9259127	N/A	2024/03/09	Automated Statchk
Total Oil and Grease	BAL	9265784	2024/03/09	2024/03/09	Andrews Philip
OC Pesticides (Selected) & PCB	GC/ECD	9264041	2024/03/08	2024/03/11	Li Peng
OC Pesticides Summed Parameters	CALC	9258305	N/A	2024/03/06	Automated Statchk
pH	AT	9259905	2024/03/06	2024/03/07	Nachiketa Gohil
Phenols (4AAP)	TECH/PHEN	9260625	N/A	2024/03/07	Chloe Pollock
Field Temperature	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Sulphate by Automated Turbidimetry	SKAL	9259366	N/A	2024/03/07	Alina Dobreanu
Field Temperature	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Total Kjeldahl Nitrogen in Water	SKAL	9261020	2024/03/07	2024/03/08	Rajni Tyagi
Total PAHs	CALC	9259174	N/A	2024/03/08	Automated Statchk
Total Phosphorus (Colourimetric)	SKAL/P	9260440	2024/03/07	2024/03/07	Sachi Patel
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	9265786	2024/03/09	2024/03/09	Andrews Philip
Total Suspended Solids	BAL	9260533	2024/03/08	2024/03/09	Madhav Somani
Turbidity	AT	9259832	N/A	2024/03/07	Surinder Rai
Un-ionized Ammonia	CALC/NH3	9258068	2024/03/13	2024/03/13	Automated Statchk
Volatile Organic Compounds in Water	GC/MS	9260755	N/A	2024/03/08	Narayan Ghimire

Bureau Veritas ID: YNY785 Dup
Sample ID: BH106-D
Matrix: Ground Water

Collected: 2024/03/05
Shipped:
Received: 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sewer Use By-Law Semivolatile Organics	GC/MS	9260314	2024/03/07	2024/03/07	Adriana Zurita

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Bureau Veritas Job #: C466842
Report Date: 2024/03/14

Cambium Environmental Inc
Client Project #: 19712-001
Sampler Initials: MC

TEST SUMMARY

Bureau Veritas ID: YNY785 Dup
Sample ID: BH106-D
Matrix: Ground Water

Collected: 2024/03/05
Shipped:
Received: 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	9259902	N/A	2024/03/07	Nachiketa Gohil
Free Residual Chlorine	SPEC	9259310	2024/03/06	2024/03/06	Taslima Aktar
Free (WAD) Cyanide	SKAL/CN	9260283	N/A	2024/03/07	Prgya Panchal
Fluoride	ISE	9259904	2024/03/06	2024/03/07	Nachiketa Gohil
Formaldehyde (HPLC)	LC/UV	9259739	2024/03/06	2024/03/07	Kimberley Linde
OC Pesticides (Selected) & PCB	GC/ECD	9264041	2024/03/08	2024/03/11	Li Peng
pH	AT	9259905	2024/03/06	2024/03/07	Nachiketa Gohil
Turbidity	AT	9259832	N/A	2024/03/07	Surinder Rai

Bureau Veritas ID: YNY786
Sample ID: BH106-S
Matrix: Ground Water

Collected: 2024/03/05
Shipped:
Received: 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sewer Use By-Law Semivolatile Organics	GC/MS	9260314	2024/03/07	2024/03/07	Adriana Zurita
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	9260721	N/A	2024/03/12	Thuy Linh Nguyen
Alkalinity	AT	9259902	N/A	2024/03/07	Nachiketa Gohil
Biochemical Oxygen Demand (BOD)	DO	9262848	2024/03/08	2024/03/13	Amrutha Anilkumar
Free Residual Chlorine	SPEC	9259310	2024/03/06	2024/03/06	Taslima Aktar
Chloride by Automated Colourimetry	SKAL	9259384	N/A	2024/03/07	Alina Dobreanu
Chromium (VI) in Water	IC	9260463	N/A	2024/03/07	Surleen Kaur Romana
Free (WAD) Cyanide	SKAL/CN	9260283	N/A	2024/03/07	Prgya Panchal
Total Cyanide	SKAL/CN	9260284	2024/03/07	2024/03/07	Prgya Panchal
Dissolved Oxygen	DO	9259295	2024/03/06	2024/03/06	Nusrat Naz
Fluoride	ISE	9259904	2024/03/06	2024/03/07	Nachiketa Gohil
Formaldehyde (HPLC)	LC/UV	9259739	2024/03/06	2024/03/07	Kimberley Linde
Hardness (calculated as CaCO3)		9258324	N/A	2024/03/12	Automated Statchk
Mercury	CV/AA	9263386	2024/03/08	2024/03/08	Aswathy Neduveli Suresh
Total Metals Analysis by ICPMS	ICP/MS	9266357	2024/03/11	2024/03/12	Prempal Bhatti
Sulphide (as H2S)	CALC	9267084	N/A	2024/03/09	Automated Statchk
Total Sulphide	SPEC	9267085	N/A	2024/03/09	Ly Vu
E.coli, (CFU/100mL)	PL	9259388	N/A	2024/03/06	Paramjit Paramjit
Total Ammonia-N	LACH/NH4	9259401	N/A	2024/03/08	Prabhjot Kaur
Total Nonylphenol in Liquids by HPLC	LC/FLU	9260251	2024/03/07	2024/03/07	Dennis Boodram
Nonylphenol Ethoxylates in Liquids: HPLC	LC/FLU	9260259	2024/03/07	2024/03/07	Dennis Boodram
Animal and Vegetable Oil and Grease	BAL	9259127	N/A	2024/03/09	Automated Statchk
Total Oil and Grease	BAL	9265784	2024/03/09	2024/03/09	Andrews Philip
OC Pesticides (Selected) & PCB	GC/ECD	9264041	2024/03/08	2024/03/11	Li Peng
OC Pesticides Summed Parameters	CALC	9258305	N/A	2024/03/06	Automated Statchk
pH	AT	9259905	2024/03/06	2024/03/07	Nachiketa Gohil
Phenols (4AAP)	TECH/PHEN	9260625	N/A	2024/03/07	Chloe Pollock
Field Temperature	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Sulphate by Automated Turbidimetry	SKAL	9259366	N/A	2024/03/07	Alina Dobreanu
Field Temperature	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Total Kjeldahl Nitrogen in Water	SKAL	9261020	2024/03/07	2024/03/11	Rajni Tyagi

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TEST SUMMARY

Bureau Veritas ID: YNY786 **Collected:** 2024/03/05
Sample ID: BH106-S **Shipped:**
Matrix: Ground Water **Received:** 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total PAHs	CALC	9259176	N/A	2024/03/08	Automated Statchk
Total Phosphorus (Colourimetric)	SKAL/P	9260440	2024/03/07	2024/03/07	Sachi Patel
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	9265786	2024/03/09	2024/03/09	Andrews Philip
Total Suspended Solids	BAL	9260533	2024/03/08	2024/03/09	Madhav Somani
Turbidity	AT	9259832	N/A	2024/03/07	Surinder Rai
Un-ionized Ammonia	CALC/NH3	9258068	2024/03/13	2024/03/13	Automated Statchk
Volatile Organic Compounds in Water	GC/MS	9260755	N/A	2024/03/08	Narayan Ghimire

Bureau Veritas ID: YNY787 **Collected:** 2024/03/05
Sample ID: BH107-D **Shipped:**
Matrix: Ground Water **Received:** 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	9260721	N/A	2024/03/12	Thuy Linh Nguyen
Alkalinity	AT	9259895	N/A	2024/03/07	Nachiketa Gohil
Chromium (VI) in Water	IC	9260463	N/A	2024/03/07	Surleen Kaur Romana
Free (WAD) Cyanide	SKAL/CN	9260283	N/A	2024/03/07	Prgya Panchal
Dissolved Oxygen	DO	9259295	2024/03/06	2024/03/06	Nusrat Naz
Hardness (calculated as CaCO3)		9258324	N/A	2024/03/12	Automated Statchk
Mercury	CV/AA	9263386	2024/03/08	2024/03/08	Aswathy Neduveli Suresh
Total Metals Analysis by ICPMS	ICP/MS	9266357	2024/03/11	2024/03/11	Prempal Bhatti
Sulphide (as H2S)	CALC	9267084	N/A	2024/03/09	Automated Statchk
Total Sulphide	SPEC	9267085	N/A	2024/03/09	Ly Vu
Total Ammonia-N	LACH/NH4	9259401	N/A	2024/03/08	Prabhjot Kaur
pH	AT	9259897	2024/03/06	2024/03/07	Nachiketa Gohil
Phenols (4AAP)	TECH/PHEN	9260625	N/A	2024/03/07	Chloe Pollock
Field Measured pH	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Field Measured pH	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Total Phosphorus (Colourimetric)	SKAL/P	9260440	2024/03/07	2024/03/07	Sachi Patel
Turbidity	AT	9259832	N/A	2024/03/07	Surinder Rai
Un-ionized Ammonia	CALC/NH3	9258068	2024/03/13	2024/03/13	Automated Statchk

Bureau Veritas ID: YNY787 Dup **Collected:** 2024/03/05
Sample ID: BH107-D **Shipped:**
Matrix: Ground Water **Received:** 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	9260721	N/A	2024/03/12	Thuy Linh Nguyen

Bureau Veritas ID: YNY788 **Collected:** 2024/03/05
Sample ID: BH107-S **Shipped:**
Matrix: Ground Water **Received:** 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	9260721	N/A	2024/03/12	Thuy Linh Nguyen

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Bureau Veritas Job #: C466842
Report Date: 2024/03/14

Cambium Environmental Inc
Client Project #: 19712-001
Sampler Initials: MC

TEST SUMMARY

Bureau Veritas ID: YNY788
Sample ID: BH107-S
Matrix: Ground Water

Collected: 2024/03/05
Shipped:
Received: 2024/03/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	9259895	N/A	2024/03/07	Nachiketa Gohil
Chromium (VI) in Water	IC	9260463	N/A	2024/03/07	Surleen Kaur Romana
Free (WAD) Cyanide	SKAL/CN	9260283	N/A	2024/03/07	Prgya Panchal
Dissolved Oxygen	DO	9259295	2024/03/06	2024/03/06	Nusrat Naz
Hardness (calculated as CaCO3)		9258324	N/A	2024/03/12	Automated Statchk
Mercury	CV/AA	9263386	2024/03/08	2024/03/08	Aswathy Neduveli Suresh
Total Metals Analysis by ICPMS	ICP/MS	9266357	2024/03/11	2024/03/12	Prempal Bhatti
Sulphide (as H2S)	CALC	9267084	N/A	2024/03/09	Automated Statchk
Total Sulphide	SPEC	9267085	N/A	2024/03/09	Ly Vu
Total Ammonia-N	LACH/NH4	9259401	N/A	2024/03/08	Prabhjot Kaur
pH	AT	9259897	2024/03/06	2024/03/07	Nachiketa Gohil
Phenols (4AAP)	TECH/PHEN	9260625	N/A	2024/03/07	Chloe Pollock
Field Measured pH	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Field Measured pH	PH	ONSITE	N/A	2024/03/13	Christine Gripton
Total Phosphorus (Colourimetric)	SKAL/P	9260440	2024/03/07	2024/03/07	Sachi Patel
Turbidity	AT	9259832	N/A	2024/03/07	Surinder Rai
Un-ionized Ammonia	CALC/NH3	9258068	2024/03/13	2024/03/13	Automated Statchk

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.7°C
Package 2	6.0°C
Package 3	6.3°C

Sample YNY785 [BH106-D] : Turbidity: Test Group: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

ABN-SEWER Analysis: Due to the sample matrix, a smaller amount was used for analysis. Detection limits were adjusted accordingly.

Sample YNY786 [BH106-S] : ABN-SEWER Analysis: Due to the sample matrix, a smaller amount was used for analysis. Detection limits were adjusted accordingly.

Mercury Analysis: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample YNY788 [BH107-S] : Mercury Analysis: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9260314	2,4,6-Tribromophenol	2024/03/07	85	10 - 130	96	10 - 130	72	%				
9260314	2-Fluorobiphenyl	2024/03/07	61	30 - 130	68	30 - 130	65	%				
9260314	D14-Terphenyl (FS)	2024/03/07	99	30 - 130	103	30 - 130	96	%				
9260314	D5-Nitrobenzene	2024/03/07	75	30 - 130	91	30 - 130	82	%				
9260314	D8-Acenaphthylene	2024/03/07	68	30 - 130	80	30 - 130	71	%				
9260755	4-Bromofluorobenzene	2024/03/08	99	70 - 130	102	70 - 130	103	%				
9260755	D4-1,2-Dichloroethane	2024/03/08	113	70 - 130	105	70 - 130	104	%				
9260755	D8-Toluene	2024/03/08	99	70 - 130	98	70 - 130	97	%				
9264041	2,4,5,6-Tetrachloro-m-xylene	2024/03/11	58	50 - 130	50	50 - 130	47 (1)	%				
9264041	Decachlorobiphenyl	2024/03/11	63	50 - 130	77	50 - 130	77	%				
9259295	Dissolved Oxygen	2024/03/06							0.11	30		
9259310	Free Chlorine	2024/03/06	83 (1)	85 - 115	104	85 - 115	<0.1	mg/L	NC	25		
9259366	Dissolved Sulphate (SO4)	2024/03/07	NC	75 - 125	93	80 - 120	<1.0	mg/L	0.76	20		
9259384	Dissolved Chloride (Cl-)	2024/03/07	NC	80 - 120	97	80 - 120	<1.0	mg/L	0.22	20		
9259401	Total Ammonia-N	2024/03/08	101	75 - 125	101	80 - 120	<0.050	mg/L	NC	20		
9259739	Formaldehyde	2024/03/07	102	40 - 130	109	40 - 130	<10	ug/L	NC	40		
9259832	Turbidity	2024/03/07			99	80 - 120	<0.1	NTU	0.54	20		
9259895	Alkalinity (Total as CaCO3)	2024/03/07			93	85 - 115	<1.0	mg/L	0.97	20		
9259897	pH	2024/03/07			101	98 - 103			0.47	N/A		
9259902	Alkalinity (Total as CaCO3)	2024/03/07			93	85 - 115	<1.0	mg/L	0.56	20		
9259904	Fluoride (F-)	2024/03/07	98	80 - 120	100	80 - 120	<0.10	mg/L	12	20		
9259905	pH	2024/03/07			101	98 - 103			1.3	N/A		
9260251	Nonylphenol (Total)	2024/03/07	105	50 - 130	107	50 - 130	<0.001	mg/L	NC	40		
9260259	Nonylphenol Ethoxylate (Total)	2024/03/08	110	50 - 130	102	50 - 130	<0.025	mg/L	NC	40		
9260283	WAD Cyanide (Free)	2024/03/07	104	80 - 120	104	80 - 120	<1	ug/L	NC	20		
9260284	Total Cyanide (CN)	2024/03/07	102	80 - 120	104	80 - 120	<0.0050	mg/L	NC	20		
9260314	1,3-Dinitropyrene	2024/03/07	85	30 - 130	91	30 - 130	<0.4	ug/L	NC	40		
9260314	1,6-Dinitropyrene	2024/03/07	84	30 - 130	88	30 - 130	<0.4	ug/L	NC	40		
9260314	1,8-Dinitropyrene	2024/03/07	83	30 - 130	89	30 - 130	<0.4	ug/L	NC	40		
9260314	3,3'-Dichlorobenzidine	2024/03/07	40	30 - 130	116	30 - 130	<0.8	ug/L	NC	40		
9260314	7H-Dibenzo(c,g) Carbazole	2024/03/07	88	30 - 130	93	30 - 130	<0.4	ug/L	NC	40		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9260314	Anthracene	2024/03/07	96	30 - 130	104	30 - 130	<0.2	ug/L	NC	40		
9260314	Benzo(a)anthracene	2024/03/07	108	30 - 130	114	30 - 130	<0.2	ug/L	NC	40		
9260314	Benzo(a)pyrene	2024/03/07	108	30 - 130	109	30 - 130	<0.2	ug/L	NC	40		
9260314	Benzo(b/j)fluoranthene	2024/03/07	113	30 - 130	113	30 - 130	<0.2	ug/L	NC	40		
9260314	Benzo(e)pyrene	2024/03/07	113	30 - 130	113	30 - 130	<0.2	ug/L	NC	40		
9260314	Benzo(g,h,i)perylene	2024/03/07	106	30 - 130	109	30 - 130	<0.2	ug/L	NC	40		
9260314	Benzo(k)fluoranthene	2024/03/07	109	30 - 130	115	30 - 130	<0.2	ug/L	NC	40		
9260314	Bis(2-ethylhexyl)phthalate	2024/03/07	124	30 - 130	123	30 - 130	<2	ug/L	NC	40		
9260314	Chrysene	2024/03/07	108	30 - 130	111	30 - 130	<0.2	ug/L	NC	40		
9260314	Dibenzo(a,h)anthracene	2024/03/07	107	30 - 130	111	30 - 130	<0.2	ug/L	NC	40		
9260314	Dibenzo(a,i)pyrene	2024/03/07	63	30 - 130	64	30 - 130	<0.2	ug/L	NC	40		
9260314	Dibenzo(a,j) acridine	2024/03/07	97	30 - 130	100	30 - 130	<0.4	ug/L	NC	40		
9260314	Di-N-butyl phthalate	2024/03/07	95	30 - 130	96	30 - 130	<2	ug/L	NC	40		
9260314	Fluoranthene	2024/03/07	120	30 - 130	124	30 - 130	<0.2	ug/L	NC	40		
9260314	Indeno(1,2,3-cd)pyrene	2024/03/07	108	30 - 130	112	30 - 130	<0.2	ug/L	NC	40		
9260314	Pentachlorophenol	2024/03/07	54	30 - 130	47	30 - 130	<1	ug/L	NC	40		
9260314	Perylene	2024/03/07	100	30 - 130	105	30 - 130	<0.2	ug/L	NC	40		
9260314	Phenanthrene	2024/03/07	97	30 - 130	105	30 - 130	<0.2	ug/L	NC	40		
9260314	Pyrene	2024/03/07	120	30 - 130	124	30 - 130	<0.2	ug/L	NC	40		
9260440	Total Phosphorus	2024/03/07	103	80 - 120	99	80 - 120	<0.004	mg/L	0.074	20	106	80 - 120
9260463	Chromium (VI)	2024/03/07	106	80 - 120	104	80 - 120	<0.50	ug/L	NC	20		
9260533	Total Suspended Solids	2024/03/09			99	80 - 120	<10	mg/L	NC	20		
9260625	Phenols-4AAP	2024/03/07	101	80 - 120	101	80 - 120	<0.0010	mg/L	3.7	20		
9260721	Dissolved (0.2u) Aluminum (Al)	2024/03/12	108	80 - 120	107	80 - 120	<5	ug/L	NC	20		
9260755	1,1,2,2-Tetrachloroethane	2024/03/08	132 (2)	70 - 130	109	70 - 130	<0.40	ug/L	NC	30		
9260755	1,2-Dichlorobenzene	2024/03/08	107	70 - 130	97	70 - 130	<0.40	ug/L	NC	30		
9260755	1,4-Dichlorobenzene	2024/03/08	112	70 - 130	108	70 - 130	<0.40	ug/L	NC	30		
9260755	Benzene	2024/03/08	101	70 - 130	92	70 - 130	<0.20	ug/L	NC	30		
9260755	Chloroform	2024/03/08	116	70 - 130	104	70 - 130	<0.20	ug/L	NC	30		
9260755	cis-1,2-Dichloroethylene	2024/03/08	112	70 - 130	101	70 - 130	<0.50	ug/L	NC	30		
9260755	Ethylbenzene	2024/03/08	99	70 - 130	92	70 - 130	<0.20	ug/L	NC	30		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9260755	Methylene Chloride(Dichloromethane)	2024/03/08	114	70 - 130	100	70 - 130	<2.0	ug/L	NC	30		
9260755	o-Xylene	2024/03/08	91	70 - 130	85	70 - 130	<0.20	ug/L	NC	30		
9260755	p+m-Xylene	2024/03/08	104	70 - 130	99	70 - 130	<0.20	ug/L	NC	30		
9260755	Tetrachloroethylene	2024/03/08	100	70 - 130	94	70 - 130	<0.20	ug/L	NC	30		
9260755	Toluene	2024/03/08	101	70 - 130	91	70 - 130	<0.20	ug/L	NC	30		
9260755	Total Xylenes	2024/03/08					<0.20	ug/L	NC	30		
9260755	trans-1,3-Dichloropropene	2024/03/08	111	70 - 130	104	70 - 130	<0.40	ug/L	NC	30		
9260755	Trichloroethylene	2024/03/08	106	70 - 130	100	70 - 130	<0.20	ug/L	NC	30		
9260755	Vinyl Chloride	2024/03/08	102	70 - 130	93	70 - 130	<0.20	ug/L	NC	30		
9261020	Total Kjeldahl Nitrogen (TKN)	2024/03/08	104	80 - 120	99	80 - 120	<0.10	mg/L	2.9	20	99	80 - 120
9262848	Total BOD	2024/03/13					<2	mg/L	5.5	30	102	80 - 120
9263386	Mercury (Hg)	2024/03/08	96	75 - 125	102	80 - 120	<0.10	ug/L	NC	20		
9264041	a-Chlordane	2024/03/11	85	50 - 130	81	50 - 130	<0.005	ug/L	NC	30		
9264041	g-Chlordane	2024/03/11	79	50 - 130	84	50 - 130	<0.005	ug/L	NC	30		
9264041	Hexachlorobenzene	2024/03/11	76	50 - 130	74	50 - 130	<0.005	ug/L	NC	30		
9264041	Lindane	2024/03/11	75	50 - 130	76	50 - 130	<0.003	ug/L	NC	30		
9264041	Mirex	2024/03/11	85	30 - 130	81	30 - 130	<0.005	ug/L	NC	40		
9264041	o,p-DDT	2024/03/11	80	50 - 130	77	50 - 130	<0.005	ug/L	NC	30		
9264041	p,p-DDT	2024/03/11	85	50 - 130	66	50 - 130	<0.005	ug/L	NC	30		
9265784	Total Oil & Grease	2024/03/09			98	80 - 110	<0.50	mg/L	0.25	25		
9265786	Total Oil & Grease Mineral/Synthetic	2024/03/09			96	65 - 130	<0.50	mg/L	0	25		
9266357	Total Antimony (Sb)	2024/03/11	105	80 - 120	104	80 - 120	<0.50	ug/L	NC	20		
9266357	Total Arsenic (As)	2024/03/11	98	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
9266357	Total Beryllium (Be)	2024/03/11	90	80 - 120	91	80 - 120	<0.40	ug/L	NC	20		
9266357	Total Boron (B)	2024/03/11	87	80 - 120	89	80 - 120	<10	ug/L	3.1	20		
9266357	Total Cadmium (Cd)	2024/03/11	97	80 - 120	97	80 - 120	<0.090	ug/L	NC	20		
9266357	Total Chromium (Cr)	2024/03/11	95	80 - 120	96	80 - 120	<5.0	ug/L	NC	20		
9266357	Total Cobalt (Co)	2024/03/11	96	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		
9266357	Total Copper (Cu)	2024/03/11	95	80 - 120	95	80 - 120	<0.90	ug/L	NC	20		
9266357	Total Iron (Fe)	2024/03/11	97	80 - 120	99	80 - 120	<100	ug/L	NC	20		
9266357	Total Lead (Pb)	2024/03/11	98	80 - 120	100	80 - 120	<0.50	ug/L	NC	20		

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			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9266357	Total Molybdenum (Mo)	2024/03/11	100	80 - 120	100	80 - 120	<0.50	ug/L	3.5	20		
9266357	Total Nickel (Ni)	2024/03/11	94	80 - 120	96	80 - 120	<1.0	ug/L	NC	20		
9266357	Total Selenium (Se)	2024/03/11	96	80 - 120	99	80 - 120	<2.0	ug/L	NC	20		
9266357	Total Silver (Ag)	2024/03/11	95	80 - 120	96	80 - 120	<0.090	ug/L	NC	20		
9266357	Total Thallium (Tl)	2024/03/11	100	80 - 120	100	80 - 120	<0.050	ug/L	NC	20		
9266357	Total Tungsten (W)	2024/03/11	103	80 - 120	102	80 - 120	<1.0	ug/L	NC	20		
9266357	Total Uranium (U)	2024/03/11	101	80 - 120	102	80 - 120	<0.10	ug/L	5.7	20		
9266357	Total Vanadium (V)	2024/03/11	96	80 - 120	97	80 - 120	<0.50	ug/L	NC	20		
9266357	Total Zinc (Zn)	2024/03/11	96	80 - 120	100	80 - 120	<5.0	ug/L	NC	20		
9266357	Total Zirconium (Zr)	2024/03/11	102	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
9267085	Total Sulphide	2024/03/09	82	80 - 120	108	80 - 120	<0.0018	mg/L	NC	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) The recovery was above the upper control limit. This may represent a high bias in some results for this specific analyte. For results that were not detected (ND), this potential bias has no impact.

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Anastassia Hamanov, Scientific Specialist

Christine Gripton, Senior Project Manager

Cristina Carriere, Senior Scientific Specialist

Paramjit Paramjit, Analyst I

Suwan (Sze Yeung) Fock, B.Sc., Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

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Page of

NONT-2024-03-318

Bottle Order #: 978961

INVOICE TO:	REPORT TO:	PROJECT INFORMATION:
Company Name: #17950 Cambium Environmental Inc	Company Name: #26906 Cambium Environmental Inc	Quotation #: C26318
Attention: ACCOUNTS PAYABLE	Attention: Kyle Horner	P.O. #:
Address: 194 Sophia Street PO Box 325	Address: 31 Hyperion Court, Suite 102	Project: 19712-001
Peterborough ON K9H 1E5	Kingston ON K7P 7G3	Project Name:
Tel: (705) 742-7900 Fax: (705) 742-7907	Tel: (613) 389-2323 Fax:	Site #:
Email: accounting@cambium-inc.com	Email: kyle.horner@cambium-inc.com maren.catt@cambium-inc.com	Sampled By: Maren Catt

COC #: C#978961-01-01

Project Manager: Christine Gripton

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
- ☐ Table 1 ☐ Res/Park ☐ Medium/Fine
- ☐ Table 2 ☐ Ind/Comm ☐ Coarse
- ☐ Table 3 ☐ Agri/Other ☐ For RSC
- ☐ Table ___

Other Regulations
- ☐ CCME ☑ Sanitary Sewer Bylaw
- ☐ Reg 558 ☑ Storm Sewer Bylaw
- ☐ MISA Municipality Brighton
- ☑ PWQO ☐ Reg 406 Table
- ☐ Other

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

Field Filtered (please circle): Metals / Hg / Cr VI

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests..
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	PWQO Metals and Inorganics	Brighton Sanitary Sewer Bylaw (127-2016)	Free Residual Chlorine	E.coli, (CFU/100mL)	# of Bottles	Comments
1		BH106-D	March 5 2024		GW	✓	✓	✓	✓	31	
2		BH106-S	"		"	✓	✓	✓	✓	31	
3		BH107-D	"		"	✓				10	
4		BH107-S	"		"	✓				10	
5											
6											
7											
8											
9											
10											

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Maren Catt	24/03/05	6:45pm	Sarah Sinclair	2024/03/06	08:36	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	8/7/8 6/6/6	Present		
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COC-TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

White: Bureau Veritas Yellow: Client

3 COOLERS ON ICE

Bureau Veritas Canada (2019) Inc.

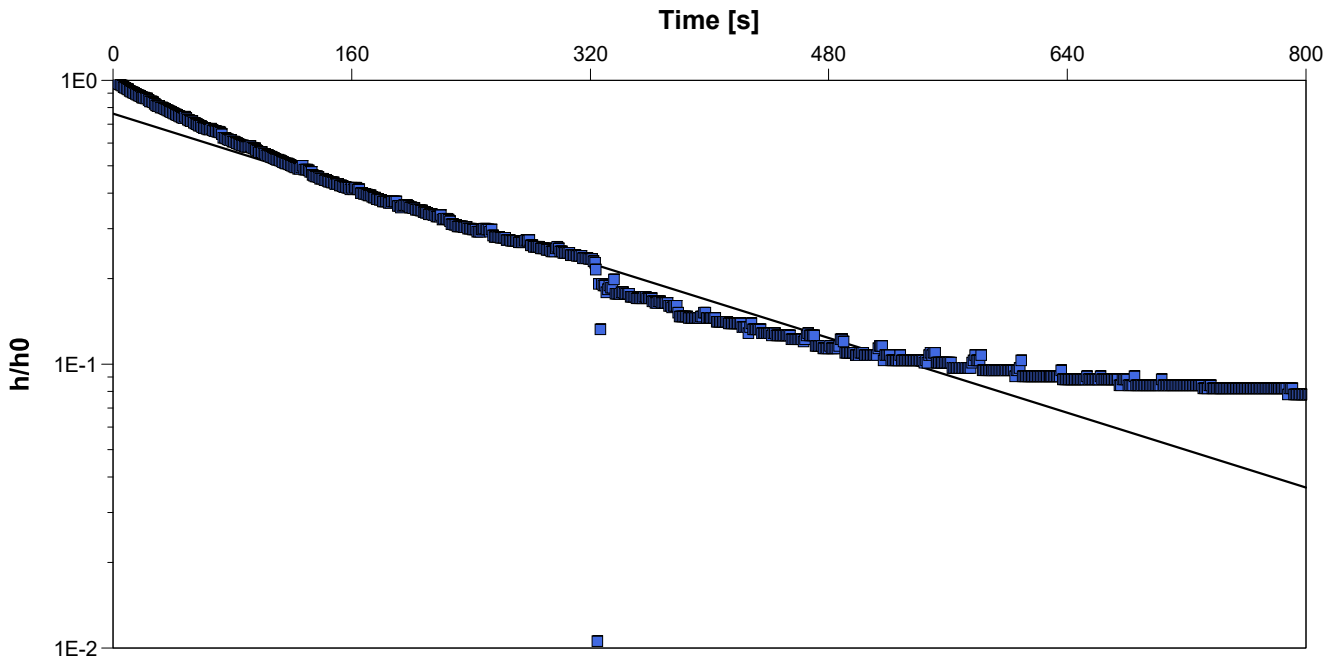
6/6/17

Appendix G

Hydraulic Test Analysis Results

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH101-S: Test 1	Test Well: BH101-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 1.40 m		

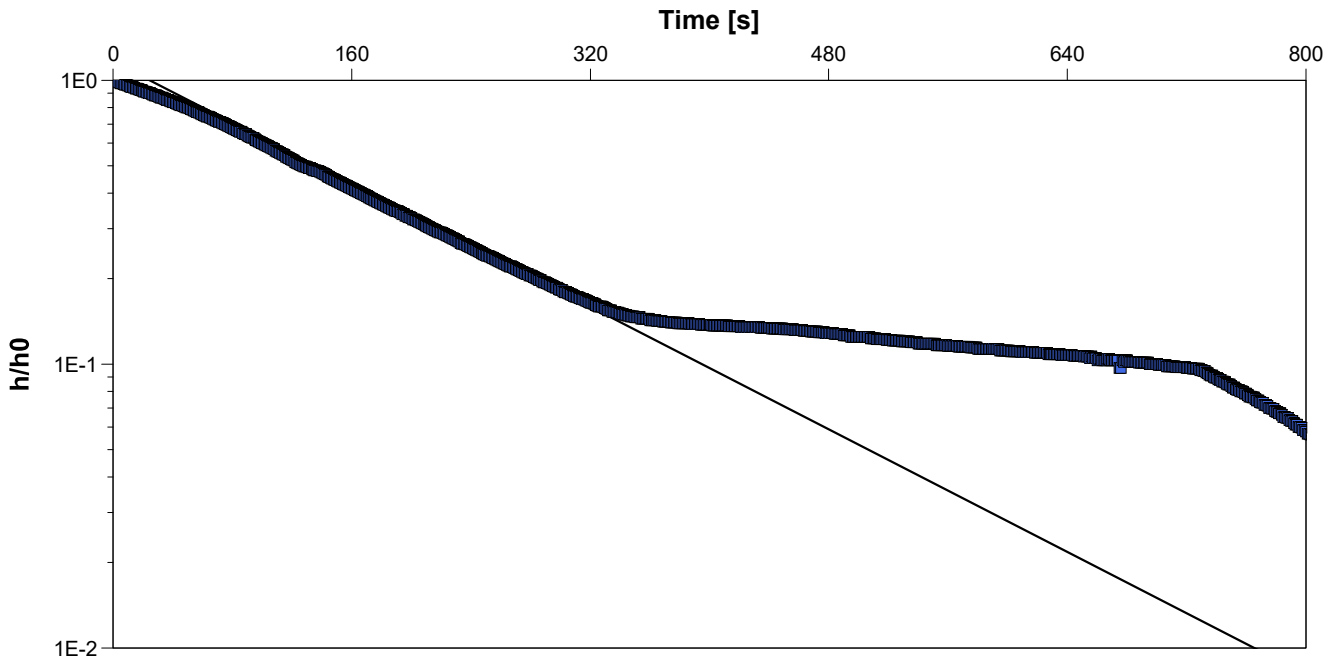


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101-S	2.82×10^{-6}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH101-S: Test 2	Test Well: BH101-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 1.40 m		

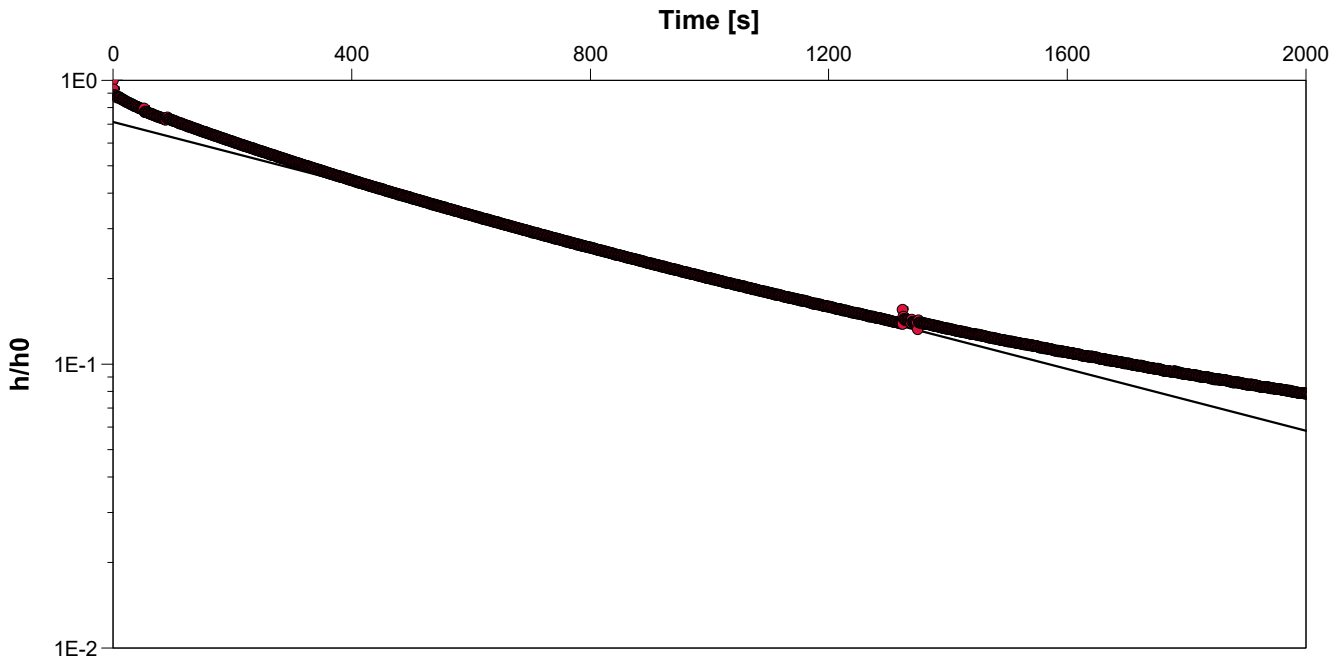


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101-S	4.62×10^{-6}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH101-D: Test 1	Test Well: BH101-D
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 5.22 m		

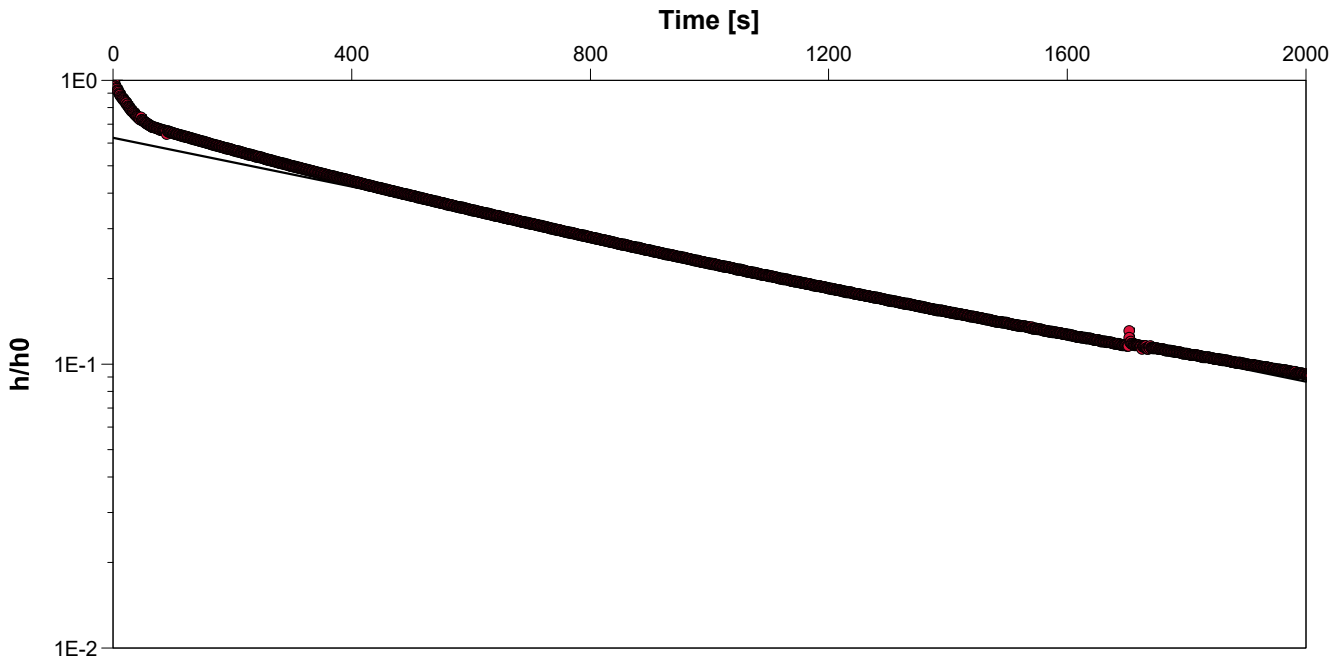


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101-D	5.50×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH101-D: Test 2	Test Well: BH101-D
Test Conducted by: mc		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 5.22 m		

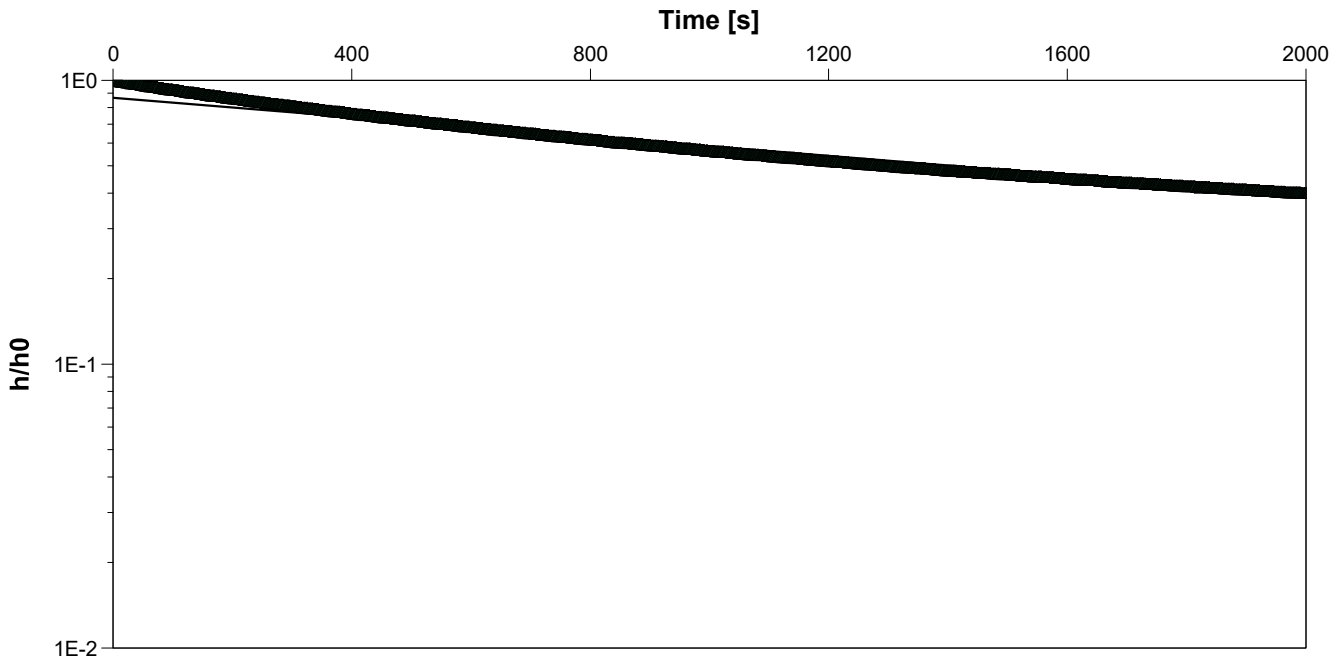


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101-D	4.35×10^{-7}	

	Slug Test Analysis Report
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH106-S: Falling head test	Test Well: BH106-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 3.20 m		

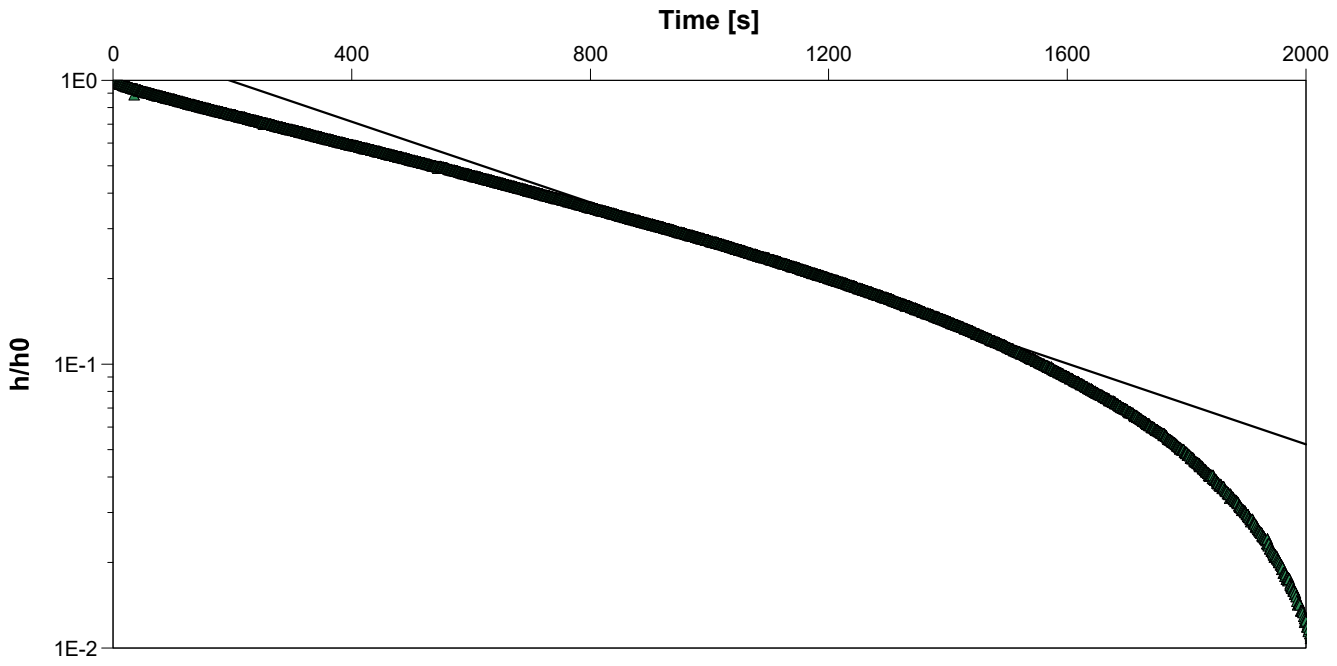


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH106-S	2.91×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH106-S: Test 1	Test Well: BH106-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 3.20 m		

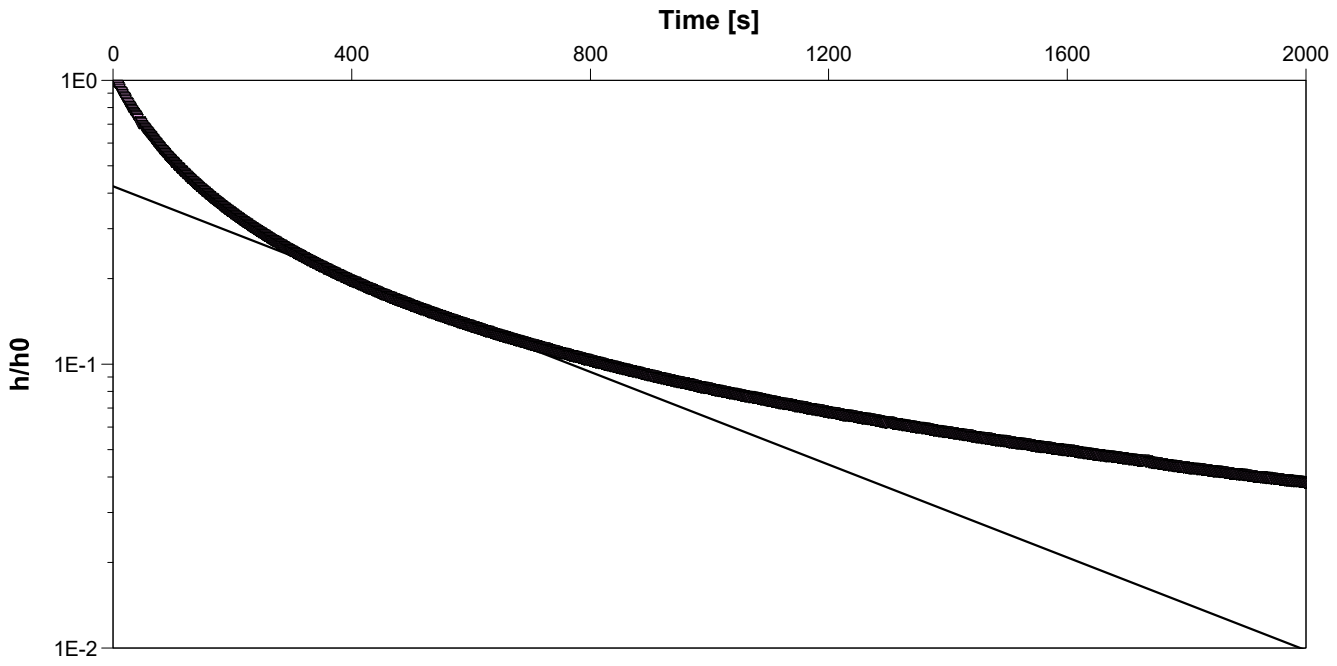


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH106-S	1.22×10^{-6}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH106-D: Test 1	Test Well: BH106-D
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 4.23 m		

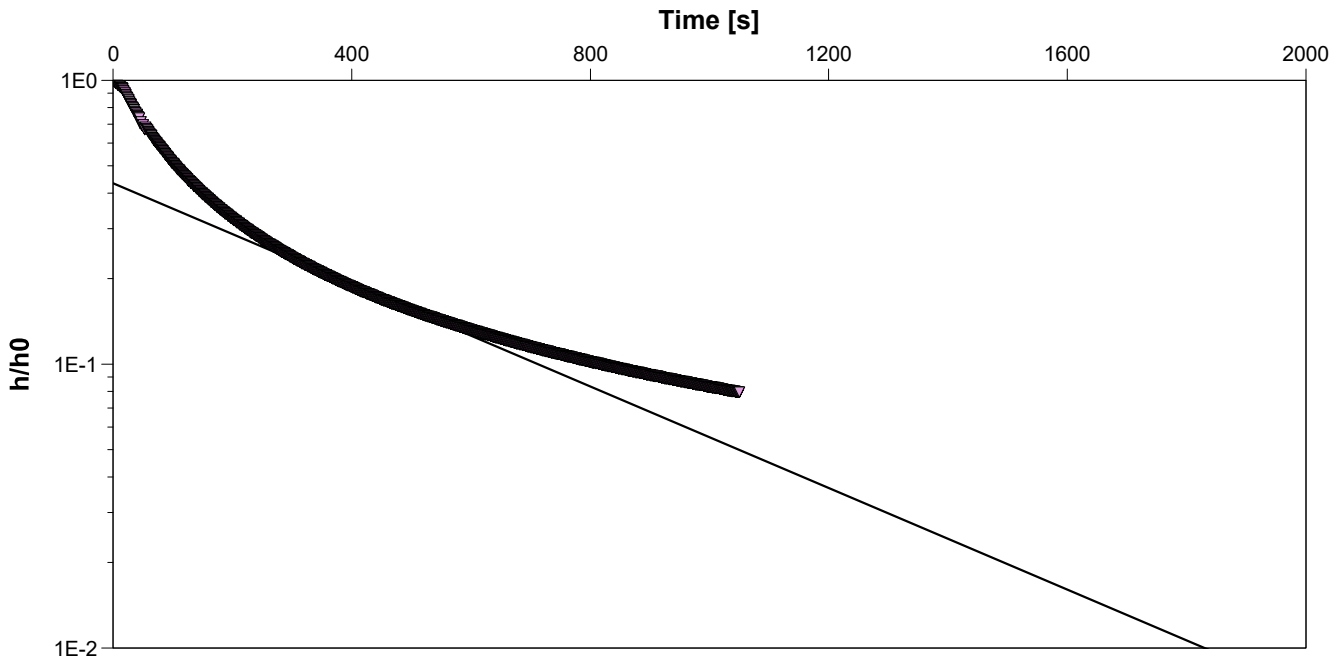


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH106-D	8.28×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH106-D: Test 2	Test Well: BH106-D
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 4.23 m		

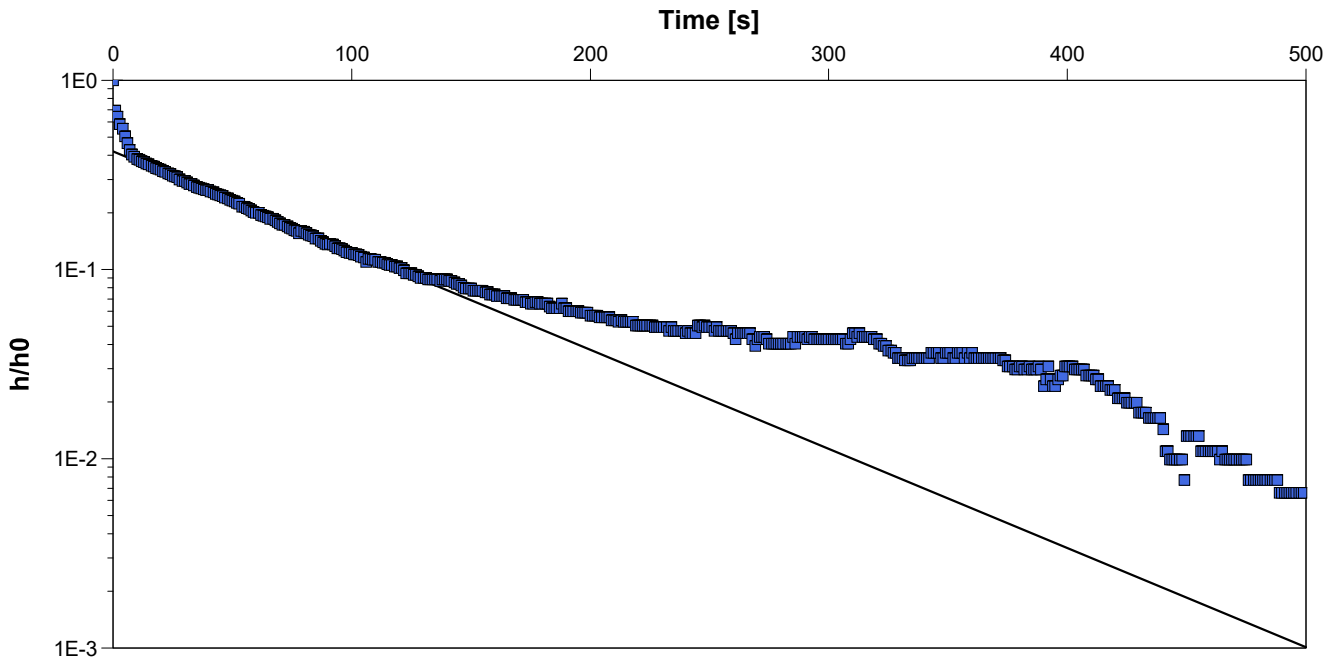


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH106-D	9.07×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L. Richards & Associates Ltd.

Location: 100 County Rd 64, Brighton	Slug Test: BH107-S: Test 1	Test Well: BH107-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/14/2024
Aquifer Thickness: 1.81 m		

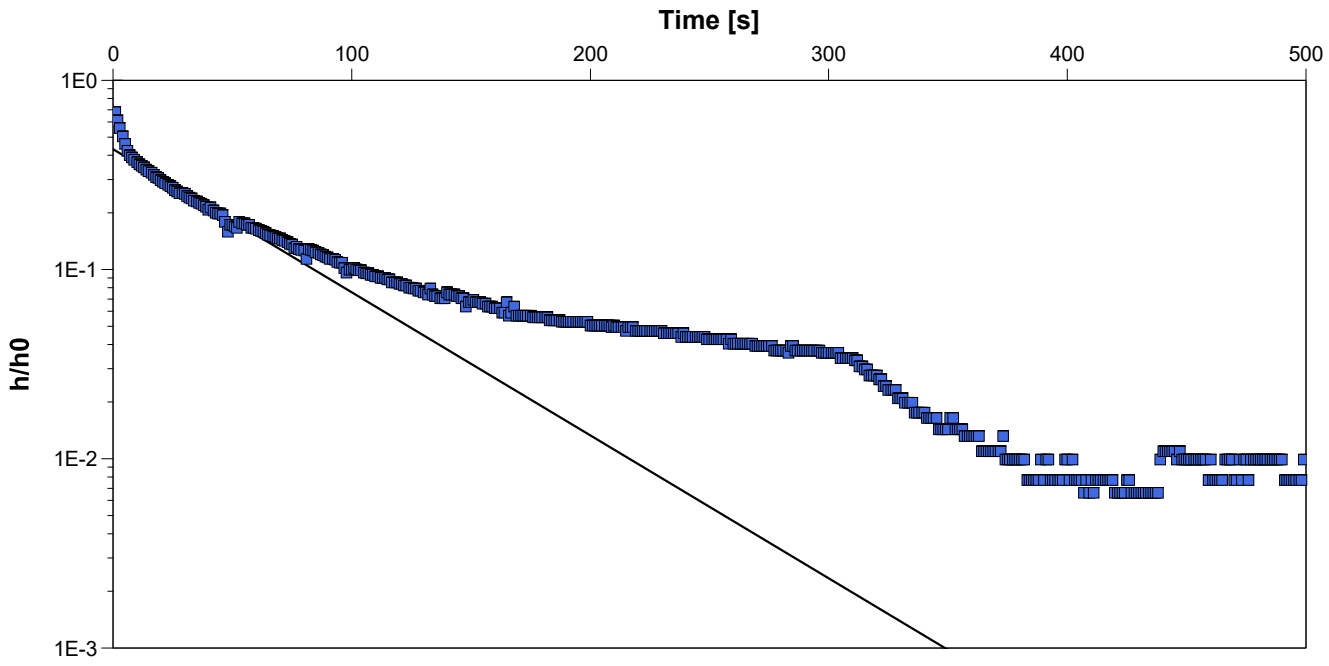


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107-S	9.93×10^{-6}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L. Richards & Associates Ltd.

Location: 100 County Rd 64, Brighton	Slug Test: BH107-S: Test 2	Test Well: BH107-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/14/2024
Aquifer Thickness: 1.81 m		

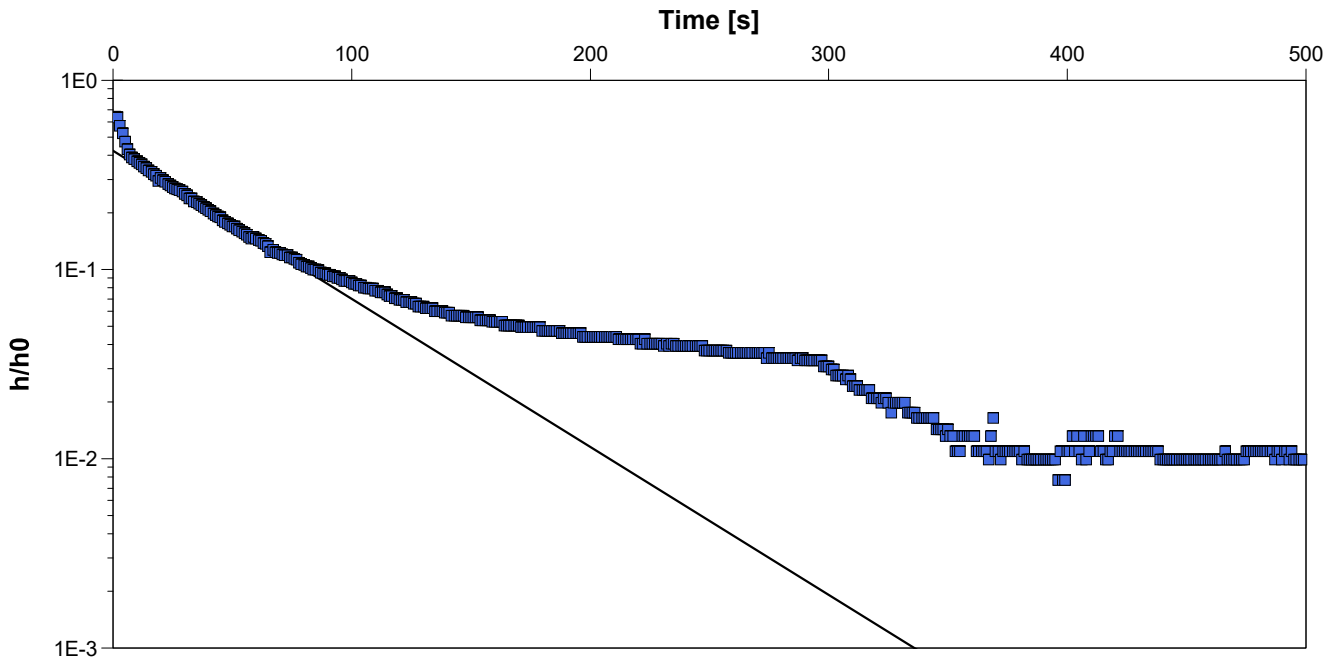


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107-S	1.43×10^{-5}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L. Richards & Associates Ltd.

Location: 100 County Rd 64, Brighton	Slug Test: BH107-S: Test 3	Test Well: BH107-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/14/2024
Aquifer Thickness: 1.81 m		

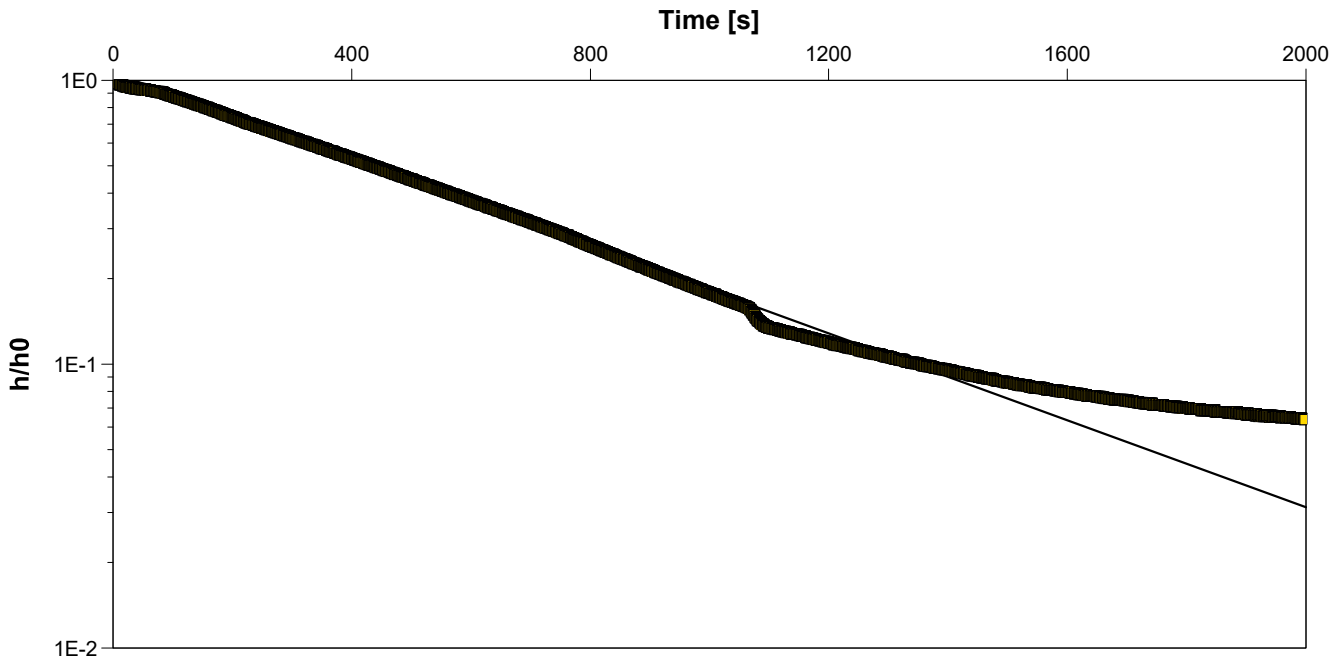


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107-S	1.48×10^{-5}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH107-D: Test 1	Test Well: BH107-D
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/9/2024
Aquifer Thickness: 5.60 m		

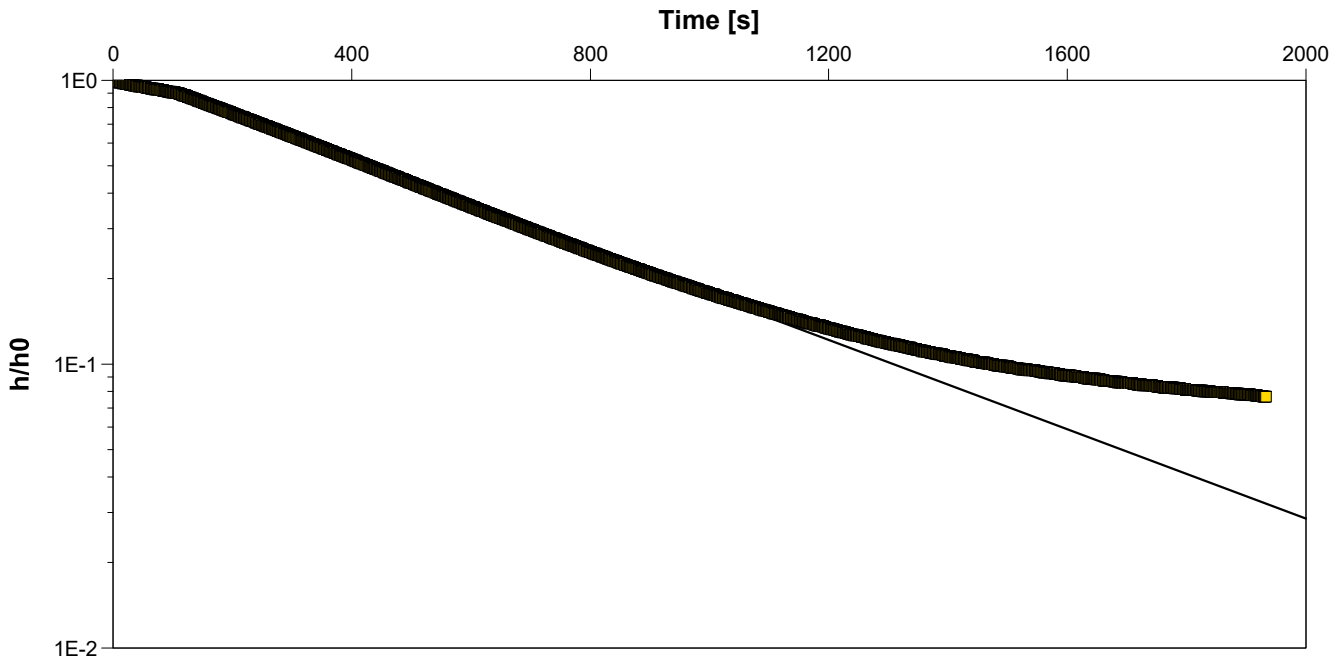


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107-D	7.75×10^{-7}	

	Slug Test Analysis Report
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH107-D: Test 2	Test Well: BH107-D
Test Conducted by:		Test Date: 5/10/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/10/2024
Aquifer Thickness: 5.60 m		

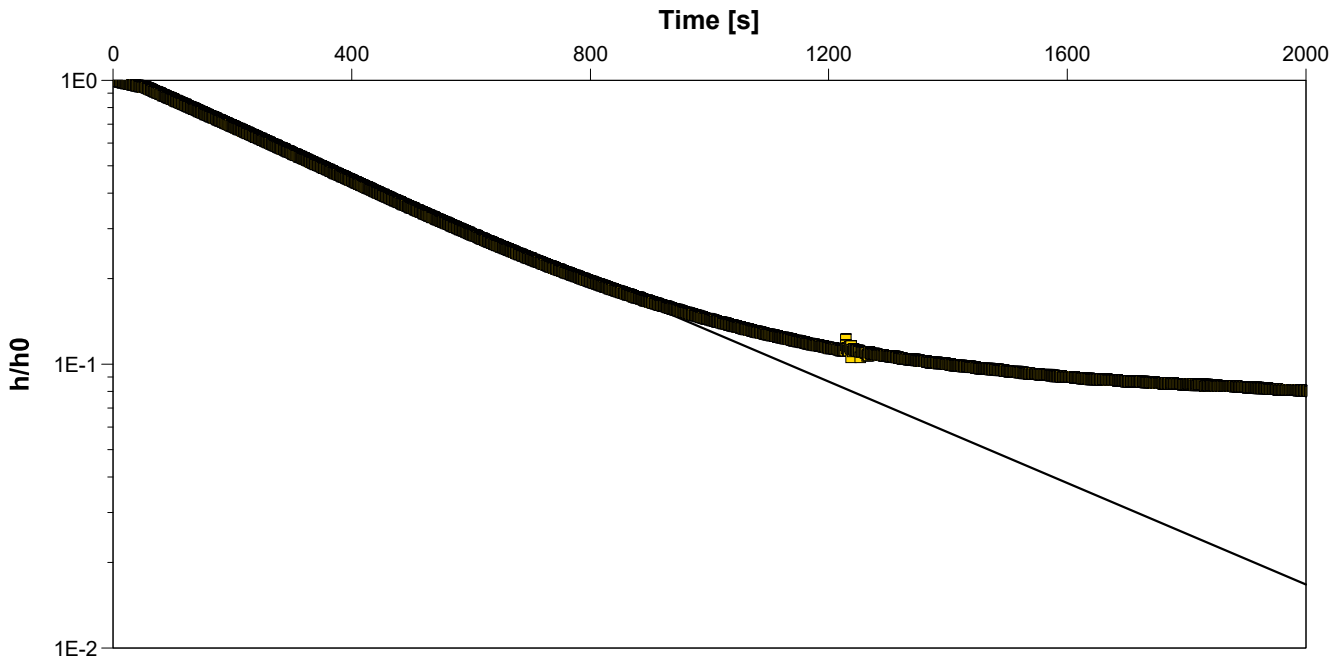


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107-D	7.96×10^{-7}	

	Slug Test Analysis Report
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH107-D: Test 3	Test Well: BH107-D
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/10/2024
Aquifer Thickness: 5.60 m		

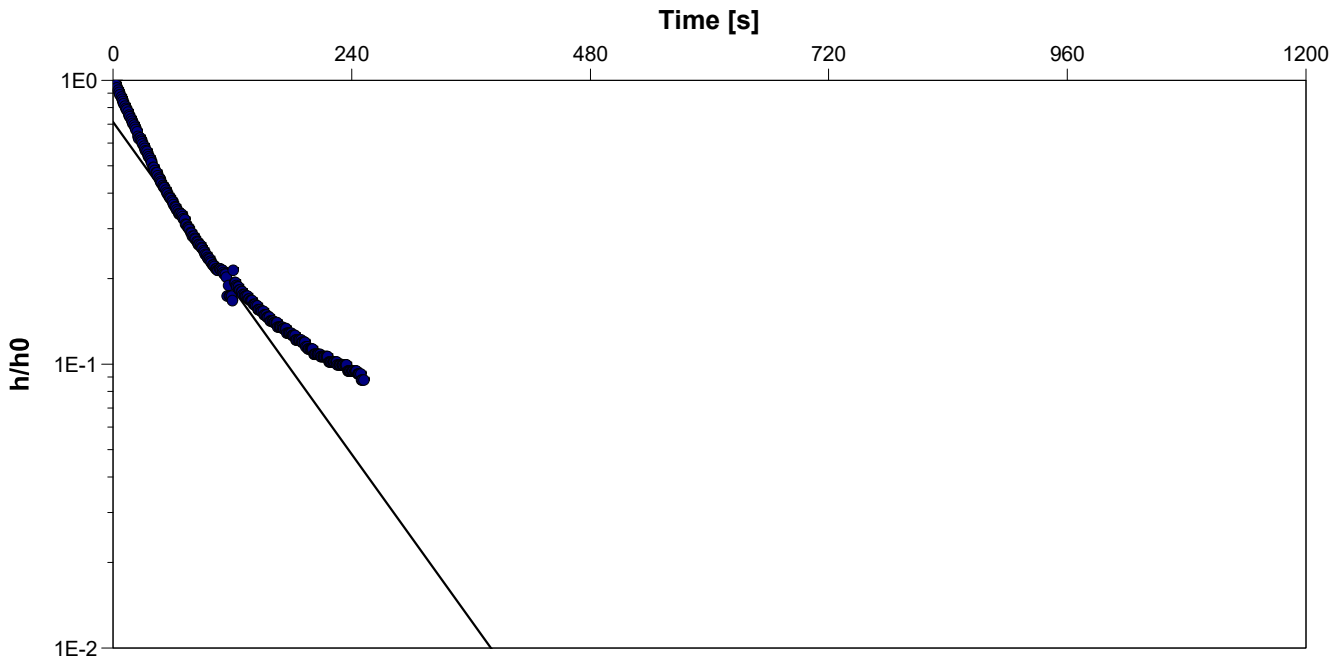


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107-D	9.04×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH112-S: Test 1	Test Well: BH112-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/10/2024
Aquifer Thickness: 2.32 m		

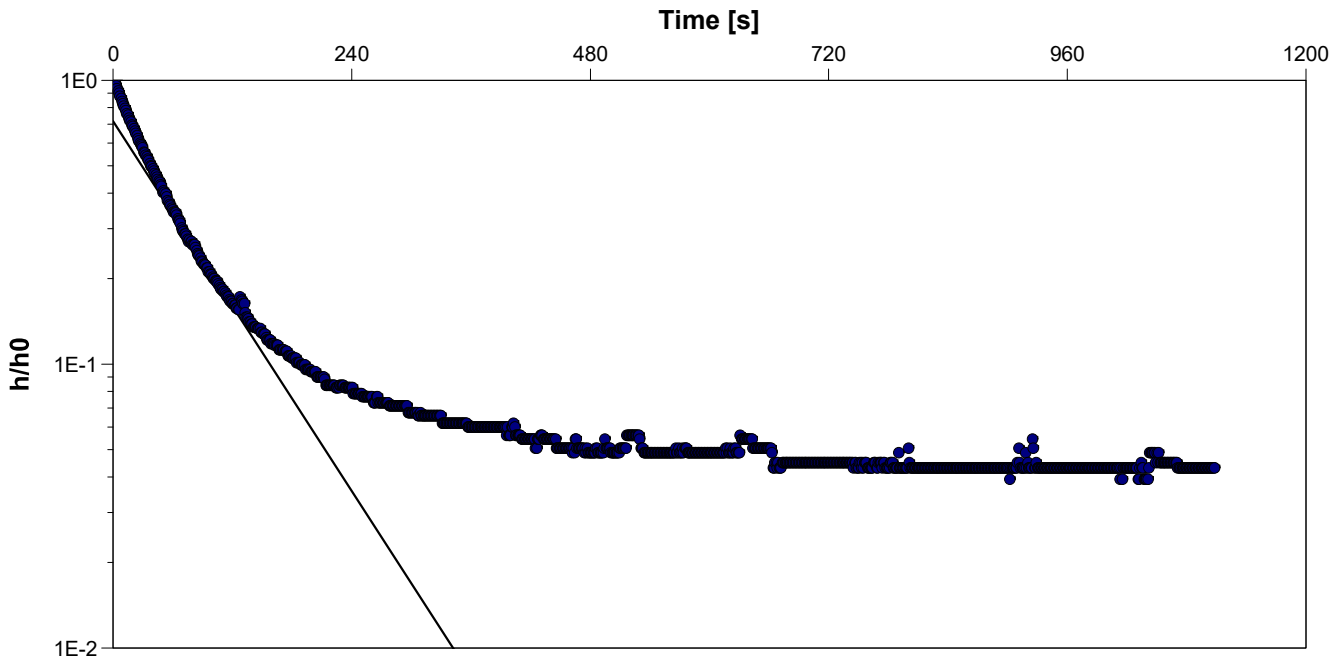


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH112-S	8.35×10^{-6}	

	Slug Test Analysis Report
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH112-S: Test 2	Test Well: BH112-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/10/2024
Aquifer Thickness: 2.32 m		

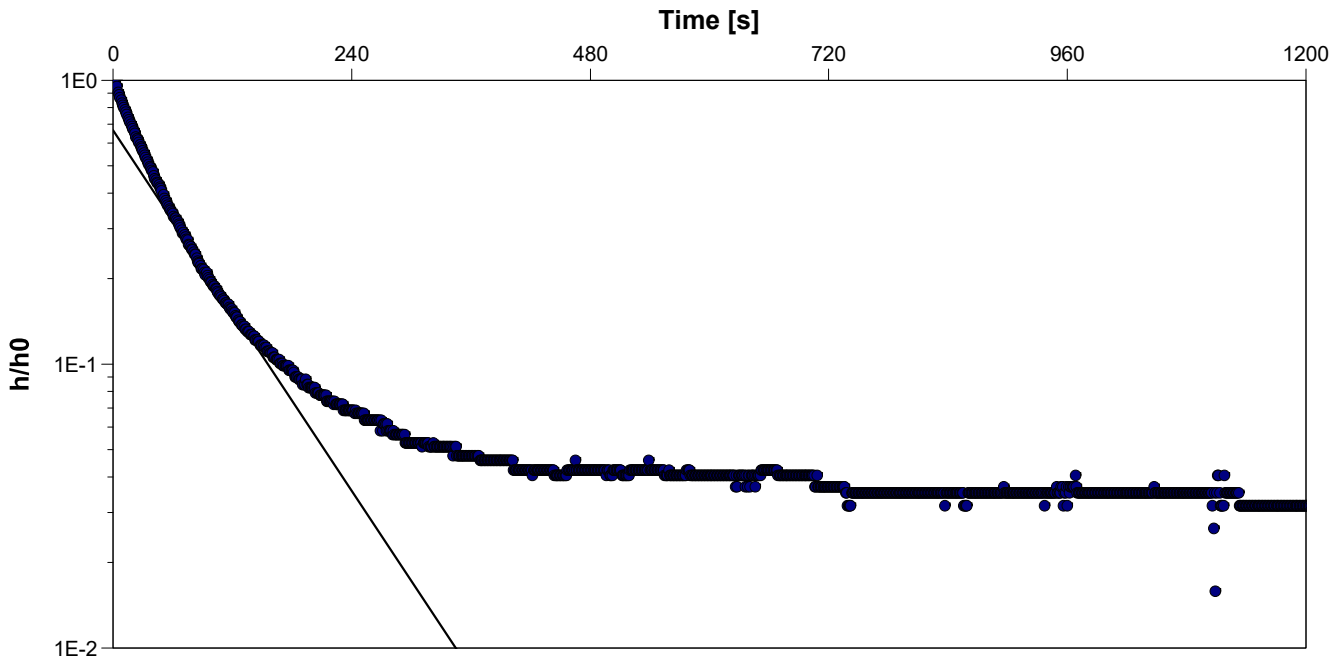


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH112-S	9.29×10^{-6}	

	Slug Test Analysis Report
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH112-S: Test 3	Test Well: BH112-S
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/10/2024
Aquifer Thickness: 2.32 m		

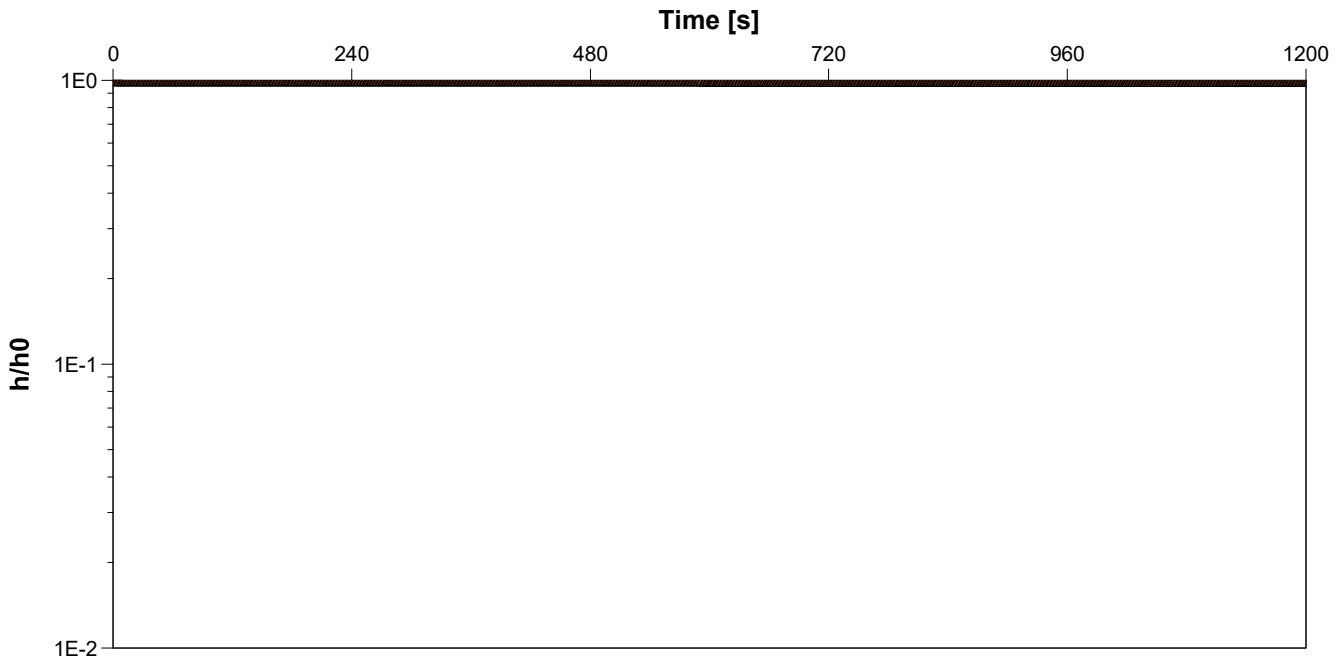


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH112-S	9.06×10^{-6}	

	Slug Test Analysis Report
	Project: Hydrogeological Assessment
	Number: 19712-001
	Client: J.L Richards & Associates Limited

Location: 100 County Rd 64, Brighton, ON	Slug Test: BH112-D: Test 1	Test Well: BH112-D
Test Conducted by: MC		Test Date: 3/7/2024
Analysis Performed by: NA	Bouwer & Rice	Analysis Date: 5/10/2024
Aquifer Thickness: 4.40 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH112-D	4.14×10^{-9}	

Appendix H

Dewatering Calculations

DEWATERING CALCULATIONS - SEWAGE PUMPING STATION (SPS) - CONSTRUCTION

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	83.3	75.9	73.9	8.0	7	3.61E-07	7.40	13.34	4.22	17.56	1.43	9.40	2.00	4.22	**0.000067**	**0.07**	**5,799**
	Maximum K	83.3	75.9	73.9	8.0	7	1.28E-05	7.40	79.45	4.22	83.68	2.99	9.40	2.00	4.22	**0.001137**	**1.14**	**98,205**
	Geometric mean K	83.3	75.9	73.9	8.0	7	1.51E-06	7.40	27.28	4.22	31.50	2.01	9.40	2.00	4.22	**0.000199**	**0.20**	**17,200**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

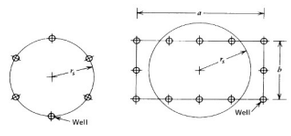
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

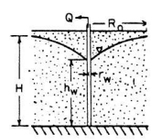
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

DEWATERING CALCULATIONS - SEWAGE PUMPING STATION (SPS) - OPERATIONAL

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	83.3	76.9	74.9	6.7	5.8	3.61E-07	6.40	11.54	3.52	15.05	1.45	8.40	2.00	3.52	**0.000052**	**0.05**	**4,485**
	Maximum K	83.3	76.9	74.9	6.7	5.8	1.28E-05	6.40	68.72	3.52	72.23	3.02	8.40	2.00	3.52	**0.000886**	**0.89**	**76,570**
	Geometric mean K	83.3	76.9	74.9	6.7	5.8	1.51E-06	6.40	23.59	3.52	27.11	2.04	8.40	2.00	3.52	**0.000155**	**0.15**	**13,354**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

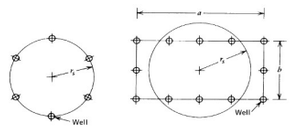
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

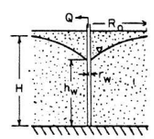
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

DEWATERING CALCULATIONS - SEPTIC RECEIVING TANK - CONSTRUCTION

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	83.3	79.1	77.1	10.3	5.5	3.61E-07	4.20	7.57	4.25	11.82	1.02	6.20	2.00	4.25	**0.000038**	**0.04**	**3,297**
	Maximum K	83.3	79.1	77.1	10.3	5.5	1.28E-05	4.20	45.09	4.25	49.34	2.45	6.20	2.00	4.25	**0.000565**	**0.57**	**48,820**
Geometric mean K		83.3	79.1	77.1	10.3	5.5	1.51E-06	4.20	15.48	4.25	19.73	1.54	6.20	2.00	4.25	**0.000106**	**0.11**	**9,187**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

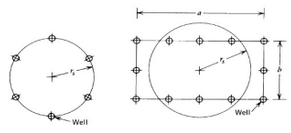
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

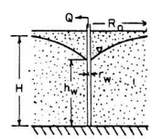
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

DEWATERING CALCULATIONS - SEPTIC RECEIVING TANK - OPERATIONAL

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	83.3	80.1	78.1	8.6	4.6	3.61E-07	3.20	5.77	3.55	9.32	0.97	5.20	2.00	3.55	**0.000027**	**0.03**	**2,339**
	Maximum K	83.3	80.1	78.1	8.6	4.6	1.28E-05	3.20	34.36	3.55	37.91	2.37	5.20	2.00	3.55	**0.000391**	**0.39**	**33,820**
	Geometric mean K	83.3	80.1	78.1	8.6	4.6	1.51E-06	3.20	11.79	3.55	15.34	1.46	5.20	2.00	3.55	**0.000075**	**0.07**	**6,448**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

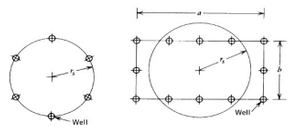
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

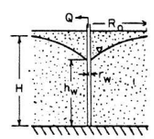
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

DEWATERING CALCULATIONS - MAIN PROCESSING AREA - CONSTRUCTION

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	83.3	77.3	75.3	80.4	60.0	3.61E-07	6.00	10.81	39.19	50.00	0.24	8.00	2.00	39.19	**0.000279**	**0.28**	**24,121**
	Maximum K	83.3	77.3	75.3	80.4	60.0	1.28E-05	6.00	64.42	39.19	103.61	0.97	8.00	2.00	39.19	**0.002483**	**2.48**	**214,552**
Geometric mean K		83.3	77.3	75.3	80.4	60.0	1.51E-06	6.00	22.11	39.19	61.30	0.45	8.00	2.00	39.19	**0.000636**	**0.64**	**54,938**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

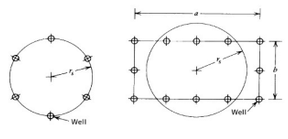
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

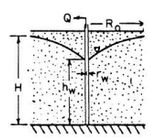
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

DEWATERING CALCULATIONS - ADDITIONAL CLARIFIER TANK DEPTH - CONSTRUCTION

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	77.3	74.5	72.5	48.0	18.0	4.99E-07	2.80	5.93	16.58	22.52	0.31	4.80	2.00	16.58	**0.000098**	**0.10**	**8,431**
	Maximum K	77.3	74.5	72.5	48.0	18.0	8.67E-07	2.80	7.82	16.58	24.41	0.39	4.80	2.00	16.58	**0.000134**	**0.13**	**11,597**
	Geometric mean K	77.3	74.5	72.5	48.0	18.0	7.09E-07	2.80	7.07	16.58	23.66	0.36	4.80	2.00	16.58	**0.000119**	**0.12**	**10,315**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

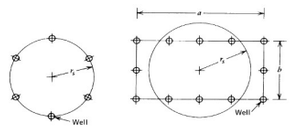
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

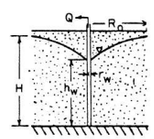
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

DEWATERING CALCULATIONS - MAIN PROCESSING AREA - OPERATIONAL

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	83.3	78.3	76.3	67.0	50.0	3.61E-07	5.00	9.01	32.65	41.67	0.24	7.00	2.00	32.65	**0.000209**	**0.21**	**18,090**
	Maximum K	83.3	78.3	76.3	67.0	50.0	1.28E-05	5.00	53.68	32.65	86.34	0.97	7.00	2.00	32.65	**0.001862**	**1.86**	**160,914**
Geometric mean K		83.3	78.3	76.3	67.0	50.0	1.51E-06	5.00	18.43	32.65	51.08	0.45	7.00	2.00	32.65	**0.000477**	**0.48**	**41,203**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

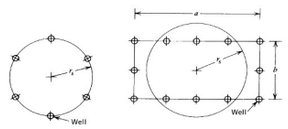
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

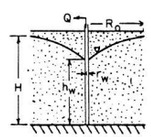
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

DEWATERING CALCULATIONS - ADMINISTRATION BUILDING - CONSTRUCTION

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	s	R	$r_s = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_s)$	H	$h_w = H-s$	r_s	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K[1]	83.3	81.5	79.5	29.0	14.6	3.61E-07	1.80	3.24	11.61	14.85	0.25	3.80	2.00	11.61	**0.000048**	**0.05**	**4,151**
	Maximum K	83.3	81.5	79.5	29.0	14.6	1.28E-05	1.80	19.33	11.61	30.94	0.98	3.80	2.00	11.61	**0.000429**	**0.43**	**37,034**
	Geometric mean K	83.3	81.5	79.5	29.0	14.6	1.51E-06	1.80	6.63	11.61	18.24	0.45	3.80	2.00	11.61	**0.000110**	**0.11**	**9,463**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

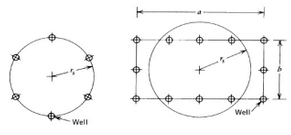
r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

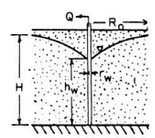
h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater



$$r_s = \sqrt{\frac{ab}{\pi}}$$



Radial flow, water table aquifer

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_O / r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

DEWATERING CALCULATIONS - UNDERGROUND SERVICE LINES - CONSTRUCTION

Modified Dupuit-Forchheimer Equation: unconfined flow into a linear excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial depth to groundwater	Target Depth to groundwater	Base of Aquifer	Unit length of trench (a)	Width of Trench (b)	Hydraulic Conductivity (K)	s	R	$r_s = b/2$	R_o	$\ln(R_o/r_s)$	If $R_o >> r_s$, $L = R_o/2$ else, $L = R/2 + r_s$	H	h = H-s	Q_{ends}	Q_{trench}	Q_{total}		
		masl	masl	masl	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	m^3/s	m^3/s	L/s	L/d
Elongated Trench @ 50 m Increments	Minimum K[1]	83.3	78.6	76.6	50	2	3.61E-07	4.70	8.47	1.00	9.47	2.25	5.24	6.70	2.00	0.000021	0.000141	**0.000162**	**0.16**	**13,960**
	Maximum K	83.3	78.6	76.6	50	2	1.28E-05	4.70	50.46	1.00	51.46	3.94	26.23	6.70	2.00	0.000418	0.000998	**0.001416**	**1.42**	**122,331**
	Geometric mean K	83.3	78.6	76.6	50	2	1.51E-06	4.70	17.32	1.00	18.32	2.91	9.66	6.70	2.00	0.000067	0.000319	**0.000386**	**0.39**	**33,359**

[1]Minimum, maximum and mean hydraulic conductivity values calculated from results of all tested overburden and bedrock wells

s = target drawdown (initial - target depth to groundwater) (m)

R_o = radius of influence of construction dewatering/pumping (m)

L = distance to line source (m)

r_s = equivalent single well radius (m)

H = Initial hydraulic head in aquifer (m)

h = hydraulic head at radius of well (m)

Q = construction dewatering rate (m^3/s)

*Where depth to base of aquifer is unknown, use depth value of 2 m below target depth to groundwater

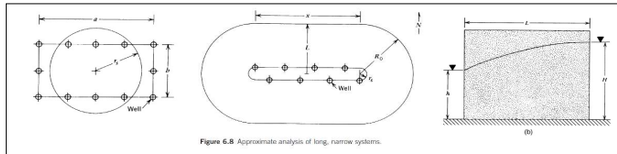


Figure 6.8 Approximate analysis of long, narrow systems.

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

$$Q = \frac{\pi K(H^2 - h^2)}{\ln R_0/r_s} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right] \quad (6.10b)$$

x = unit length of trench

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

if R >>> rs, R_o = R

else, $R_o = R + r_s$

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

Appendix B

Natural Heritage Reports

NATURAL HERITAGE MEMORANDUM

Cambium Inc.
P.O. Box 325
Peterborough, Ontario. K9J 6Z3
Telephone: (705) 742.7900 1 (866) 217.7900

To: Susan Jingmaio Shi, Sr. Environmental Engineer
J.L. Richards and Associates Ltd.
sshi@jlrichards.ca

From: Matthew Wheeler, Sr. Ecologist
Cambium Inc.
matthew.wheeler@cambium-inc.com

Date: August 25, 2022

Re: Natural Heritage Existing Conditions and Impact Assessment Memorandum
Brighton, Ontario
Cambium Project Number: 16197-001
J L Richards Project Number: 31795-000.1

Introduction

The Municipality of Brighton is carrying out an addendum to the Municipal Class Environmental Assessment (MCEA) Schedule B project, for facility upgrades at the existing Wastewater Treatment Plant (WWTP) in Brighton, Ontario. The details of the proposed Schedule B Class EA addendum can be found on the Municipality's public website advertising the Notice of Study Commencement. Cambium Inc. (Cambium) was retained by J.L. Richards and Associates Limited (JLR) to conduct a desktop review of Natural Heritage features as required by the MCEA process (Figure 1).

The existing Brighton Wastewater Pollution Control Plant (WPCP) is a lagoon-based system located at 100 County Road 64, Brighton, Ontario. The WPCP requires updates to the existing infrastructure to ensure compliance with the limits stated in the Environmental Compliance Approval (ECA) for current operations and to meet future needs of the municipality. The entire property will be considered the Site for this report.

Description of Natural Heritage Features

The natural heritage features have been reviewed based on existing publicly accessible data sets. However, a field investigation was not completed as a part of the natural heritage review process. The Site is within Ecoregion 6E of Ontario (Crins, Gray, Uhlig, & Wester, 2009). The Site contains or is adjacent to (within 120 m of) the following mapped natural heritage and/or hydrologic features:

- Arena Creek (on Site and adjacent lands) is coldwater fish habitat
- Unevaluated wetlands (on Site and adjacent lands)
- Woodlands (on Site and adjacent lands)
- Presqu'ile Bay Marsh, a coastal Provincially Significant Wetland (PSW) (on adjacent lands)
- Potential habitat for provincially listed species at risk (SAR) on and adjacent to the Site from element occurrence data from the Natural Heritage Information Centre (NHIC) and air photo interpretation of potential SAR habitat;
    - Wood Thrush (Special Concern)
    - Black Tern (Special Concern)
    - Grass Pickerel (Special Concern)
    - Midland Painted Turtle (Special Concern)
    - Snapping Turtle (Special Concern)
    - Blanding's Turtle (Threatened)
    - Barn Swallow (Threatened)
    - Least Bittern (Threatened)
- No federally listed aquatic SAR are documented to be present in Arena Creek. However, aquatic SAR are mapped as present within the PSW of Presqu'ile Bay Marsh, approximately 400 m downstream. The Department of Fisheries and Oceans (DFO) SAR mapping contains records for the following SAR which occur, or may occur, on adjacent lands south of County Road 64;
    - Grass Pickerel (Special Concern)
    - Eastern Pondmussel (Special Concern)
    - Bridle Shiner (Special Concern)
    - Pugnose Shine (Threatened)
    - Shortnose Cisco (Endangered)

The provincial and federal background data does not contain a name for the watercourse on the Site. However, it is locally known as Arena Creek as the watercourse flows through the King Edward Arena property, north of

the Site. The watercourse conveys water on the Site southward and outlets into Presqu'ile Bay Marsh coastal PSW. The Land Inventory Ontario Aquatic Resource Area data set documents the following fish species in this coldwater watercourse; Banded Killifish, Blackchin Shiner, Brook Stickleback, Creek Chub, Fathead Minnow, Northern Redbelly Dace, White Sucker, and Yellow Perch. While the provincial database indicates this is a coldwater thermal regime, the fish species within the data set indicates that it is likely a mixed thermal regime of coolwater and warm water species. No fall spawning species are documented in the system.

The Site is within the jurisdiction of the Lower Trent Conservation and their regulated area encompasses portions of the Site associated with Arena Creek and the unevaluated wetlands. As the Site contains wetlands and a watercourse, the Study will consider regulations on the infrastructure as imposed by the local Conservation Authority's Regulation under the *Conservation Authorities Act*, 1990 (i.e., O. Reg. 163/06).

The *Endangered Species Act, 2007* (ESA) protects endangered and threatened species and their habitats from harm or destruction. Habitat for endangered and threatened species is also afforded protection under provincial natural heritage policy; however, it is ultimately the proponent's responsibility to ensure that no harm to these species or their habitats occurs on their property.

Impact Assessment and Recommendations

Fisheries

An environmental consultant knowledgeable in fish and fish habitat regulations, mitigation, and design strategies should be retained as a part of the team designing the relocation of Arena Creek. A field investigation should be performed to determine if fish can pass from south of County Road 64 northward into Arena Creek. In addition, it is recommended that fish community sampling and habitat mapping be completed within Arena Creek and within the proposed channel relocation area. Potential constraints and opportunities for the construction of a new channel should be identified during the field investigation. Confirmation of existing conditions and fish species present, including aquatic SAR, will contribute to the channel relocation detail design.

The DFO does not typically participate in the pre-construction design or planning of projects. DFO should be engaged to complete a Request for Project Review after the channel relocation detail design is 90% complete. The design team should provide DFO with an explanation of the proposed works, design drawings and a statement demonstrating how the design meets the requirements of the *Fisheries Act* and regulations. A

geomorphologist may be required to review the location and design of the relocated channel to prevent impacts to the aeration pond and minimize future maintenance work on the new channel from erosion.

The creek relocation should be designed to comply with fish and fish habitat protection provisions in the *Fisheries Act.* In particular, measures should be implemented to avoid;

- causing the death of fish
- the harmful alteration, disruption or destruction of fish habitat in your work, undertaking or activity

Measures to protect fish should consider:

- **In-water Work Window**: Based on the documented fish assemblage in Arena Creek, the restricted activity timing window to protect fish and fish habitat is from April 1 to July 15. All in water work is prohibited during this period when fish are potentially spawning. In-water work is permitted from **July 16 to March 31**.
- **Habitat Elements**: if possible, the new channel design should include substrates or habitat structures to support fish spawning. Where possible, riparian vegetation should be maintained, and re-vegetation areas should include planting and/or seeding of native species. If tree removal is planned, consider utilizing coarse woody debris or root wads for the new channel.
- **Channel Stability**: The new channel should be created in a 'fish-friendly' manner with natural channel design to ensure long term stability of the channel. Live willow stakes, a soil bio-engineering technique, can be incorporated into the banks of the new channel to provide biophysical stability, shading of the watercourse and allochthonous materials for fish. Soil bio-engineering will actively prevent erosion of the new watercourse channel.
- **Erosion and Sediment Control**: An erosion and sediment control plan should be developed to prevent sediment from entering the watercourse and harming fish or fish habitat during construction.
- **Permits and Approvals**; It is recommended that the DFO Request for Review process should be undertaken through consultation with DFO. if a *Fisheries Act* Authorization is required, the tender and drawings for construction work should include all conditions of the authorization or letter of advice. A Conservation Authority permit is likely required to work within their regulated area (i.e., in-water work, work adjacent to the watercourse and wetlands).

Migratory Birds

Nesting birds and their nests, eggs, and young are protected under the *Migratory Birds Convention Act*, 1994. Vegetation clearing on the Site should occur outside the breeding bird season, which extends from April 15 to August 15 in the local area (as per Environment and Climate Change Canada Guidelines).

If vegetation clearing or construction is to occur between April 15 and August 15, the vegetation should be investigated by a qualified biologist to confirm if any active nests are present, prior to site alteration. Vegetation clearing can proceed provided there are no active nests. If active nests are confirmed, the nests should be left undisturbed until young have fledged or the nest is determined to be inactive. Note that some birds nest on the ground and in low-lying vegetation and shrubs; therefore, all habitat types should be inspected prior to ground disturbance if removals are to occur during the breeding season.

Species at Risk

Midland Painted Turtle, Snapping Turtle and Blanding's Turtle have the potential to be encountered on and adjacent to the Site. Turtles and snakes are particularly vulnerable to construction-related impacts on sites adjacent to wetlands, watercourses, and waterbodies. Arena Creek is unlikely to support turtle overwintering. However, turtles may utilize the aeration cell, waste stabilization pond and the watercourse for travel and foraging.

As the Site is located adjacent to potential habitat for turtles, workers should be aware turtles nest in terrestrial habitats from May 15 to July 15 and eggs can incubate until September 15. As a mitigative strategy, it is recommended that silt fence can be installed around the construction area to exclude turtles from the work area. All stockpiled materials should be kept inside the exclusion fencing area and ideally should be covered and well secured around the base, to prevent turtles from nesting in loose substrates such as sand, soil, wood chips and aggregates. Should any nesting turtles be encountered, work should stop immediately, and the turtle should be left to finish nesting undisturbed. The turtle should be photographed, and the nest marked to ensure it is not disturbed during construction, or until eggs have hatched (late August – September). If a nest is laid in a stockpile or other area that requires disturbance, Cambium should be contacted to determine if the nest can be relocated.

If individual turtles are encountered, they should be photographed and allowed time to move out of harm's way. SAR should not be handled by unauthorized individuals.

Closing

This memo provides a description of the existing conditions within the Study Area, assessment of potential effects on natural heritage elements, and provides recommendations to eliminate or minimize negative environmental effects during and post-construction. Enhancement measures are recommended to provide long term stability to the new channel and associated terrestrial and aquatic ecosystems. Agency consultation for permits, approvals and authorizations are specified in this memo. Feel free to contact the undersigned should you have any questions regarding this memo.

Kind regards,

Cambium Inc.

Matthew Wheeler, B.A. Hons.

Project Manager / Senior Ecologist

MBW

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Field Summary Memo: Black Ash Survey, Brighton Wastewater Treatment Plant, Brighton, Ontario

March 19, 2024

Prepared for:
J.L. Richards

Cambium Reference: 16197-001

CAMBIUM INC.

866.217.7900

cambium-inc.com

Table of Contents

List of Appendices

1.0 Introduction

Cambium Inc. (Cambium) was retained by J.L. Richards (the Client) to perform a survey for Black Ash (the Study) at the Brighton Wastewater Treatment Plant in Brighton, Ontario (the Site). The area surveyed was north and northeast of the wastewater treatment plant and the adjacent watercourse, which is a tributary to Lake Ontario. An equipment access route was created by removing select trees and shrubs north of the watercourse to facilitate geotechnical drilling. A survey was undertaken to determine if Black Ash (*Fraxinus nigra*), listed as an endangered species under the Endangered Species Act, was present.

This summary memo details the methodology and findings of the Black Ash survey, conducted March 6, 2024.

2.0 Background Information

Black Ash (*Fraxinus nigra*), is listed as endangered provincially and threatened federally. A Minister's Order (O.Reg. 23/22) which came into force on January 26, 2022 temporarily paused the species and habitat protection provisions for Black Ash under the ESA, for a period of two years (i.e., until January 26, 2024). As of January 26, 2024, following the expiry of the period of temporary suspension, Black Ash individuals and its habitat are protected by the ESA (ERO, 2024).

Black Ash is a facultative wetland species that occurs in areas with moist to wet soils, including floodplain forests. The largest threat to this species is Emerald Ash Borer, an invasive beetle from Asia that has been introduced to North America. The larvae of this species tunnel through the tree's cambium layer under the bark, which causes the bark to fall off, eventually girdling and killing the tree.

Black Ash was added to the SARO List on January 26, 2022, as endangered. With a SARO List classification of endangered, the ESA prohibits killing, harming, harassing, possessing, transporting, trading and selling of live or dead Black Ash, and damaging or destroying its habitat.

3.0 Survey Methodology

A Cambium biologist completed the Black Ash survey in two areas. A detailed transect approach was taken within the area of disturbance and a 10 m radius around the disturbance (Area 1). A single transect approach was taken to search for Black Ash from the treeline to within 10 m of the forest surrounding the open field west of the disturbance (Area 2). The forest in Area 2, though not disturbed, was also surveyed for this species.

Area 1 (approximately 0.15 ha) was surveyed with four roughly 50 m long east to west transects spaced five meters apart. The path created to facilitate geotechnical drilling was surveyed for the presence of Black Ash. Any Black Ash observed, including any damaged by the disturbance were flagged with white flagging tape and numbered. If present, the size of the trunk (diameter at breast height; dbh) was recorded for Black Ash trees of any size. The forest within 10 m of the disturbance was also surveyed for the presence of Black Ash.

Area 2 (approximately 0.5 ha) was surveyed 10 m from the tree line north, south, and west of the open field north of the wastewater treatment plant. One transect was completed and if observed Black Ash were demarcated with white flagging tape, and numbered.

If observed, the Cambium biologist took notes on the health of any Black Ash observed (e.g. alive or dead, signs of Emerald Ash Borer, etc.).

4.0 Summary of Observations

No Black Ash trees were observed in Area 1 during transects. No Black Ash were observed to have been damaged by the path clearing for the geotechnical investigation. It is notable that White Ash (*Fraxinus americana*) was observed around the disturbance area. White Ash is an upland species, as compared to Black Ash, which is a wetland species, and was found growing throughout Area 1. Area 1 is well drained, and elevated compared to the area immediately north of it by approximately 3-5 m. The presence of White Ash likely indicates that the area of the disturbance does not contain sufficient soil moisture necessary to support Black Ash. No Black Ash were found north of Area 1 (at a slightly lower elevation) either. White Ash is not a species at risk protected by the ESA.

No Black Ash were observed in Area 2 during transects. Three Green Ash (*Fraxinus pennsylvanica*) were observed north of the open field in Area 2. Green Ash is also not a species at risk and does not pose a risk to development. Green Ash can grow in either upland or wetland environments.

Overall, no Black Ash were observed on the Site. No Black Ash were damaged by the clearing of trees and shrubs for the geotechnical investigation.

5.0 Closing

Cambium trusts that the information presented herein meets with your needs at this time as a presentation of the natural features associated with the Site. If you have questions with respect to the enclosed information, please contact the undersigned.

Respectfully submitted,

Cambium Inc.

DocuSigned by:
Matthew Wheeler
444192DEEE8D462...

Matthew Wheeler, B.A. Hons.
Project Manager / Senior Ecologist

DocuSigned by:
Kayla Vizza
25FD9B24921647C...

Kayla Vizza, M.Sc.
Technician

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6.0 References

Catling, P. W. (2022). *Black Ash (Fraxinus nigra) in Ontario. Ontario Recovery Strategy Series.* Peterborough, Ontario: Ministry of the Environment, Conservation and Parks.

ERO. (2024, January 25). *Protecting Black Ash and its habitat under the Endangered Species Act, 2007*. Retrieved from Environmental Registry of Ontario: https://ero.ontario.ca/notice/019-7378

Standard Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

Facts, conditions, information and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

Reliance

Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

Appendix A
Photographs

Photo 1 Disturbed area facing east. March 2024

Photo 2 An example of a leaf scar and terminal bud on a White Ash. Leaf scars are a diagnostic feature to identify Ash species. March 2024.

Photo 3 A representative photo of the forest community in Area 1. March 2024

Photo 4A representative photo of the forest community in Area 2, at the edge of the open field. March 2024.

Appendix B

Black Ash Survey Map

Ontario

Ministry of Natural Resources and Forestry

Make-a-Map: Natural Heritage Areas

Black Ash Survey Area (16197-001)

Map created:3/7/2024

Legend

- Assessment Parcel
- ANSI
- Earth Science Provincially Significant/sciences de la terre d'importance provinciale
- Earth Science Regionally Significant/sciences de la terre d'importance régionale
- Life Science Provincially Significant/sciences de la vie d'importance provinciale
- Life Science Regionally Significant/sciences de la vie d'importance régionale
- Conservation Reserve
- Provincial Park

Notes:

Enter map notes

0.1 0 0.04 0.1 Kilometres

Absence of a feature in the map does not mean they do not exist in this area.

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Natural Resources and Forestry(OMNRF) shall not be liable in any way for the use of, or reliance upon, this map or any information on this map.

NATURAL HERITAGE MEMORANDUM

Cambium Inc.
P.O. Box 325
Peterborough, Ontario. K9J 6Z3
Telephone: (705) 742.7900 1 (866) 217.7900

To: Susan Jingmaio Shi, Sr. Environmental Engineer
J.L. Richards and Associates Ltd.
sshi@jlrichards.ca

From: Matthew Wheeler, Sr. Ecologist
Cambium Inc.
matthew.wheeler@cambium-inc.com

Date: May 8, 2024

Re: Natural Heritage Existing Conditions and Impact Assessment Memorandum
Brighton, Ontario
Cambium Project Number: 16197-001
J L Richards Project Number: 31795-000.1

Introduction

The Municipality of Brighton is carrying out an addendum to the Municipal Class Environmental Assessment (MCEA) Schedule B project, for facility upgrades at the existing Wastewater Treatment Plant (WWTP) in Brighton, Ontario. The details of the proposed Schedule B Class EA addendum can be found on the Municipality's public website advertising the Notice of Study Commencement. Cambium Inc. (Cambium) was retained by J.L. Richards and Associates Limited (JLR) to conduct a desktop review of Natural Heritage features as required by the MCEA process (Figure 1).

The existing Brighton Wastewater Pollution Control Plant (WPCP) is a lagoon-based system located at 100 County Road 64, Brighton, Ontario. The WPCP requires updates to the existing infrastructure to ensure compliance with the limits stated in the Environmental Compliance Approval (ECA) for current operations and to meet the municipality's future needs. The entire property will be considered the Site for this report.

Description of Natural Heritage Features

The natural heritage features have been reviewed based on existing publicly accessible data sets. However, a field investigation was not completed as a part of the natural heritage review process. The Site is within Ecoregion 6E of Ontario (Crins, Gray, Uhlig, & Wester, 2009). The Site contains or is adjacent to (within 120 meters [m] of) the following mapped natural heritage and/or hydrologic features:

- Arena Creek (on Site and adjacent lands) provides direct fish habitat with a coldwater thermal regime
- Unevaluated wetlands (on Site and adjacent lands)
- Woodlands (on Site and adjacent lands)
- Presqu'ile Bay Marsh, a coastal Provincially Significant Wetland (PSW) (on adjacent lands)

- Potential habitat for provincially listed species at risk (SAR) on and adjacent to the Site from element occurrence data from the Natural Heritage Information Centre (NHIC) and air photo interpretation of potential SAR habitat;
    - Barn Swallow (Threatened) (*Hirundo rustica*)
    - Black Ash (Endangered) (*Fraxinus nigra*)
    - Black Tern (Special Concern) (*Chlidonias niger*)
    - Blanding's Turtle (Threatened) (*Emydoidea blandingii*)
    - Butternut (Endangered) (*Juglans cinerea*)
    - Bobolink (Threatened) (*Dolichonyx oryzivorus*)
    - Eastern Meadowlark (Threatened) (*Sturnella magna*)
    - Eastern Small-footed Myotis (Endangered) (*Myotis leibii*)
    - Eastern Wood-pewee (Special Concern) (*Contopus virens*)
    - Grass Pickerel (Special Concern) (*Esox americanus vermiculatus*)
    - King Rail (Endangered) (*Rallus elegans*)
    - Least Bittern (Threatened) (*Ixobrychus exilis*)
    - Little Brown Bat (Endangered) (*Myotis lucifugus*)
    - Northern Myotis (*Myotis septentrionalis*)
    - Pale-bellied Frost Lichen (Endangered) (*Physconia subpallida*)
    - Red-headed Woodpecker (Endangered) (*Melanerpes erythrocephalus*)
    - Tri-colored Bat (Endangered) (*Perimyotis subflavus*)
    - Wood Thrush (Special Concern) (*Hylocichla mustelina*)
- No federally listed aquatic SAR are documented to be present in Arena Creek. However, aquatic SAR are mapped as present within the PSW of Presqu'ile Bay Marsh, approximately 400 m downstream. The creek also connects with Lake Ontario, potentially allowing SAR to travel upstream during high-flow events. The Department of Fisheries and Oceans (DFO) SAR mapping contains records for the following SAR which occur, or may occur, on adjacent lands south of County Road 64 and in Arena Creek;
    - Bridle Shiner (Special Concern) (*Notropis bifrenatus*)
    - Eastern Pondmussel (Special Concern) (*Ligumia nasuta*)
    - Grass Pickerel (Special Concern)
    - Pugnose Shiner (Threatened) (*Notropis anogenus*)
    - Shortnose Cisco (Endangered) (*Coregonus reighardi*)

The provincial and federal background data does not contain a name for the watercourse on the Site. However, it is locally known as Arena Creek, as the watercourse flows through the King Edward Arena property north of

the Site. The watercourse conveys water on the Site southward and outlets into Presqu'ile Bay Marsh coastal PSW. The Land Inventory Ontario Aquatic Resource Area data set documents the following fish species in this coldwater watercourse; Banded Killifish (*Fundulus diaphanous*), Blackchin Shiner (*Notropis heterodon*), Brook Stickleback (*Culaea inconstans*), Creek Chub (*Semotilus atromaculatus*), Fathead Minnow (*Pimephales promelas*), Northern Redbelly Dace (*Chrosomus eos*), White Sucker (*Catostomus commersonii*), and Yellow Perch (*Perca flavescens*). While the provincial database indicates this is a coldwater thermal regime, the fish species within the data set indicate that it is likely a mixed thermal regime of cool water and warm water species. No fall spawning species are documented in the system.

The Site is within the jurisdiction of the Lower Trent Conservation (LTC) and their regulated area encompasses portions of the Site associated with Arena Creek and the unevaluated wetlands. As the Site contains wetlands and a watercourse, the Study will consider regulations on the infrastructure as required by the *Conservation Authorities Act*, 1990.

The *Endangered Species Act, 2007* (ESA) protects endangered and threatened species and their habitats from harm or destruction. Habitat for endangered and threatened species is also afforded protection under provincial natural heritage policy; however, it is ultimately the proponent's responsibility to ensure that no harm to these species or their habitats occurs on their property.

Preliminary Impact Assessment and Recommendations

Note that the impact assessment and recommendations presented herein are based on the preliminary design alternatives. As such, the impact assessment and recommendations should be updated when a technically preferred alternative is carried forward into detail design.

Fisheries

An environmental consultant knowledgeable in fish and fish habitat regulations, mitigation, and design strategies should be retained as a part of the team designing the relocation of Arena Creek. A field investigation should be performed to determine if fish can pass from south of County Road 64 northward into Arena Creek. In addition, it is recommended that fish community sampling and habitat mapping be completed within Arena Creek and within the proposed channel relocation area. Potential constraints and opportunities for the construction of a new channel should be identified during the field investigation. Confirmation of existing conditions and fish species present, including aquatic SAR, will contribute to the channel relocation detail design.

The DFO does not typically participate in the pre-construction design or planning of projects. DFO should be engaged to complete a Request for Project Review after the channel relocation detail design is 100% complete. The design team should provide DFO with an explanation of the proposed works, design drawings and a statement demonstrating how the design meets the requirements of the *Fisheries Act* and regulations. The design must quantify the area impact within direct fish habitat. A geomorphologist may be required to review the location and design of the relocated channel to prevent impacts to the embankment of the aeration pond and minimize future maintenance work on the new channel from erosion.

The creek relocation should be designed to comply with fish and fish habitat protection provisions in the *Fisheries Act.* In particular, measures should be implemented to avoid;

- causing the death of fish
- the harmful alteration, disruption or destruction of fish habitat in your work, undertaking or activity

Measures to protect fish should consider:

- **In-water Work Window:** Based on the documented fish assemblage in Arena Creek, the restricted activity timing window to protect fish and fish habitat prohibits all in-water work from April 1 to July 15 when fish are potentially spawning. In-water work is permitted from **July 16 to March 31**.
- **Habitat Elements**: if possible, the new channel design should include substrates or habitat structures to support fish spawning. Where possible, riparian vegetation should be maintained, and re-vegetation areas should include planting and/or seeding of native species. If tree removal is planned, consider utilizing coarse woody debris or root wads for the new channel.
- **Channel Stability**: The new channel should be created in a 'fish-friendly' manner with natural channel design to ensure long term stability of the channel. Live willow stakes, a soil bio-engineering technique, can be incorporated into the banks of the new channel to provide biophysical stability, shading of the watercourse and allochthonous materials for fish. Soil bio-engineering will actively prevent erosion of the new watercourse channel.
- **Erosion and Sediment Control**: An erosion and sediment control plan should be developed to prevent sediment from entering the watercourse and harming fish or fish habitat during construction.
- **Permits and Approvals**; It is recommended that the DFO Request for Review process should be undertaken through consultation with DFO. If a *Fisheries Act* Authorization is required, the tender and

drawings for construction work should include all conditions of the authorization or letter of advice. A Conservation Authority permit is likely required to work within their regulated area (i.e., in-water work, work adjacent to the watercourse and wetlands).

Migratory Birds

Nesting birds and their nests, eggs, and young are protected under the *Migratory Birds Convention Act*, 1994 (MBCA), which prohibits killing, capturing, injuring, taking or disturbing of the listed migratory birds. Including damaging, destroying, removing, or disturbing of nests of all migratory bird species that contain a live birds or viable eggs. In 2022, new Migratory Birds Regulations (MBR) were adopted that afford year-round protection to the nests of 18 migratory species, until the nest is deemed to be abandoned. Nest abandonment must be reported through the Abandoned Nest Registry, administered by Environment and Climate Change Canada (ECCC), if there is a need to damage, disturb, destroy, or remove a nest of a species listed in Schedule 1 of the MBR. The time period to confirm nest abandonment varies by species, and ranges from 12 to 36 months. Vegetation clearing on the Site should occur outside the breeding bird season, which extends from April 15 to August 15 in the local area (as per Environment and Climate Change Canada Guidelines).

If vegetation clearing or construction is to occur between April 15 and August 15, the vegetation should be investigated by a qualified biologist to confirm if any active nests are present, prior to site alteration. Vegetation clearing can proceed provided there are no active nests. If active nests are confirmed, the nests should be left undisturbed until young have fledged or the nest is determined to be inactive. Note that some birds nest on the ground and in low-lying vegetation and shrubs; therefore, all habitat types should be inspected prior to ground disturbance if removals are to occur during the breeding season.

Species at Risk

Blanding's Turtles have the potential to be encountered on and adjacent to the Site. Turtles are particularly vulnerable to construction-related impacts on sites adjacent to wetlands, watercourses, and waterbodies. A field investigation will be required to determine if Arena Creek has suitable conditions to support turtle overwintering. Turtles may utilize the aeration cell, waste stabilization pond, and the watercourse for travel and foraging.

As the Site is located adjacent to potential habitat for turtles, workers should be aware turtles nest in terrestrial habitats from May 15 to July 15. Turtle nests typically incubate and hatch in August to the end of October. As a mitigative strategy, it is recommended that silt fence can be installed around the construction area to exclude turtles from the work area by May 15 and maintained to October 15. All stockpiled materials should be kept

inside the exclusion fencing area and ideally should be covered and well secured around the base, to prevent turtles from nesting in loose substrates such as sand, soil, wood chips and aggregates. Should any nesting turtles be encountered, work should stop immediately, and the turtle should be left to finish nesting undisturbed. The turtle should be photographed and the nest marked to ensure it is not disturbed during construction or until eggs have hatched (late August – October). If a nest is laid in a stockpile or other area that requires disturbance, Cambium should be contacted to determine if the nest can be relocated. If individual turtles are encountered, they should be photographed and allowed time to move out of harm's way. SAR should not be handled by unauthorized individuals.

Species at risk (SAR) bats may utilize portions of the property for their lifecycle. A field investigation should be undertaken to determine if the Site has suitable habitat features for SAR bats. As needed, SAR bat acoustic surveys can be undertaken to document the species present and their habitat usage on the Site.

Black Ash and Butternut may be present on the Site. A field investigation should be undertaken to document the presence or absence of these SAR trees on the site. Breeding birds will be documented during this survey to see which common and SAR birds are utilizing the Site.

Closing

This memo provides a description of the existing conditions within the Study Area, a preliminary assessment of potential effects on natural heritage elements and provides recommendations to eliminate or minimize negative environmental effects during and post-construction. Enhancement measures are recommended to provide long-term stability to the new channel and associated terrestrial and aquatic ecosystems. The following field activities are recommended to document existing conditions and assess the impacts of the technically preferred alternative: turtle visual encounter surveys, bat habitat surveys, fisheries and aquatic surveys, Butternut and Black Ash survey, and a breeding bird survey. Agency consultation for permits, approvals and authorizations will be specified to reflect the field-verified natural heritage features and species on the Site. Feel free to contact the undersigned should you have any questions regarding this memo.

Kind regards,

Cambium Inc.

DocuSigned by:

Matthew Wheeler

444192DEEE8D462...

Matthew Wheeler, B.A. Hons.

Project Manager / Senior Ecologist

MBW

P:\16100 to 16199\16197-001 J L Richards & Associates Limited - ENV - MCEA Brighton WWTP\Deliverables\REPORT - 2024 Memo\Draft\2024-05-08 MCEA Brighton-Memo 16197-001.docx

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Building Sciences

Construction Testing & Inspections

Telephone
(866) 217.7900
(705) 742.7900

Facsimile
(705) 742.7907

Website
cambium-inc.com

Mailing Address
P.O. Box 325,
Peterborough, Ontario
Canada, K9J 6Z3

Locations
Peterborough
Kingston
Barrie
Ottawa
Whitby

Laboratory
Peterborough

March 25, 2025

J.L. Richards and Associates Ltd.
203 - 863 Princess Street
Kingston ON K7L 5N4

Attn: Susan Jingmaio Shi
Sent via email to: <sshi@jlrichards.ca>

Re: SAR Screening for Proposed Tree Clearing Area: Brighton Wastewater Treatment Plant, Brighton, Ontario
Cambium Reference: 16197-001

Dear Susan Jingmaio Shi,

Cambium Inc. (Cambium) was retained by J.L. Richards and Associates (the Client) to complete a Species at Risk (SAR) Assessment (the Study) for proposed tree clearing to accommodate the Brighton Wastewater Pollution Control Plant (WPCP) facility expansion. The existing WPCP is a lagoon-based system located at 100 County Road 64, Brighton, Ontario. The WPCP requires updates to the existing infrastructure to ensure compliance with limits stated in the Environmental Compliance Approval (ECA) for current operations, and to meet the municipality's future needs.

The proposed area of tree clearing is located west of the existing lagoon and south of the mapped watercourse (Arena Creek). The area proposed to be cleared, as well as an additional 30 m perimeter, will be considered the Site for this purpose of the Study, as shown in Figure 1, below.

The Study outlined herein serves to assess the potential presence of provincially listed SAR and their habitats, which are afforded protection under the *Endangered Species Act, 2007* (ESA).

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March 25, 2025

Figure 1 Site boundary, identified in red, with the proposed area of clearing shown as yellow polygon.

REGULATORY FRAMEWORK

Protection of SAR in Ontario is governed by the following legislation:

- *Migratory Birds Convention Act, 1994* (Canada, 1994)
- *Species at Risk Act* (Canada, 2002)
- *Endangered Species Act, 2007* (Ontario, 2007)

MIGRATORY BIRDS CONVENTION ACT, 1994 (MBCA)

The *Migratory Birds Convention Act, 1994* [MBCA; (Canada, 1994)] prohibits the killing or capturing of migratory birds, as well as any damage, destruction, removal or disturbance of active nests. While Environment and Climate Change Canada (ECCC) can issue permits allowing the destruction of nests for certain activities or for protection of property, it does not typically issue permits in the case of industrial or construction activities.

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In 2022, new Migratory Birds Regulations (MBR) were adopted that afford year-round protection to the nests of sixteen migratory species, until the nest is deemed to be abandoned. Nest abandonment must be reported through the Abandoned Nest Registry, administered by ECCC, if there is a need to damage, disturb, destroy, or remove a nest of a species listed in Schedule 1 of the MBR. The time period to confirm nest abandonment varies by species, and ranges from 12 to 36 months.

SPECIES AT RISK ACT (SARA)

The purpose of the federal *Species at Risk Act* [SARA; (Canada, 2002)] is to prevent endangered or threatened species from becoming extinct or extirpated, to help in the recovery of endangered, threatened, and extirpated species, and to manage species of special concern to help prevent them from becoming endangered or threatened. At a federal level, species at risk designations are initially determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). If approved by the federal Minister of the Environment and Climate Change, species are added to the federal List of Wildlife Species at Risk. Species that are included on Schedule 1 of the List as endangered or threatened are afforded protection of their defined critical habitat on federal lands under the Act.

On private or provincially owned lands, only aquatic species and migratory birds listed as endangered, threatened, or extirpated or Schedule 1 are protected under the SARA, unless ordered by the Governor in Council. It is assumed that there are no federal lands associated with the Site.

ENDANGERED SPECIES ACT, 2007 (ESA)

The purpose of the provincial *Endangered Species Act, 2007* [ESA (Ontario, 2007)] is to identify provincial SAR, protect those species and their habitats, promote the recovery of those species, and promote stewardship activities to assist in the protection and recovery of SAR. SAR designations for species in Ontario are initially determined by the Committee on the Status of Species at Risk in Ontario (COSSARO), and if approved by the provincial Minister of

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Environment, Conservation and Parks, species are added to the Species at Risk Ontario (SARO) list, contained in O. Reg. 230/08 (MECP, 2024).

Subsection 9(1) of the ESA prohibits the killing, harming, or harassing of species identified as endangered or threatened under the Act, while subsection 10(1)(a) prohibits the damage or destruction of the habitat of species identified as endangered or threatened.

General habitat protection is provided by the ESA to all threatened and endangered species. Species-specific habitat protection is only afforded to those species for which a habitat regulation has been prepared and passed into law as a regulation of the ESA. The ESA has a permitting process to allow activities to occur that would affect protected species and/or their habitats as well as a registration process for certain activities and species.

TECHNICAL APPROACH AND DATA COLLECTION METHODS

Cambium conducted a desktop review of published natural heritage data and information available for the Site. Background information sources consulted included:

- Ministry of Natural Resources and Forestry (MNRF) Natural Heritage Information Centre (NHIC) Data, accessed via the MNRF Natural Heritage Areas Make-a-Map application, for SAR reported as occurring in the vicinity of the Site (MNRF, 2024a)
- List of SAR in Ontario (MECP, 2024) (O.Reg. 230/08) including COSSARO species assessment reports
- Atlas of the Breeding Birds of Ontario (Cadman, Sutherland, Beck, Lepage, & Couturier, 2007)
- Ontario Reptile and Amphibian Atlas (ORAA) (Ontario Nature, 2020)
- Information contained in natural heritage related map layers from Land Information Ontario (Land Information Ontario, 2024)
- Publicly accessible high-resolution aerial imagery and topographic base mapping

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March 25, 2025

The desktop review was supplemented by a targeted field investigation to review existing habitat conditions on the Site. The field investigation served to cross-reference SAR species known to be present, or having the potential to be present, on the Site and adjacent lands, with existing field conditions.

A summary of the field investigations completed on the Site is presented in Table 1. Photographs of general Site conditions are provided as Appendix A.

Table 1 Summary of Field Investigations

Date	Time On Site	Weather	Observer	Activities
2025-03-18	0830-1300	Temp:-3°C-9°C Wind: 2 Noise: 1 Cloud: 0	K. Vizza	Terrestrial Habitat and Vegetation Survey General Wildlife Investigations

Notes: Wind = Beaufort Wind Scale value (0 = 0-2 kph, 1 = 3-5 kph, 2 = 6-11 kph, 3= 12-19 kph, 4 = 20-30 kph, 5 = 31-39 kph, 6 = 40-50 kph). Noise is reported based on background noise levels: Index 0 – no appreciable effect, 1 – slightly affecting sampling, 2 – moderately affecting sampling, 3 – seriously affecting sampling, 4 – profoundly affecting sampling.

SAR ASSESSMENT RESULTS

A list of SAR, with potential to occur in the general vicinity of the Site has been compiled based on known species' ranges, habitat requirements, and review of background information sources outlined above. In addition, the list has been augmented with direct field observations from the field investigation. Cambium has employed a habitat-based screening, in order to identify suitable habitat for species located on or adjacent to the Site.

A detailed description of all SAR species with the potential to occur on the Site is provided in Appendix B (attached) and a discussion of the results is provided below.

ENDANGERED AND THREATENED SPECIES

Based on this screening, the Site and/or adjacent lands may provide habitat for the following threatened and endangered species:

- Black Ash (*Fraxinus nigra*)
- Butternut (*Juglans cinerea*)

- Red-Headed Woodpecker (*Melanerpes erythrocephalus*)
- Eastern Red Bat (*Lasiurus borealis*)
- Eastern Small-footed Myotis (*Myotis leibii*)
- Hoary Bat (*Lasiurus cinereus*)
- Little Brown Bat (*Myotis lucifugus*)
- Northern Myotis (*Myotis septentrionalis*)
- Silver-haired Bat (*Lasionycteris noctivagans*)
- Tri-colored Bat (*Perimyotis subflavus*)

The treed communities on the Site are primarily composed of sparse, but mature and healthy, Manitoba Maple (*Acer negundo*) with Basswood (*Tilia americana*), young White Ash (*Fraxinus americana*), Black Locust (*Robinia pseudoacacia*), and Norway Maple (*Acer platanoides*) occurring to a lesser extent.

No Black Ash were observed on the Site. It is notable that White Ash was observed around the Site; which, as compared to Black Ash (a wetland species) occupies upland habitat and therefore a different habitat niche. The presence of White Ash indicates that the area of proposed clearing does not contain sufficient soil moisture necessary to support Black Ash.

No Butternut were observed on the Site.

A thorough review of the treed area was completed for potential bat maternity roosting habitat including an examination of each individual tree to document snags, cavities, loose bark or leaf clusters, that could be used by bats as maternity habitat; no suitable cavity trees, or suitable trees with peeling bark that would support bats as maternity roosts were identified.

No suitable nesting cavities or foraging snags were present to support Red-headed Woodpecker.

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Construction Testing & Inspections

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(866) 217.7900
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(705) 742.7907

Website
cambium-inc.com

Mailing Address
P.O. Box 325,
Peterborough, Ontario
Canada, K9J 6Z3

Locations
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March 25, 2025

SPECIAL CONCERN SPECIES AND SARA-ONLY LISTED SPECIES

Species listed as special concern under the ESA, or those species in Appendix A that are listed exclusively under the SARA, are not afforded specific protections under the ESA or SARA (on non-federal lands); however, mitigation measures to reduce or eliminate impacts to those species and their habitats are provided in the following section of this letter.

- Canada Warbler (*Cardellina canadensis*)
- Eastern Wood-Pewee (*Contopus virens*)
- Golden Winged Warbler (*Vermivora chrysoptera*)
- Olive-sided Flycatcher (*Contopus cooperi*)
- Wood Thrush (*Hylocichla mustelina*)
- American Eel (*Anguilla rostrata*)
- Bridle Shiner (*Ntoropis bifrenatus*)
- Grass Pickerel (*Esox americanus*)
- Northern Brook Lamprey (*Ichthyomyzon fossor*)
- Silver Lamprey (Great Lakes - Upper St. Lawrence River population) (*Ichthyomyzon unicuspis*)
- Monarch Butterfly (*Danaus plexippus*)
- Yellow-banded Bumble Bee (*Bombus terricola*)

MITIGATION

The mitigation measures and best management practices outlined below should be implemented on the Site, to minimize the potential for impacts to SAR or their habitats that are afforded protection under Sections 9(1) and 10(1) of the *Endangered Species Act, 2007*.

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Telephone
(866) 217.7900
(705) 742.7900

Facsimile
(705) 742.7907

Website
cambium-inc.com

Mailing Address
P.O. Box 325,
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Canada, K9J 6Z3

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GENERAL WILDLIFE AND HABITATS

- Inspect the work area and equipment daily for the presence of wildlife prior to commencing work.
- If any wildlife is observed in the work area, work will stop immediately and will not continue until the wildlife has moved safely out of the work area. Do not touch, harm, or harass wildlife.
- In addition to the above, if a SAR is encountered during construction, a qualified biologist should be contacted for further guidance. Note the individual's location and photograph it, if possible, without harming or harassing it.
- If injured wildlife is observed in the work area, protect the individual from further harm and contact a qualified biologist immediately.
- Implement standard construction best management practices to protect natural areas adjacent to the work area, such as vehicle maintenance and refueling protocols, spill prevention, site housekeeping, noise and dust mitigation, removal of all materials at completion of work, etc.

BIRDS

- Limit vegetation removal to the extent feasible, including limb pruning.
- Avoid clearing of vegetation during the core nesting season for breeding birds, to avoid contravention of the *Migratory Birds Convention Act, 1994* (Canada, 1994). The core nesting season extends from April 15 to August 15 in the local area (as per Environment and Climate Change Canada Guidelines).
- If clearing must occur within the core nesting season for breeding birds, a qualified biologist must perform a nest survey; if any active nests are observed, they must be buffered and remain undisturbed until they are no longer active. Nest surveys must be completed within 24 hours of the proposed clearing; if clearing takes longer than 24 hours, additional nest surveys may be required. If the biologist determines that nests may be

present, even if not detected (i.e., vegetation is dense and not feasibly searchable), works in that area will be delayed until after the nesting season. Nest surveys must be carried out in a matter that will not harm or harass nesting birds.

BATS

- Limit tree removal, including limb pruning, to the extent feasible.
- Avoid clearing of trees during the active period for bats (April 1 – September 30).
- If tree or rock pile disturbance must occur during the active period for bats (i.e., up to April 15th to align with active season for breeding birds), a qualified biologist is required to conduct a habitat assessment prior to removals. A targeted investigation was completed to investigate the area and no candidate bat roosting habitat were identified within the Site (see above).

INVERTEBRATES

- Limit vegetation removal to the extent feasible.
- If vegetation is to be removed, limit clearing during the active season for insects (April – October) where feasible.

FISH AND OTHER AQUATIC SPECIES

- Detailed mitigation measures to protect fish habitat, as it is defined under the federal Fisheries Act (Canada, 1985) is outside the scope of this letter; however, standard measures to protect fish habitat will also protect SAR fish, aquatic invertebrates, and herptiles, to some extent.
- Construction activities will not occur within 30 m of Arena Creek on the Site
- Install sediment and erosion control measures if work is proposed adjacent to Arena Creek and erosion and/or run-off may result from the proposed works.

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(705) 742.7900

Facsimile
(705) 742.7907

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cambium-inc.com

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Canada, K9J 6Z3

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- Consult and abide by mitigation measures to protect fish habitat when working near water, as outlined by Fisheries and Oceans Canada: https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html

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(705) 742.7900

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March 25, 2025

CLOSING

Based on our assessment of existing conditions and review of available records, and provided that recommendations identified herein are adhered to, we are of the opinion that the proposed tree clearing can be carried out in a manner that does not impact SAR or impair the function of their habitats that are afforded protection under Sections 9(1) and 10(1) of the *Endangered Species Act, 2007*.

We trust this information meets your current needs. If you require anything further or would like to discuss the contents of this letter, please contact the undersigned.

Best regards,

Cambium Inc.

Kayla Vizza, M.Sc. Technologist	Camden Jermey, B.Sc., Can-CISEC Senior Ecologist – Team Lead

CJ/kv

Encl. *Cambium Qualifications & Limitations*
Appendix A – Photo Log
Appendix B – SAR Screening

P:\16100 to 16199\16197-001 J L Richards & Associates Limited - ENV - MCEA Brighton WWTP\Deliverables\REPORT - 2025 SAR Memo\2025-03-25 LTR SAR Screening - Brighton WWTP (16197-001).docx

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CAMBIUM QUALIFICATIONS AND LIMITATIONS

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

Facts, conditions, information and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

Reliance

Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

Figure 1 On-Site treeline facing west, March 2025

Figure 2 On-site treeline facing east, March 2025.

***Figure** 3 A representative photo of the trees in the proposed area of clearing (south side, facing north), March 2025*

Figure 4 A representative photo of the trees in the proposed development zone (north side, facing south), March 2025

Appendix B: Species at Risk - Brighton WWTP

COMMON NAME	SCIENTIFIC NAME	Federal SARA	Provincial ESA	Provincial S-RANK	SPECIES DESCRIPTION AND HABITAT REQUIREMENTS
Birds					
Canada Warbler	*Cardellina canadensis*	THR	SC	S4B	The Canada Warbler is a small songbird with bright yellow underparts and bluish-grey back and tail (1). It can be found in a variety of forest types, but is most abundant in moist, mixed forests with a well-developed, dense shrub layer. Nests are usually located on or near the ground on mossy logs, and along stream banks (3).
Eastern Wood-Pewee	*Contopus virens*	SC	SC	S4B	The Eastern Wood-pewee is a species of 'flycatcher', a bird that eats flying insects. It grows to approximately 15 cm, has greyish-olive upper parts and pale bars on its wings. This species lives in the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It prefers intermediate-age forest stands with little understory vegetation (1). It typically creates nests on tree branches 2-12 m in height (2).
Golden Winged Warbler	*Vermivora chrysoptera*	THR	SC	S4B	The Golden-winged Warbler is a small songbird with distinctive yellow wing patches and patches behind their eyes. It inhabits early successional habitat of old fields and favour areas where trees are spread out or forest edges to use for perching, singing, and searching for food. They seem to prefer regeneration zones with young shrub growth, surrounded by mature forest, locations that have recently been disturbed, such as field edges, hydro or utility right-of-ways, or logged areas for their breeding sites; often frequenting clusters of herbaceous plants and low bushes (1).
Olive-sided Flycatcher	Contopus cooperi	SC	SC	S4B	The Olive-sided Flycatcher is a medium-sized songbird with olive colouring, often seen perching on top of tall trees waiting to catch their prey. It prefers open areas along natural mature forest edges, forest edges near natural openings such as rivers or swamps, human-made openings, or burned forest openings with numbers of dead trees. Breeding habitat usually consists of coniferous or mixed forests adjacent to rivers or wetlands, in Ontario often nesting in White and Black Spruce, Jack Pine, and Balsam Fir (1).

Appendix B: Species at Risk - Brighton WWTP

COMMON NAME	SCIENTIFIC NAME	Federal SARA	Provincial ESA	Provincial S-RANK	SPECIES DESCRIPTION AND HABITAT REQUIREMENTS
Red-headed Woodpecker	*Melanerpes erythrocephalus*	END	END	S4B	The Red-headed Woodpecker is a mid-sized bird, at around 20 cm long, with a vivid red head, neck and breast as well a strong bill. The species can be found in open woodland and woodland edges, often near man-made landscapes such as parks, golf courses and cemeteries. These areas must contain a large number of dead trees for perching and nesting (1).
Wood Thrush	*Hylocichla mustelina*	THR	SC	S4B	The Wood Thrush is a medium-sized songbird of around 20 cm with rusty brown coloured upper parts and white underparts with large dark spots. It breeds in deciduous and mixed forests with moderate understories, shade and abundant leaf litter where it forages for food, including larval and adult insects as well as plant material. They prefer moist stands of trees with well-developed undergrowth and tall trees for perches (1).
Fish					
American Eel	*Anguilla rostrata*	No Status	END	S1?	The American Eel is a long, slender bodied fish, with one long fin extending down the back and around the tail, and two small pectoral fins. It has thick lips, and a protruding lower jaw that extends out above the upper jaw. At the juvenile stage, they swim up the St. Lawrence River to reach Lake Ontario and connected tributaries where they will remain for 8 to 23 years before migrating back to their spawning grounds. In Ontario, the American eel prefers mud, sand or gravel substrates during the juvenile stage when they reside primarily in the benthic zone of waterbodies. More mature eels are able to thrive in most environments provided there is available cover during daylight hours, and the habitat is accessible (2).

Appendix B: Species at Risk - Brighton WWTP

COMMON NAME	SCIENTIFIC NAME	Federal	Provincial		SPECIES DESCRIPTION AND HABITAT REQUIREMENTS
		SARA	ESA	S-RANK	
Bridle Shiner	*Ntoropis bifrenatus*	SC	SC	S2	The Bridle Shiner is a small minnow with a slender body growing up to six centimetres in length. It has a small mouth which extendas back to the lower edge of the eye. Adults are generally silvery, often with green-blue iridescence. The surface of the body is straw-coloured while the underside is silvery-white. Bridle Shiners also have a dark stripe that extends along the side of the body, but may be faint and difficult to see. They prefer clear, unpolluted streams, rivers and lakes with an abundance of aquatic vegetation. They prefer warm water habitats where the bottom is either sand, silt, or organic debris. (2)
Grass Pickerel	*Esox americanus*	SC	SC	S3	Like other members of the pike family, the Grass Pickerel has a long, cylindrical body with a long snout and forked tail. Colouration may vary, but often consists of several thin, dark, wavy vertical bars along the sides. The fins are dusky to yellow-green. Adults have a dark bar extending below the eye. Grass Pickerel are foujnd in wetlands, pond, slow moving streams and shallow bays of larger lakes with warm, shallow, clear water and abundant aquatic vegetation. In Ontario, Grass Pickerel is found in coastal wetlands in the Great Lakes and tributaries of Lake St. Clair, Lake Erie, Lake Huron, the Niagara River, Lake Ontario and the St. Lawrence River, and inland in the Severn River system (2).
Northern Brook Lamprey	*Ichthyomyzon fossor*	SC	SC	S3	The Northern Brook Lamprey is a small, elongate fish growing up to 16 cm long with a round, jawless mouth, sevel gill openings, and no pectoral or pelvic fins. This species has a larval stage, in which they require soft substrates for burrowing and typically use slow-moving portions of coolwater streams, and an adult stage, in which they are more typically associated with fast flowing ripples in coolwater strams with rock or gravel bottoms (1).
Silver Lamprey (Great Lakes - Upper St. Lawrence River population)	*Ichthyomyzon unicuspis*	SC	SC	S3	The Silver Lamprey is an eel-shaped fish growing from 9 to 39 cm long, with a sucking disc mouth and no jaws or paired fins. They can be differed from other lamprey species based on fin shapes and teeth arrangements. Their habitat requirements include clear water, the availability of fish hosts, and relatively clean beds of sand or organic debris (1).
Invertebrates					

Appendix B: Species at Risk - Brighton WWTP

COMMON NAME	SCIENTIFIC NAME	Federal SARA	Provincial ESA	Provincial S-RANK	SPECIES DESCRIPTION AND HABITAT REQUIREMENTS
Monarch Butterfly	*Danaus plexippus*	SC	SC	S2N,S4B	The Monarch is an orange and black butterfly with small white spots and a wingspan of around 10 cm. It relies on milkweed plants as a food source for growing caterpillars, but the adult butterflies forage in diverse habitats for nectar from wildflowers (1).
Yellow-banded Bumble Bee	*Bombus terricola*	SC	SC	S3S5	The Yellow-banded Bumble Bee is a medium-sized bumble bee with a distinct yellow and black abdominal band pattern found on its queens, males, and workers. This species is a forage and habitat generalist, able to use a variety of nectaring plants and environmental conditions. It can be found in mixed and coniferous woodlands, particularly for nesting and overwintering, as well as a variety of open habitat such as native grasslands, farmlands and urban areas. The Yellow-banded Bumble Bee ranges from the Mixedwood Plains of southern Ontario to the Hudson Bay Lowlands in the north (1). Their nest sites are often found underground in abandoned burrows or decomposing logs.
Mammals					
Eastern Red Bat	*Lasiurus borealis*	No Status	END	S4	The Eastern Red Bat bat has similar habitat needs to the Hoary Bat. It roosts among the foliage of trees and occasionally shrubs. They roost alone, including at maternity roosts (with pups), and prefer sites with foliage overhead for cover, and open areas for flight below. Deciduous, mixed, and coniferous forests are are used, but roost trees are usually deciduous trees. Trees used for maternity roosts are typically mature tall trees, with a large diameter, reaching or exceeding the height of the surrounding canopy. Foraging habitat includes a variety of open habitats. (3)
Eastern Small-footed Myotis	*Myotis leibii*	No Status	END	S2S3	The Eastern Small-footed Myotis has fur with black roots and shiny brown tips as well as very small feet. In the spring and summer, the Eastern Small-footed Myotis will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees. They change their roosting locations daily and hunt at night for insects. They hibernate in winter, often in caves and abandoned mines choosing colder and drier sites than other similar bats (1).

Appendix B: Species at Risk - Brighton WWTP

COMMON NAME	SCIENTIFIC NAME	Federal SARA	Provincial ESA	Provincial S-RANK	SPECIES DESCRIPTION AND HABITAT REQUIREMENTS
Hoary Bat	*Lasiurus cinereus*	No Status	END	S4	The Hoary Bat has similar habitat needs to theEastern Red Bat. It roosts among the foliage of trees and occasionally shrubs. Hoary Bats roost alone, including at maternity roosts (with pups), and prefer sites with foliage overhead for cover, and open areas for flight below. Deciduous, mixed, and coniferous forests are are used, but roost trees are usually deciduous trees. Trees used for maternity roosts are typically mature tall trees, with a large diameter, reaching or exceeding the height of the surrounding canopy. Foraging habitat includes a variety of open habitats. (3)
Little Brown Myotis	*Myotis lucifugus*	END	END	S4	The Little Brown Myotis has glossy brown fur and a fleshy projection covering the entrance to its ears. This species roosts in trees and buildings, often selecting attics, abandoned buildings and barns for summer colonies where they can raise their young. Little Brown Bats hibernate from October/November to March/April, most often in caves or abandoned mines that are humid and remain above freezing (1).
Silver-haired Bat	*Lasionycteris noctivagans*	No Status	END	S4	Silver-haired Bats primarily roost under the bark and in the cavities of trees. They are reliant on mature or semi-mature forests where large cavity and decaying trees occur. Although they can utilize both deciduous and coniferous trees, deciduous trees more commonly have the characteristics requires by this species. Old woodpecker cavities are commonly used. Maternity roosts usually include small groups of females within these habitat features. Foraging habitat is not well understood but includes openings within forests, and along forest edges. (3)
Tri-colored Bat	*Perimyotis subflavus*	END	END	S3?	The Tri-colored Bat is small, with pale brown with orange-red forearms, muzzle, and ears. It is named for the black, yellow, and brown hairs on its back. It is considered rare in this region of Ontario which is at the northernmost limit of the natural range. These bats prefer to nest in foliage, tree cavities and woodpecker holes, but are occasionally found in buildings; though this is not their preferred habitat. Winter hibernation takes place in caves, mines and deep crevices. Tri-colored Bats prefer an open forest habitat type in proximity to water (6).

Appendix B: Species at Risk - Brighton WWTP

COMMON NAME	SCIENTIFIC NAME	Federal SARA	Provincial ESA	Provincial S-RANK	SPECIES DESCRIPTION AND HABITAT REQUIREMENTS
Trees, plants, fungi and lichens					
Black Ash	*Fraxinus nigra*	No Status	END	S4	The Black Ash is a smaller-sized tree with a narrow crown, light grey and scaly bark, and green, oval leaflets on a central stalk. It grows everywhere in Ontario except for the far north, preferring moist climates and soils such as swampy woodlands (1).
Butternut	*Juglans cinerea*	END	END	S2?	The Butternut is a medium sized tree reaching 30 m in height. It has large compound leaves with 11 to 17 leaflets. The fruit is oval, fuzzy and sticky. In Ontario, the Butternut prefers moist, well-drained soil, often along streams, or occasionally well-drained gravel sites. It grows alone or in small groups in deciduous forests (1).

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Appendix C

Existing Lagoon Drawings

ONTARIO

MINISTRY OF THE ENVIRONMENT

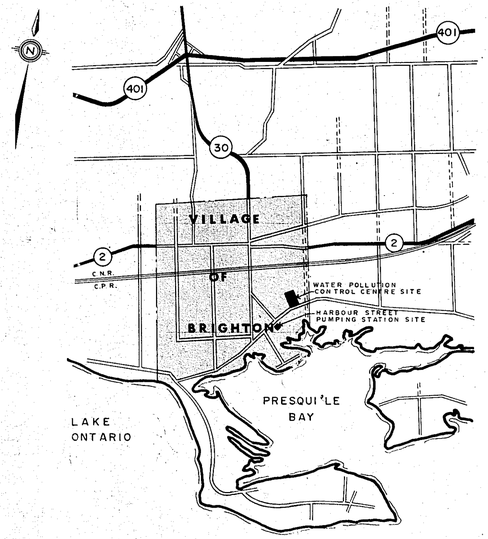
MINISTER: HONOURABLE WILLIAM G. NEWMAN

PROJECT Nº 2 — 0320 — 74

VILLAGE OF BRIGHTON

WATER POLLUTION CONTROL CENTRE EXTENSION

AND HARBOUR STREET PUMPING STATION



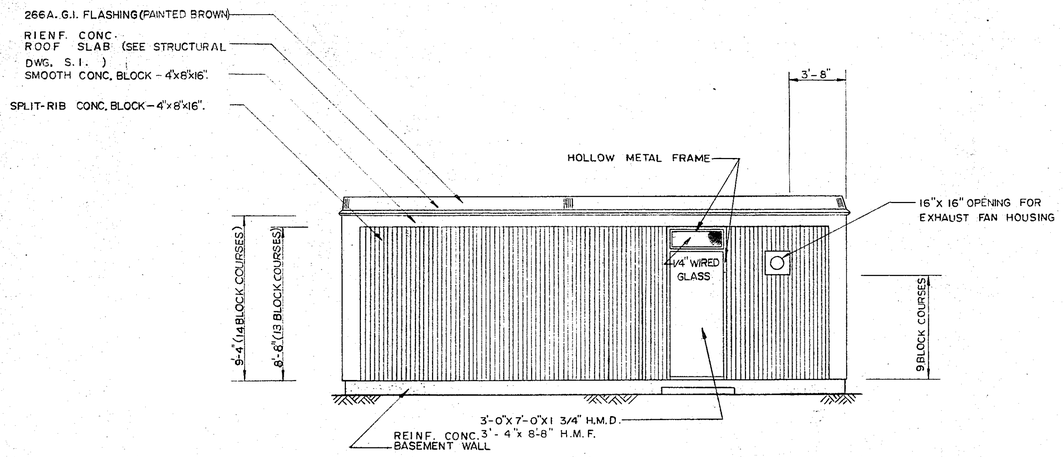
LIST OF DRAWINGS

DWG Nº G1	GENERAL – SITE PLANS	
DWG Nº G2	GENERAL – PLAN & PROFILE – 42"Ø BY-PASS SEWER	
DWG Nº G3	GENERAL – PLAN & PROFILE – 36"Ø OUTLET SEWER	
DWG Nº G4	GENERAL – PLAN & PROFILE – 42"Ø INLET SEWER & DETAILS	
DWG Nº G5	GENERAL – PLAN & PROFILE – ACCESS ROADS	
DWG Nº A1	ARCHITECTURAL – CONTROL BUILDING — ELEVATIONS	
DWG Nº A2	ARCHITECTURAL – CONTROL BUILDING — PLAN, SECTIONS & DETAILS	
DWG Nº A3	ARCHITECTURAL – PUMP HOUSE – PLAN, SECTIONS, ELEVATIONS & DETAILS	
DWG Nº A4	ARCHITECTURAL – PUMP HOUSE – DETAILS	
DWG Nº S1	STRUCTURAL – CHEMICAL STORAGE TANK FOUNDATION & MANHOLE NO1, PLANS & SECTIONS	
DWG Nº S2	STRUCTURAL – CONTROL BUILDING – PLANS, SECTIONS & DETAILS	
DWG Nº S3	STRUCTURAL – WALKWAY – OUTLET CHAMBER PLANS, ELEVATIONS, SECTIONS & DETAILS	
DWG Nº S4	STRUCTURAL – PUMP HOUSE – PLANS, SECTIONS & DETAILS	
DWG Nº S5	STRUCTURAL – PUMP HOUSE – SECTIONS & DETAILS	
DWG Nº M1	MECHANICAL – HYDRAULIC PROFILE & FLOW DIAGRAM	
DWG Nº M2	MECHANICAL – PLAN OF AERATION CELL	
DWG Nº M3	MECHANICAL – CONTROL BUILDING – SITE PLAN, PLAN & SECTIONS	
DWG Nº M4	MECHANICAL – OUTLET CHAMBER, MIXING CHAMBER & SUMP PIT DETAILS	
DWG Nº M5	MECHANICAL – CHEMICAL STORAGE TANK DETAILS & CHEMICAL FEED FLOW DIAGRAM	
DWG Nº M6	MECHANICAL – WALKWAY DETAILS	
DWG Nº M7	MECHANICAL – AERATION CELL CROSS SECTIONS & MISCELLANEOUS DETAILS	
DWG Nº M8	MECHANICAL – PUMP HOUSE – PLANS	
DWG Nº M9	MECHANICAL – PUMP HOUSE – SECTIONS	
DWG Nº M10	MECHANICAL – PUMP HOUSE – PLAN, SECTION & DETAILS	
DWG Nº M11	MECHANICAL – PUMP HOUSE & CONTROL BUILDING PLUMBING & VENTILATION	
DWG Nº M12	MECHANICAL – PUMP HOUSE – WATER SEALING SYSTEM & MISCELLANEOUS DETAILS	
DWG Nº M13	MECHANICAL – W.P.C.C. – MISCELLANEOUS DETAILS	
DWG Nº M14	MECHANICAL – W.P.C.C. & PUMP HOUSE — MISCELLANEOUS DETAILS	
DWG Nº M15	MECHANICAL — PUMP HOUSE — MISCELLANEOUS DETAILS	
DWG Nº E1	ELECTRICAL — W.P.C.C. — LAYOUT	
DWG Nº E2	ELECTRICAL — PUMP HOUSE — LAYOUT	
DWG Nº E3	ELECTRICAL — W.P.C.C. & PUMP HOUSE — DETAILS	

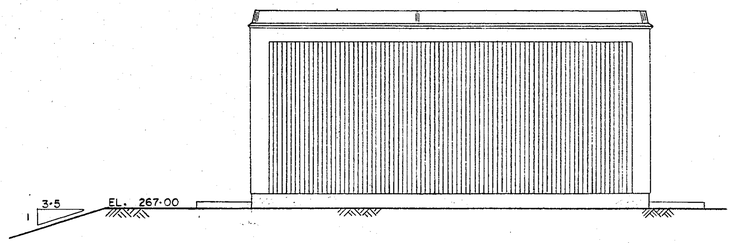
TOTTEN SIMS HUBICKI ASSOCIATES LT

CONSULTANTS

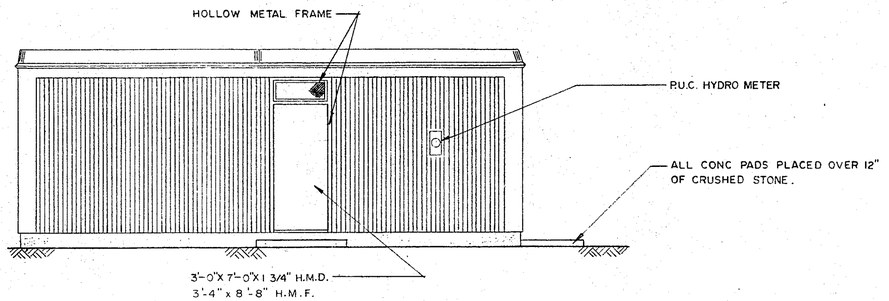
COBOURG WHITBY KINGSTON TORONTO MUSKOKA



NORTH ELEVATION



WEST ELEVATION



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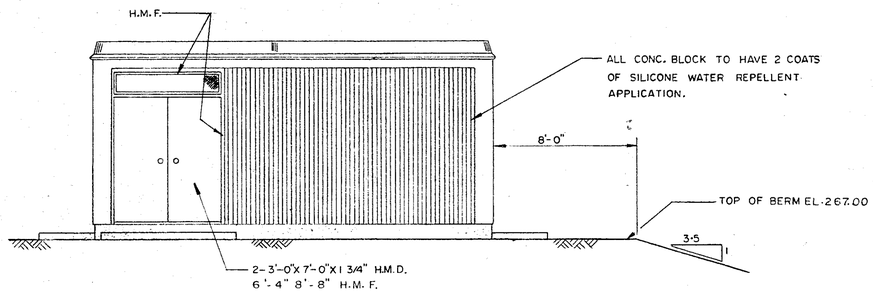

EAST ELEVATION

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. C. EBERLEE PROVINCE OF ONTARIO

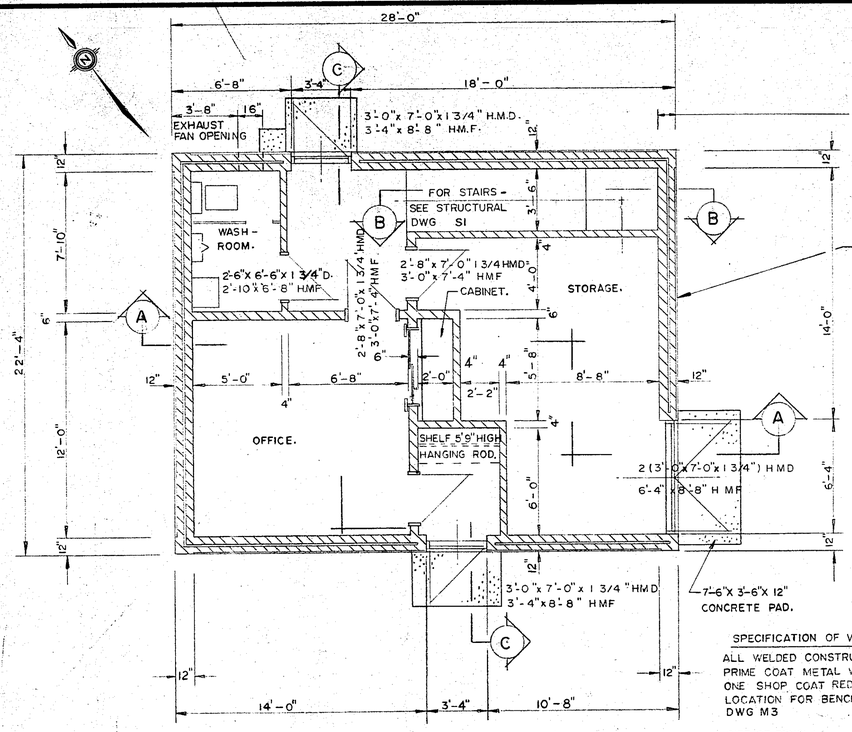
No.	DATE	BY	REVISIONS
1	MAR/77	P.E.G.	AS CONSTRUCTED

DESIGN	M.P.
DRAWN	A.D.G.
CHECKED	M.P.
APPROVED	R.C.E.
SCALE	1/4"=1'-0"

MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
ARCHITECTURAL - CONTROL BUILDING - ELEVATIONS

DATE APRIL 1974
PROJECT 52-1895-01
DRAWING A1

Ozhawa Blueprint



FLOOR PLAN

SCALE: 1/4" = 1'-0"

ALL CORNERS TO BE IN SMOOTH FACED BLOCK, SEE ELEVATIONS.

CAVITY WALL:
6"x 8"x 16" CONC. BLOCK.
2" CAVITY WITH 1" STYROFOAM INSULATION.

4"x 8"x 16" SPLIT RIB CONC. BLOCK.

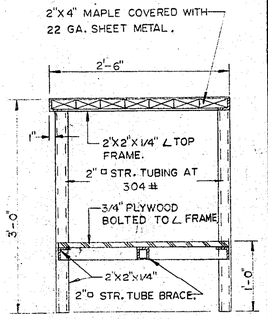
APPROVED 12" CAVITY WALL BLOCK REINFORCEMENT EVERY SECOND COURSE WELL BEDDED IN MORTAR.

ALL EXTERIOR & INTERIOR CORNERS TO BE IN BULLNOSED CONC. UNITS.

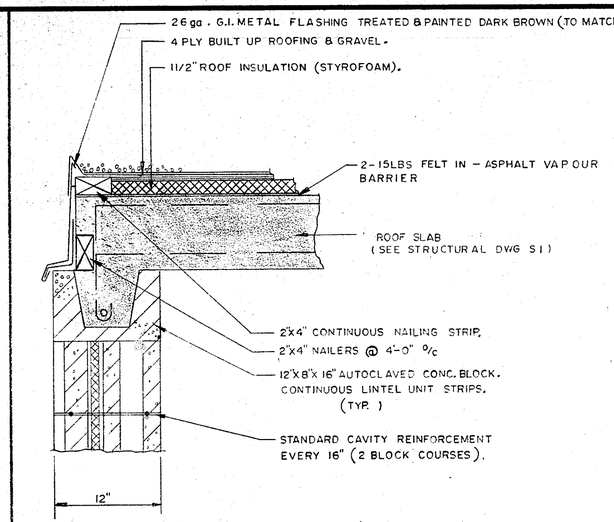
SPECIFICATION OF W. BENCH:
ALL WELDED CONSTRUCTION, PRIME COAT METAL WITH ONE SHOP COAT RED OXIDE, LOCATION FOR BENCH SEE DWG M3

SIZE OF BENCH:
2'-6"x 3'-0" HIGH x 7'-0" LG. WITH INTERMEDIATE SUPT. AT BACK SIDE ONLY.

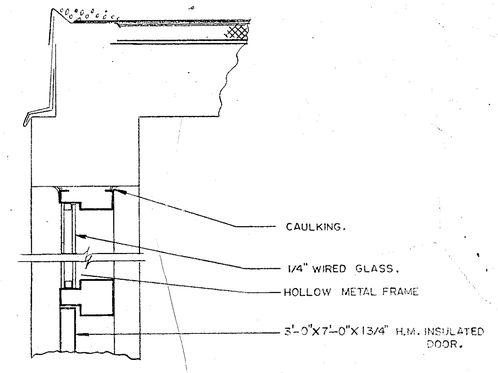
SCALE: 1" = 1'-0"



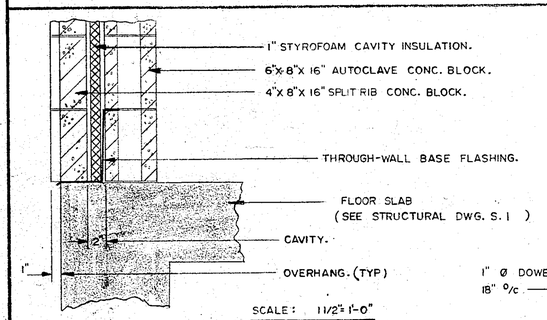
WORK BENCH



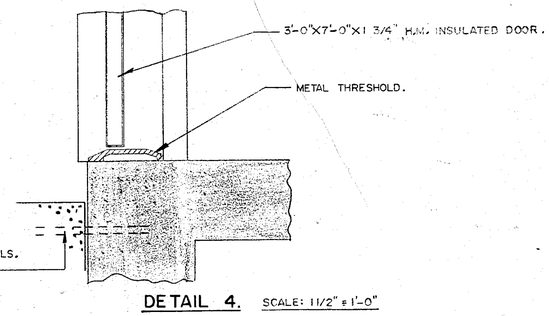
DETAIL 1. SCALE: 1 1/2" = 1'-0"



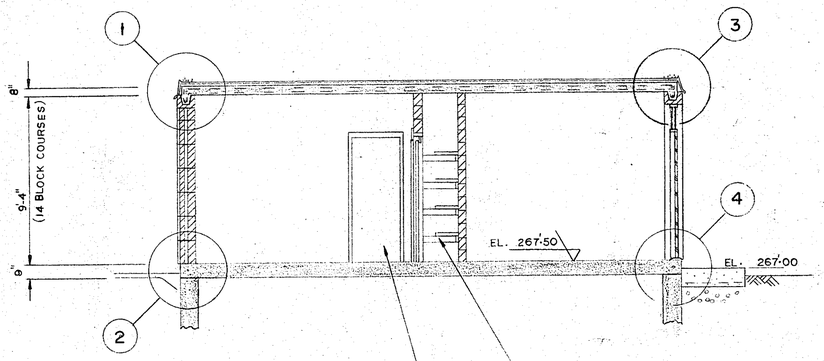
DETAIL 3. SCALE 1 1/2" = 1'-0"



DETAIL 2. SCALE: 1 1/2" = 1'-0"

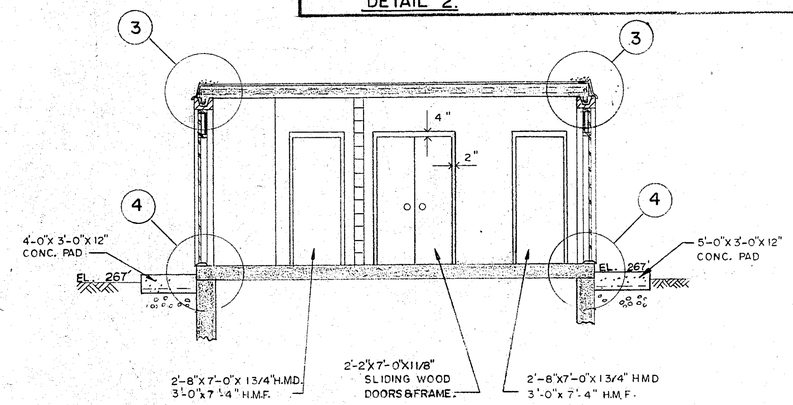


DETAIL 4. SCALE: 1 1/2" = 1'-0"



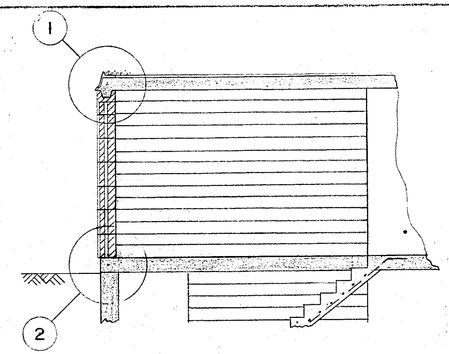
SECTION A-A

SCALE: 1/4" = 1'-0"



SECTION C-C

SCALE: 1/4" = 1'-0"



SECTION B-B

SCALE: 1/4" = 1'-0"

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. G. EBERLEE PROVINCE OF ONTARIO

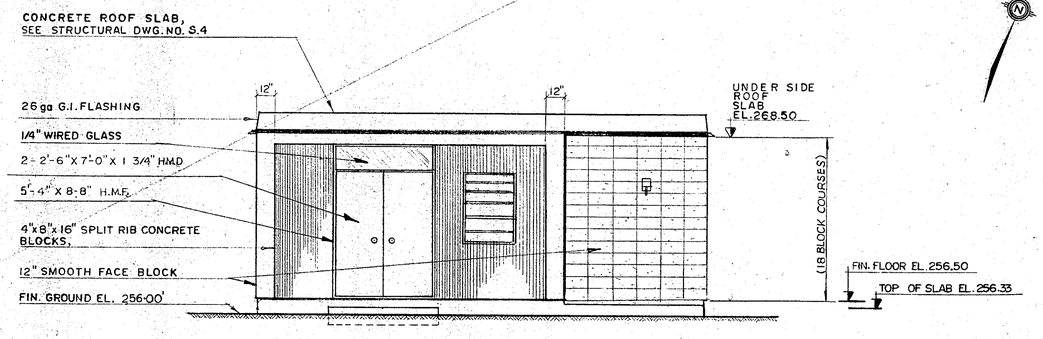
No.	DATE	BY	REVISIONS
1	MAR/77	P.E.G.	AS CONSTRUCTED

DESIGN	M.P.
DRAWN	A.D.G.
CHECKED	M.P.
APPROVED	P.C.E.
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
ARCHITECTURAL - CONTROL BUILDING - PLAN, SECTIONS AND DETAILS

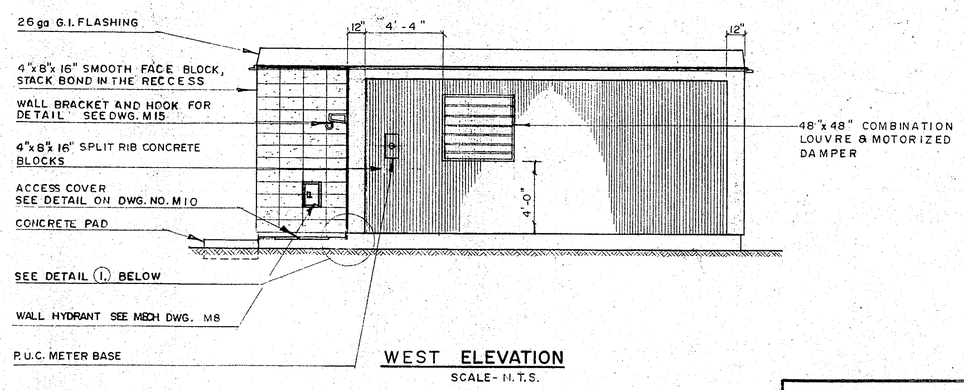
DATE APRIL 1975
PROJECT 52-1895-01
DRAWING A2

Oshawa Blueprint



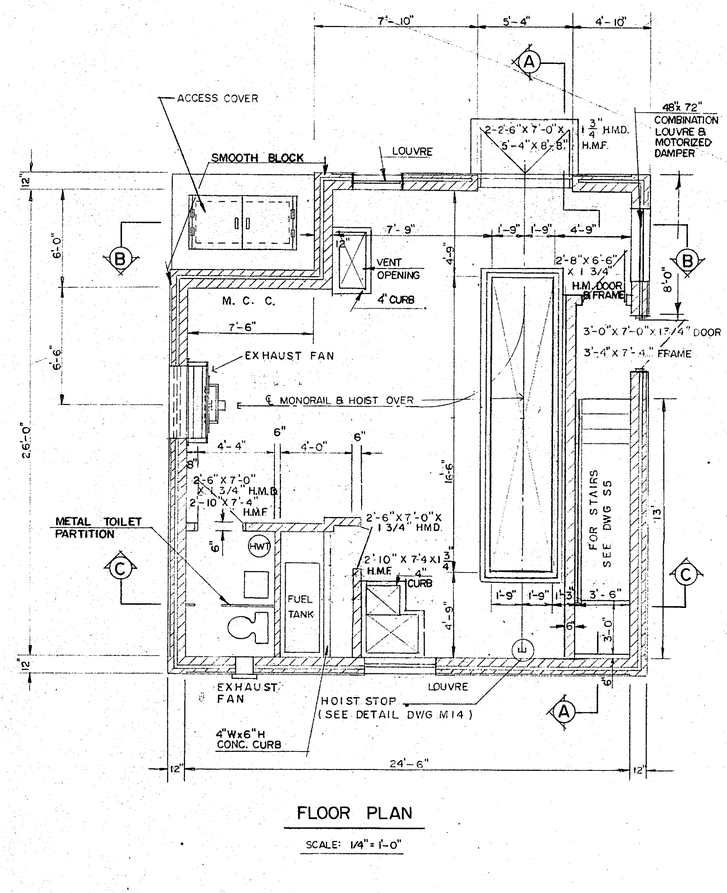
FRONT (ENTRANCE) ELEVATION

SCALE - N.T.S.



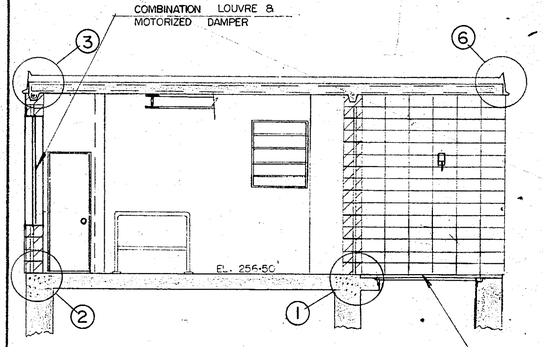
WEST ELEVATION

SCALE - N.T.S.



FLOOR PLAN

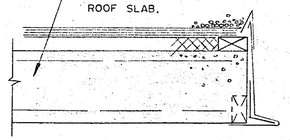
SCALE: 1/4" = 1'-0"



SECTION B-B

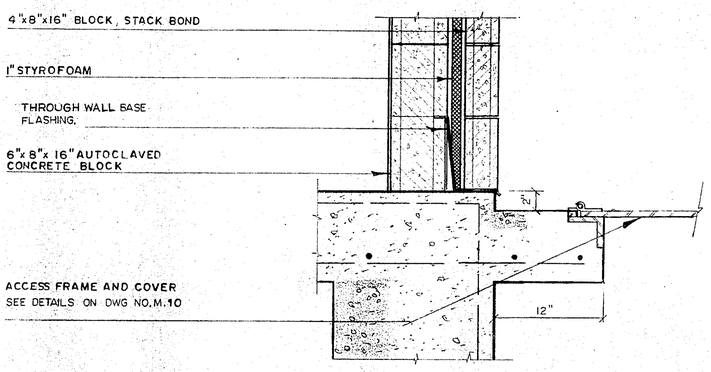
N.T.S.

FOR DETAIL OF ACCESS COVER SEE DETAIL DWG M10



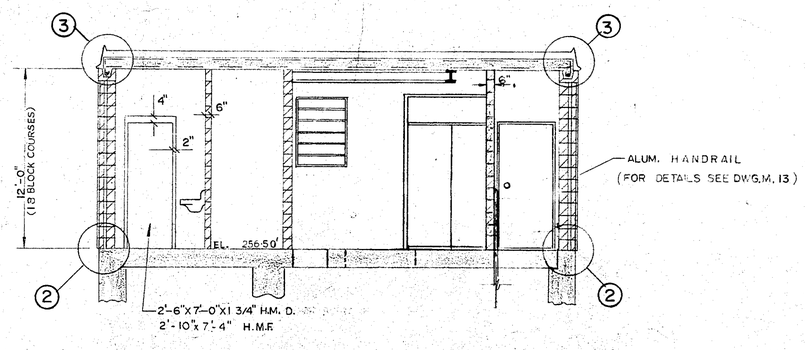
DETAIL 6.

SCALE 1 1/2" = 1'-0"



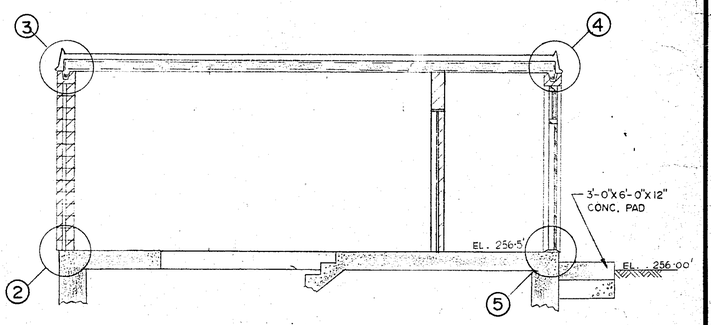
DETAIL (1)

SCALE - 1 1/2" = 1'-0"



SECTION C-C

N.T.S.



SECTION A-A

N.T.S.

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CONSULTANTS

COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. C. EDERLEE PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
	MARCH 77	P.C.G.	AS CONSTRUCTED

DESIGN M.P
DRAWN A.D.G.
CHECKED M.P
APPROVED P.C.E.
SCALE AS NOTED

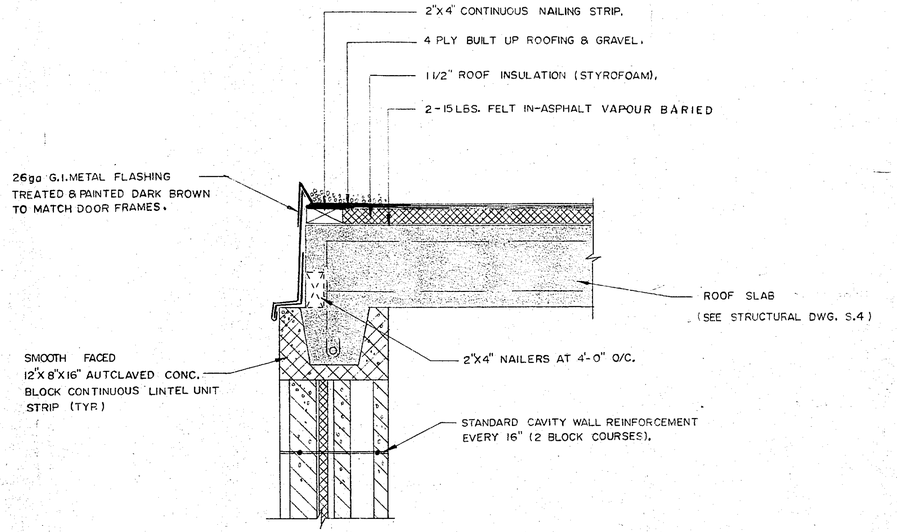
MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION

ARCHITECTURAL - PUMP HOUSE - PLAN, SECTIONS, ELEVATIONS & DETAILS

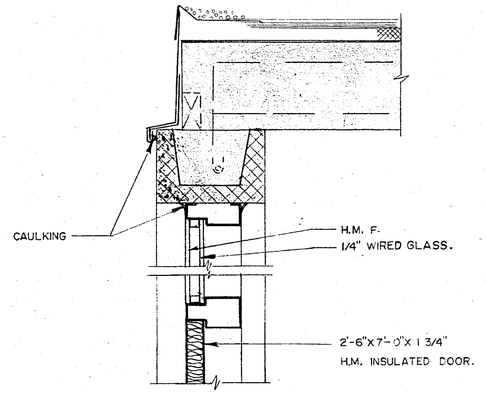
DATE APRIL-1975
PROJECT 52-1895-01
DRAWING A3

Oshawa, Blueprint



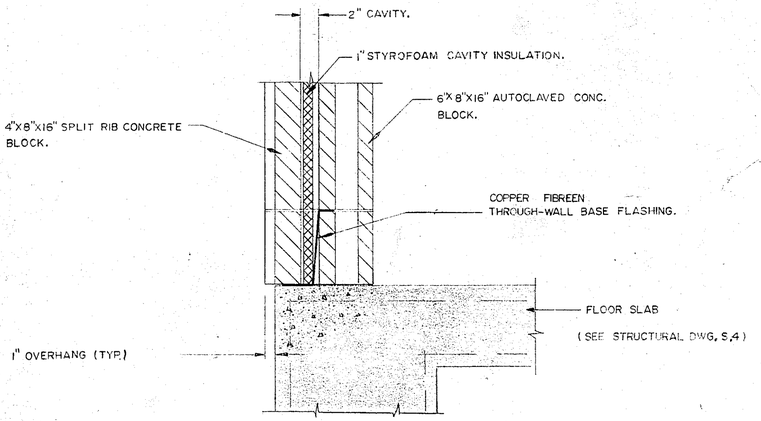
DETAIL 3.

SCALE: 1 1/2" = 1'-0"



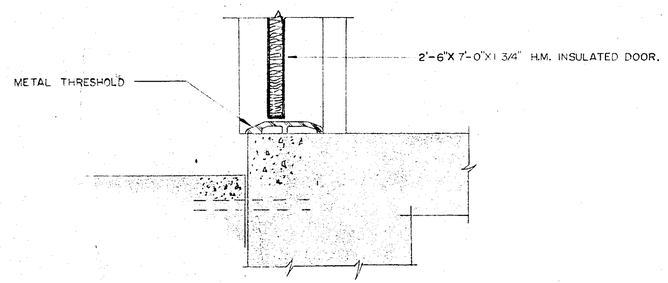
DETAIL 4.

SCALE: 1 1/2"=1'-0"



DETAIL 2.

SCALE: 1 1/2" = 1'-0"



DETAIL 5.

SCALE: 1 1/2" = 1'-0"

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

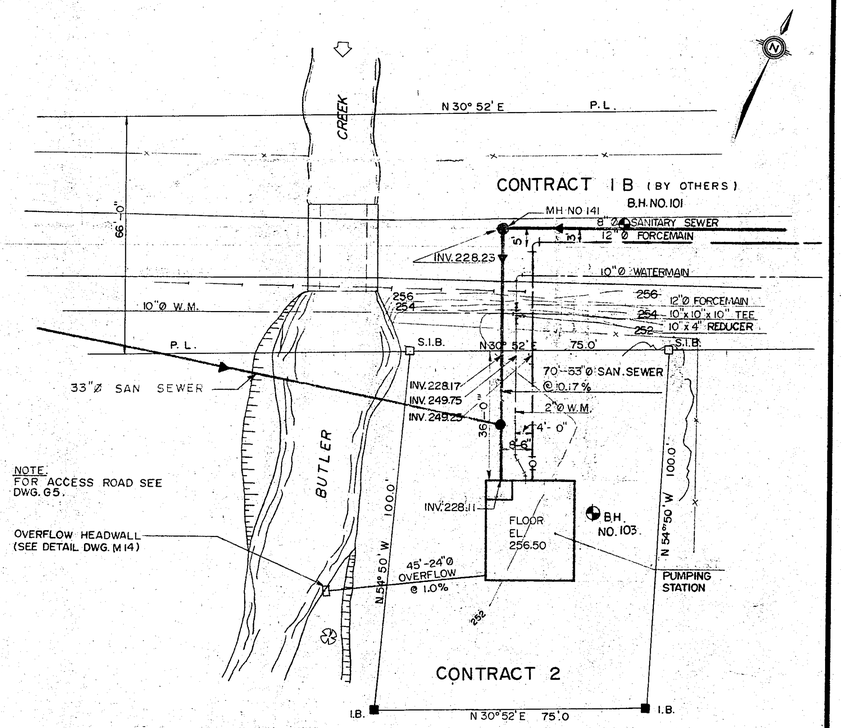
REGISTERED PROFESSIONAL ENGINEER P. C. EDERLEE PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MARCH.77	P.C.G.	AS CONSTRUCTED

DESIGN M.P.
DRAWN A.D.G.
CHECKED M.P.
APPROVED P.C.E.
SCALE AS NOTED

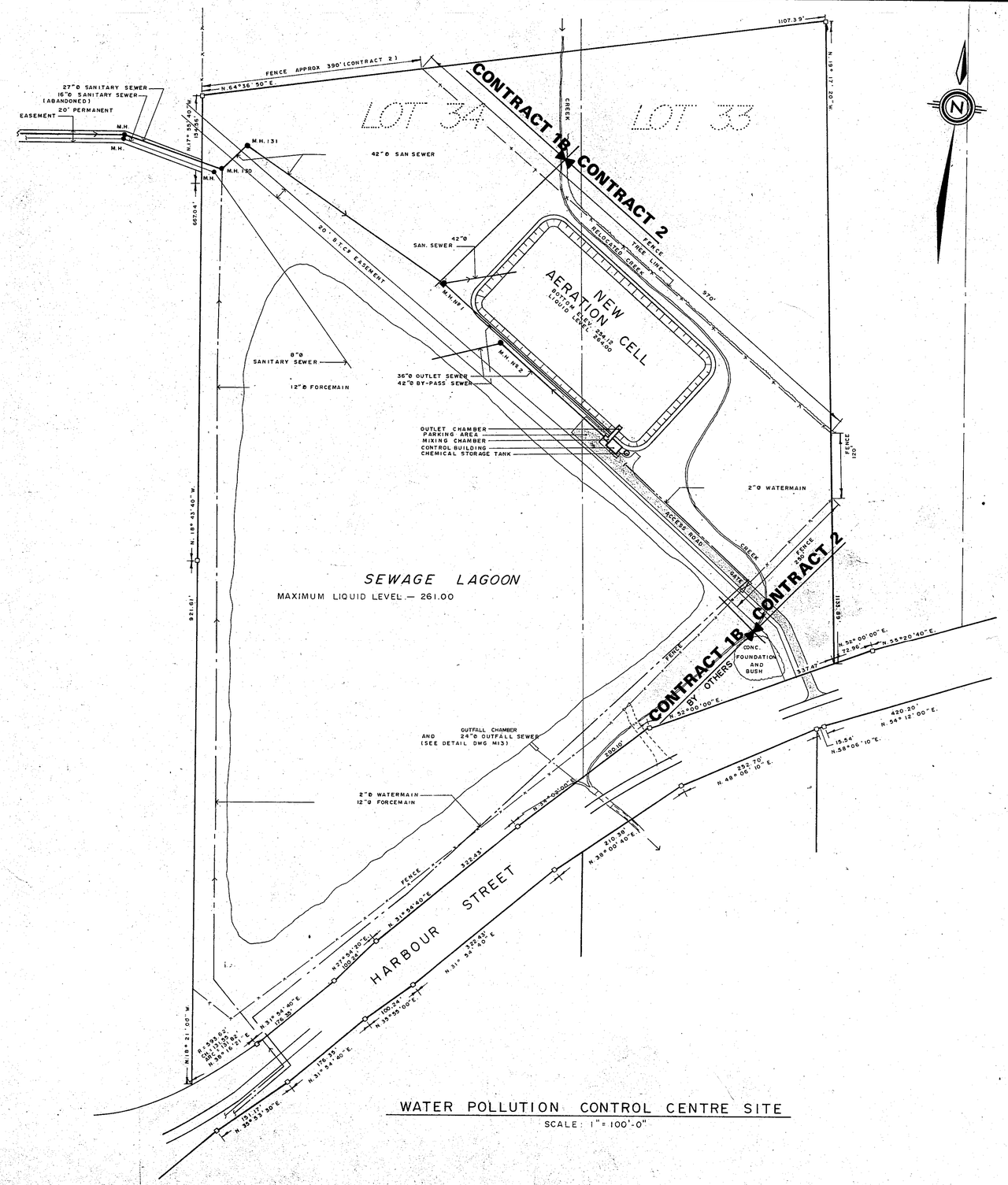
MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION
ARCHITECTURAL - PUMP HOUSE - DETAILS

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING A4



HARBOUR STREET PUMPING STATION SITE

SCALE — 1"= 20'-0"



WATER POLLUTION CONTROL CENTRE SITE

SCALE: 1"= 100'-0"

ABBREVIATIONS

ALUM.	- ALUMINUM	I.D.	- INSIDE DIAMETER
B.H.	- BOREHOLE	INV.	- INVERT
℄	- CENTRE TO CENTRE	L.L.	- LIQUID LEVEL
℄	- CENTRE LINE	MAX.	- MAXIMUM
CONC.	- CONCRETE	MIN.	- MININUM
C.W.	- COLD WATER	M.H.	- MANHOLE
Ø	- DIAMETER	# or Nº	- NUMBER
D.I.	- DUCTILE IRON	℄	- ON CENTRE
DWG.	- DRAWING	O.D.	- OUTSIDE DIAMETER
DWLS.	- DOWELS	PL	- PLATE
EL.	- ELEVATION	P.V.C.	- POLYVINYL CHLORIDE
EXP.	- EXPANSION	REINF.	- REINFORCED
EXIST.	- EXISTING	SAN. SEWER	- SANITARY SEWER
F.M.	- FORCEMAIN	S.I.B.	- STANDARD IRON BAR
H.M.D.	- HOLLOW METAL DOOR	U.B.C.M.	- UNDERGROUND BELL CABLE MARKER
H.M.F.	- HOLLOW METAL FRAME	W.M.	- WATERMAIN
H.W.	- HOT WATER	Y.HYD.	- YARD HYDRANT
HYD.	- HYDRANT		
I.B.	- IRON BAR		

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CONSULTANTS

COBOURG WHITBY KINGSTON TORONTO BRACEBRIDGE

REGISTERED PROFESSIONAL ENGINEER P. C. EDERLEE PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER R. B. BAKER PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.77	P.E.G.	AS CONSTRUCTED

DESIGN	J.T.
DRAWN	J.L.H. & M.J.A.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

W.P.C.C. EXTENSION AND HARBOUR ST. PUMPING STATION

GENERAL SITE PLANS

DATE APRIL 1975

PROJECT 52-1895-01

DRAWING G1

TRANSTEX 18 100-2-75

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P. C. ESHRISE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO
R. B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
⚠	MAR.3/77	B.F.	AS CONSTRUCTED

DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	VERT. 1"=10'-0" HORIZ. 1"=40'-0"

MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
GENERAL - PLAN & PROFILE - 42" Ø BY-PASS SEWER

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING G2

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

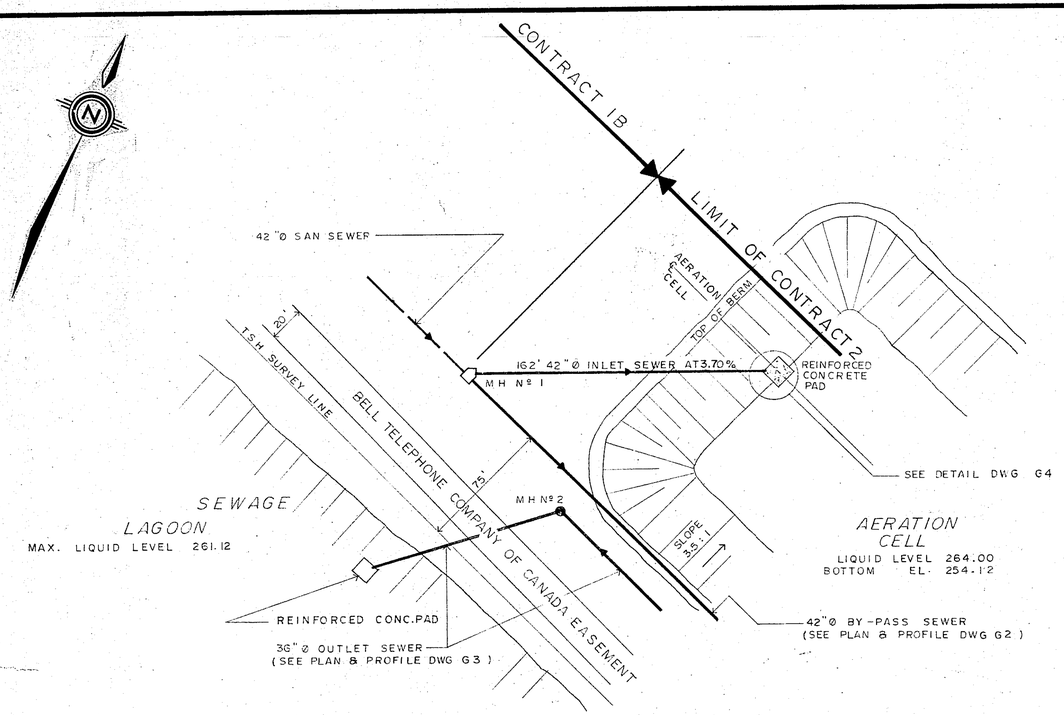
REGISTERED PROFESSIONAL ENGINEER — P. C. EBERLEE — PROVINCE OF ONTARIO
REGISTERED PROFESSIONAL ENGINEER — R. B. BAKER — PROVINCE OF ONTARIO

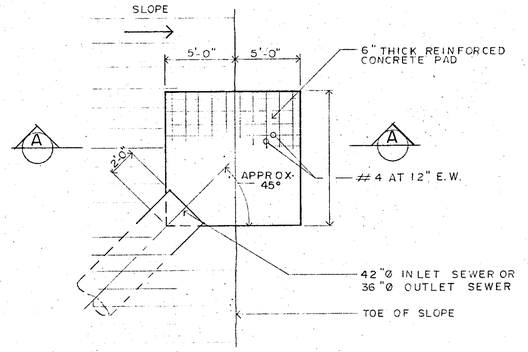
No.	DATE	BY	REVISIONS
1	MAR/77	P.E.G.	AS CONSTRUCTED

DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	VERT. 1"=10'-0" HORIZ. 1"=40'-0"

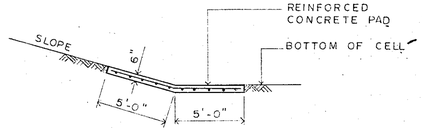
MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
GENERAL — PLAN & PROFILE - 36"Ø OUTLET SEWER

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING G3





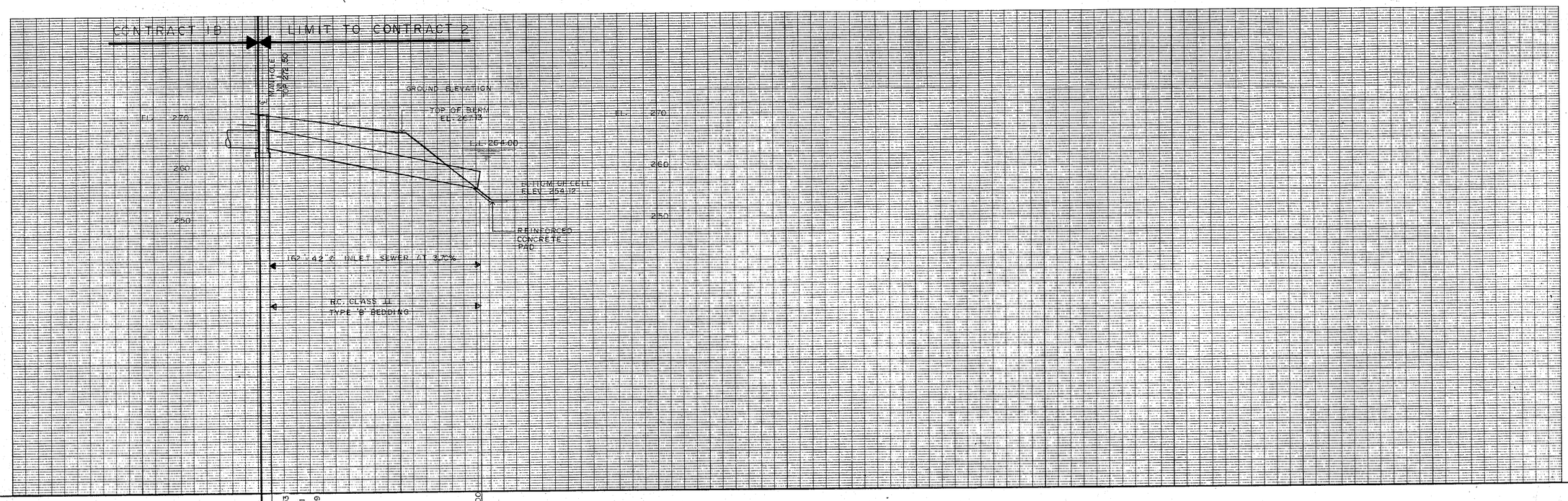
PLAN



SECTION 'A-A'

REINFORCED CONCRETE PAD DETAILS

SCALE : 3/16"= 1'-0"



INVERT ELEVATION SANITARY SEWER	N.W. 264.33 N.E. 264.11 Ø EL. 99	256.00			
ELEVATION EXISTING GROUND	266.7	266.7		266.5	
CHAINAGE	0+00	1+62		2+00	

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. C. EDERLEE PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER R. B. BAKER PROVINCE OF ONTARIO

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DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	VERT. 1"=10'-0" HORIZ. 1"=40'-0"

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
GENERAL - PLAN & PROFILE - 42" Ø INLET SEWER & DETAILS

DATE APRIL. 1975
PROJECT 52-1895-01
DRAWING G4

totten sims hubicki associates limited

CONSULTANTS

COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER — P. C. EBERLEE — PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER — R. B. BAKER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR/77	P.E.G.	AS CONSTRUCTED

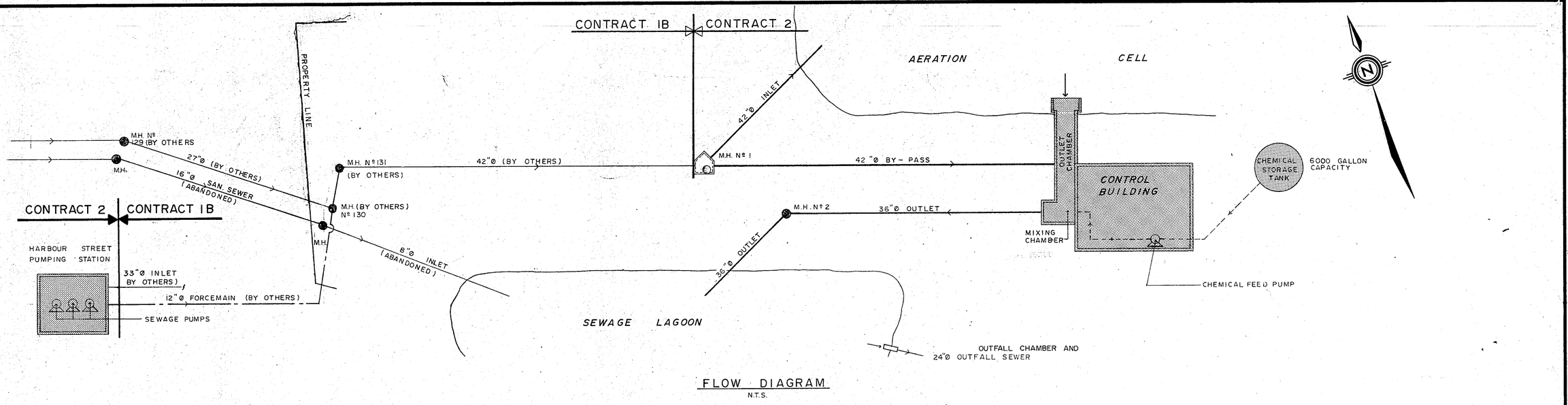
DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	VERT. 1"=10'-0" HORIZ. 1"=40'-0"

MINISTRY OF THE ENVIRONMENT

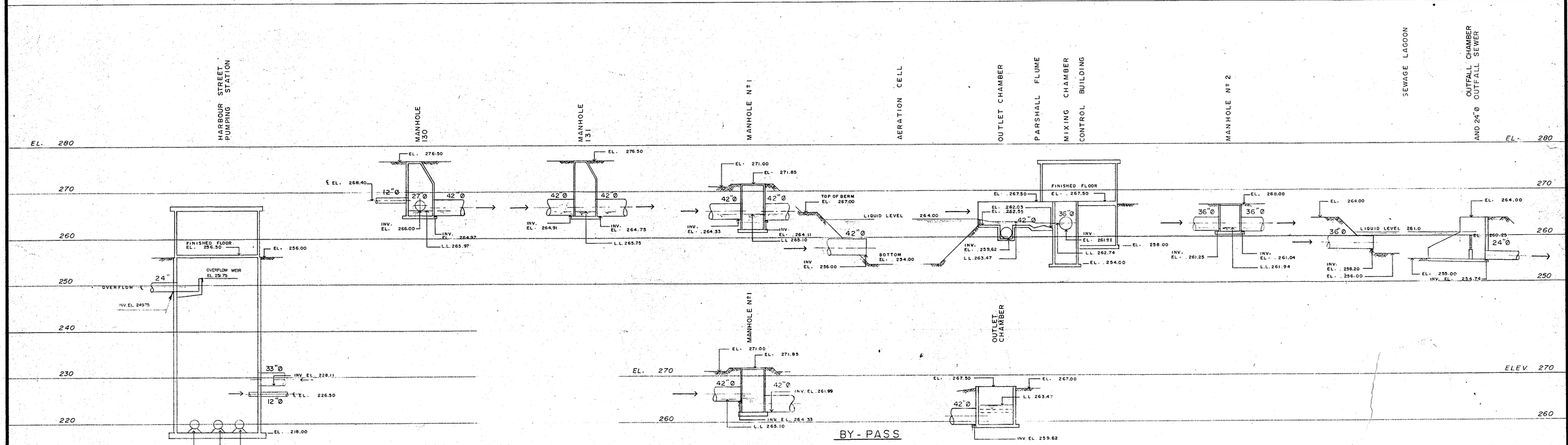
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
W.P.C.C. EXTENSION AND HARBOUR ST. PUMPING STATION

GENERAL - PLAN & PROFILE - ACCESS ROADS.

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING G5



FLOW DIAGRAM
N.T.S.



HYDRAULIC PROFILE
VERT 1"=10'-0" HORIZ. N.T.S.

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO P. C. EBERLEE
REGISTERED PROFESSIONAL ENGINEER R. B. BAKER PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.77	P.E.G.	AS CONSTRUCTED

DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT
PROJECT Nº 12-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
MECHANICAL - HYDRAULIC PROFILE & FLOW DIAGRAM

DATE	APRIL 1975
PROJECT	52-1895-01
DRAWING	M1

Oshawa, Blueprint

B.H. Nº 2A

B.H. Nº 5A

PROPERTY LINE

CREEK

TREE LINE

APPLE ORCHARD AND DENSE UNDER BRUSH

TREE LINE

FENCE (SEE DWG G1)

RELOCATED CREEK

R=100'

B.H. Nº 4A

TOP OF BERM EL. 267.13

R=40'

B.H. Nº 11A

B.H. Nº 8A

45'-6"

57'-6"

185'-0"

57'-6"

45'-6"

8'-0"

C WALKWAY

WALKWAY (SEE DETAILS DWGS M6 & S2)

15'-0"Ø x 6" THICK REINFORCED CONC. PAD (TYP.) SEE DWG S2

B.H. Nº 9A

AERATION CELL

BOTTOM EL. 254.12

LIQUID LEVEL 264.00

AERATOR

AERATOR

REINFORCED CONCRETE PAD

STATION 7+11

STATION 3+20

130'-0"

SLOPE 3.5:1

B.H. Nº 6A

B.H. Nº 7A

B.H. Nº 10A

42"Ø INLET SEWER AT 3.10% (SEE PLAN AND PROFILE DWG G4)

45'-6"

OUTLET CHAMBER

M.H. Nº 1

42"Ø BY-PASS SEWER AT 0.61% (SEE PLAN AND PROFILE DWG G2)

42"Ø SAN. SEWER

B.H Nº 14A

B.H Nº 13A

MIXING CHAMBER

CONTROL BUILDING

T.H.

M.H. Nº 2

36"Ø OUTLET SEWER AT 0.22% (SEE PLAN AND PROFILE DWG G3)

PARKING AREA

3/4"Ø P.V.C. CONDUIT

2"Ø P.V.C. WATERMAIN (SEE PLAN AND PROFILE DWG G5)

ACCESS ROAD

PRIME AND DOUBLE SURFACE TREATMENT

20' BELL TELEPHONE COMPANY OF CANADA EASEMENT

T.S.H. SURVEY LINE

36"Ø OUTLET SEWER AT 2.58%

U.B.C.M.

U.U.S.C.M.

STATION 3+55

STATION B.O.C. 1+50

COURSE WATER

LIMIT OF CONTRACT

B.H. Nº 3A

LEGEND

CONTOUR LINES

SPOT ELEVATIONS IN CREEK BED x262.9

NOTES:

1. FOR SANITARY SEWER LENGTHS AND INVERTS AND ACCESS ROAD ELEVATIONS SEE PLAN & PROFILE DWGS.
2. FOR DETAIL OF AREA AROUND CONTROL BUILDING SEE SITE PLAN DWG M3.
3. FOR BOREHOLE DATA SEE SOILS REPORT SUBMITTED BY SITE INVESTIGATION SERVICES LTD. PETERBOROUGH, ONTARIO.

SEWAGE LAGOON

MAXIMUM LIQUID LEVEL — 261.00

BOTTOM ELEV. — 256.00

(SEE DWG M 7)

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COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P. C. BEDLEE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

R. B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.77	P.E.G.	AS CONSTRUCTED

DESIGN J.T.
DRAWN J.L.H.
CHECKED R.B.B.
APPROVED P.C.E.
SCALE 1" = 30'-0"

MINISTRY OF THE ENVIRONMENT

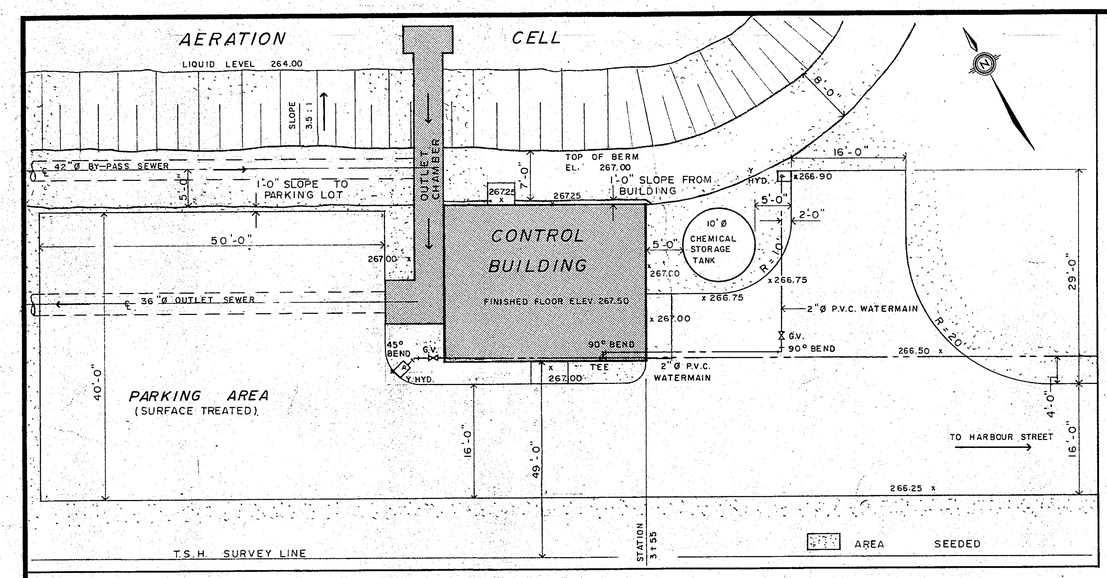
PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

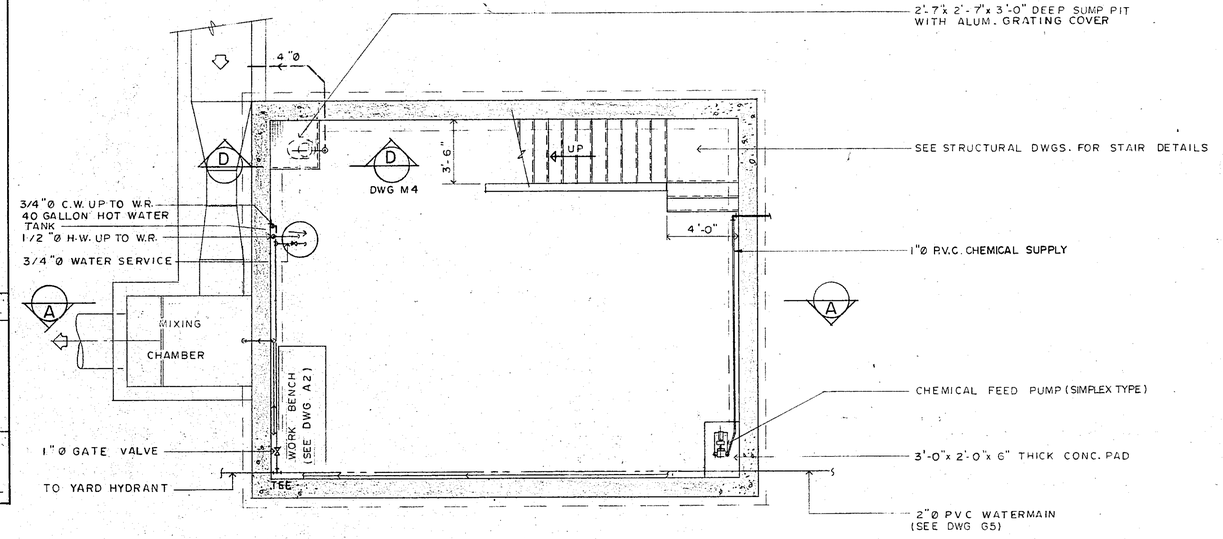
WATER POLLUTION CONTROL CENTRE EXTENSION

MECHANICAL - PLAN OF AERATION CELL

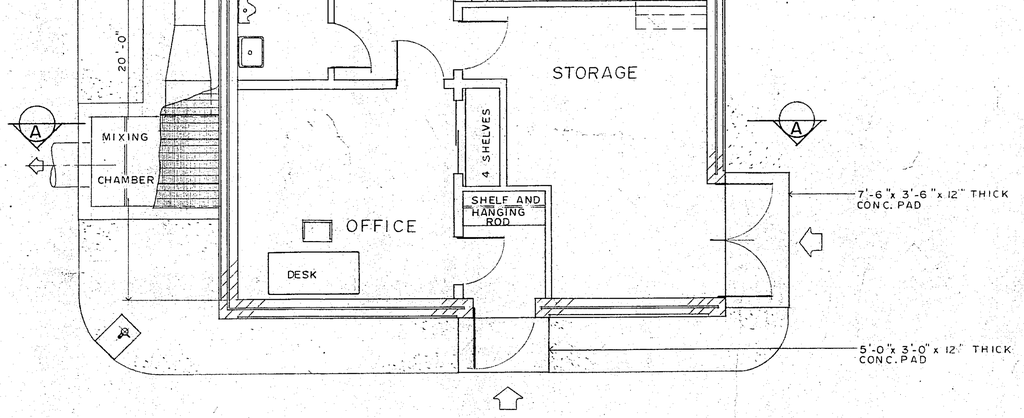
DATE APRIL, 1975
PROJECT 52-1895-01
DRAWING M2



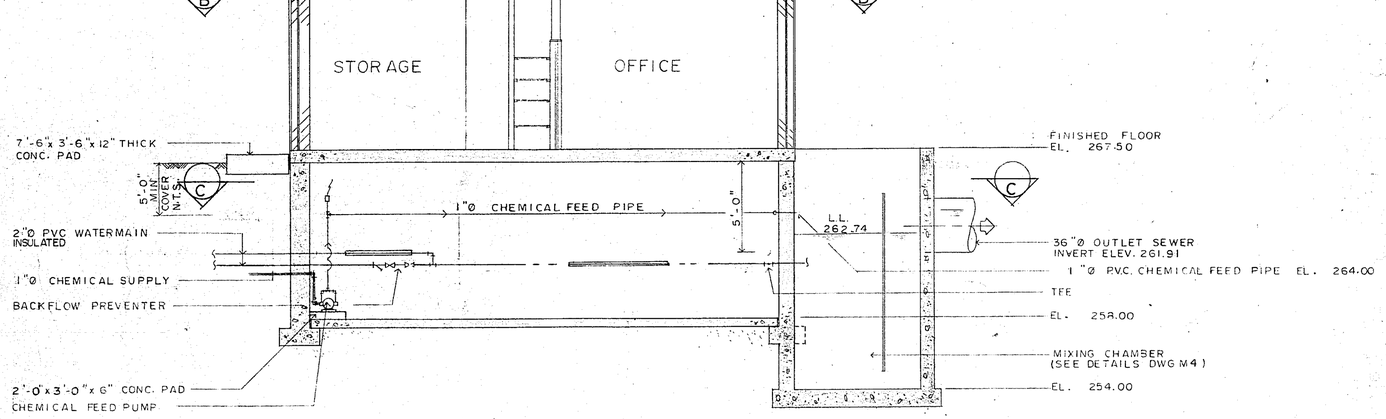
SITE PLAN
SCALE: 1"=10'-0"



PLAN AT 'C-C'
SCALE: 1/4"=1'-0"



PLAN AT 'B-B'
SCALE: 1/4"=1'-0"



SECTION 'A-A'
SCALE: 1/4"=1'-0"

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

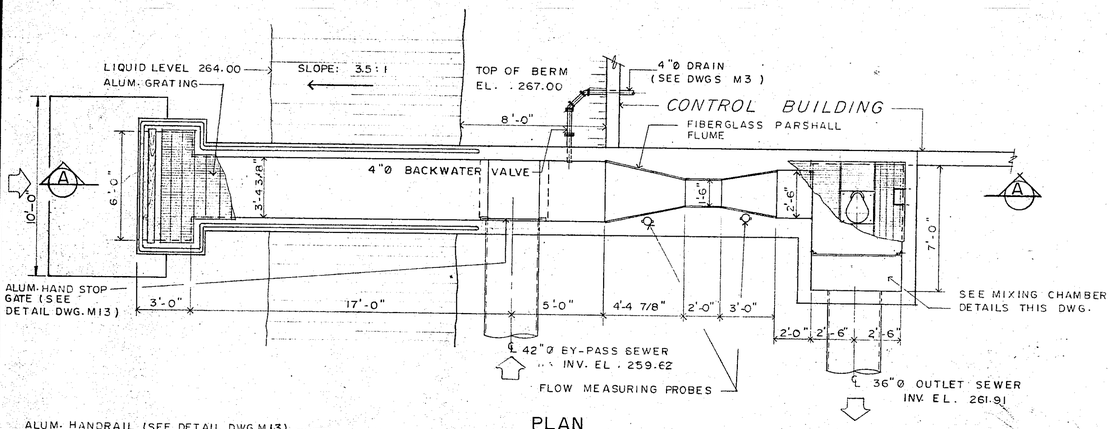
R. C. EDERLEE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO
R. B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.77	P.E.G.	AS CONSTRUCTED

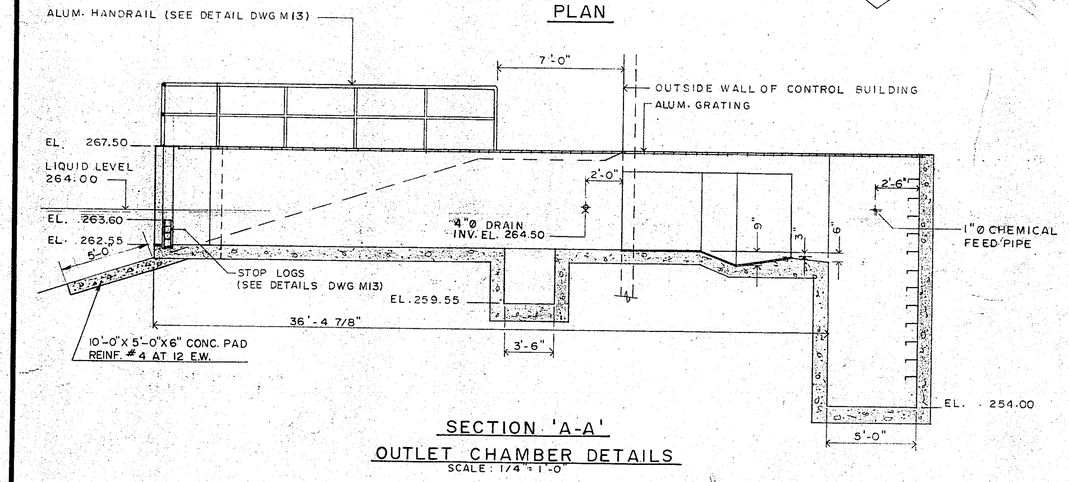
DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
MECHANICAL - CONTROL BUILDING - SITE PLAN, PLAN & SECTIONS

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING M3



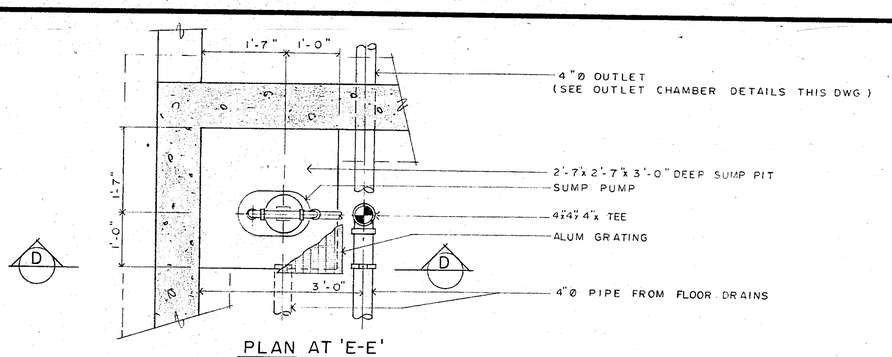
PLAN



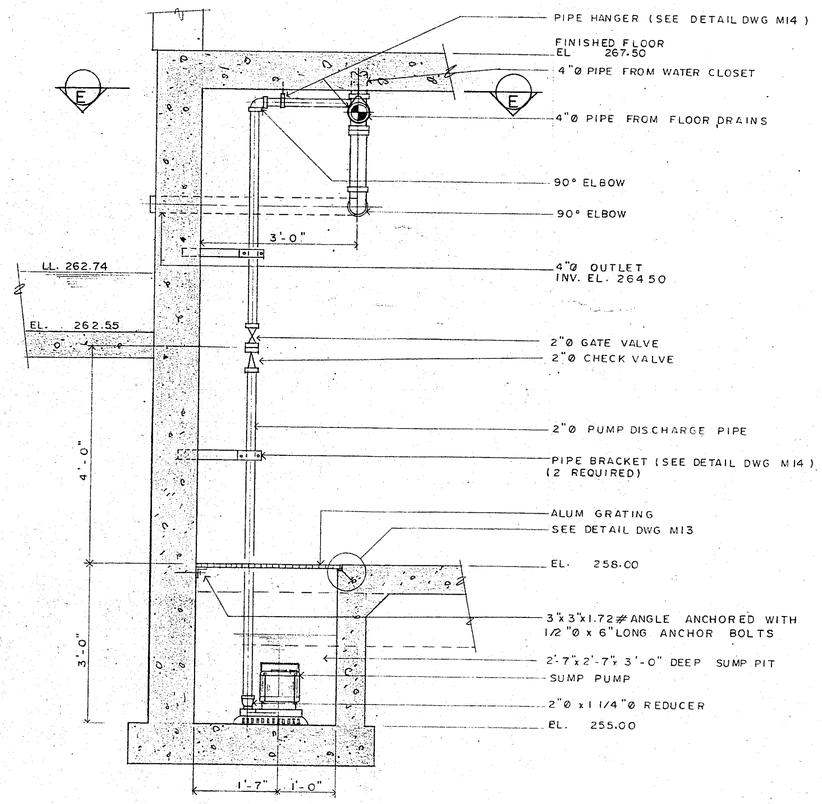
SECTION 'A-A'

OUTLET CHAMBER DETAILS

SCALE: 1/4" = 1'-0"



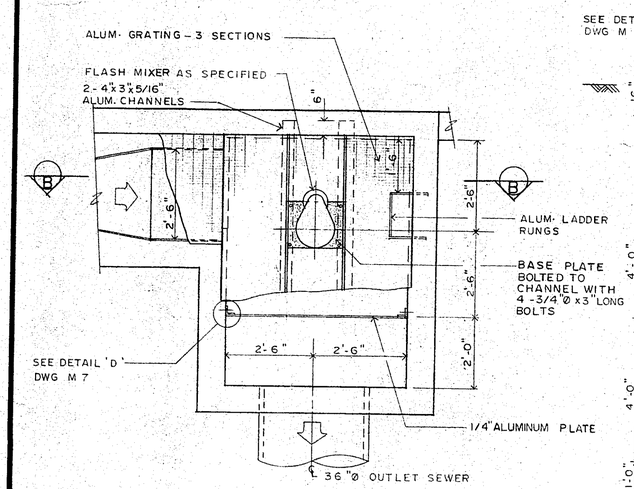
PLAN AT 'E-E'



SECTION 'D-D'

DETAILS OF SUMP PIT AND PIPING

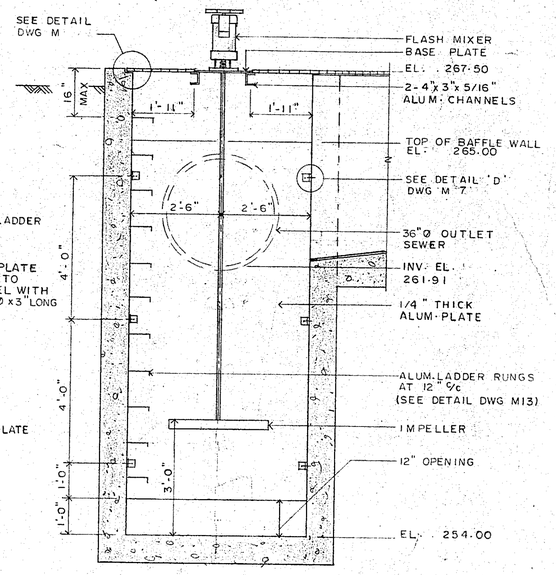
SCALE: 3/4" = 1'-0"



PLAN

DETAILS OF MIXING CHAMBER

SCALE: 1/2" = 1'-0"



SECTION B-B

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P.C. ELLIOTT — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

R.B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.77	P.E.G.	AS CONSTRUCTED

DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

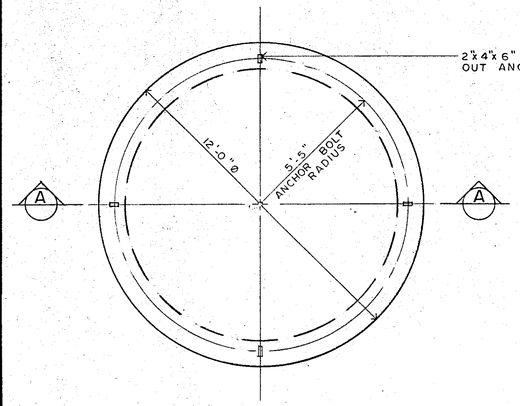
WATER POLLUTION CONTROL CENTRE EXTENSION

MECHANICAL - OUTLET CHAMBER, MIXING CHAMBER & SUMP PIT DETAILS

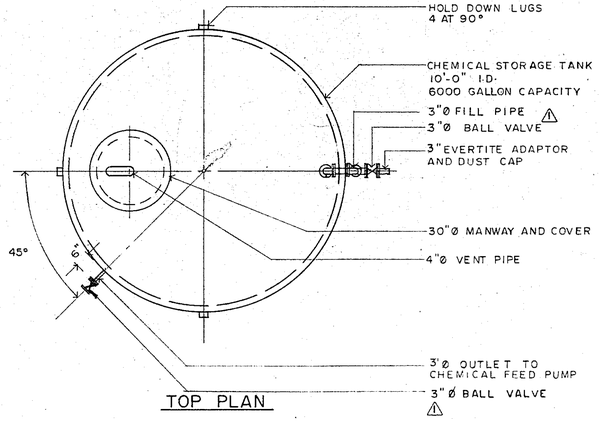
DATE: APRIL, 1975

PROJECT 52-1895-01

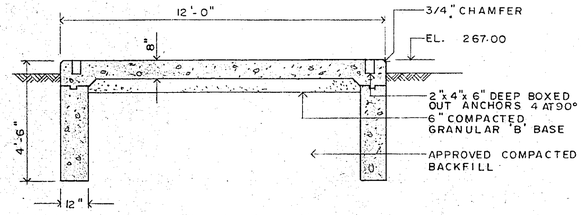
DRAWING M4



BASE PLAN



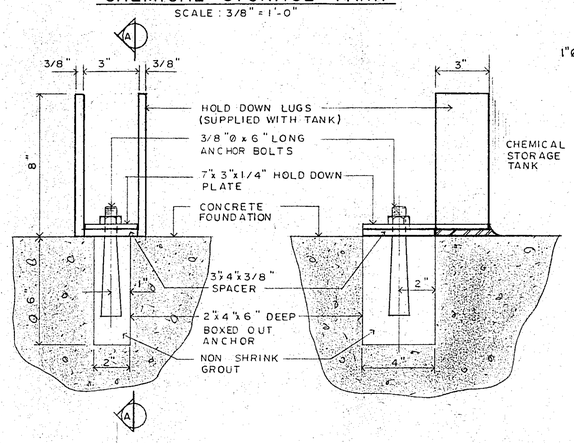
TOP PLAN



SECTION 'A-A'

CONCRETE FOUNDATION DETAILS FOR CHEMICAL STORAGE TANK

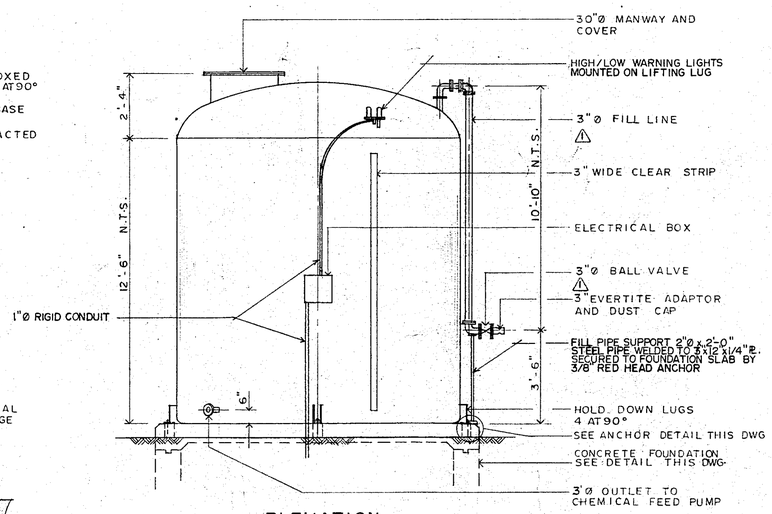
SCALE : 3/8" = 1'-0"



ELEVATION SECTION 'A-A'

ANCHOR DETAILS

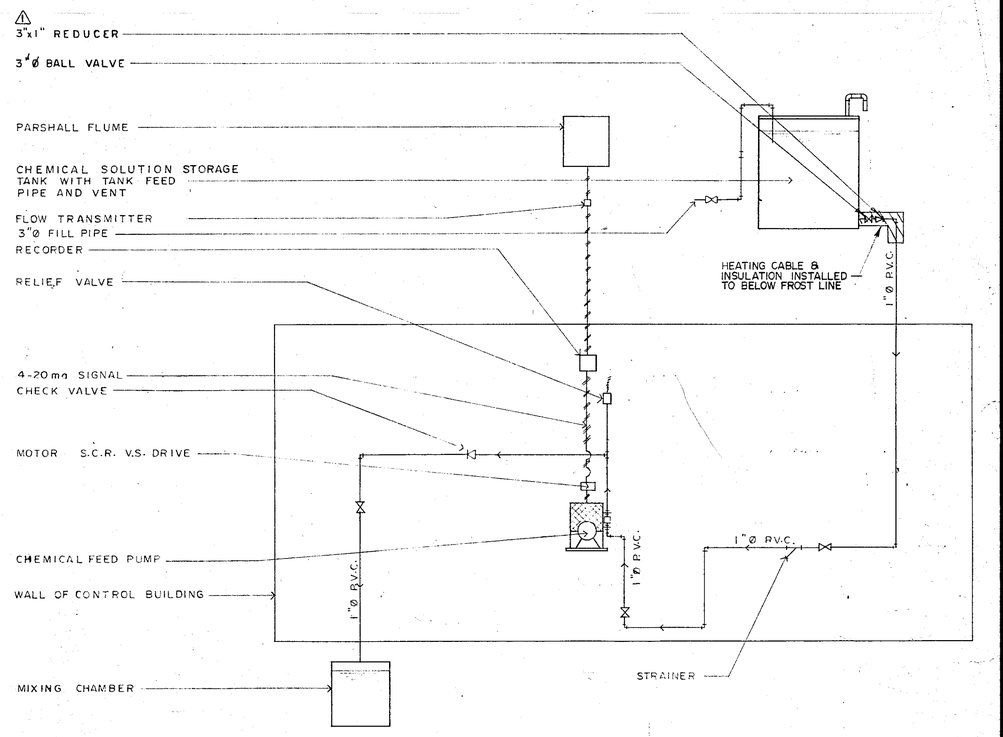
SCALE : 3"=1'-0"



ELEVATION

CHEMICAL STORAGE TANK DETAILS

SCALE: 3/8" = 1'-0"



CHEMICAL FEED FLOW DIAGRAM

N.T.S.

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CONSULTANTS

COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. C. HERITE PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER R. B. BAKER PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
2	MAR/77	A.L.E.	AS CONSTRUCTED
1	3/3/76	D.L.N.	GENERAL PIPE SIZE REVISED

DESIGN	J. T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

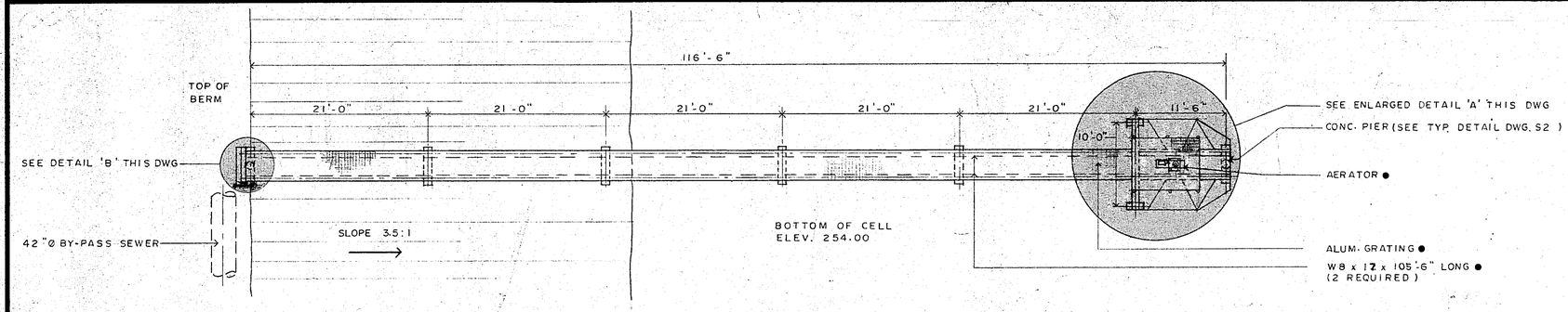
WATER POLLUTION CONTROL CENTRE EXTENSION

MECHANICAL - CHEMICAL STORAGE TANK DETAILS & CHEMICAL FEED FLOW DIAGRAM

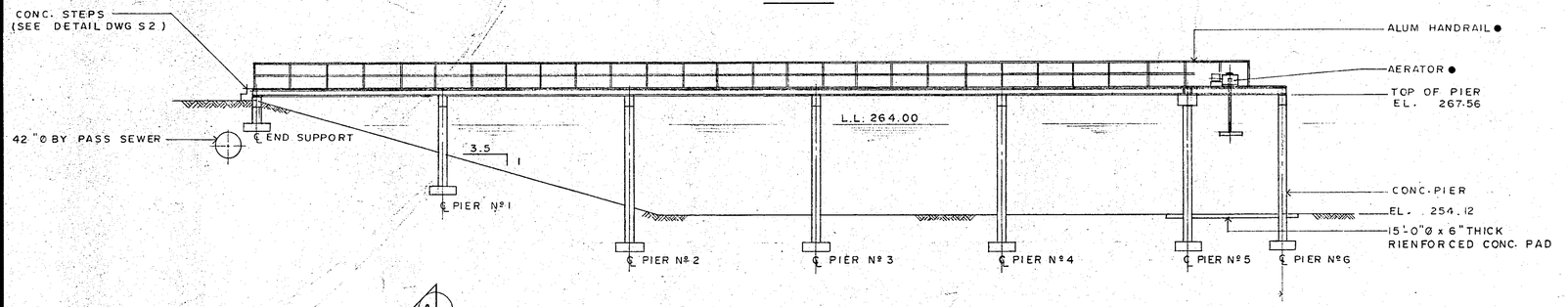
DATE APRIL 1975

PROJECT 52-1895-01

DRAWING M5

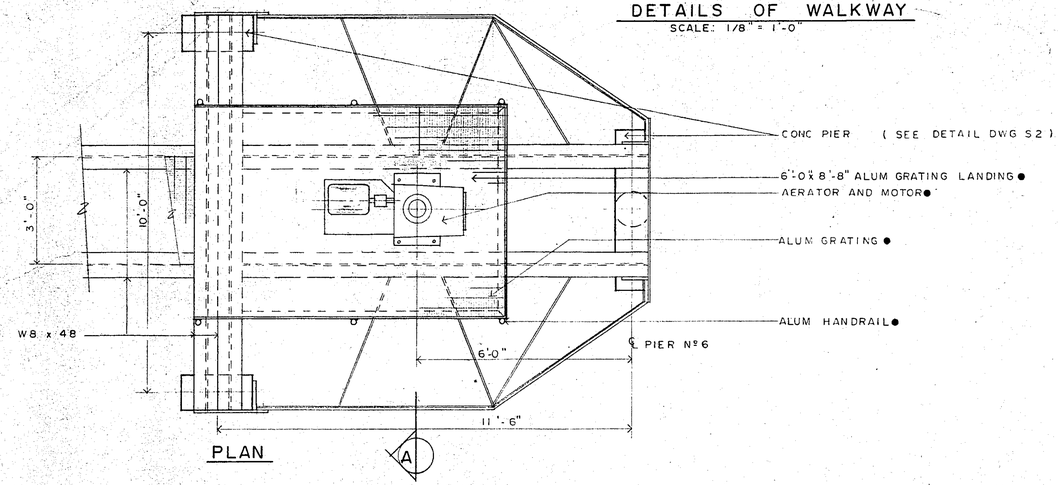


PLAN

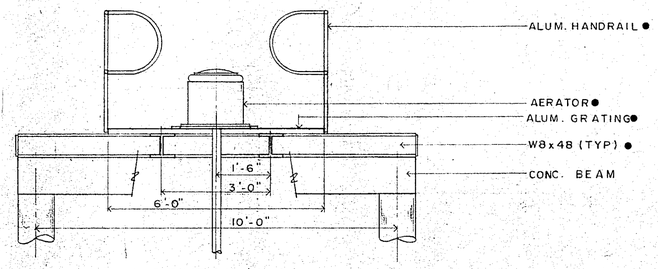


ELEVATION

DETAILS OF WALKWAY
SCALE: 1/8" = 1'-0"

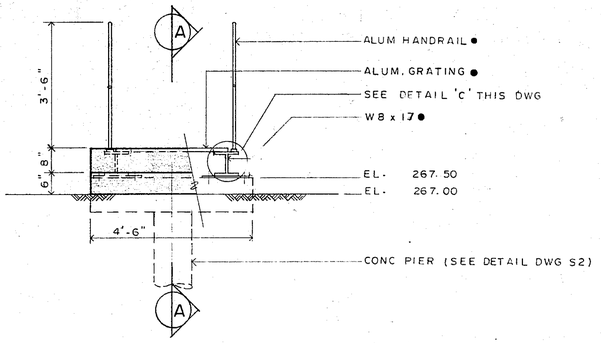


PLAN

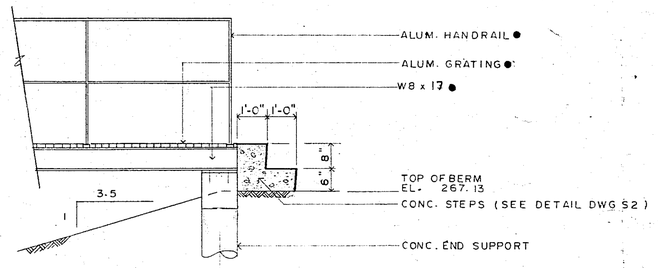


SECTION 'A-A'

DETAIL 'A'
SCALE: 1/2" = 1'-0"

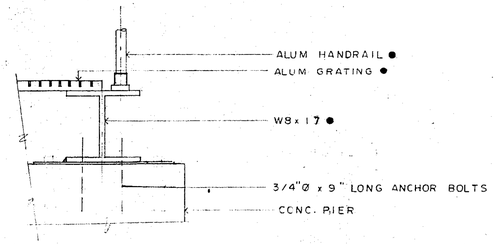


ELEVATION



SECTION 'A-A'

DETAIL 'B'
SCALE: 1/2" = 1'-0"



DETAIL 'C'
N.T.S.

NOTE:

● INDICATES EQUIPMENT AND MATERIALS SUPPLIED BY PRESELECTED SUPPLIER.

totten sims hubicki associates limited
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P. C. EBERLEE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

R. D. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

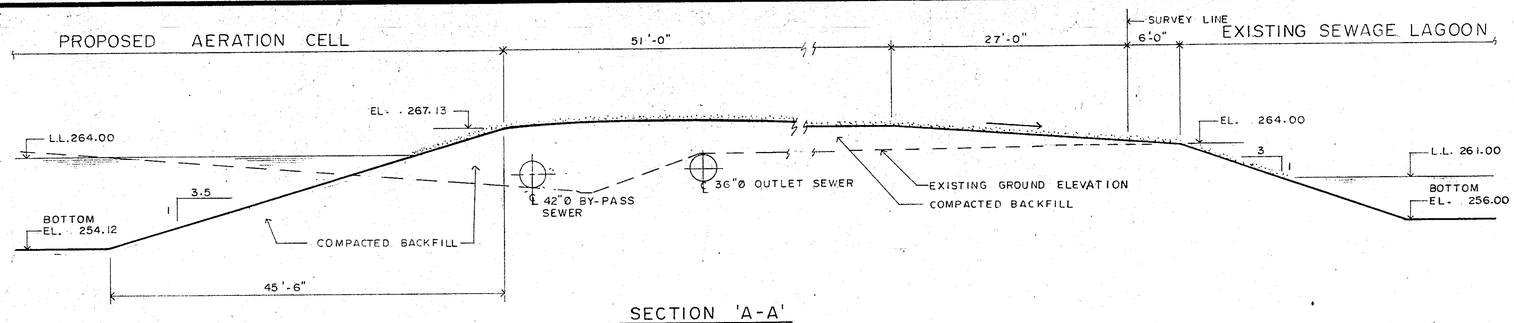
No.	DATE	BY	REVISIONS
1	MAR 77	P.E.G.	AS CONSTRUCTED

DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	AS SHOWN

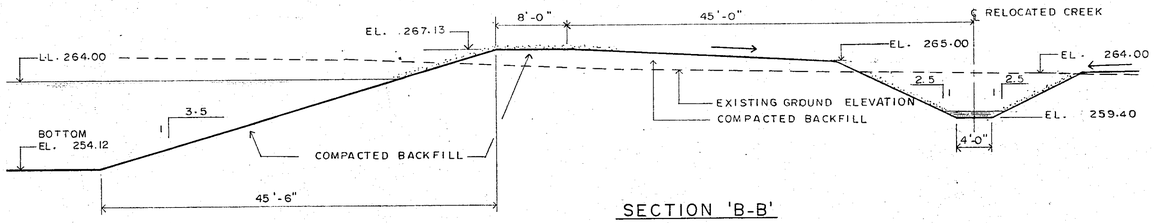
MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
MECHANICAL - WALKWAY DETAILS

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING M6

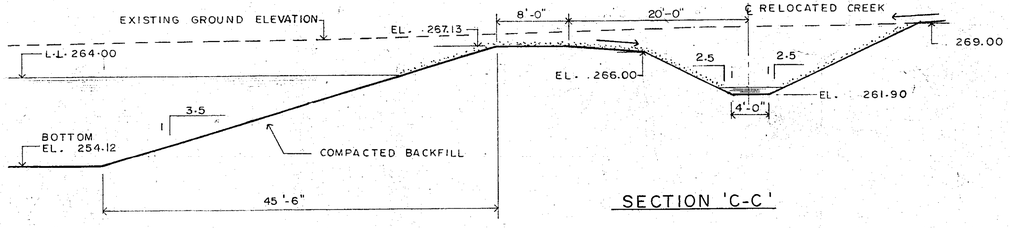
Ottawa Blueprint



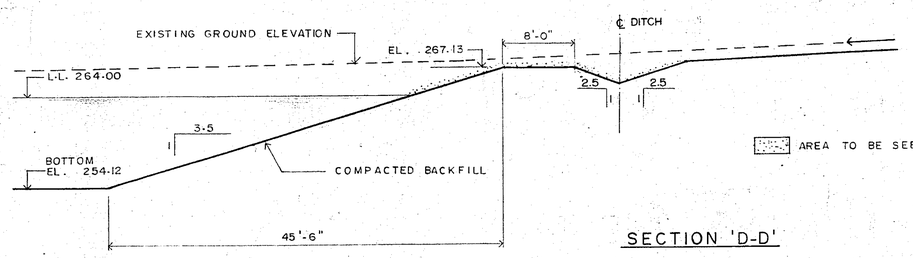
SECTION 'A-A'



SECTION 'B-B'



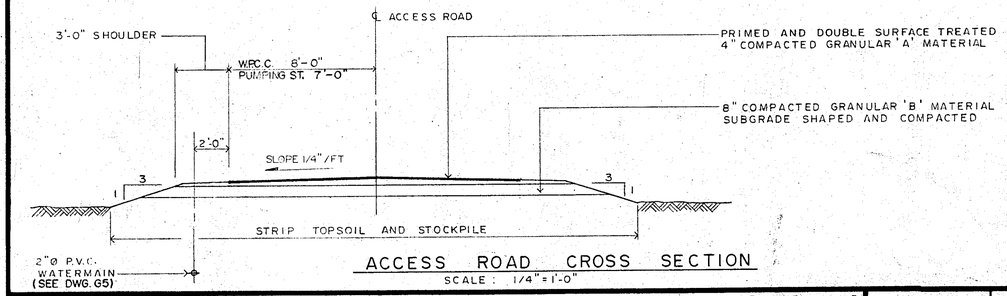
SECTION 'C-C'



SECTION 'D-D'

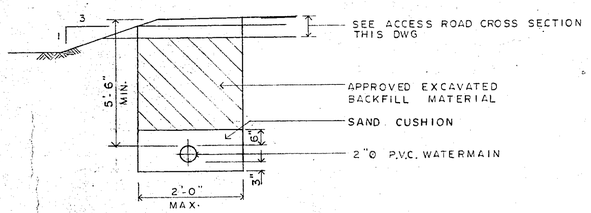
CROSS SECTIONS

SCALE: 1/8"=1'-0"



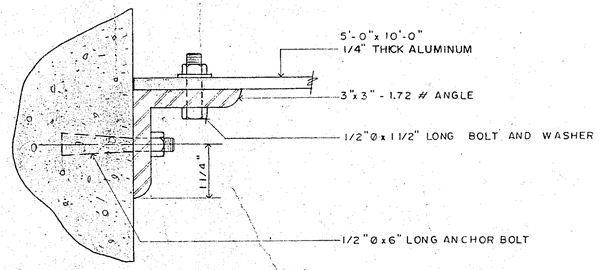
ACCESS ROAD CROSS SECTION

SCALE: 1/4"=1'-0"



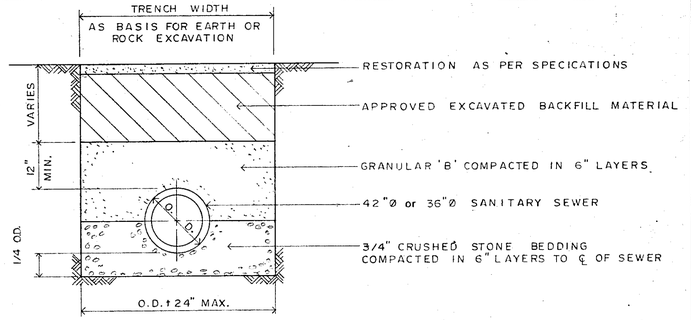
WATERMAIN TRENCH DETAIL

N.T.S



DETAIL 'D'

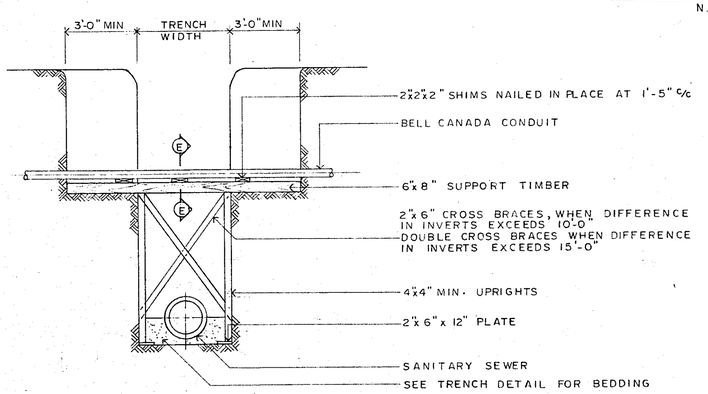
N.T.S.



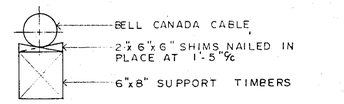
TYPICAL TRENCH DETAIL

TYPE 'B' BEDDING

N.T.S.



ELEVATION



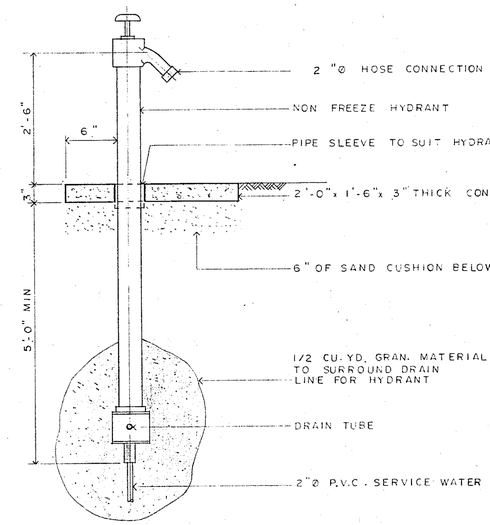
SECTION 'E-E'

NOTES:

1. ALL TIMBER FOR SUPPOT DURING CONSTRUCTION TO BE LEFT IN PLACE ON COMPLETION OF WORK.
2. ALL SILLS MUST BEAR ON SOLID GROUND OR 1500 P.S.I. CONCRETE
3. SUPPORTING TIMBERS ARE TO BE CARRIED 3'-0" INTO SIDES OF EXCAVATION

DETAILS FOR SUPPORTING BURIED CABLE

N.T.S.



NON FREEZE YARD HYDRANT DETAIL

N.T.S.

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P. C. EERLE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

R. B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.77	P.E.G.	AS CONSTRUCTED

DESIGN	J.T.
DRAWN	J.L.H.
CHECKED	R.B.B.
APPROVED	P.C.E.
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

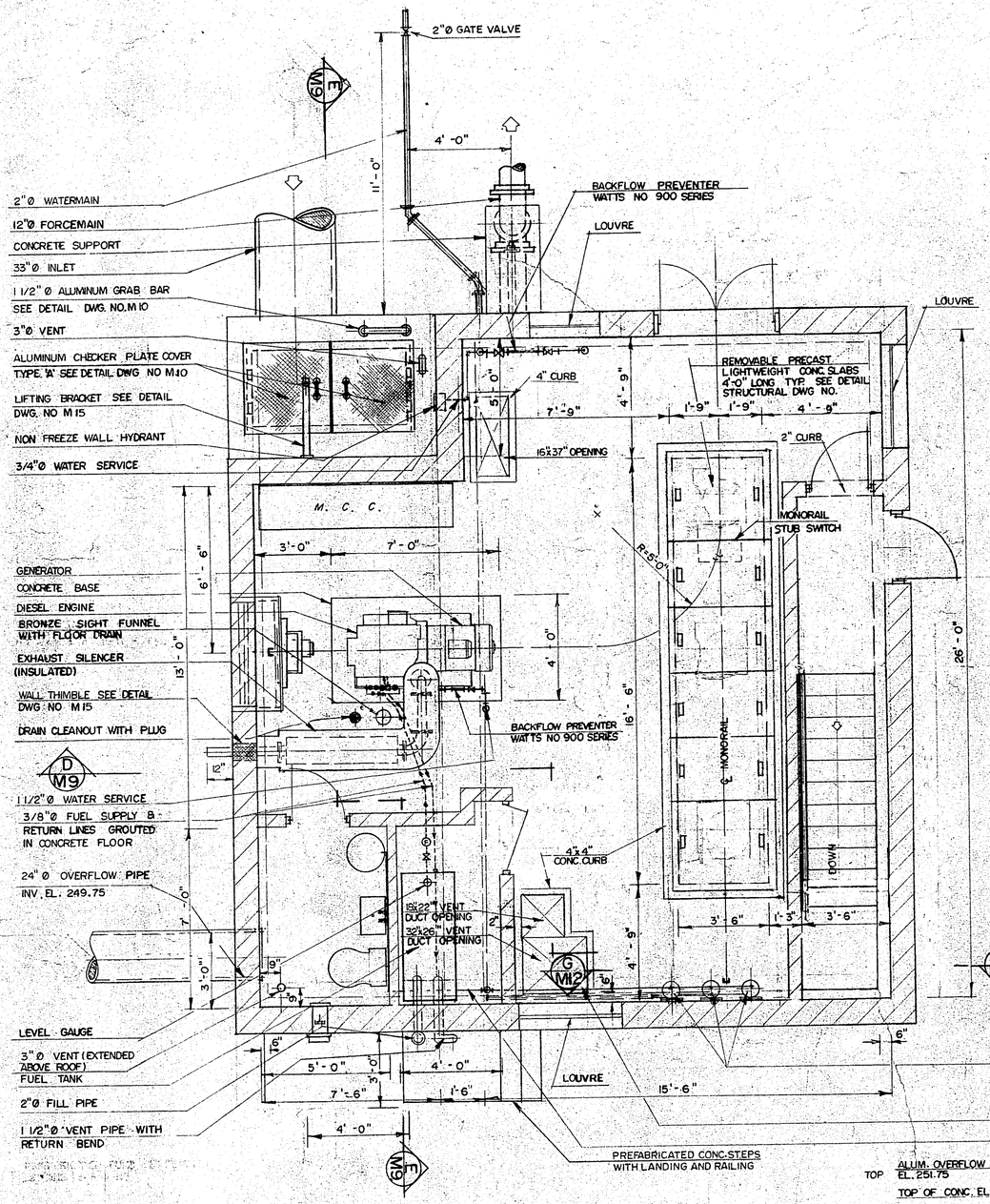
WATER POLLUTION CONTROL CENTRE EXTENSION

MECHANICAL— AERATION CELL CROSS SECTIONS AND MISCELLANEOUS DETAILS

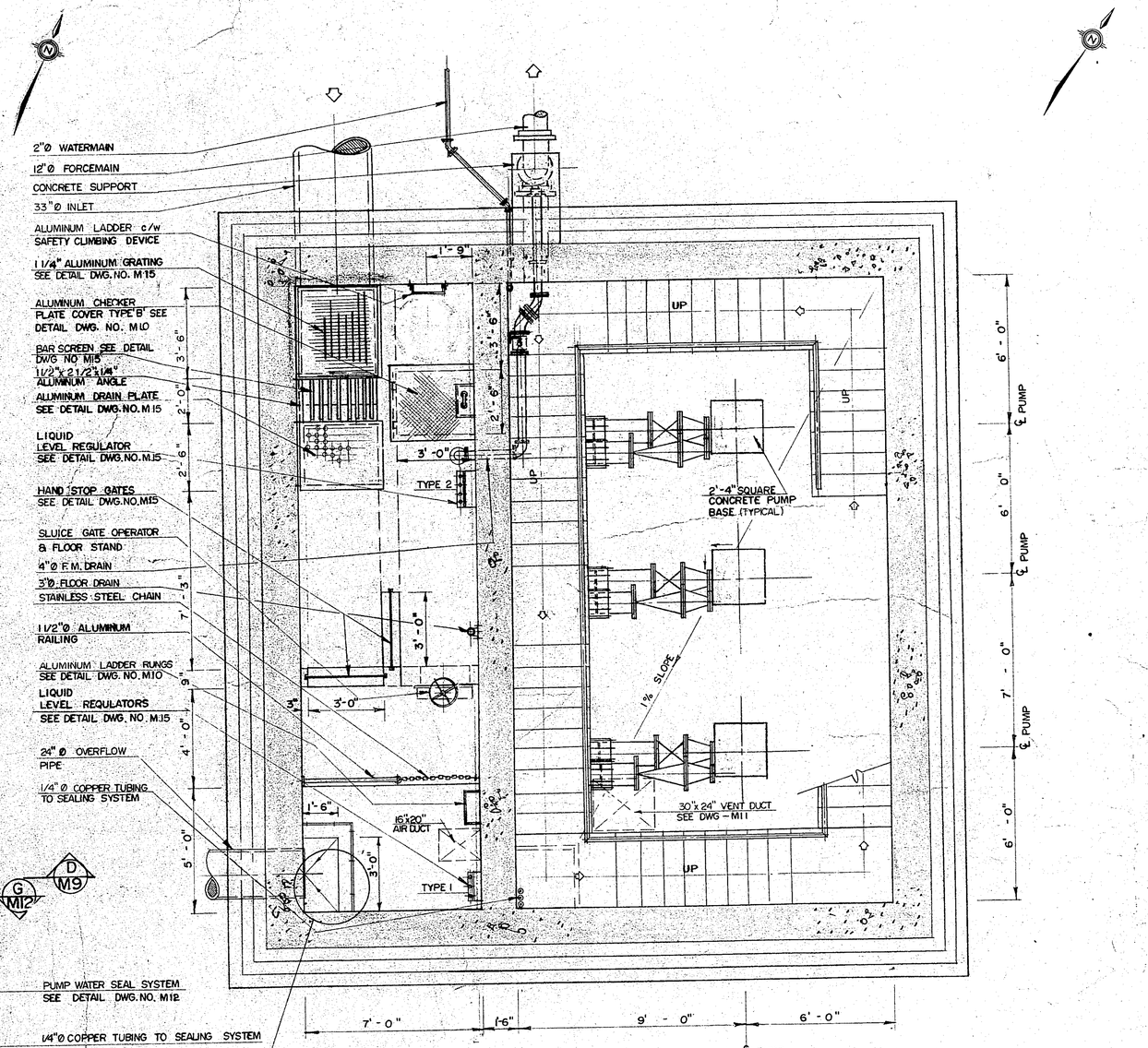
DATE APRIL. 1975

PROJECT 52-1895-01

DRAWING M7



PLAN AT A-A · ELEVATION 265.00



PLAN AT B-B · ELEVATION 253.00

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P. C. BERGE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

R. B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

NO.	DATE	BY	REVISIONS
1	MARCH 77	P.C.G.	AS CONSTRUCTED

DESIGN	T. J. K.
DRAWN	M. J. A.
CHECKED	R. B. B.
APPROVED	P. C. E.
SCALE	3/8" = 1'-0"

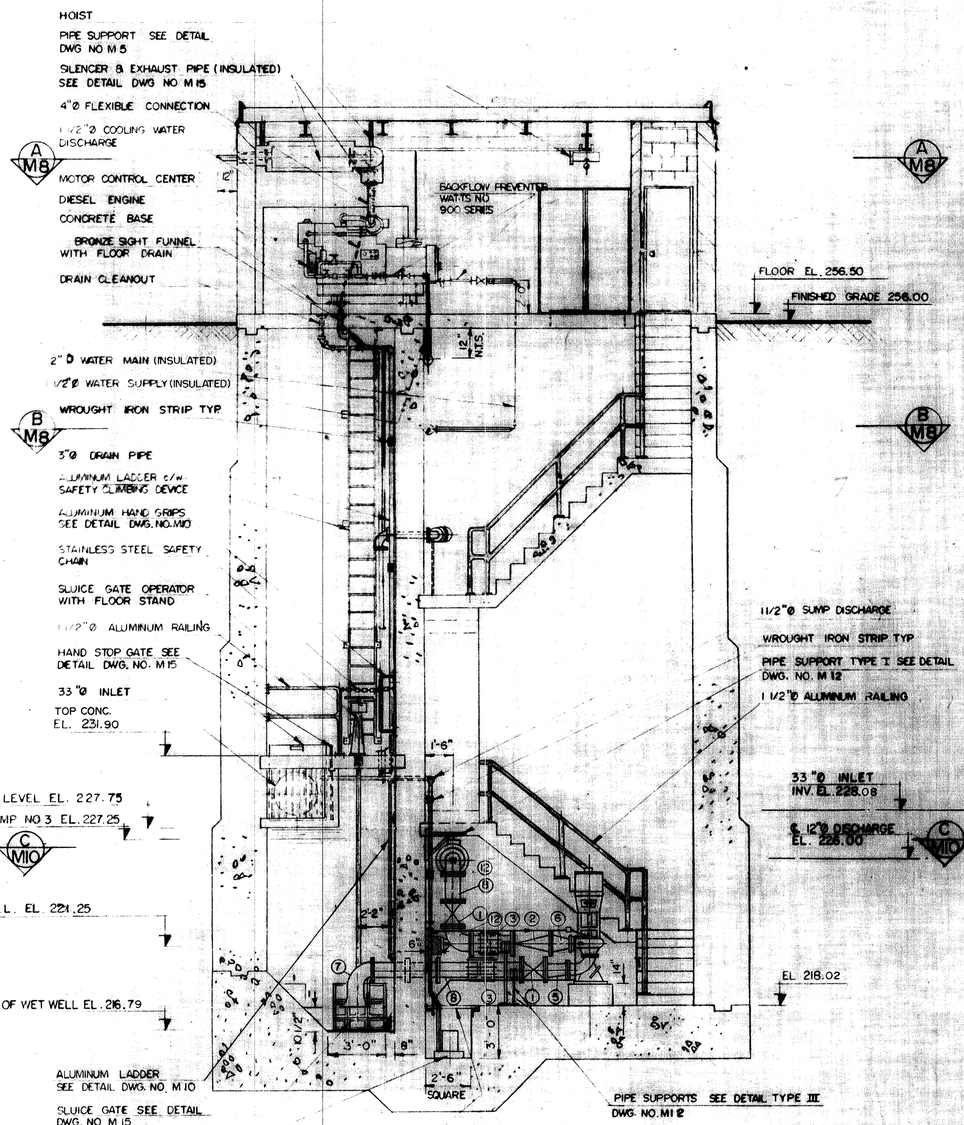
MINISTRY OF THE ENVIRONMENT

PROJECT N° 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION

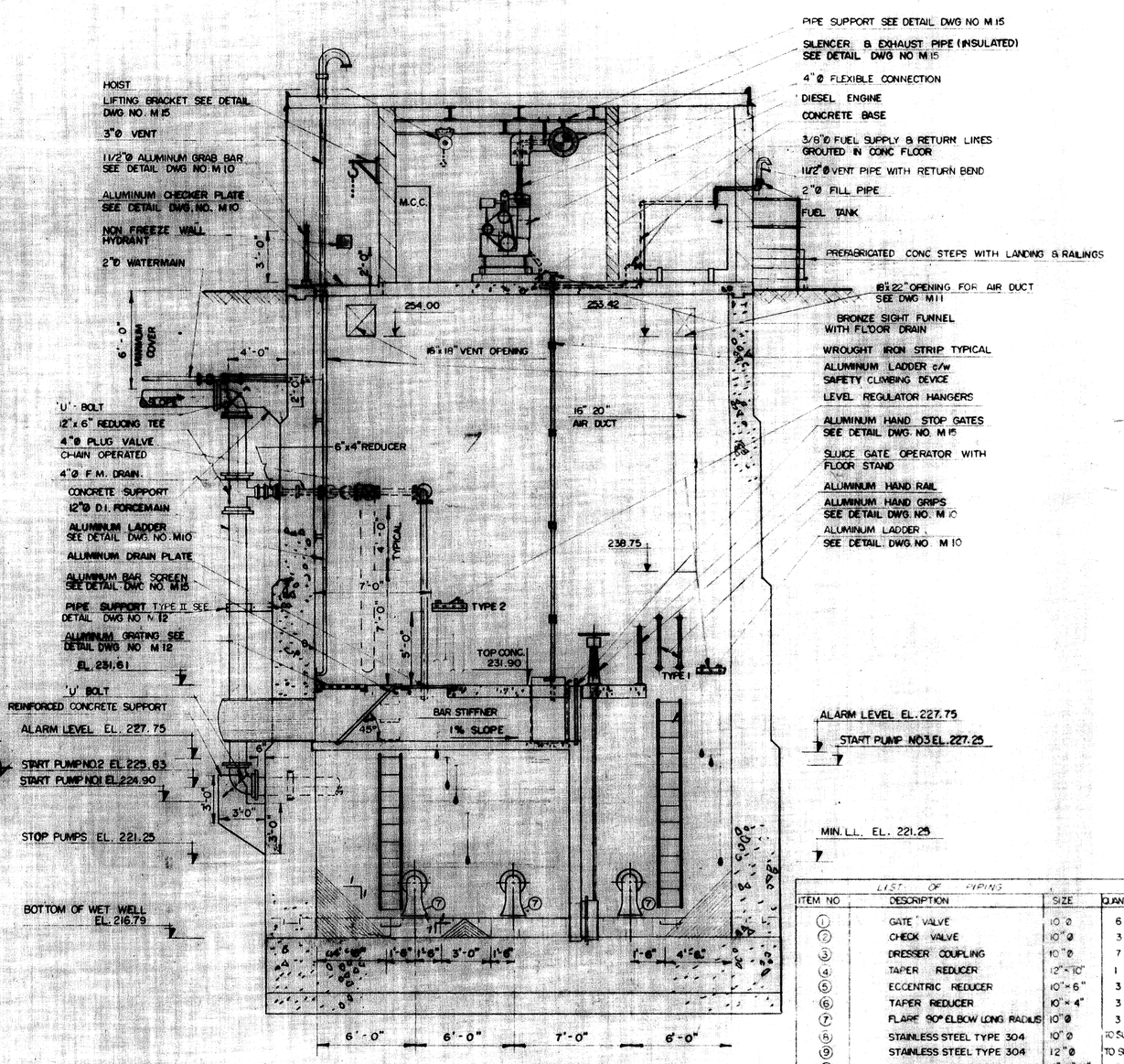
MECHANICAL — PUMP HOUSE — PLANS

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING M8

Oshawa Blueprint



SECTION - 'D - D'



SECTION — 'E - E'

LIST OF PIPING

ITEM NO	DESCRIPTION	SIZE	QUANTITY
1	GATE VALVE	10"Ø	6
2	CHECK VALVE	10"Ø	3
3	DRESSER COUPLING	10"Ø	7
4	TAPER REDUCER	12"x 10"	1
5	ECCENTRIC REDUCER	10"x 6"	3
6	TAPER REDUCER	10"x 4"	3
7	FLARE 90° ELBOW LONG RADIUS	10"Ø	3
8	STAINLESS STEEL TYPE 304	10"Ø	TO SUIT
9	STAINLESS STEEL TYPE 304	12"Ø	TO SUIT
10	45° REDUCING LATERAL	12"x12"x10"	2
11	45° ELBOW	10"Ø	2
12	90° BASE ELBOW	10"Ø	4
13	DRESSER COUPLING	12"Ø	2

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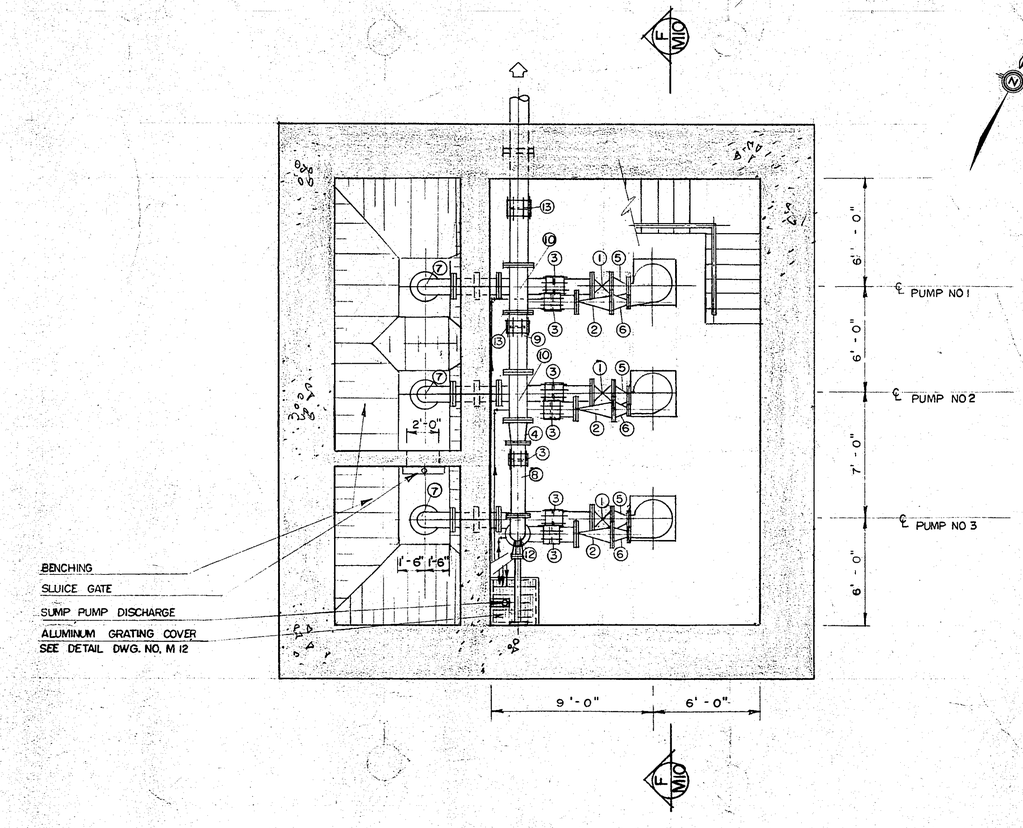
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

DESIGN T.S.K.
DRAWN M.J.B.
CHECKED
SCALE 1/4" = 1'-0"

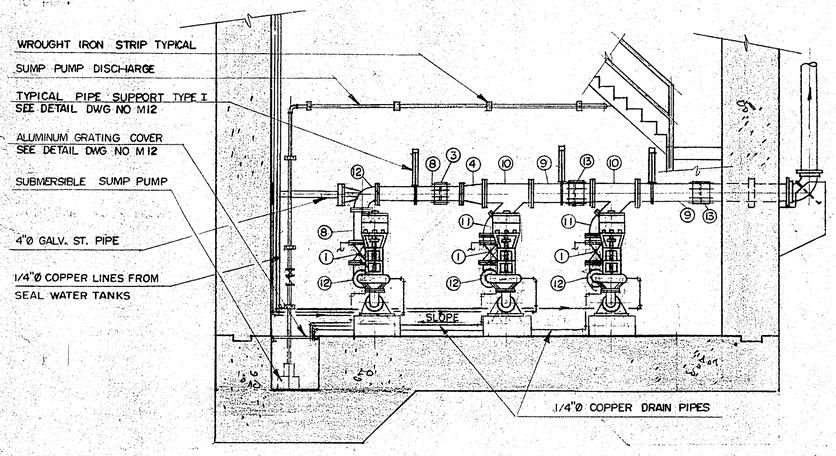
MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2 - 0320 - 74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION
MECHANICAL — PUMP HOUSE — SECTIONS

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING M9



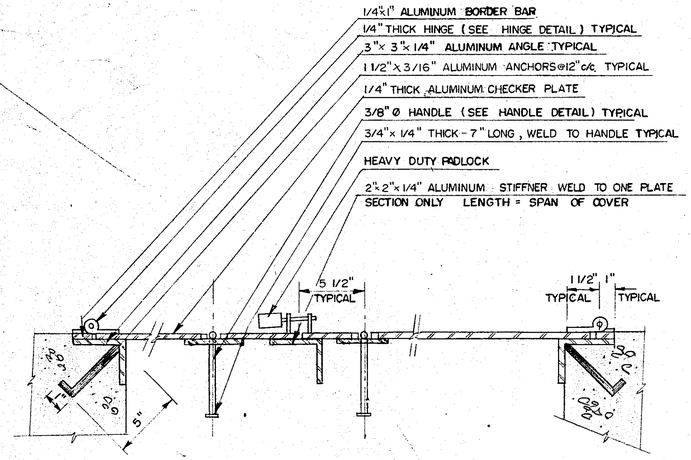
PLAN AT 'C-C' ELEVATION 227.00

SCALE - 1/4" = 1'-0"

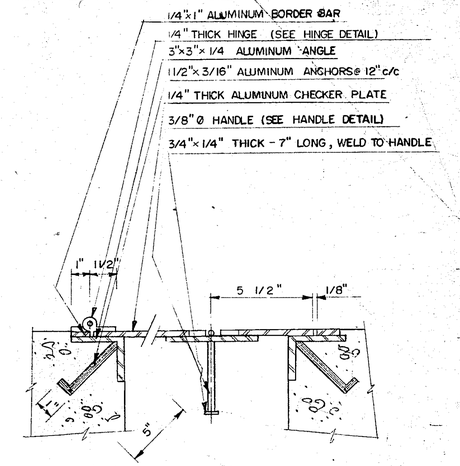


SECTION 'F-F'

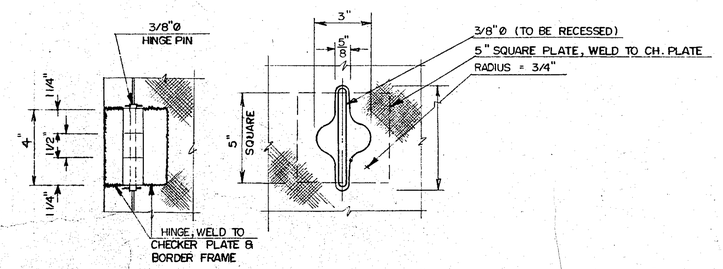
SCALE 1/4" = 1'-0"



TYPE 'A'



TYPE 'B'

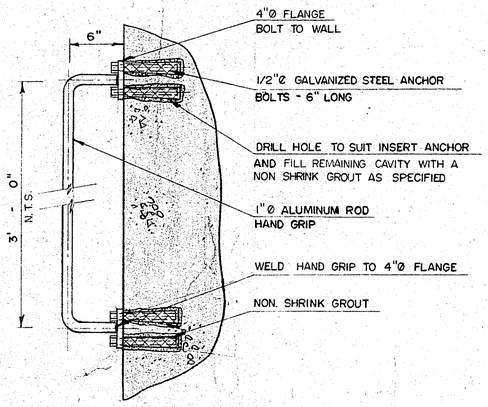


HINGE DETAIL

HANDLE DETAIL

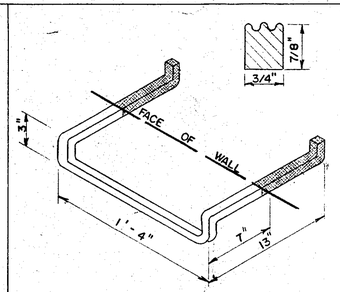
CHECKER PLATE COVER DETAILS TYPE 'A'

N. T. S.



HAND GRIP DETAIL

SCALE - 1 1/2" = 1'-0"

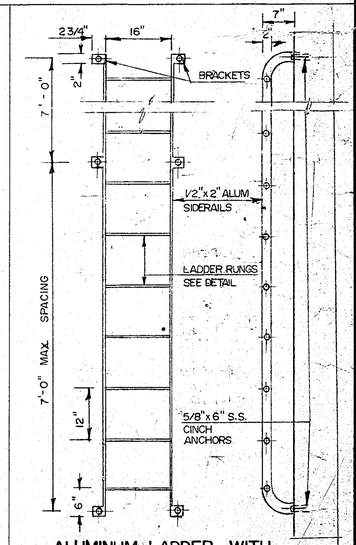


NOTE

// SET IN WALL WITH HOOKS UP @ 12"c/c

ALUMINUM LADDER RUNG DETAIL

N. T. S.



ALUMINUM LADDER WITH SAFETY CLIMBING DEVICE

N. T. S.

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COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P. C. EBERLEE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

R. B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

NO.	DATE	BY	REVISIONS
1	MARCH 77	P.C.G.	AS-CONSTRUCTED

DESIGN T. J. K.
DRAWN M. J. A.
CHECKED R. B. B.
APPROVED P. C. E.
SCALE AS NOTED

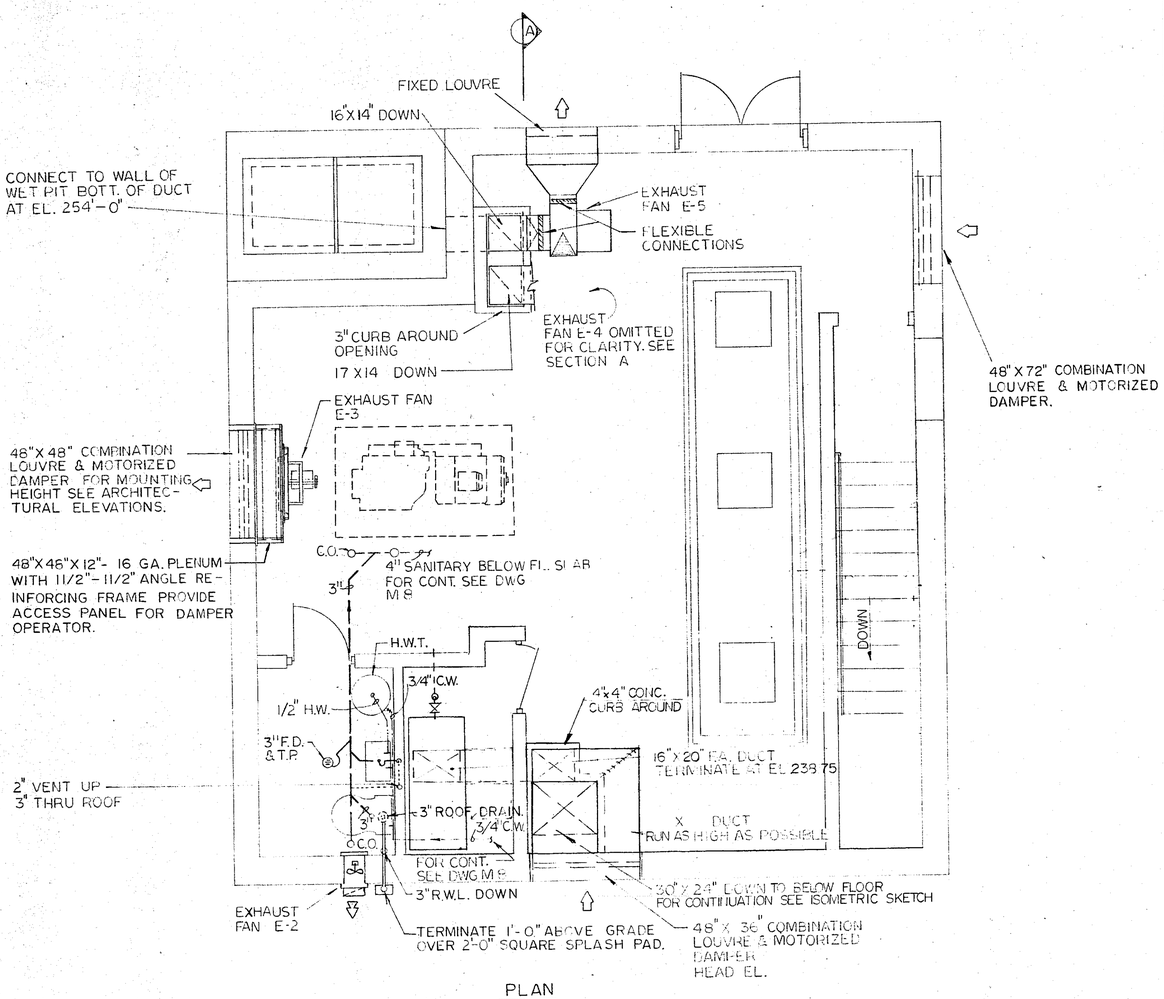
MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2 - 0320 - 74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION

MECHANICAL — PUMP HOUSE — PLAN, SECTION & DETAILS

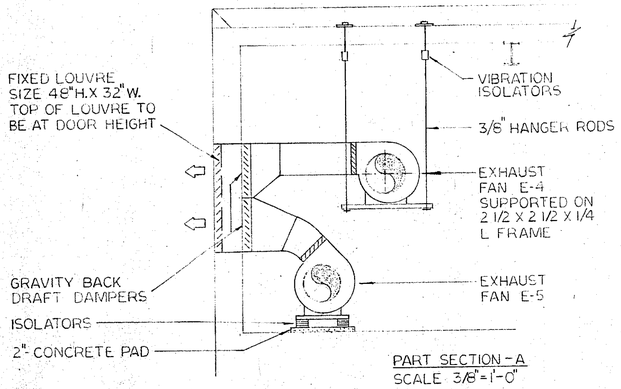
DATE APRIL, 1975
PROJECT 52-1895-01
DRAWING M10

Oshawa Blueprint



PLAN

SCALE : 3/8" = 1'-0"



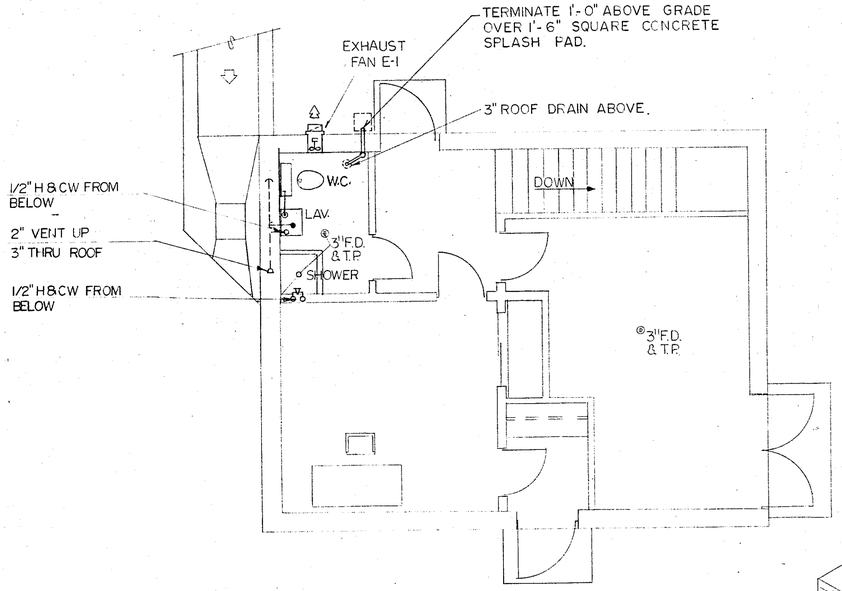
PART SECTION - A

SCALE 3/8" = 1'-0"

PUMPING STATION

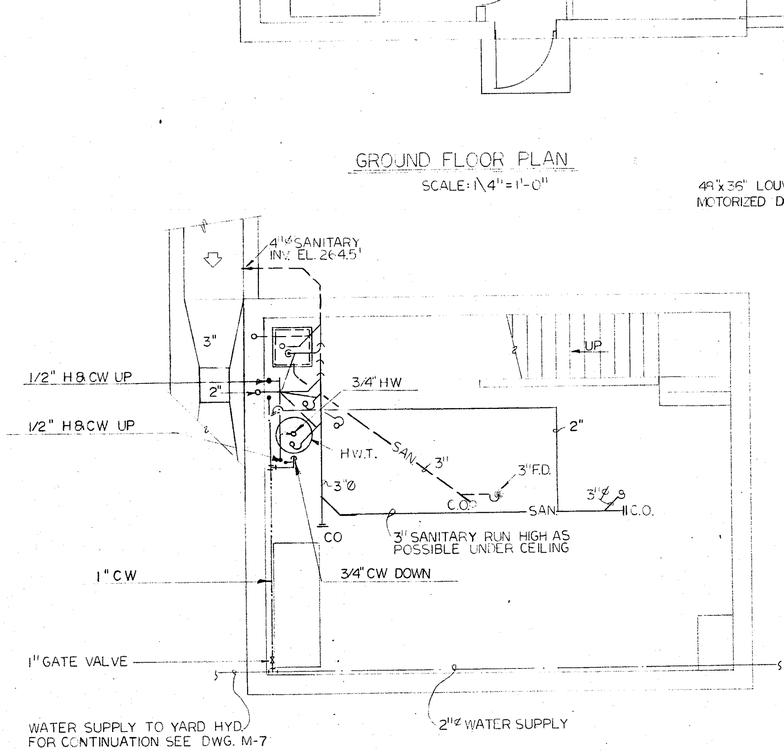
LEGEND & SYMBOLS

——·——·——	COLD WATER ABOVE GRADE
— — — —	COLD WATER BELOW GRADE
——··——	HOT WATER ABOVE GRADE
——SAN——	SANITARY SEWER ABOVE GRADE
— —SAN— —	SANITARY SEWER BELOW GRADE
----------	VENT LINE
—‖ C.O.	CLEANOUT ABOVE GRADE
—o C.O.	CLEANOUT BELOW GRADE
H.W.T.	HOT WATER TANK
◉ F.D.	FLOOR DRAIN
T.P.	TRAP PRIMER



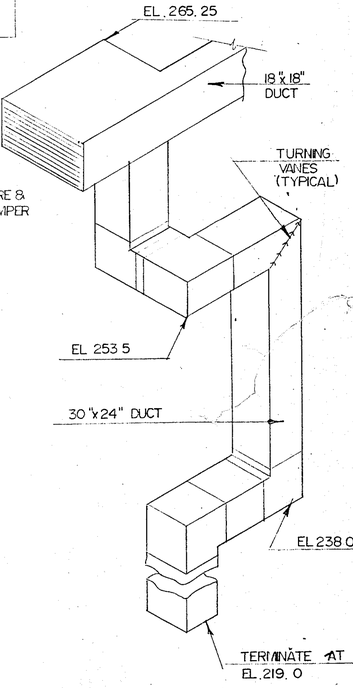
GROUND FLOOR PLAN

SCALE: 1\4" = 1'-0"



BASEMENT PLAN

SCALE: 1/4" = 1'-0"



ISOMETRIC OF PUMP PIT F.A. DUCT

N.T.S.

CONTROL BUILDING

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CONSULTANTS

COBOURG WHITBY KINGSTON TORONTO MUSKOKA

P. C. EBERLEE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

D. H. PERRY — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MARCH 77	P.C.G.	AS CONSTRUCTED

DESIGN	J. R.
DRAWN	M. F.
CHECKED	J. R.
APPROVED	
SCALE	AS SHOWN

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

W.P.C.C. EXTENSION AND HARBOUR ST. PUMPING STATION

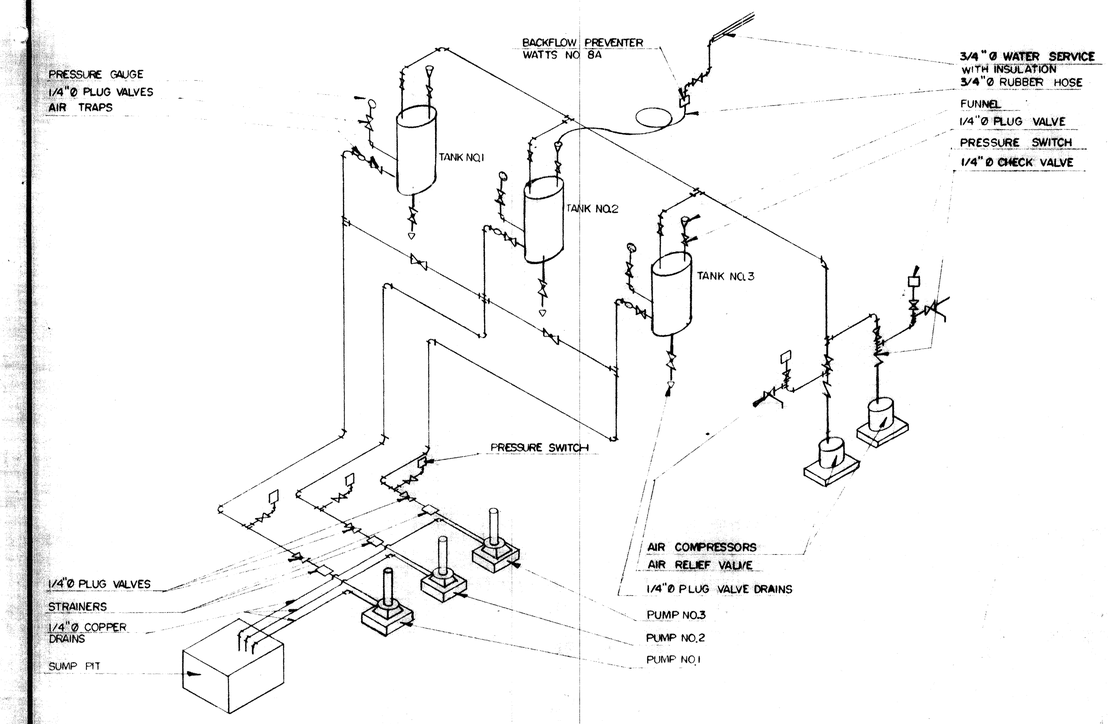
MECHANICAL - PUMP HOUSE & CONTROL BUILDING - PLUMBING & VENTILATION.

DATE APRIL 197

PROJECT 52-1895

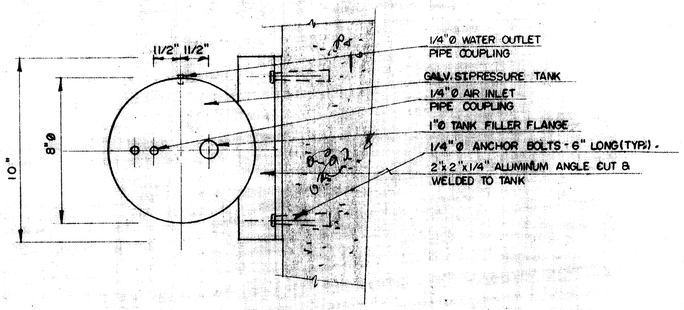
DRAWING M1

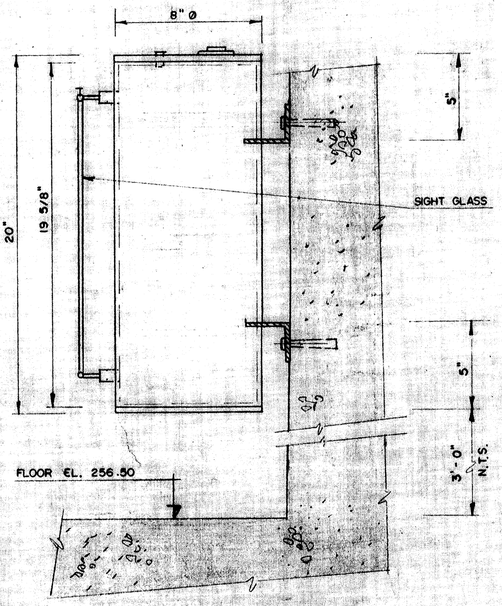
TRANSTEX 19 220-1-79



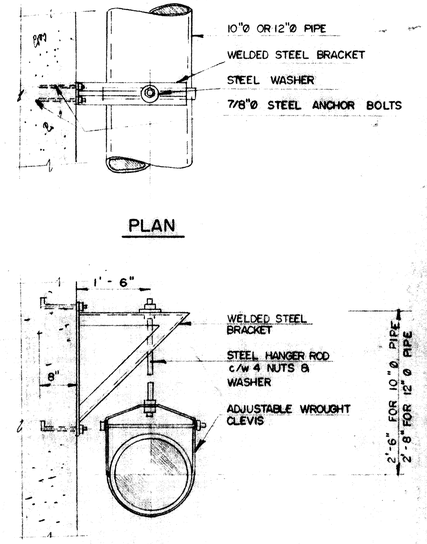
SCHEMATIC
N. T. S.

SEALING SYSTEM OF RAW SEWAGE PUMPING STATION

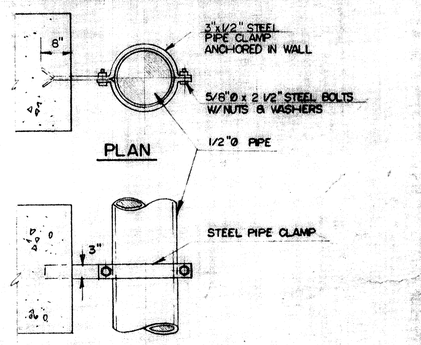




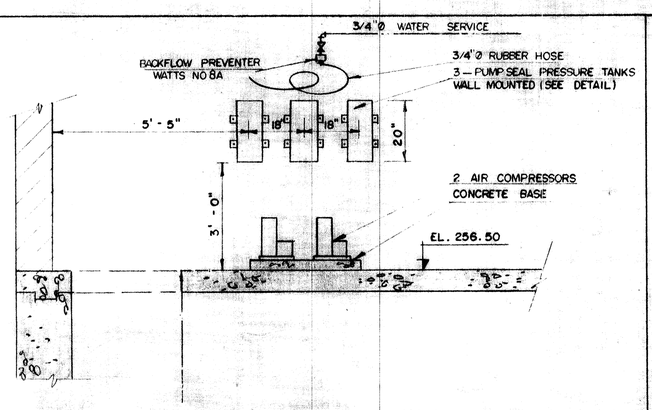
PRESSURE TANK DETAIL
SCALE - 3"=1'-0"



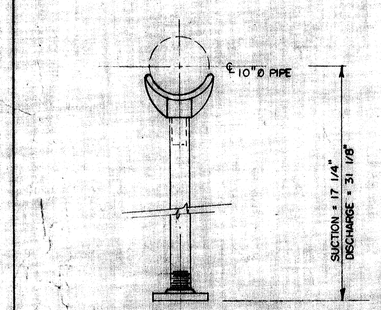
PIPE SUPPORT TYPE I
SCALE - 3/4"=1'-0"



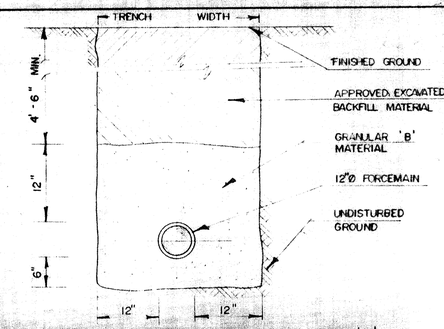
PIPE SUPPORT TYPE II
SCALE - 3/4"=1'-0"



SECTION 'G-G'
SCALE - 1/2"=1'-0"



PIPE SUPPORT TYPE III
SCALE - 1"=1'-0"



BEDDING DETAIL FOR 12"Ø FORCEMAIN ALT.-'A'
N. T. S.

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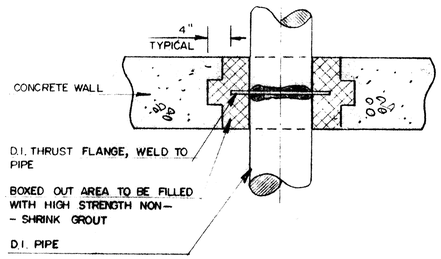
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

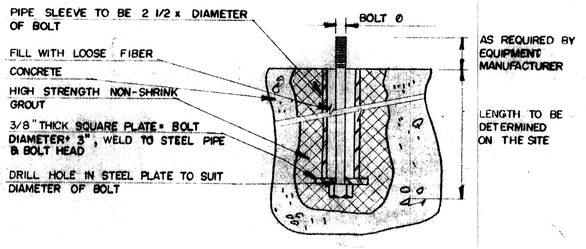
P. C. PIERCE
R. E. BAKER

MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION
MECHANICAL — PUMP HOUSE — WATER SEALING SYSTEM & MISCELLANEOUS DETAILS

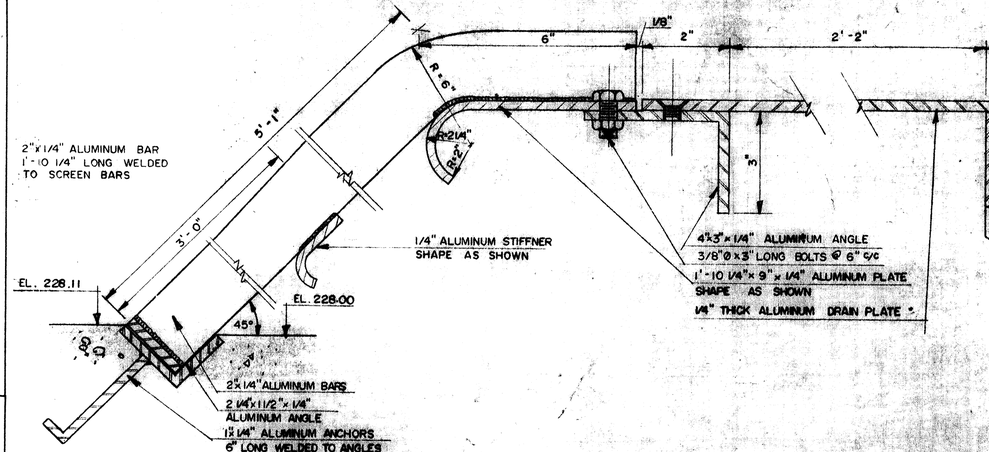
DATE APRIL 1975
PROJECT 52-1895-01
DRAWING M12



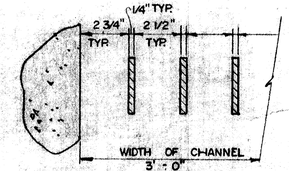
THRUST FLANGE DETAIL (TYPICAL)
SCALE - 1" = 1'-0"



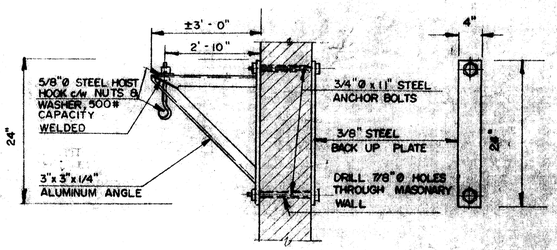
ANCHOR BOLT DETAIL
N. T. S.



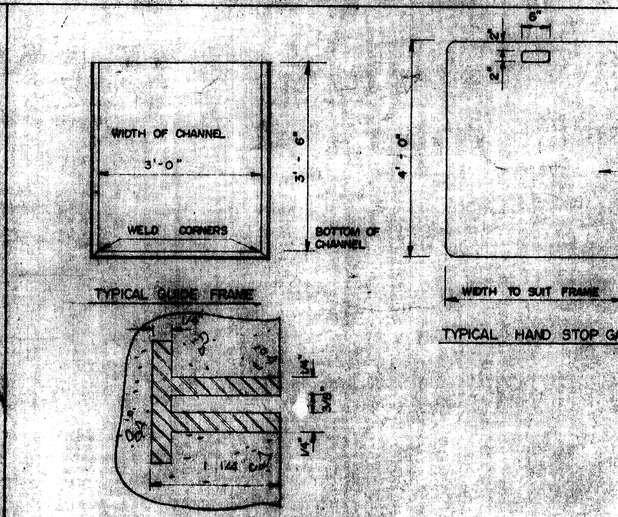
BAR SCREEN DETAILS
N. T. S.



12 BARS REQ'D

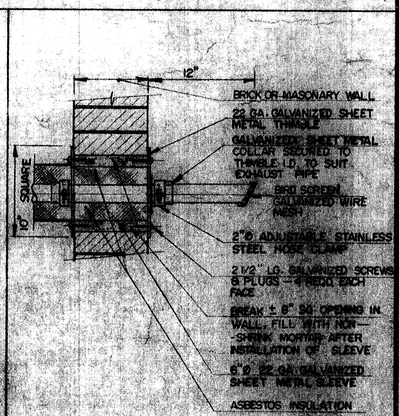


LIFTING BRACKET DETAIL
SCALE — 1" = 1'-0"

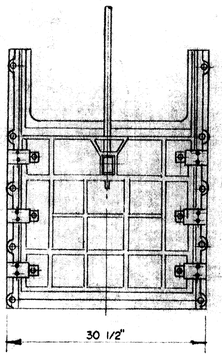


TYPICAL HAND STOP GATE

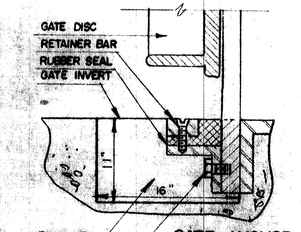
HAND STOP GATE DETAILS
N.T.S.



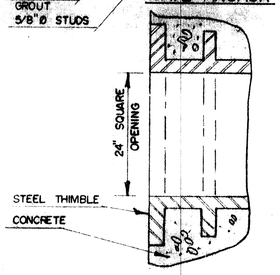
EXHAUST WALL THIMBLE
SCALE — 1 1/2" = 1'-0"



FLANGE BACK 24" SQUARE OPENING SLUICE GATE

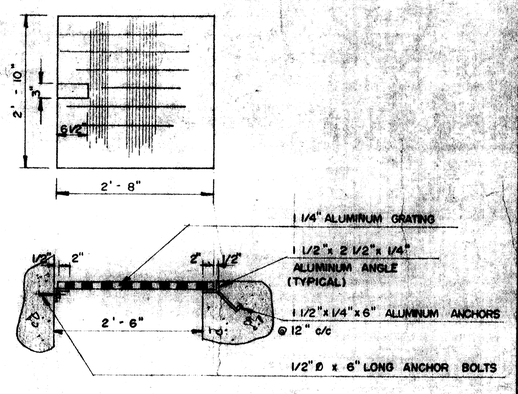


GATE ANCHOR

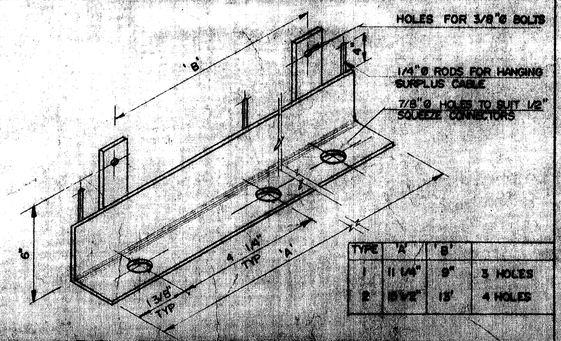


THIMBLE

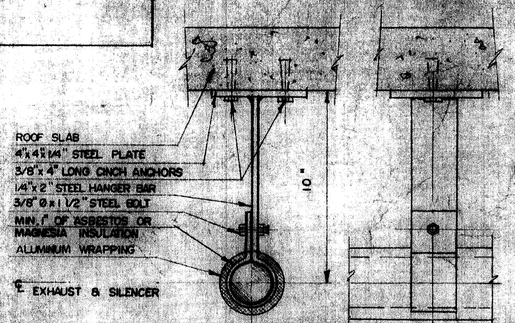
SLUICE GATE DETAILS
N.T.S.



SUMP PIT GRATING DETAILS
SCALE 3/4" = 1'-0"



LEVEL REGULATOR HANGER DETAILS



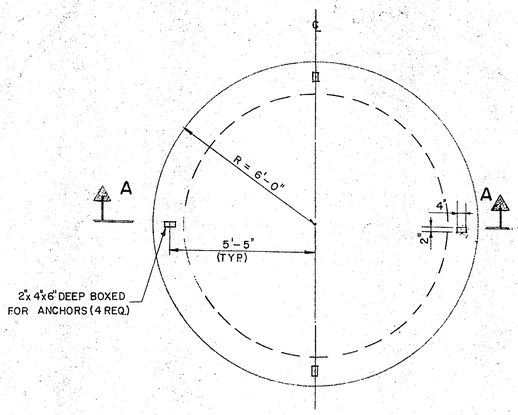
EXHAUST INSULATION DETAIL
N. T. S.

totten sims hubicki associates limited
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REVISIONS | DATE | NOTED

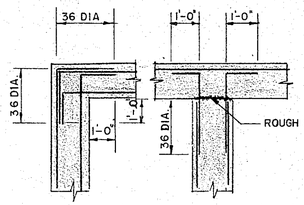
MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION
MECHANICAL — PUMP HOUSE — MISCELLANEOUS DETAILS

DATE APRIL 1975
PROJECT 52: 1895-01
DRAWING M15



PLAN

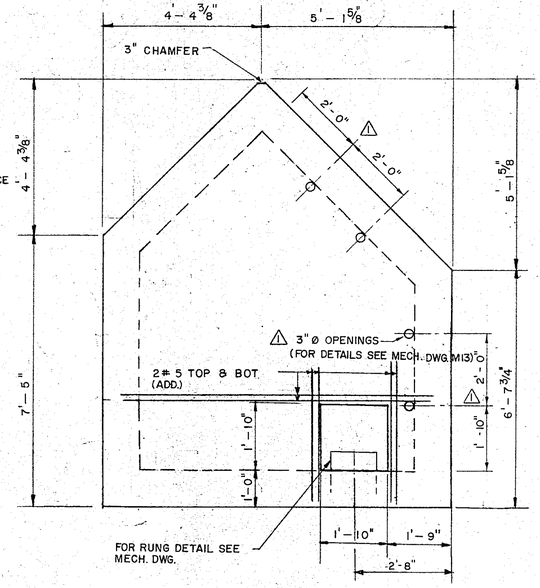
SCALE 3/8" = 1'-0"



CORNER INTERSECTION

TYP WALL REINF DETAILS

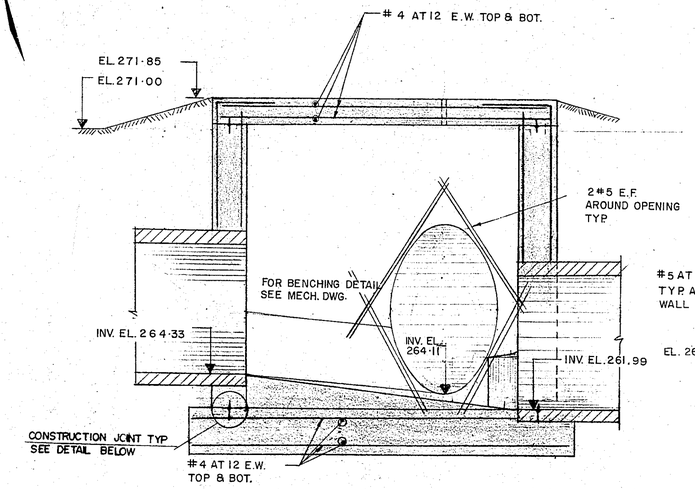
N.T.S.



ROOF SLAB PLAN

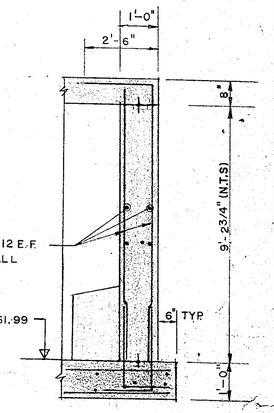
SCALE 1/2" = 1'-0"

SEE SECTION B-B FOR OTHER REINF.



SECTION B-B

SCALE 1/2" = 1'-0"



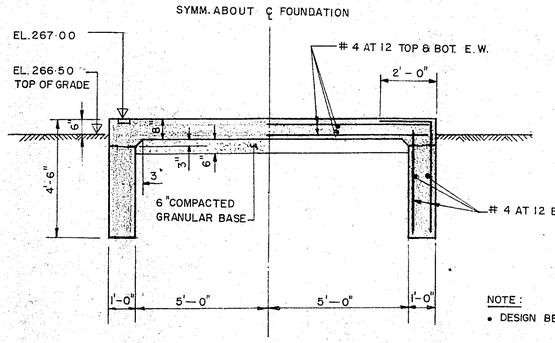
SECTION C-C

SCALE 1/2" = 1'-0"

TYP. FOR ALL WALLS UNLESS NOTED

NOTES:

- DESIGN WATERTABLE EL. 270.00.
- DESIGN BEARING PRESSURE 2 K.S.F
- FOR SLIDING GATE ANCHOR LOCATIONS SEE MECH. DWG.



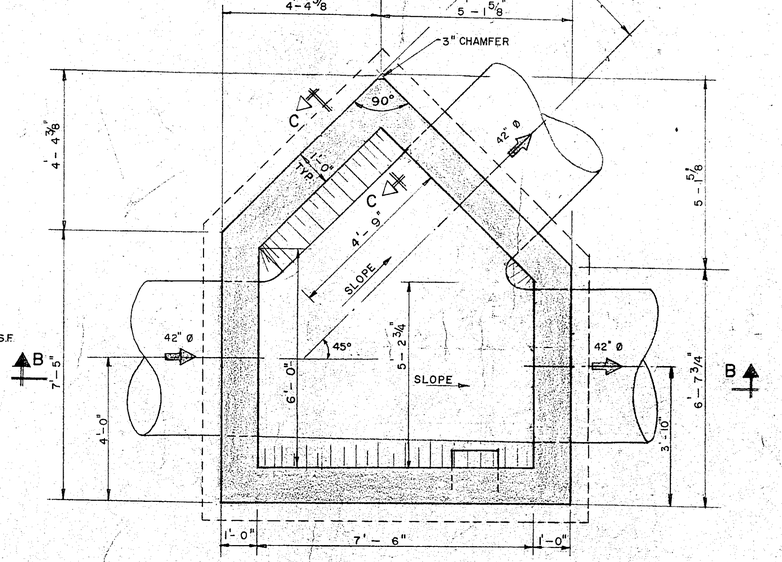
NOTE:

- DESIGN BEARING PRESSURE 2 K.S.F

SECTION A-A

SCALE 3/8" = 1'-0"

FOUNDATION DETAILS FOR CHEMICAL STORAGE TANK



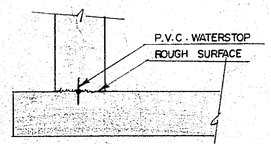
BASE SLAB PLAN

SCALE 1/2" = 1'-0"

MANHOLE Nº 1

GENERAL NOTES

- THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS Nº S2 TO S5. ALL DIMENSIONS, ELEVATIONS, OPENINGS FOR PIPES, SLEEVES, EQUIPMENT LOCATIONS AND THE LIKE SHALL BE CHECKED WITH THE ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.
- ALL EXTERIOR FOOTINGS FOR BUILDINGS TO HAVE 4'-0" (MIN.) FROST PROTECTION.
- REPORT THE WATERTABLE DURING CONSTRUCTION.
- SET ALL ANCHORS, INSERTS, ETC., AS REQUIRED BY OTHER TRADES.
- PROVIDE 2 - #5 E.F. AROUND OPENINGS IN REINF. CONC. WALLS, SLABS ETC., UNLESS NOTED OTHERWISE.
- STRENGTH OF CONCRETE SHALL BE NOT LESS THAN 4000 P.S.I. AT 28 DAYS EXCEPT BENCHING AND MASONRY FILL CONCRETE WHICH SHALL BE 3000 P.S.I. CARE TO BE TAKEN IN PLACING CONCRETE TO ACHIEVE WATERTIGHT CONCRETE STRUCTURE. PROVIDE WATERSTOP IN ALL CONSTRUCTION JOINTS.
- CONCRETE PROTECTION FOR REINFORCEMENT – REFER TO N.B.C. & A.C.I. 318 IN GENERAL
  - SURFACES NOT EXPOSED TO WEATHER, WATER AND GROUND
    SLABS AND WALLS 3/4"
    BEAMS AND COLUMNS 1 1/2".
  - SURFACES EXPOSED TO WEATHER, WATER AND SOIL
    SLABS & WALLS 2".
  - SURFACES OF CONCRETE DEPOSITED AGAINST THE GROUND AND FOOTINGS 3".
- STEEL MEMBERS SHALL CONFORM TO C.S.A. G40-21 GRADE 44W & C.S.A.-S16.
- WELDING SHALL CONFORM TO C.S.A.-S16 & W59.
- EXPOSED MEMBERS SHALL BE GALVANIZED AND PROVIDE GALVANIZED TOUCH UP.
- REFER TO MECHANICAL DRAWINGS FOR BENCHING, GRATINGS, AND SUPPORT DETAILS, RAILINGS, MISCELLANEOUS IRON AND ALUMINUM DETAILS & SERVICES.
- CAULK ALL JOINTS AND MAKE WATERTIGHT JOINTS BETWEEN PIPES, SLEEVES, AND WALLS, ETC.
- FOR TYPICAL WALL REINFORCEMENT & CONSTRUCTION JOINT DETAILS SEE DWG. Nº. S1.



TYPICAL CONSTRUCTION JOINT DETAIL

N. T. S.

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. C. EBERLEE PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER CIVIL T. V. MOSUR PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
2	MAR. 77	P.E.G	AS CONSTRUCTED.
1	2/19/76	V.T.	REVISE LOCATION & NUMBER OF OPENINGS

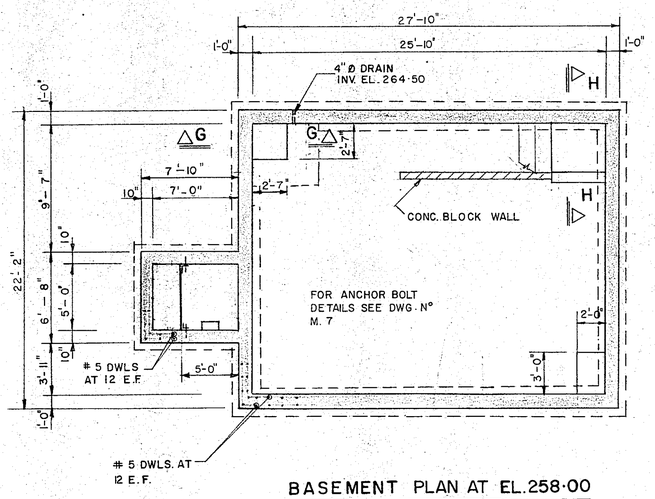
DESIGN	T.V.M.
DRAWN	R.A.S.
CHECKED	D.B.
APPROVED	P.C.E.
SCALE	AS NOTED

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION

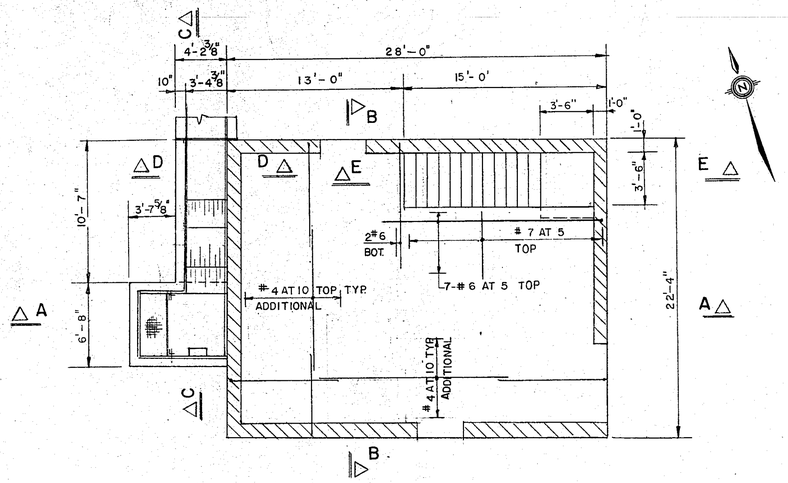
STRUCTURAL - CHEMICAL STORAGE TANK FOUNDATION AND MANHOLE Nº 1 PLANS & SECTIONS.

DATE APR., 1975
PROJECT 52-1895-01
DRAWING S1



BASEMENT PLAN AT EL. 258·00

SCALE 3/16 = 1'-0"

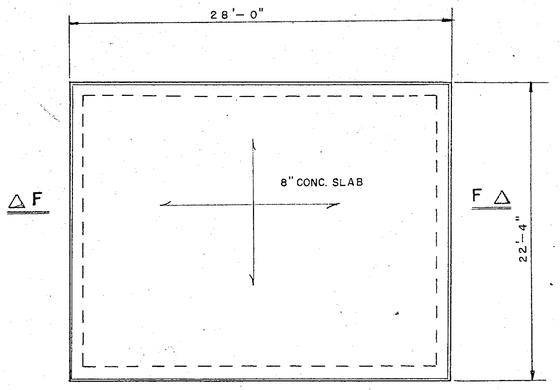


PLAN AT EL. 267·50

SCALE 3/16 = 1'-0"

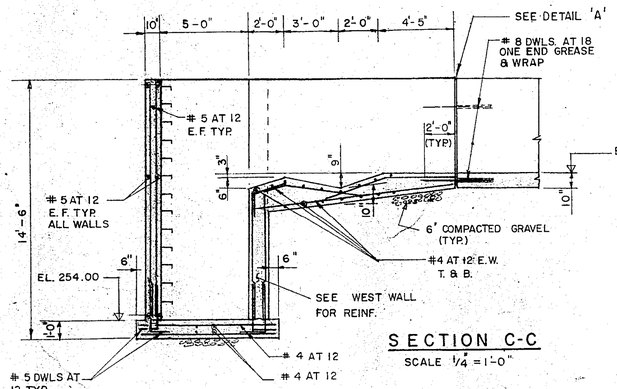
NOTE

FOR LINTEL DETAILS
SEE SPECIFICATION.



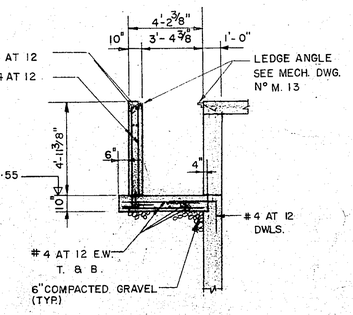
ROOF PLAN AT EL. 277·00

SCALE 3/16 = 1'-0"



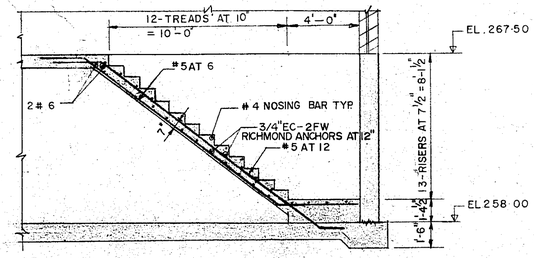
SECTION C-C

SCALE 1/4 = 1'-0"



SECTION D-D

SCALE 1/4 = 1'-0"

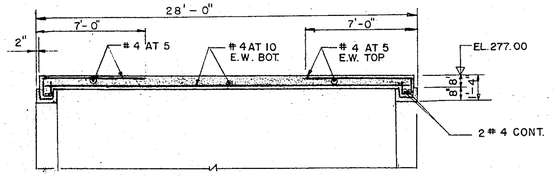


SECTION E-E

SCALE 1/4" = 1'-0"

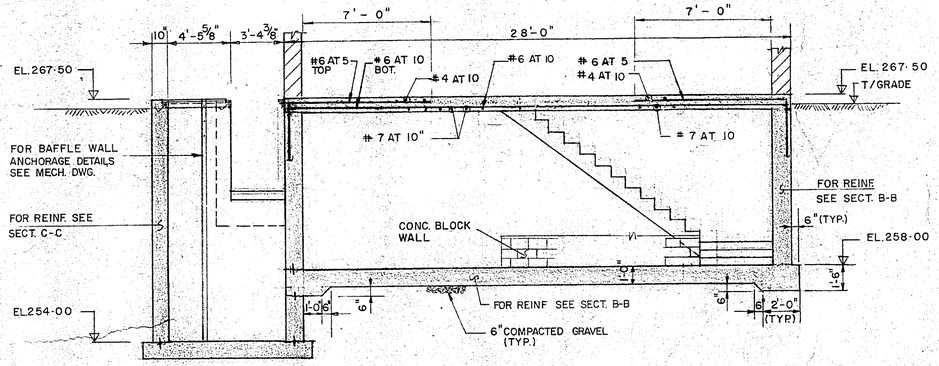
NOTE

- FOR LEDGE ANGLE & ANCHOR DETAILS SEE MECH. DWG.



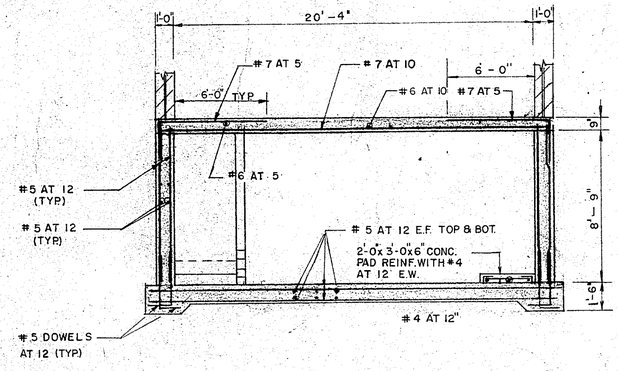
SECTION F-F

SCALE 3/16 = 1'-0"



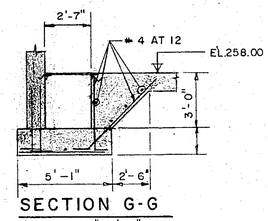
SECTION A-A

SCALE 1/4" = 1'-0"



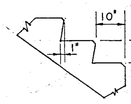
SECTION B-B

SCALE 1/4 = 1'-0"



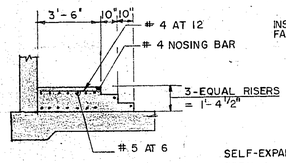
SECTION G-G

SCALE 1/4" = 1'-0"



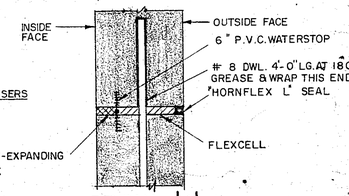
STAIR DETAIL

N.T.S.



SECTION H-H

SCALE 1/4"=1'-0"



DETAIL 'A'

N.T.S.

NOTE

- FOR TYPICAL CORNER & CONSTRUCTION JOINT DETAILS SEE DWG Nº. S1
- DESIGN BEARING PRESSURE 4 K.S.F.
- DESIGN WATERTABLE EL. 264.00

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

P. C. LESSLEE — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

R. V. MOSURE — REGISTERED PROFESSIONAL ENGINEER — CIVIL — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.77	P.E.G.	AS CONSTRUCTED

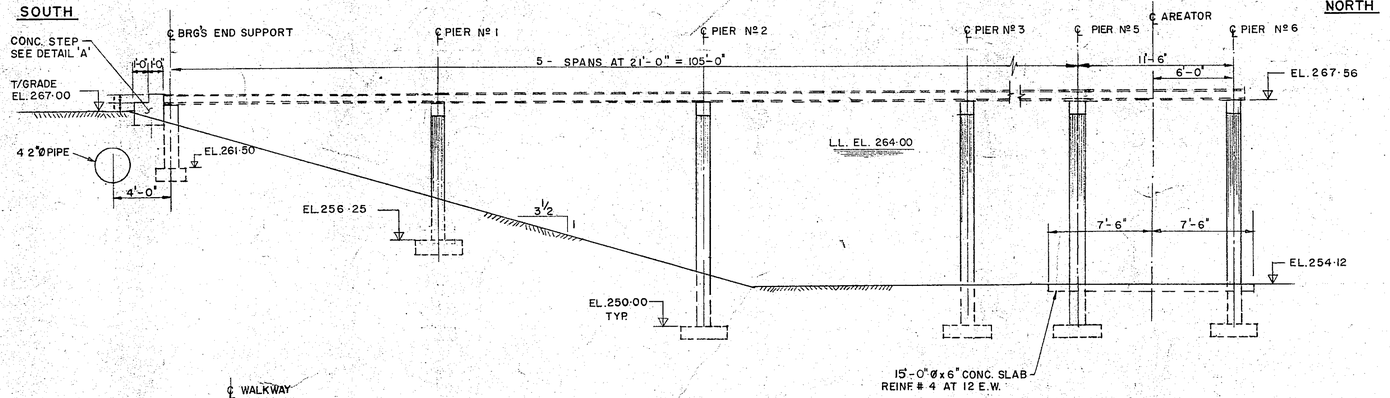
DESIGN	T.V.M.
DRAWN	R.A.S.
CHECKED	D.B.
APPROVED	P. C. E.
SCALE	AS NOTED

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
STRUCTURAL - CONTROL BUILDING - PLANS, SECTIONS & DETAIL.

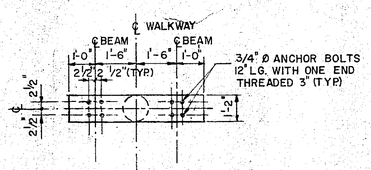
DATE APR., 1975
PROJECT 52-1895-01
DRAWING S2

Dataset Blueprint

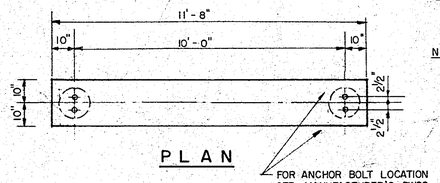


ELEVATION OF WALKWAY

SCALE 3/16"=1'-0"



PLAN

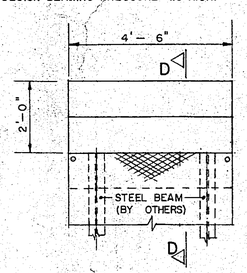


PLAN

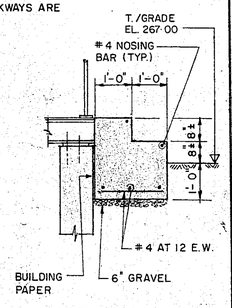
FOR ANCHOR BOLT LOCATION SEE MANUFACTURER'S DWGS.

NOTE

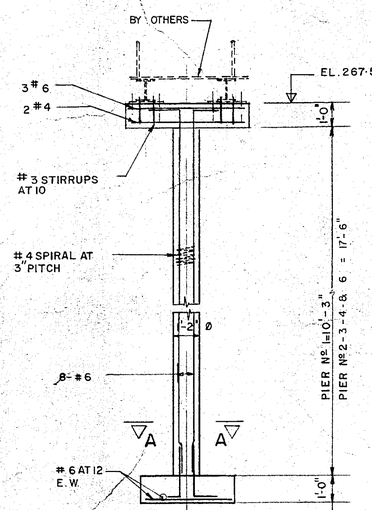
- FOR LOCATION OF WALKWAYS SEE MECH. DWG. Nº M2. Nº OF WALKWAYS REQUIRED 2 (BOTH WALKWAYS ARE SIMILAR).
- DESIGN BEARING PRESSURE 4.0 K.S.F



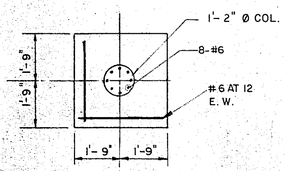
PLAN



SECTION D-D



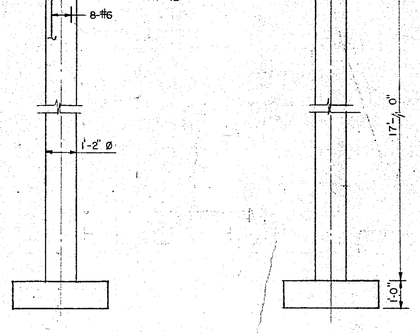
ELEVATION



SECTION A-A

PIERS Nº 1-2-3-4 & 6

SCALE 3/8"=1'-0"

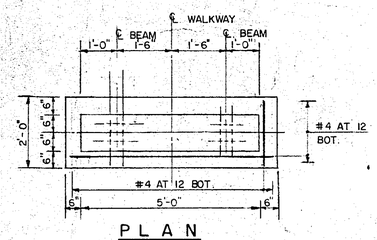


ELEVATION

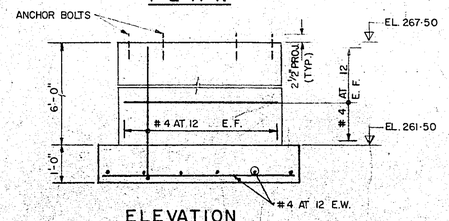
PIER Nº 5

SCALE 3/8" = 1'-0"

FOR COLUMNS & FOOTINGS REINF. SEE PIERS Nº 1-2-3-4 & 6.



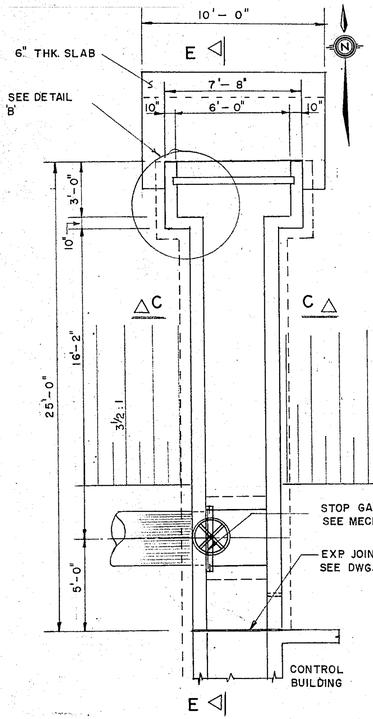
PLAN



ELEVATION

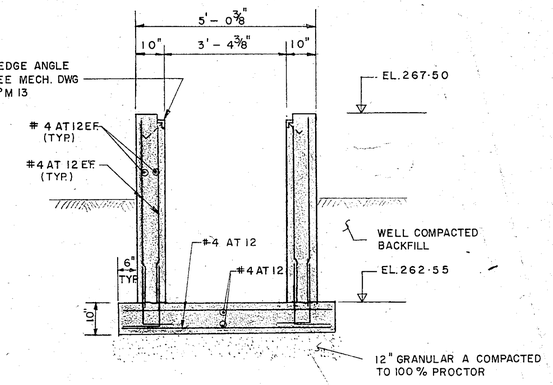
END SUPPORT DETAIL

SCALE 1/2"=1'-0"



PLAN

SCALE 1/4 = 1-0

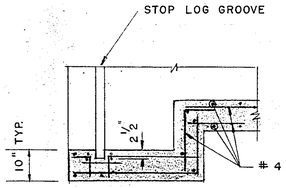


SECTION C-C

SCALE 1/2" = 1'-0"

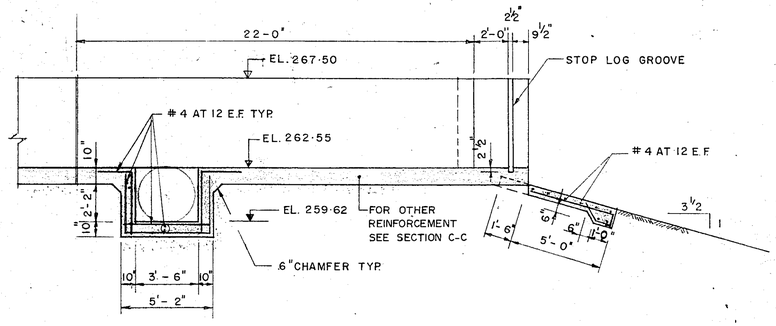
NOTE:

- DESIGN BEARING PRESSURE 4.0 K.S.F



DETAIL 'B'

SCALE 3/8=1'-0"



SECTION E-E

SCALE 1/4"=1'-0"

OUTLET CHAMBER DETAILS

totten sims hubicki associates limited

CONSULTANTS

COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. C. EDERLEE PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER CIVIL T. V. MOSUR PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MAR.7.7	P.E.G.	AS CONSTRUCTED

DESIGN	T. V. M.
DRAWN	R. A. S.
CHECKED	D. B.
APPROVED	P. C. E.
SCALE	AS NOTED

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

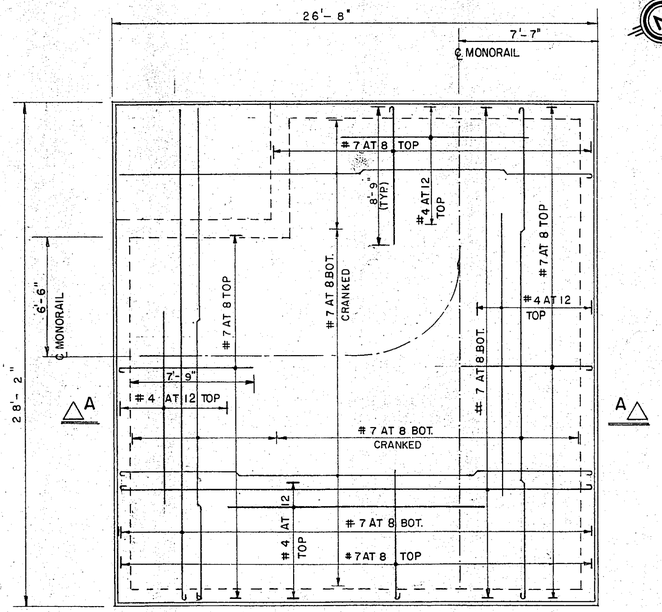
WATER POLLUTION CONTROL CENTRE EXTENSION

STRUCTURAL - WALKWAYS - OUTLET CHAMBER - PLANS, ELEVATIONS, SECTIONS & DETAILS.

DATE APR., 1975

PROJECT 52-1895-01

DRAWING S3



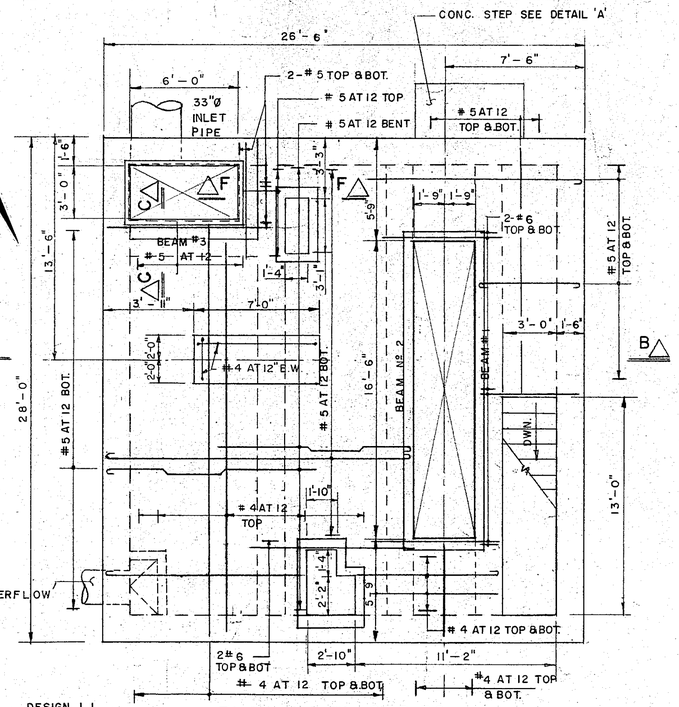
ROOF PLAN

ROOF DESIGN LOAD

DESIGN ROOF SNOW LOAD IN ACCORDANCE WITH N.B.C & SUPPLIMENTS (LATEST REVISIONS) NORMAL	39 P.S.F.
ROOF & SERVICES	20 P.S.F.
MONORAIL	2 TONS.

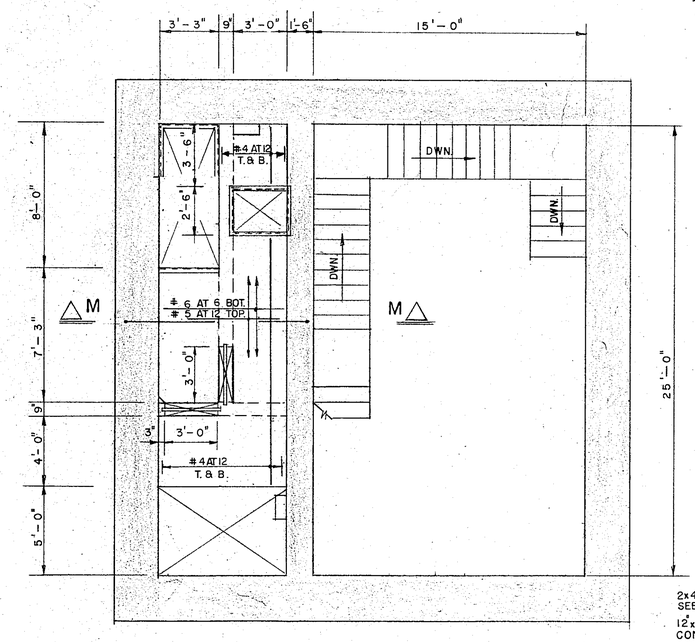
NOTE

- FOR LINTEL SEE SPECIFICATIONS.
- THIS DWG. TO BE READ IN CONJUNCTION WITH DWG. S5



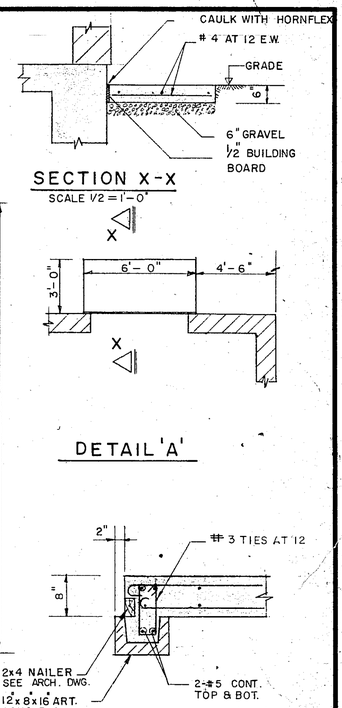
DESIGN L.L.
GENERATOR ROOM 250 P.S.F.
OTHERS 100 P.S.F.

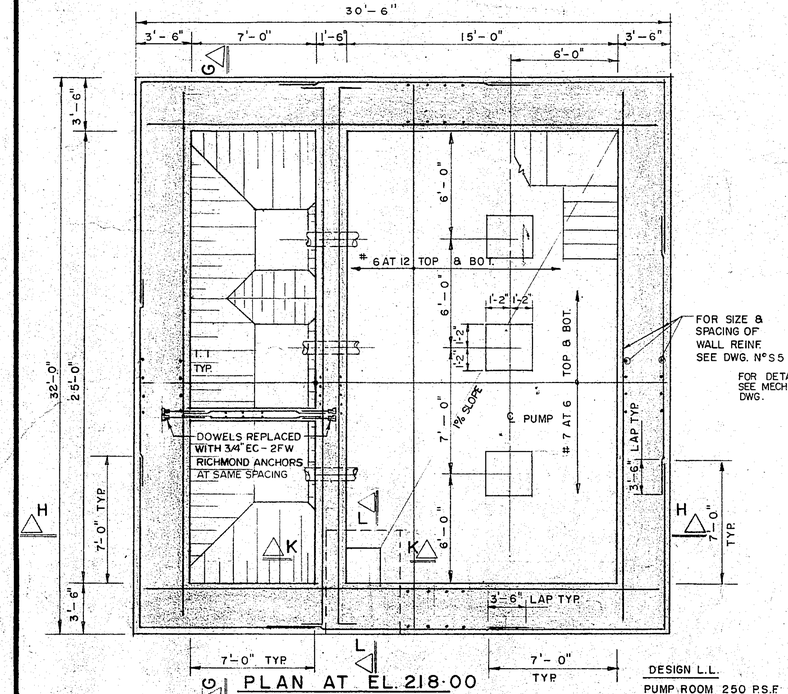
PLAN AT EL. 256·50



DESIGN L.L.
STAIRS 100 P.S.F.

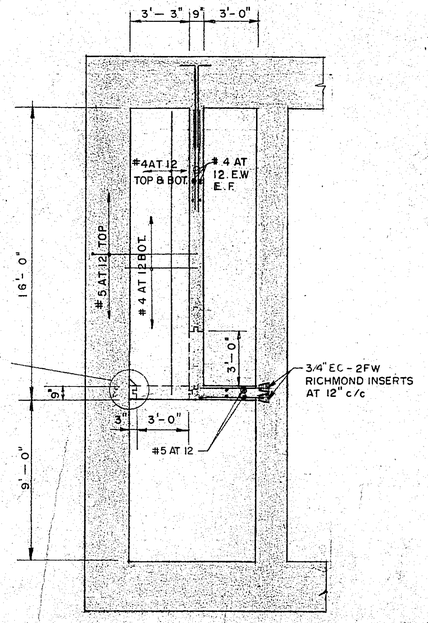
PLAN AT EL. 231·90



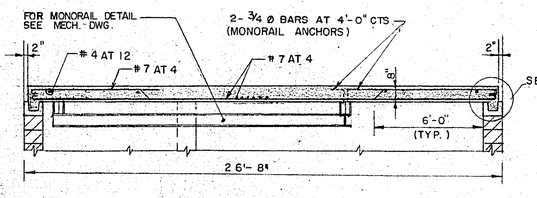


PLAN AT EL. 218·00

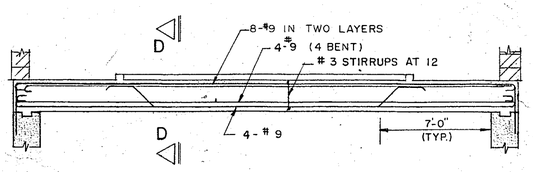
DESIGN L.L.
PUMP ROOM 250 P.S.F.
OTHERS 100 P.S.F.



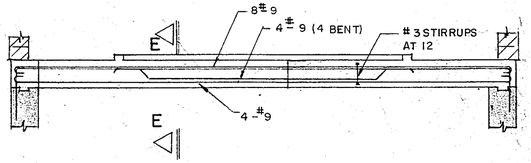
PART PLAN AT EL. 228·40



SECTION A-A



BEAM # 2



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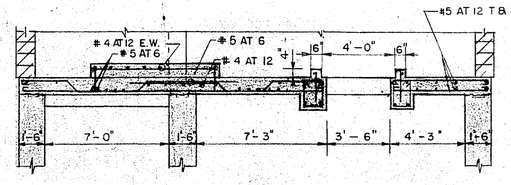
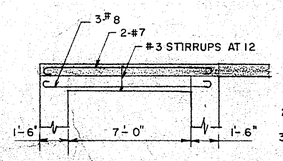


SECTION B-B



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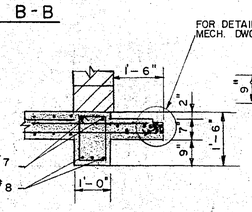
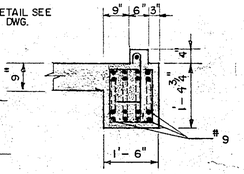


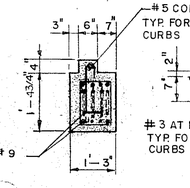
SECTION C-C

SCALE ½" = 1'-0"



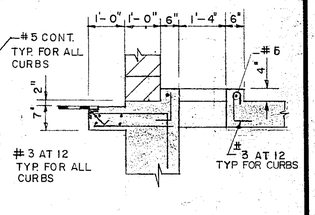
SECTION D-D

SCALE ½" = 1'-0"



SECTION E-E

SCALE 1½" = 1'-0"



SECTION F-F

SCALE ½" = 1'-0"

totten sims hubicki associates limited
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER — P. C. EBERLEE — PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER — CIVIL — T. V. MOSUR — PROVINCE OF ONTARIO

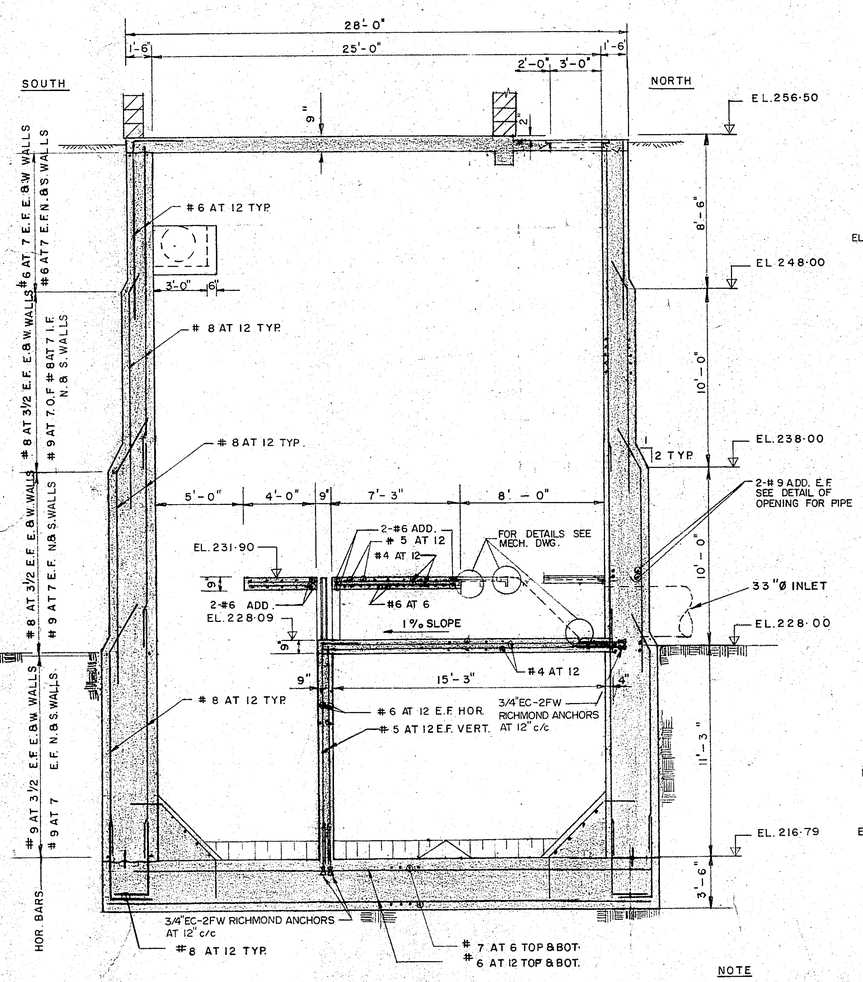
No.	DATE	BY	REVISIONS
1	MARCH 77	P.C.G.	AS CONSTRUCTED

DESIGN	T. V. M.
DRAWN	R. A. S.
CHECKED	D. B.
APPROVED	P. C. E.
SCALE	1/4" = 1'-0" UNLESS NOTED

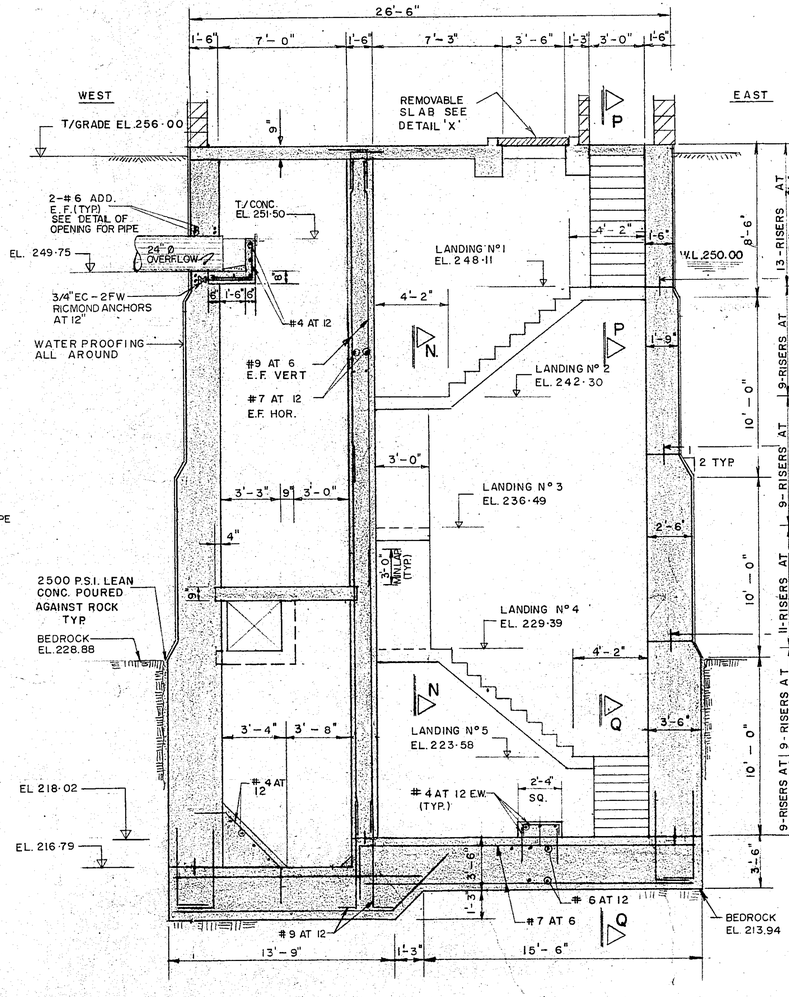
MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-C320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION
STRUCTURAL - PUMP HOUSE - PLANS SECTIONS & DETAILS

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING S4



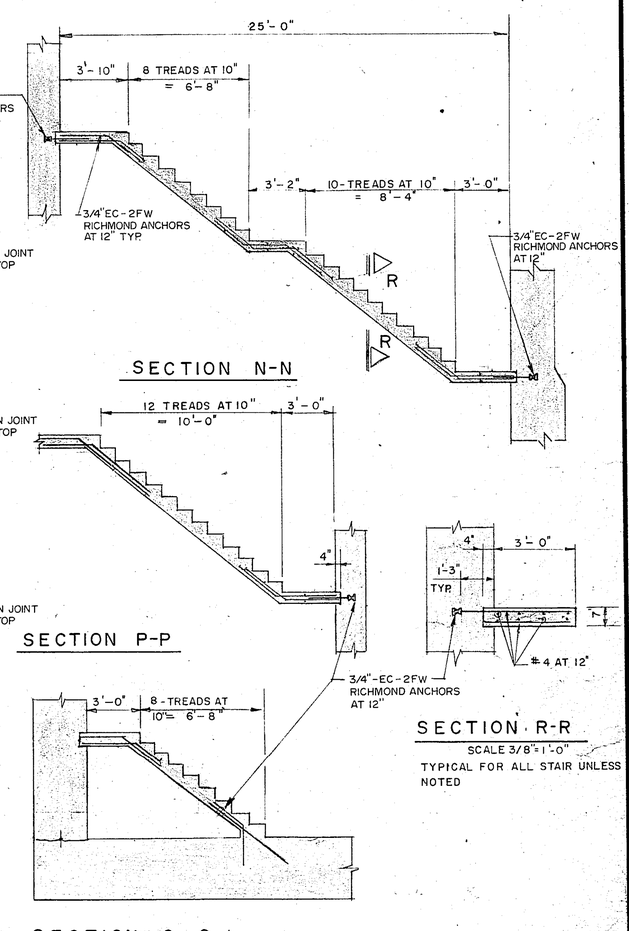
SECTION G-G



SECTION H-H

NOTE

- FOR LOCATION & DETAILS OF LADDERS, LEDGE ANGLES, PIPE SUPPORT, AND OTHER ANCHORS SEE MECH. DWG.
- CARE SHALL BE TAKEN TO POUR THE WALL AGAINST ROCK
- THIS DWG. TO BE READ IN CONJUNCTION WITH DWG. S4



SECTION N-N

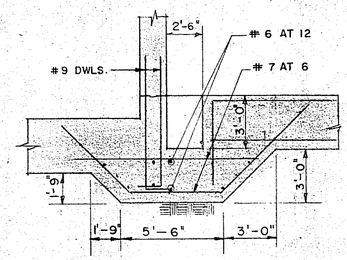
SECTION P-P

SECTION R-R

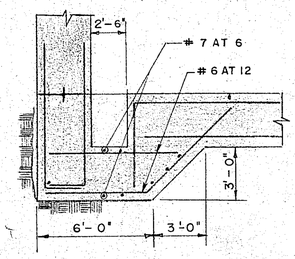
SCALE 3/8"=1'-0"

TYPICAL FOR ALL STAIR UNLESS NOTED

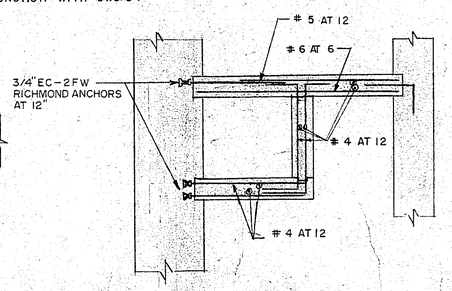
SECTION Q-Q



SECTION K-K

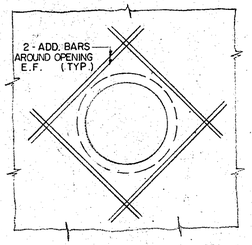


SECTION L-L



SECTION M-M

SCALE 3/8=1'-0"

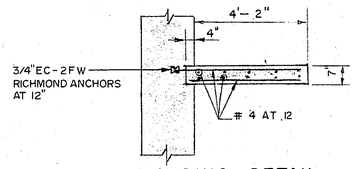


OPENING FOR PIPE

N. T. S.

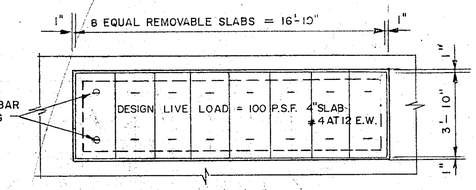
NOTE.

THIS DETAIL TYPICAL FOR ALL OPENINGS IN PUMP HOUSE.

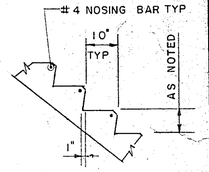


LANDING DETAIL

TYPICAL FOR ALL LANDING UNLESS NOTED



DETAIL 'X'



STAIR DETAIL

N.T.S.

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CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA BELLEVILLE

REGISTERED PROFESSIONAL ENGINEER P. C. EBERLEE PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER CIVIL T. V. MOSUR PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	MARCH 77	P.C.G.	AS CONSTRUCTED

DESIGN	T. V. M.
DRAWN	R. A. S.
CHECKED	D. B.
APPROVED	P. C. E.
SCALE	1/4"= 1'-0" UNLESS NOTED

MINISTRY OF THE ENVIRONMENT

PROJECT Nº 2-0320-74 (CONTRACT 2)

VILLAGE OF BRIGHTON

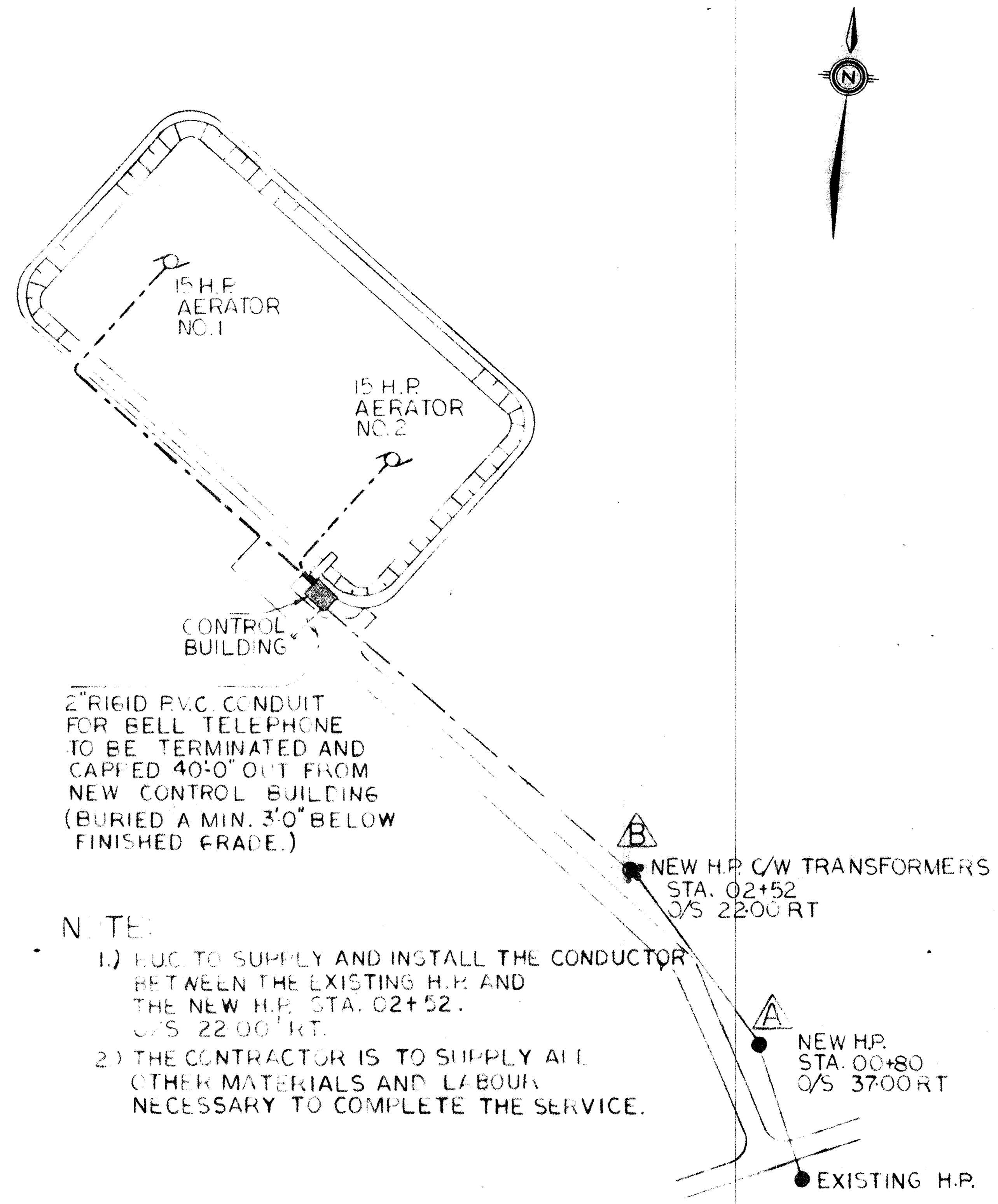
HARBOUR STREET PUMPING STATION

STRUCTURAL - PUMP HOUSE - SECTIONS & DETAILS

DATE APRIL 1975

PROJECT 52-1895-01

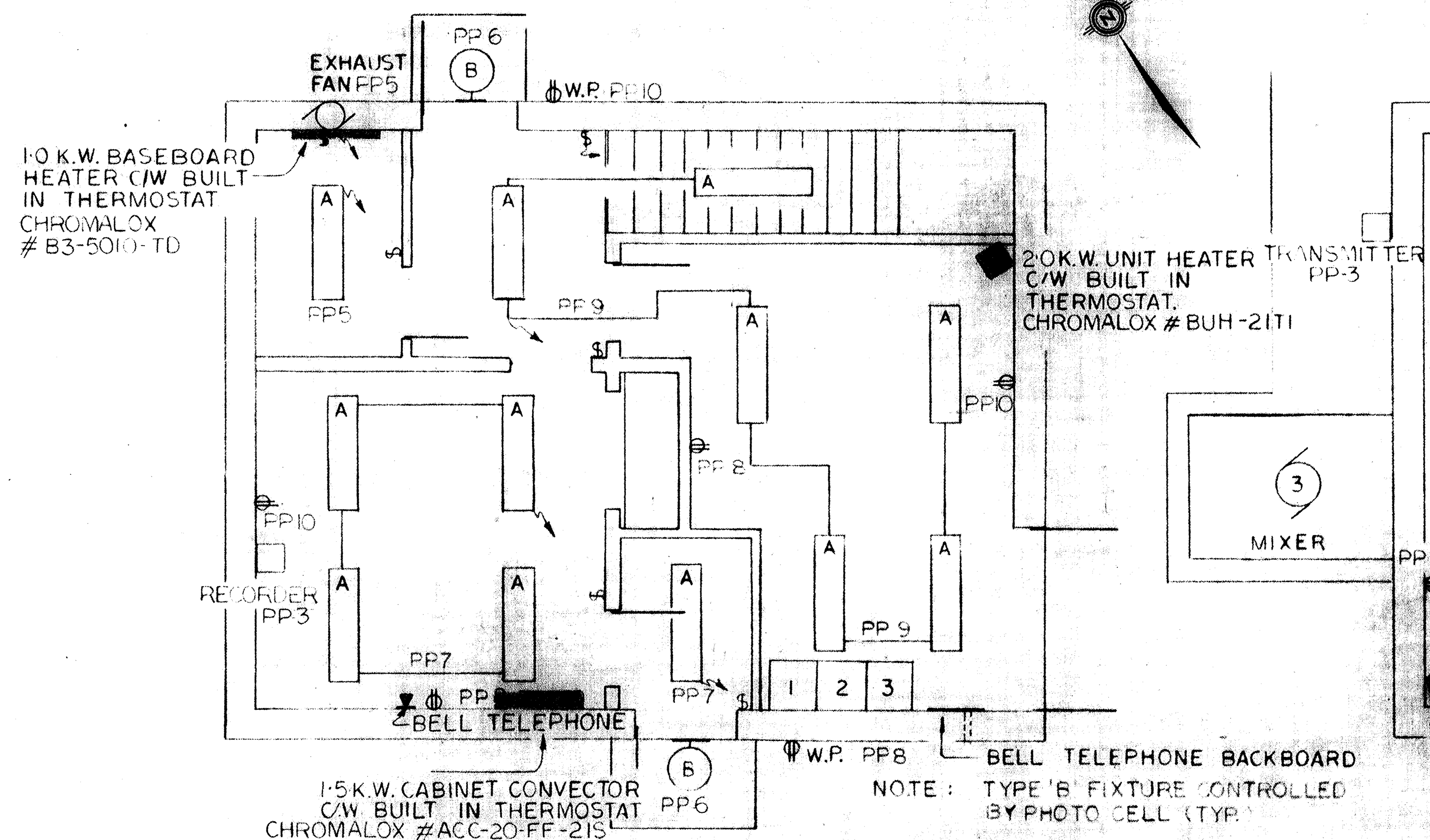
DRAWING S5



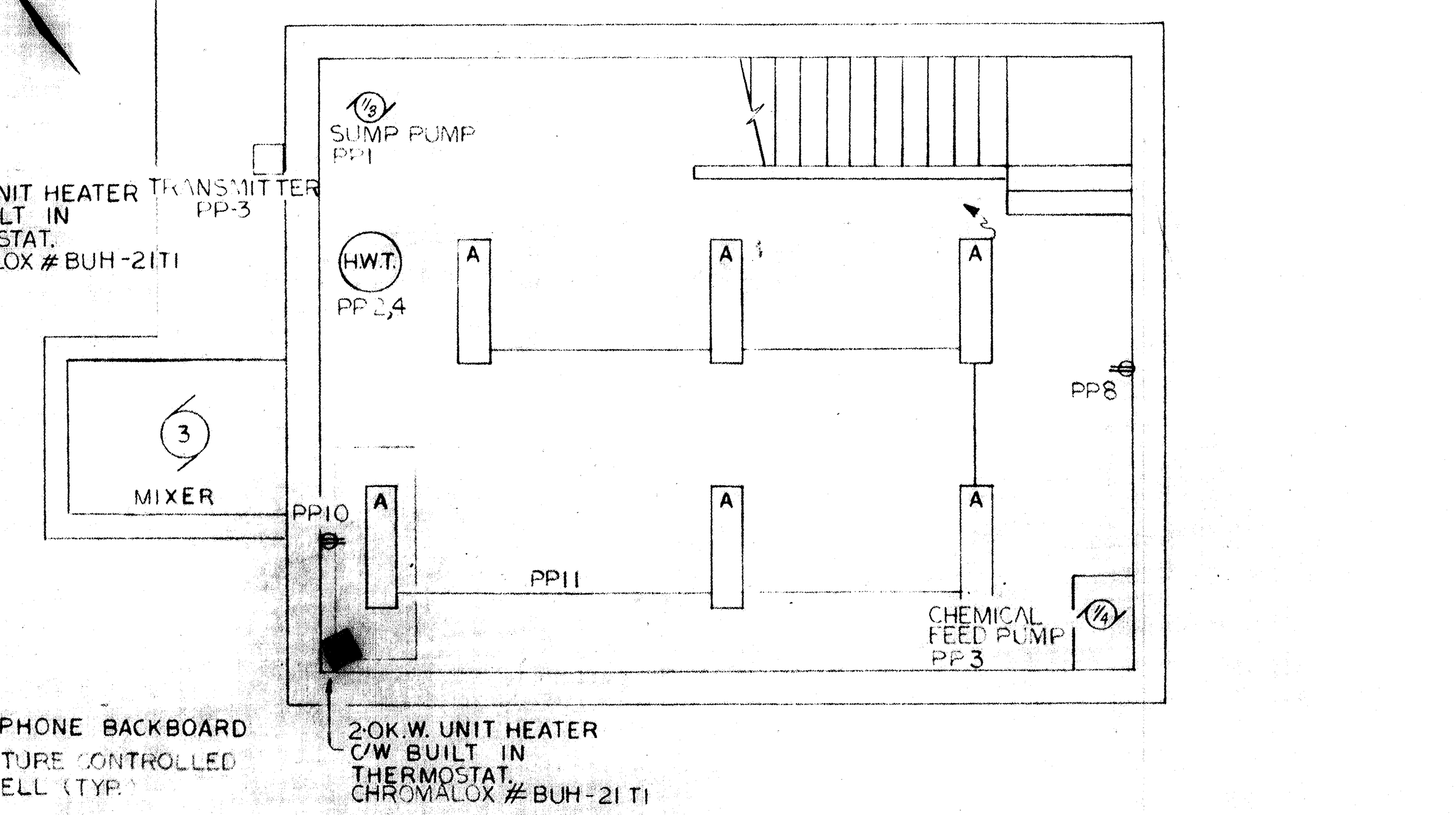
2" RIGID P.V.C. CONDUIT FOR BELL TELEPHONE TO BE TERMINATED AND CAPPED 40'-0" OUT FROM NEW CONTROL BUILDING (BURIED A MIN. 3'0" BELOW FINISHED GRADE.)

NOTES:
1.) P.U.C. TO SUPPLY AND INSTALL THE CONDUCTOR BETWEEN THE EXISTING H.P. AND THE NEW H.P. STA. 02+52, O/S 22.00 RT.
2.) THE CONTRACTOR IS TO SUPPLY ALL OTHER MATERIALS AND LABOUR NECESSARY TO COMPLETE THE SERVICE.

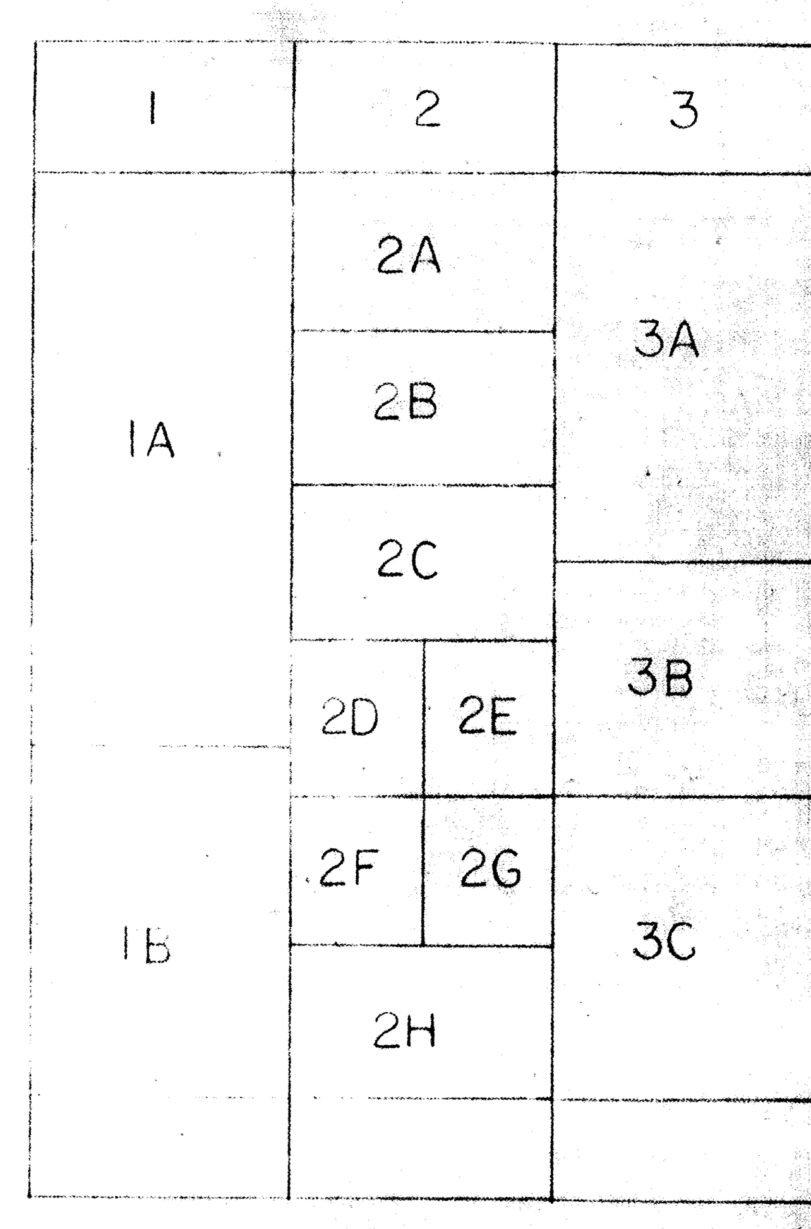
SITE PLAN SCALE 1" = 100'-0"



GROUND FLOOR SCALE 1/4" = 1'-0"



BASEMENT FLOOR SCALE 1/4" = 1'-0"



MOTOR CONTROL CENTRE LAYOUT N.T.S.

SCHEDULE

1A - Hydro Metering - To be coordinated with local P.U.C.

1B - Main Breaker - 100A, 600V, 3 pole, 60 Hz. circuit breaker.

2A - Aerator No. 1 - Size 2 magnetic starter, 600V, 3Ø, 60 Hz. full voltage non-reversing C/W circuit breaker and 1Ø, 120V control transformer

2B - Aerator No. 2 - Size 2 magnetic starter, 600V, 3Ø, 60 Hz. full voltage non-reversing C/W circuit breaker and 1Ø, 120V control transformer

2C - Mixer - Size 2 magnetic starter, 600V, 3Ø, 60 Hz. full voltage non-reversing C/W circuit breaker and 1Ø, 120V, control transformer

2D - Electric Heating - 15A, 600V, 3 pole, 60 Hz. circuit breaker

2E - Electric Heating - 15A, 600V, 3 pole, 60 Hz. circuit breaker

2F - Space

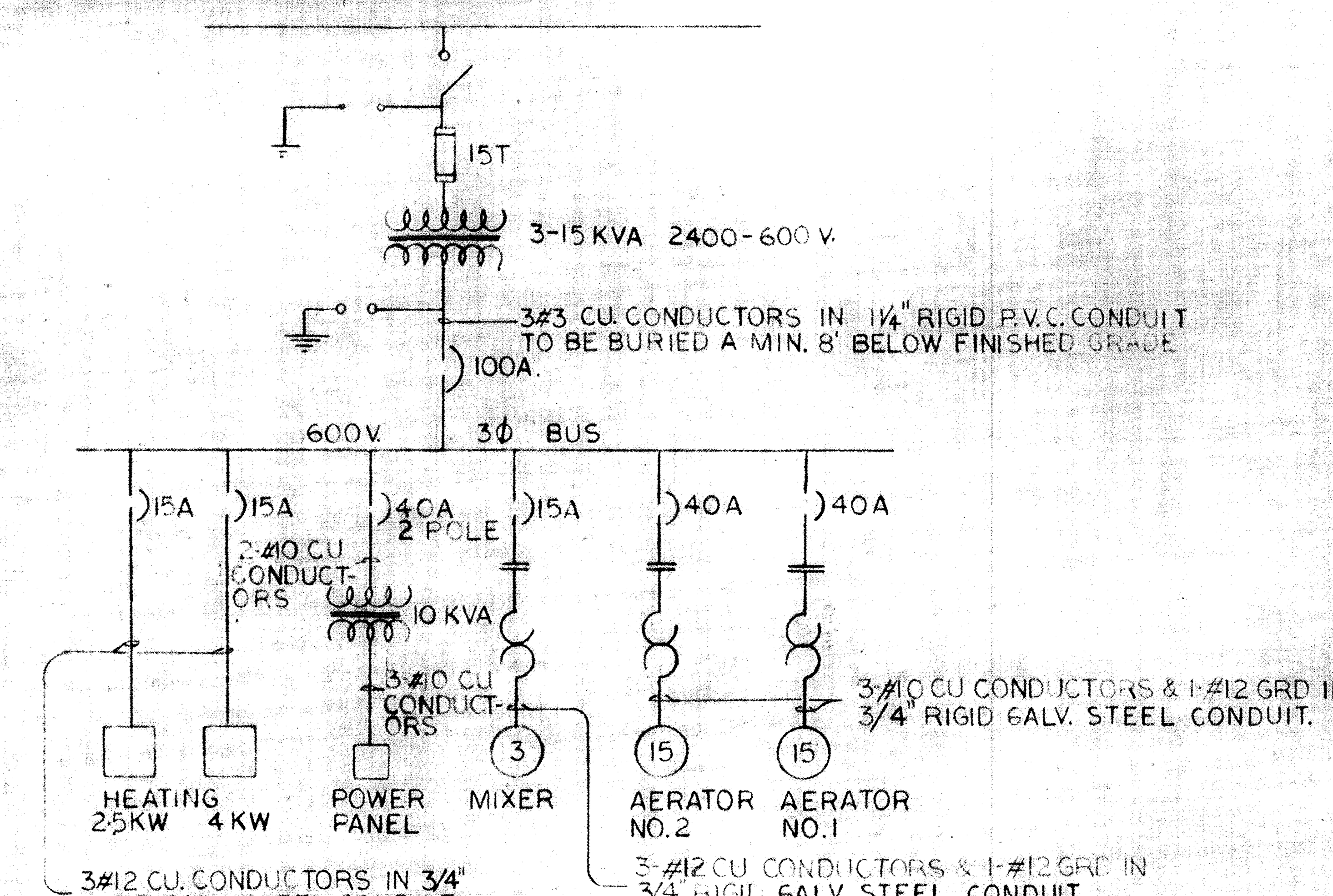
2G - Transformer Breaker - 40A, 600V, 2 pole, 60 Hz. circuit breaker

2H - Space

3A - Space

3B - Power Panel - 120/240V, 12 circuit power panel

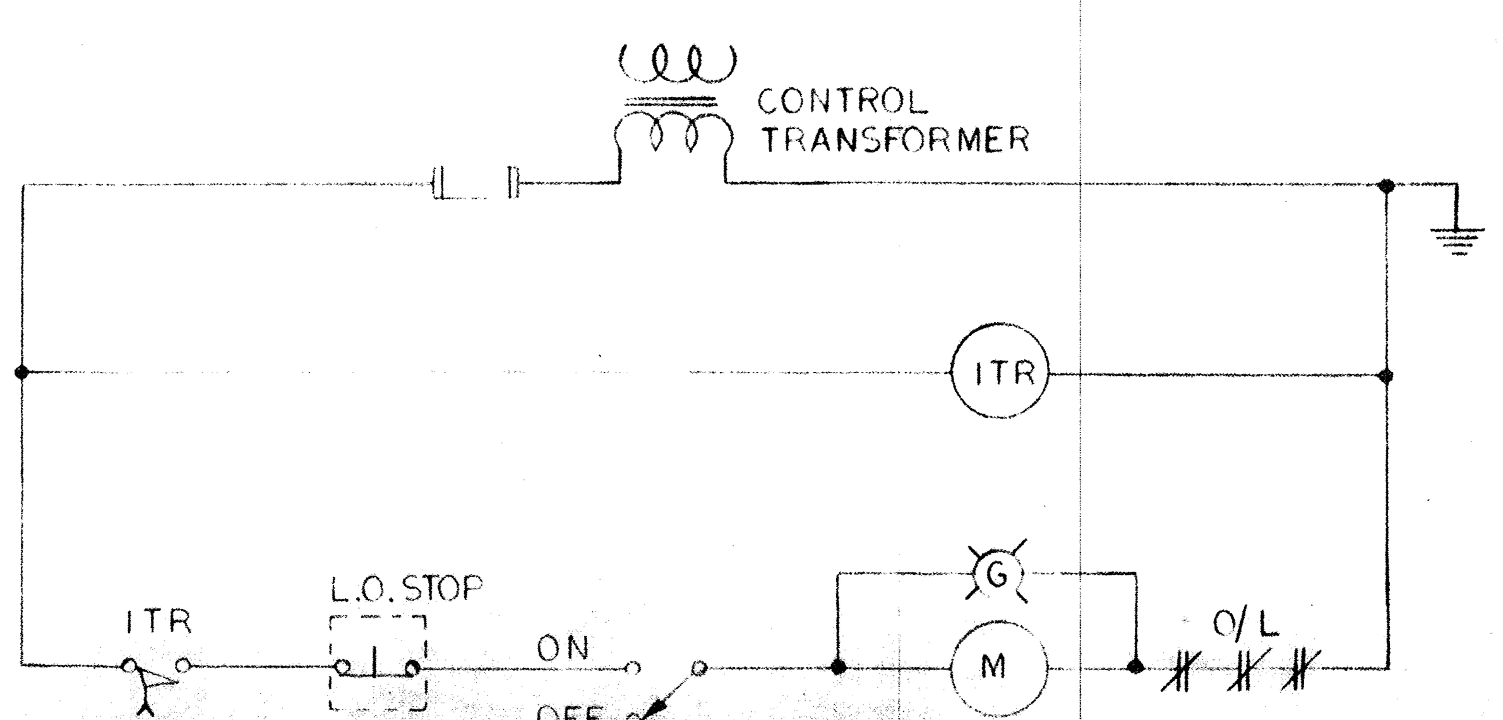
3C - Transformer - 10 K.V.A. transformer, C/W 600V, 1 phase primary and 120/240V. secondary.



SINGLE LINE DIAGRAM

LEGEND

- $ - 125V, 15A, 1 pole switch
- $ - 125V, 1 H.P., 1 pole manual starter
- Fusible/nonfusible disconnect switch, CEM 1 enclosure
- 125V, 15A, U-ground duplex receptacle
- W.P. - 125V, 15A, U-ground duplex weatherproof receptacle
- A - Lighting fixture Type "A" (Typical)
- 2 - Motor and horse power rating (Typical)

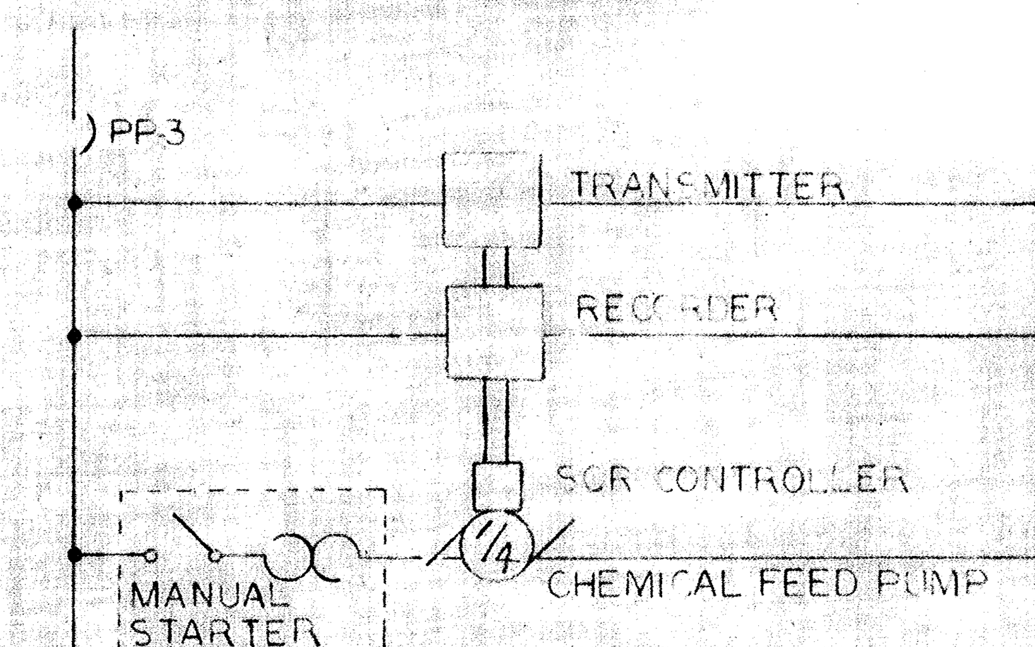


AERATOR CONTROL SCHEMATIC TYP.

120V. 240V 1Ø

KW	AREA	Breaker	Circuit	Circuit	Breaker	AREA	KW
0·8	SUMP PUMP 1/3 HP	15	1	2	20	HOT WATER HEATER	3.0
0·6	CHEMICAL FEED PUMP 1/4 HP	15	3	4			
[illegible]	WASHROOM LTG & EXHAUST FAN	15	5	6	15	EXTERIOR LTG & PHOTO CELL	0·4
0·5	OFFICE & ENTRANCE LTG	15	7	8	15	RECEPTACLES	0·4
[illegible]	OFFICE & STAIR LTG	15	9	10	15	RECEPTACLES	0·4
0·6	BASEMENT LTG	15	11	12	15	SPARE	0·4
3·7	TOTAL		100A MAINS			TOTAL	4·2

POWER PANEL LAYOUT



CHEMICAL FEED PUMP CONTROL SCHEMATIC

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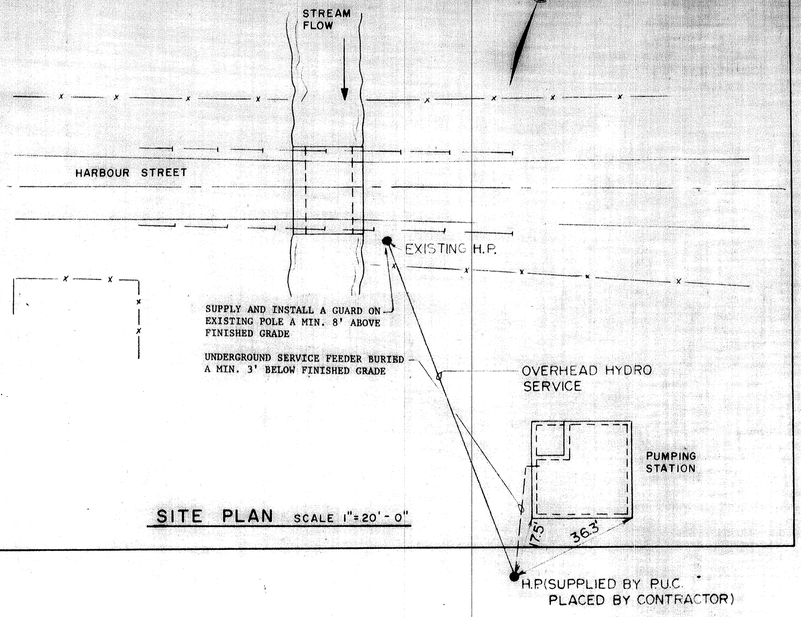
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA

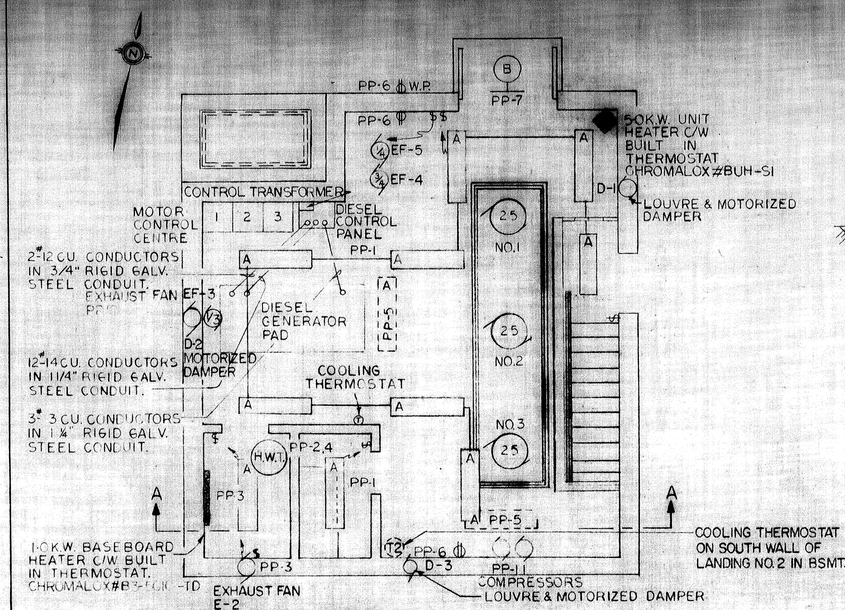
DESIGN	D.L.P.	
DRAWN	M.W.B.	
CHECKED	D.L.P.	
APPROVED		
SCALE	AS SHOWN	
	B.P.	AS CONSTRUCTED
No. DATE	BY	REVISIONS

MINISTRY OF THE ENVIRONMENT
PROJECT № 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
WATER POLLUTION CONTROL CENTRE EXTENSION
ELECTRICAL - W.P.C.C. LAYOUT

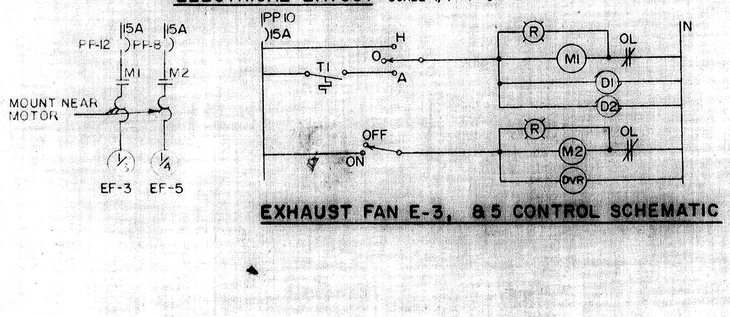
DATE APRIL 1975
PROJECT 52-1895-01
DRAWING E1



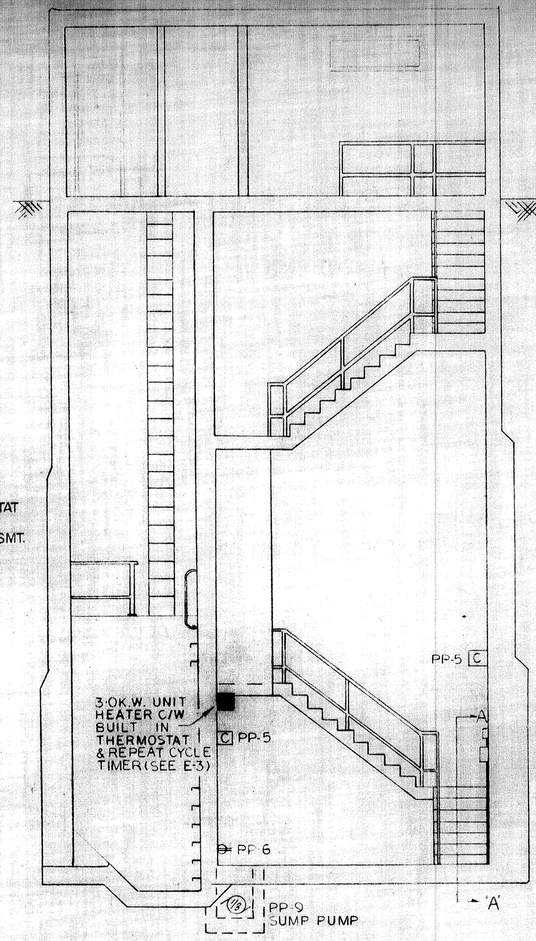
SITE PLAN SCALE 1"=20'-0"



ELECTRICAL LAYOUT SCALE 1/4"=1'-0"



EXHAUST FAN E-3, & 5 CONTROL SCHEMATIC



ELECTRICAL SECTION A-A SCALE 1/4"=1'-0"

LEGEND

- $ – 125V, 15A, 1 pole switch
- $ – 125V, 1 H.P. 1 pole manual starter.
- □ – Fusible/nonfusible disconnect switch, CEM 1 enclosure.
- ⊖ – 125V, 15A, U-ground duplex receptacle
- W.P.⊖ – 125V, 15A, U-ground duplex weatherproof receptacle.
- [A] – Lighting fixture Type "A" (Typical).
- (2) – Motor and horse power rating (Typical).

SCHEDULE

1A – Hydro Metering – To be coordinated with local P.U.C.

1B – Main Breaker – 100A, 600V, 3 Pole, 60 Hz., circuit breaker.

2A – Power Panel – 120/240 V., 12 circuit power panel.

2B – Sewage Pump – Size 2, 600V., 3Ø, 60 Hz. Autotransformer reduced voltage starter. No. 1

2C – Sewage Pump – Size 2, 600V., 3Ø, 60 Hz. Autotransformer reduced voltage starter. No. 2

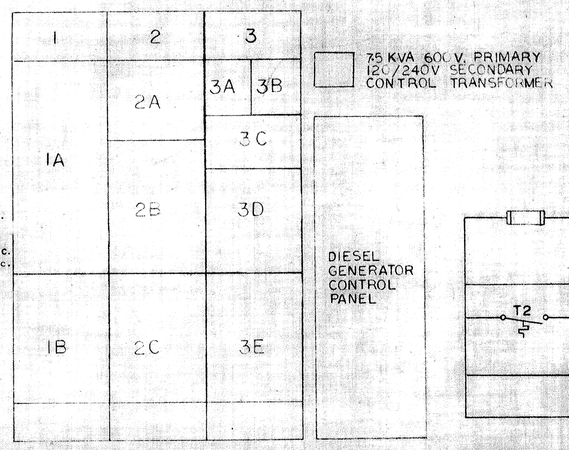
3A – Electric Heating – 15A., 600V., 3 Pole, 60 Hz. circuit breaker.

3B – Transformer Breaker – 40A., 600V., 2 Pole, 60 Hz. circuit breaker.

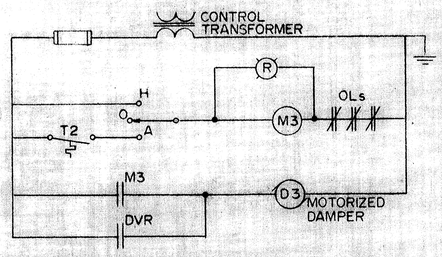
3C – EXHAUST FAN #4 (E-4) – SIZE 1, FVNR MAGNETIC STARTER c/w SELECTOR SWITCH, PILOT LIGHT, CONTROL TRANSFORMER AS SHOWN ON THE SCHEMATIC.

3D – Control Section – Relays, Pilot Lights, etc. as shown on schematic.

3E – Sewage Pump – Size 2, 600V., 3Ø, 60 Hz. Autotransformer reduced voltage starter. No. 3



MOTOR CONTROL CENTRE LAYOUT N.T.S.



EXHAUST FAN E-4 CONTROL SCHEMATIC

KW	AREA		AREA	KW
	120V. 240V. 1Ø			
0.8	GEN. ROOM AND STORAGE LTG.	15 1 / 2	20 2 – HOT WATER TANK	3.0
0.6	WASHROOM LTG.	15 3	4	
0.6	AND EXHAUST FAN, BELOW GRADE LTG.	15 5	15 6 – RECEPTACLES	0.4
0.2	EXTERIOR LTG. & PHOTO CELL	15 7	15 8 – EXHAUST FAN E-5	0.7
0.8	SUMP PUMP 1/3 H.P.	15 9	15 10 – EXH. FAN CONTROL	0.5
0.4	COMPRESSORS	15 11	15 12 – EXHAUST FAN E-3	0.9
	SPACE	13	14	
		15	16 – SPACE	
		17	18	
		19	20	
3.4	TOTAL	100 A. MAINS		TOTAL 5.5

PANEL LAYOUT

totten sims hubicki associates limited
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA

D.E. POLLARD PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

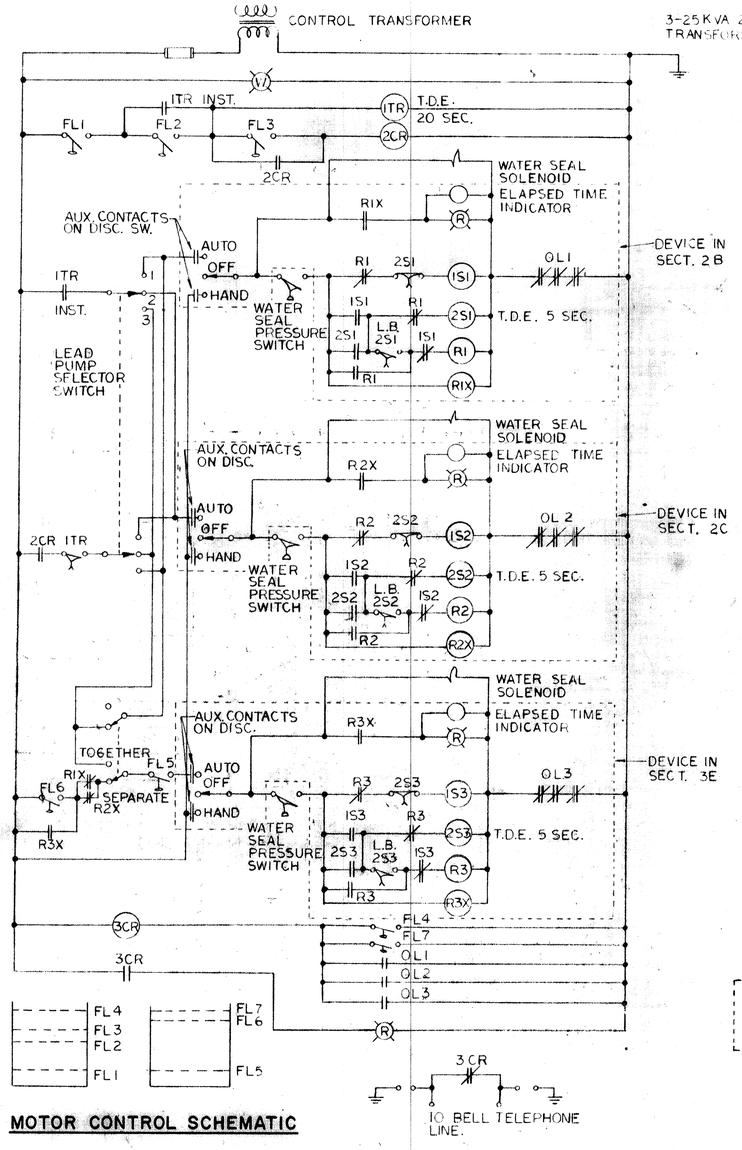
No.	DATE	BY	REVISIONS
1	MARCH 77	P.C.G.	AS CONSTRUCTED

DESIGN D.L.P.
DRAWN M.W.B.
CHECKED D.L.P.
APPROVED
SCALE AS SHOWN

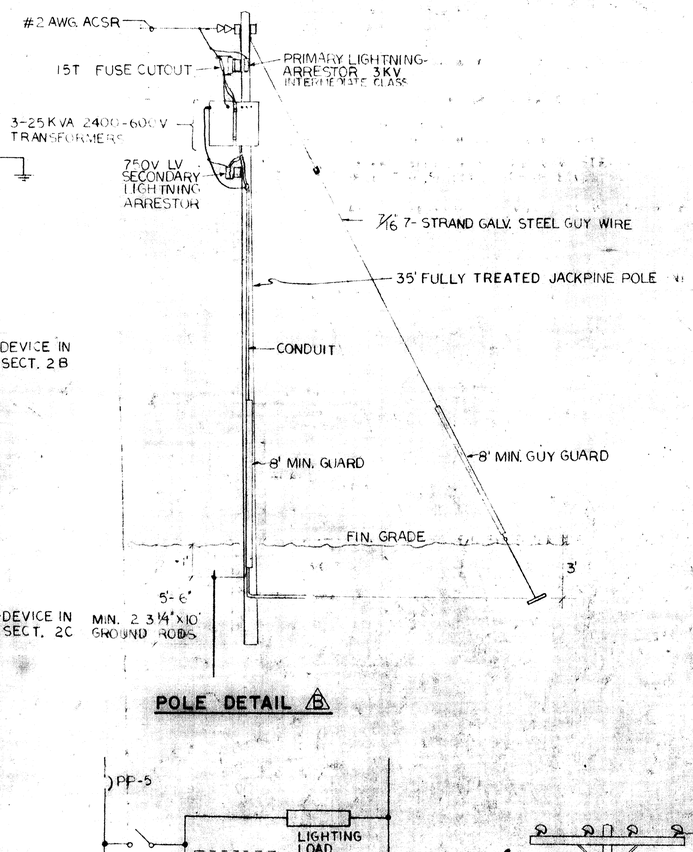
MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
HARBOUR STREET PUMPING STATION
ELEVATION - PUMP HOUSE - LAYOUT.

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING E2

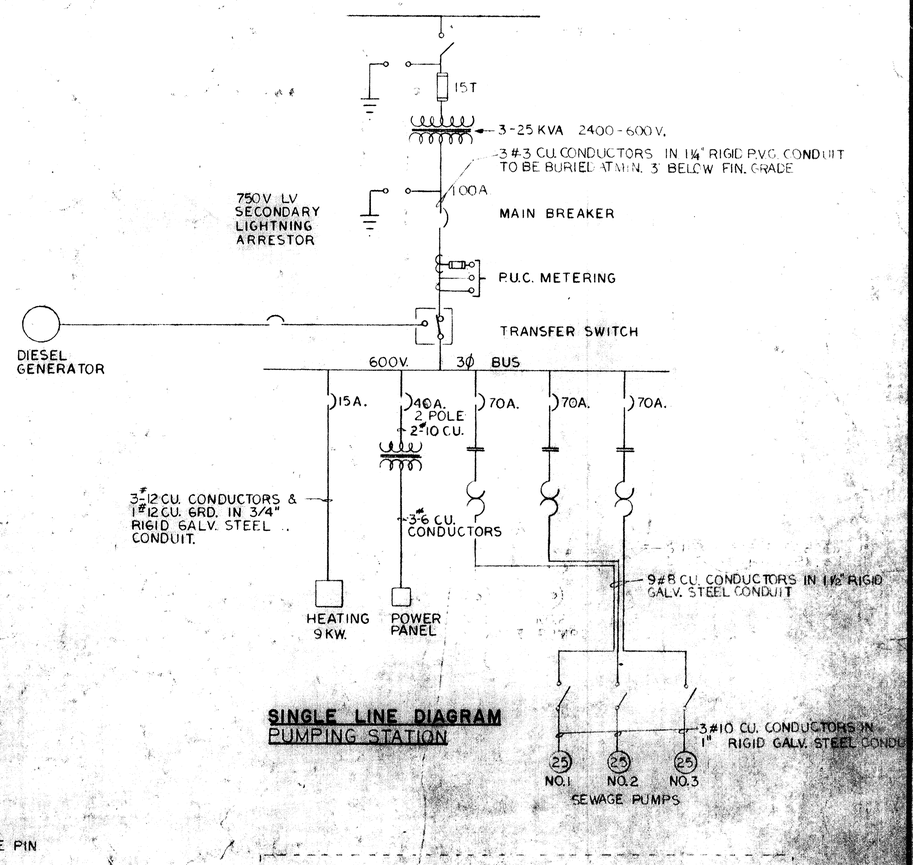
TRANSTEX 19 2M-1-79



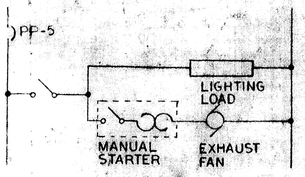
MOTOR CONTROL SCHEMATIC



POLE DETAIL (B)



SINGLE LINE DIAGRAM
PUMPING STATION



EXHAUST FAN CONTROL SCHEMATIC TYP

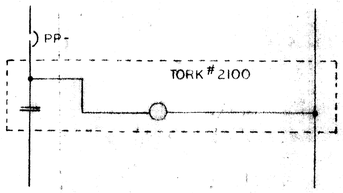
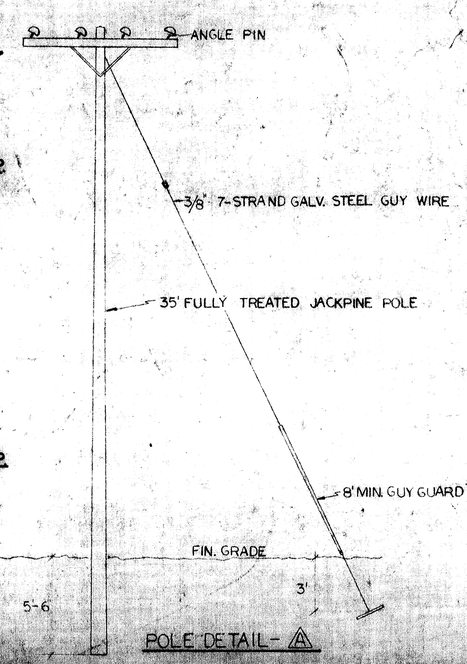
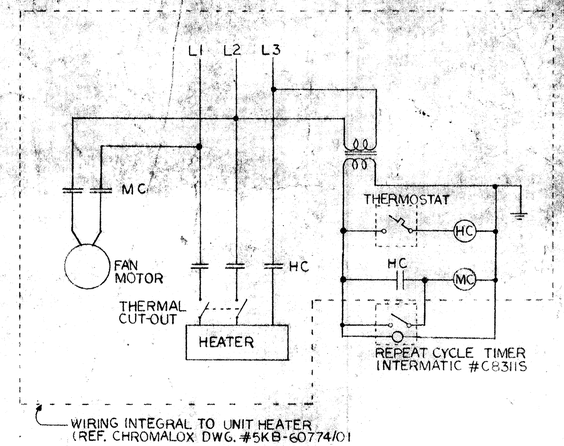


PHOTO CELL CONTROL SCHEMATIC TYP



POLE DETAIL- (A)



REVISED UNIT HEATER CONTROL SCHEMATIC

totten sims hubicki associates limited
CONSULTANTS
COBOURG WHITBY KINGSTON TORONTO MUSKOKA

P. C. FINLAYSON — PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO
D. L. POLAND — PROFESSIONAL ENGINEER

No.	DATE	BY	REVISIONS
1	MARCH 77	P.C.G.	AS CONSTRUCTED

DESIGN D.L.P.
DRAWN M.W.B.
CHECKED D.L.P.
APPROVED
SCALE AS SHOWN.

MINISTRY OF THE ENVIRONMENT
PROJECT Nº 2-0320-74 (CONTRACT 2)
VILLAGE OF BRIGHTON
W.P.C.C. EXTENSION AND HARBOUR ST. PUMPING STATION
ELECTRICAL - W.P.C.C. & PUMP HOUSE - DETAILS.

DATE APRIL 1975
PROJECT 52-1895-01
DRAWING E3

0 50 100 METERS

SLUDGE DRYING BEDS

AERATED LAGOON INLET VALVE CHAMBER

MH 197
INV – 80.79
INV – 80.81
MH 198
675ø GRAVITY SEWER
1067ø
1067ø GRAVITY SEWER
INV – 80.74
INV – 80.62
INV – 81.0
INV – 81.6
300ø FORCEMAIN
83.8
INV – 79.90
INV – 80.55
INV – 79.61
INV – 79.68
MH 200
914ø OUTLET SEWER
INV – 78.75
914ø OUTLET SEWER
INV – 79.88
1067ø BYPASS SEWER
INV – 79.18

ARENA CREEK
81.4
AERATED LAGOON (CELL)
0.68ha
3m DEEP
(±18,000m³)
3.5:1 SIDE SLOPES (TYP.)
81.0
INV – 78.08
1067ø CONC.
11.3kW MECHANICAL AERATOR (TYP. OF 2)
CATWALK
WATER LEVEL 80.5
18.8kW FLOATING AERATORS 1 & 2 (AUG. 2015)
OUTLET CHANNEL WITH PARSHALL FLUME FLOW METER C/W ULTRASONIC
CONTROL BUILDING
35m³ COAGULANT TANK (3mø)
COAGULANT MIXING CHAMBER
±2.5:1 SIDE SLOPES (TYP.)
ACCESS ROAD
FLOW DIRECTION

WASTE STABILIZATION POND
(FACULTATIVE LAGOON)
5.44ha
1.5m DEEP
(±81,000m³)

BAFFLE (TYP. 3)

WATER LEVEL 79.4

80.5
MAINTENANCE ROAD

GATE VALVE
INV – 77.70
INV – 77.69
600ø TO ARENA CREEK (EMER. BYPASS)
INV – 79.00
600ø CC
LAGOON LEVEL CONTROL STRUCTURE C/W STOP LOGS
ARENA CREEK
80.5
INV – 76.40
WETLAND INFLOW MONITORING STRUCTURE WITH TWO, 600mm WIDE, RECTANGULAR WEIRS C/W ULTRASONIC (1). WEIR INVERTS 78.80 (ADJUSTABLE)
INV – 77.44
INV 75.20
MH
INV – 77.44
600ø CC
80.1
INV 77.51
600ø CC
INV – 77.44
INV – 77.10
79.1
INV – 76.75
78.0

FORCEMAIN ACCESS CHAMBER
300ø FORCEMAIN
79.0 COUNTY ROAD 64
3:1 SIDE SLOPES (TYP.)
WATER LEVEL 78.2
79.1
MAINTENANCE ROAD
CONSTRUCTED WETLAND CELL 1
3.1ha
0.3m DEEP TERRACE
1m DEEP ZONES
CONSTRUCTED WETLAND CELL 2
3.1ha
0.3m DEEP TERRACE
1m DEEP ZONES
1m DEEP ZONE (TYP.)
MAINTENANCE ROAD
1m DEEP ZONE (TYP.)
LEVEL CONTROL STRUCTURE – WETLAND 2
INV – 77.85
79.9
600ø CC
INV – 77.70
INV – 77.10
INV – 77.10
600ø CC
ROCK LINED OUTFLOW SWALES TO MARSH AREA
INV – 77.85
LEVEL CONTROL STRUCTURE – WETLAND 1
79.5
600ø CC
WETLAND OUTFLOW FLOW CONTROL STRUCTURE WITH TWO, 600mm WIDE, RECTANGULAR WEIRS C/W ULTRASONICS (2). WEIR INVERTS 77.8 (ADJUSTABLE)

PRINCE EDWARD ST.
HARBOUR ST.
300ø FORCEMAIN FROM HARBOUR ST. SPS
BULTER CREEK
MH 234
200ø
MH 235
840ø
INV – 69.08
HARBOUR ST. SEWAGE PUMPING STATION
840ø
INV 69.5
INV – 76.17 (FLAT)
600ø OVERFLOW
FLAP GATE VALVE

CAUTION:THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE DRAWING, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

FINAL DRAWING INDICATED BY SEAL AND SIGNATURE OF DESIGN ENGINEER

LEGEND

- PROPERTY LINE
- 80.1 FINISHED GRADE ELEVATION (m)
- INV – 80.81 PIPE INVERT (m)
- DIRECTION OF FLOW
- VALVE

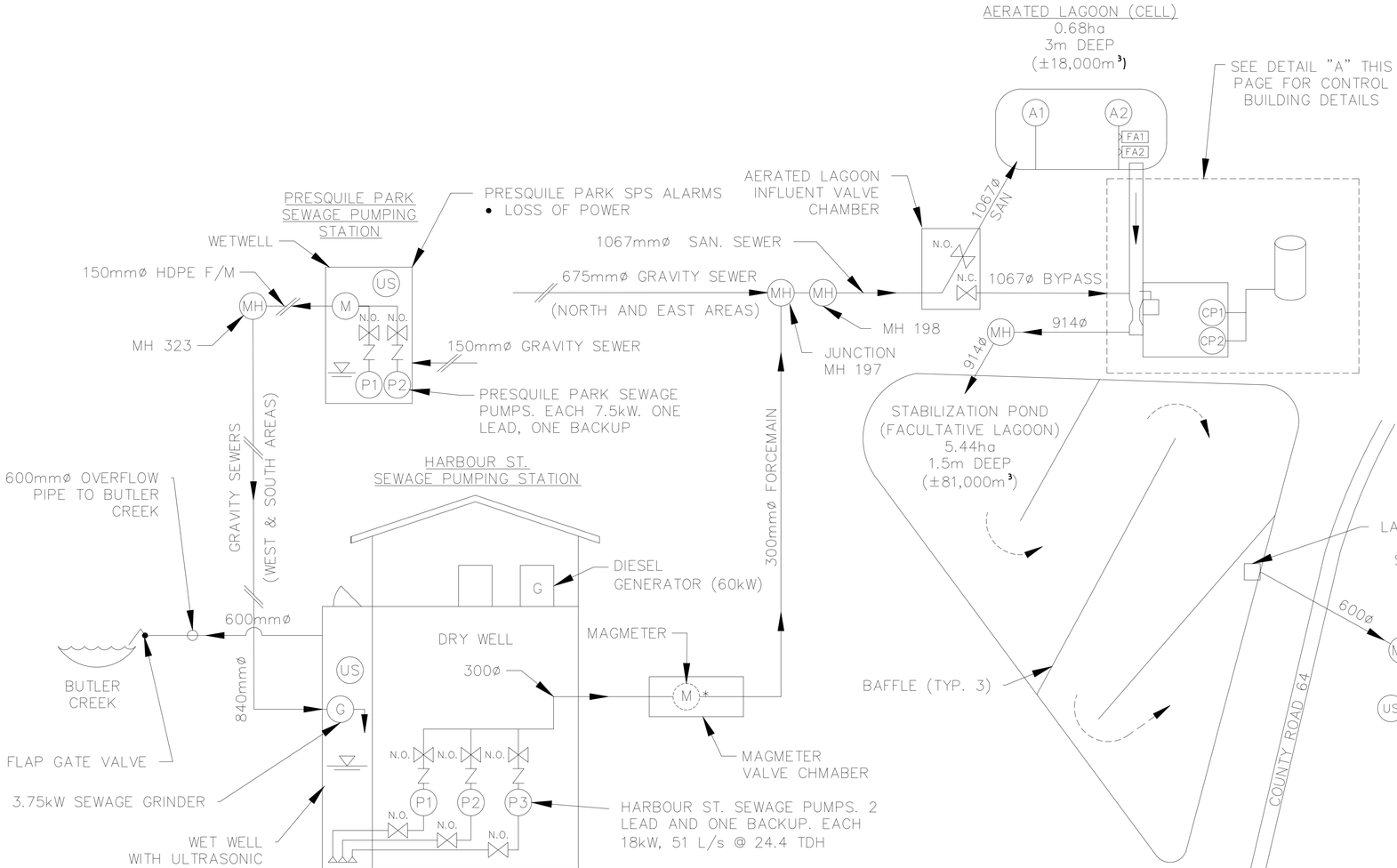
NOTE: THE LOCATION AND ELEVATION OF PIPES, MANHOLES, STRUCTURES, VALVES, ETC. ON THIS DRAWING ARE BASED ON BEST AVAILABLE INFORMATION ONLY. DETAILED LOCAL SITE MEASUREMENTS, SURVEYS, AND LOCATES SHOULD BE COMPLETED IN ADVANCE FOR ALL PROJECTS/MODIFICATIONS.

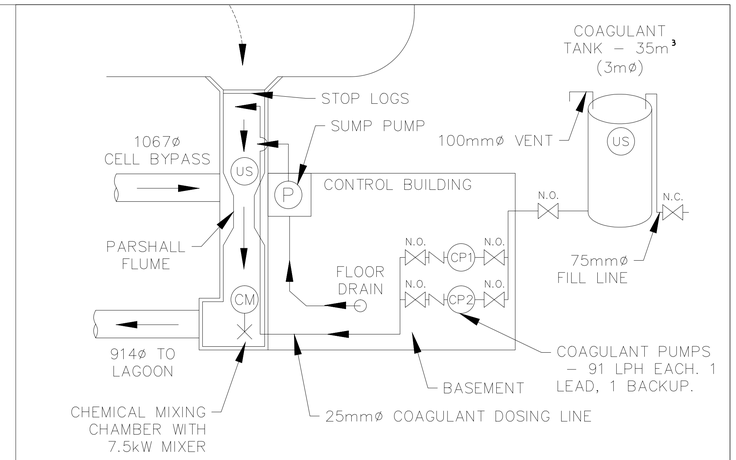
DD/MM/YY	REVISION/ISSUE

GENERAL AS CONSTRUCTED DRAWING
BRIGHTON WASTEWATER TREATMENT SYSTEM
MUNICIPALITY OF BRIGHTON

GSS ENGINEERING CONSULTANTS LTD

Design:	JTG
Drawn:	TDL
APPROVED:	JTG
Date:	JAN. 2016
Scale:	1:1000
FILE No.	15–017
FIG. No.	FIGURE 10





CONTROL BUILDING DETAIL "A"

CONTROL BUILDING ALARMS
- DOOR CONTACTS
- LOSS OF POWER
- COAGULANT PUMP FAIL
- HI/LOW BUILDING TEMPERATURE

* OFFLINE PREVIOUS TO JANUARY 2016

LEGEND

A1 A2	ORIGINAL MECHANICAL SURFACE AERATORS – 11.3kW EACH	M	MAGMETER (TYP.)
FA1 FA2	NEW FLOATING AERATORS – 18kW EACH	MH	SEWER MANHOLE
P1 P2 P3	SEWAGE PUMPS	CM	CHEMICAL MIXER
CP1 CP2	COAGULANT CHEMICAL PUMPS		
	ISOLATION VALVE (TYP.) N.O. (NORMALLY OPEN) N.C. (NORMALLY CLOSED)		
	CHECK VALVE (TYP.)		
US	ULTRASONIC LEVEL MEASUREMENT (TYP.)		
	DIRECTIONAL FLOW OF SEWAGE		

FINAL DRAWING INDICATED BY SEAL AND SIGNATURE OF DESIGN ENGINEER

OVERALL PROCESS DRAWING BRIGHTON SEWAGE COLLECTION, PUMPING & TREATMENT SYSTEM TOWN OF BRIGHTON

GSS ENGINEERING CONSULTANTS LTD

Design:	JTG
Drawn:	TDL
APPROVED:	JTG
Date:	JAN. 2016
Scale:	NTS
FILE No.	15–017
FIG. No.	FIGURE 11

Appendix D

Existing and Previous ECAs

AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER 7701-CDNKQA
Issue Date: April 21, 2022

The Corporation of the Municipality of Brighton
35 Alice St
Post Office Box, No. 189
Brighton, Ontario
K0K 1H0

Site Location: Brighton Lagoon
100 County Road 64
Lot 33 & 34, Concession B
Municipality of Brighton, County of Northumberland

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act , R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

Upgrade of existing municipal sewage work for the treatment of sanitary sewage and disposal of effluent to the natural wetland in Presqu'ile Bay via a Sewage Treatment Plant (Brighton Water Pollution Control Plant) and Final Effluent disposal facilities as follows:

Classification of Collection System: Separate Sewer System

Classification of Sewage Treatment Plant: Secondary

Design Capacity of Sewage Treatment Plant

Design Capacity with all Treatment Trains in operation	Existing Works
Rated Capacity	4,600 m^3 /d

Influent, Imported Sewage and Processed Organic Waste

Receiving Location	Types
In Collection System	Sanitary Sewage

PROPOSED WORKS:

Upgrade of the existing lagoon sewage treatment system to improve the Total Ammonia Nitrogen (TAN) treatment performance of the lagoon sewage treatment system consisting of the following:

Installation of a Moving Bed Biofilm Reactor (MBBR) treatment system having a Rated Capacity of 4,600 m^3 /d and Peak Flow Rate of 12,000 m^3 /d consisting of the following:

Inlet Channel

One (1) inlet channel rated at 12,000 m^3/d, equipped with one (1) manually cleaned bar screen with 25 mm opening;

Screening

Two (2) parallel (one duty, one standby) fine screen channels discharging to the pumping system described below:

One (1) fine screen channel (on duty) rated at 12,000 m^3/d, equipped with a 3.0 mm opening mechanically cleaned perforated plate screen;

One (1) fine screen channel (on standby) rated at 12,000 m^3/d, equipped with a 6.0 mm opening manually cleaned bar screen;

Pumping System

One (1) pumping station equipped with three (3) submersible pumps (lead/lag/standby) with variable frequency drive (VFD), each rated at 70.0 L/s @10 m TDH, equipped with one (1)magnetic flow meter, conveying screened lagoon effluent through a 350 mm diameter pipe to the MBBR described below;

Moving Bed Biofilm Reactor (MBBR)

One (1) MBBR treatment system with two (2) parallel trains, each train rated for a hydraulic loading rate of 6,000 m^3/d and having two (2) reactors cells in series, consisting of the following:

Cell #1 (BOD_5 Removal Cell), having approximate dimensions of 8.6 m wide x 3.0 m long x 6.0 m maximum side water depth, providing a maximum of 5.1 m operational depth and volume of 133 m^3, filled with High Density Polyethylene (HDPE) carrier media or equivalent measuring 25 mm diameter x 8 mm length providing a protected surface area of 650 m^2/m^3, equipped with one (1) 50 mm diameter air supply drop leg and a coarse bubble diffuser system with associated distribution piping;

Cell #2 (Nitrification Cell), having approximate dimensions of 8.5 m wide x 17.0 m long x 6.0 m maximum side water depth, providing a maximum of 5.1 m operational depth and a volume of 740 m^3, filled with High Density Polyethylene (HDPE) carrier media or equivalent measuring 25 mm diameter x 8 mm length providing a protected surface area of 650 m^2/m^3, equipped with six (6) 75 mm diameter air supply drop legs and a coarse bubble diffuser system with associated distribution piping;

Four (4) cylindrical 1,500 mm long x 300 mm diameter 5 mm openings effluent screens installed along the end wall of each cell;

Three (3) 40 Hp air blowers (two duty, one standby) each with rated capacity of 1,020 m^3 /h @ 5.6 m TDH serving as a low pressure process air supply for the MBBR aeration system, equipped with a system of coarse bubble diffusers with associated distribution pipes;

One (1) 600 mm diameter outlet pipe from the MBBR cells discharging to the Process Building outlet sump; and

One (1) 450 mm diameter pipeline extending from the Process Building outlet sump to the Effluent Outfall Structure.

Chemical Feed System

Anti-foaming agent feed system consisting of anti-foaming agent storage drums equipped with four (4) chemical feed pumps (two duty, two standby) discharging to each cell of each MBBR reactor;

Alkalinity feed system consisting of one (1) 11,000 L vertical cylindrical storage tanks and two (2) chemical feed pumps (one duty, one standby) discharging to one (1) injection quill; and

One (1) 13,200 L effective storage volume reinforced concrete containment area to be used for the containment of the alkalinity feed system and storage tank.

Effluent Outfall Structure

One (1) 5.9 m long x 3.0 m wide x 2.7 m deep outlet structure sized for 18,000 m^3 /d receiving MBBR effluent and overflow from the stabilization lagoon, discharging through one (1) 600 mm diameter pipe to the constructed wetland described below.

Including all other mechanical system, electrical system, instrumentation and control system, standby power system, piping, pumps, valves and appurtenances essential for the proper, safe and reliable operation of the Works in accordance with this Approval, in the context of process performance and general principles of wastewater engineering only.
All in accordance with supporting documents listed in **Schedule A** .
EXISTING WORKS:
Wastewater Treatment Facilities

A 0.68 hectare **aerated lagoon** with two (2) 11.2 kilowatts mechanical

aerators and two (2) 18.6 kilowatts mechanical aerators;

A secondary cast in place reinforced concrete containment tank, rectangular shape and all rebar epoxy coated to resist corrosion, consisting of concrete base, concrete wall and slight sloping floor to a corner sump, designed with an effective storage volume of 37 cubic meters and a 0.12 m free board, used as a chemical containment to house existing 26.4 cubic meters coagulant storage tank described below;

Coagulant feed system consisting of one (1) 26,400 litres external storage tank, two (2) chemical feed pumps (one duty, one standby), injection point at the chemical mixing chamber, and one (1) flash mixer;

One (1) Parshall flume flow meter located upstream of the mixing channel and measuring flow directed into the stabilization pond;

A 5.44 hectares **waste stabilization pond** (**Lagoon**) equipped with three (3) floating baffles installed from east to west direction to improve flow distribution, and effluent discharged to a constructed wetland described below;

Constructed Wetland

A constructed wetland located on the south side of County Road 64, immediately east of Harbour Street:

A **constructed wetland** having a surface area of 6.2 hectares, side slopes of 3:1 and 0.8 free board, constructed south of the waste stabilization pond consisting of Wetland Cell # 1 (North) and Wetland Cell # 2 (South), each wetland cell consisted of a 300 millimetres shallow vegetative terrace between 1.0 metre deep front and rear zones;

A 600 millimetres diameter pipe constructed and connected from the waste stabilization pond outflow chamber to the inlet flow structure of the constructed wetland;

A 3.0 metres x 2.4 metres x 3.0 metres deep inlet flow structure constructed at the front end of Wetland Cell # 1 (North) to control waste stabilization pond effluent through weirs and baffles to the wetland cells by 600 millimetres diameter pipes;

A 3.0 metres x 2.4 metres x 3.05 metres deep outlet flow structure having weirs and baffles, constructed at the rear end of Wetland Cell # 2 (South) to receive wetland effluent from a level control structure (equipped with stop logs) of each wetland cell and discharge wetland effluent through three (3)

outflow swales to the natural wetland in Presqu'ile Bay;

Two (2) 2.4 metres long emergency weir having a weir crest elevation of 79.0 metres, constructed on the common berm at the rear ends of the two wetland cells and the rear berm of Wetland Cell # 2 (South); and

Three (3) flow meters: one (1) flow meter comprising of a level sensor and two (2) V notch weirs measuring flow into Wetland Cell #1 (North) and Wetland Cell # 2 (South), and two (2) flow meters each comprising of a level sensor and a V notch weir measuring effluent flows from each constructed wetland cell.

Including all other mechanical system, electrical system, instrumentation and control system, standby power system, piping, pumps, valves and appurtenances essential for the proper, safe and reliable operation of the Works in accordance with this Approval, in the context of process performance and general principles of wastewater engineering only.
All in accordance with supporting documents listed in **Schedule A** .

For the purpose of this environmental compliance approval, the following definitions apply:

1. "Annual Average Daily Effluent Flow" means the cumulative total Final Effluent discharged during a calendar year divided by the number of days during which Final Effluent was discharged that year;

2. "Annual Average Daily Effluent Loading" means the value obtained by multiplying the Annual Average Effluent Concentration of a contaminant by the Annual Average Daily Effluent Flow over the same calendar year;

3. "Annual Average Effluent Concentration" is the mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured during a calendar year, calculated and reported as per the methodology specified in Schedule F;

4. "Annual Average Daily Influent Flow" means the cumulative total sewage flow of Influent to the Sewage Treatment Plant during a calendar year divided by the number of days during which sewage was flowing to the Sewage Treatment Plant that year;

5. "Approval" means this environmental compliance approval and any schedules attached to it, and the application;

6. "BOD5" (also known as TBOD5) means five day biochemical oxygen demand

measured in an unfiltered sample and includes carbonaceous and nitrogenous oxygen demands;

7. "Bypass" means diversion of sewage around one or more treatment processes, excluding Preliminary Treatment System, within the Sewage Treatment Plant with the diverted sewage flows being returned to the Sewage Treatment Plant treatment train upstream of the Final Effluent sampling point(s) and discharged via the approved effluent disposal facilities;

8. "CBOD5" means five day carbonaceous (nitrification inhibited) biochemical oxygen demand measured in an unfiltered sample;

9. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

10. "District Manager" means the District Manager of the appropriate local district office of the Ministry where the Works is geographically located;

11. "*E. coli*" refers to coliform bacteria that possess the enzyme beta-glucuronidase and are capable of cleaving a fluorogenic or chromogenic substrate with the corresponding release of a fluorogen or chromogen, that produces fluorescence under long wavelength (366 nm) UV light, or color development, respectively. Enumeration methods include tube, membrane filter, or multi-well procedures. Depending on the method selected, incubation temperatures include 35.5 + 0.5 °C or 44.5 + 0.2 °C (to enumerate thermotolerant species). Depending on the procedure used, data are reported as either colony forming units (CFU) per 100 mL (for membrane filtration methods) or as most probable number (MPN) per 100 mL (for tube or multi-well methods);

12. "EPA" means the *Environmental Protection Act*, R.S.O. 1990, c.E.19, as amended;

13. "Equivalent Equipment" means alternate piece(s) of equipment that meets the design requirements and performance specifications of the piece(s) of equipment to be substituted;

14. "Event" means an action or occurrence, at a given location within the Works that causes a Bypass or Overflow. An Event ends when there is no recurrence of Bypass or Overflow in the 12-hour period following the last Bypass or Overflow. Overflows and Bypasses are separate Events even when they occur concurrently;

15. "Existing Works" means those portions of the Works included in the Approval that have been constructed previously;

16. "Final Effluent" means effluent that is discharged to the environment through the approved effluent disposal facilities, including all Bypasses, that are required to meet the compliance limits stipulated in the Approval for the Sewage Treatment Plant at the Final Effluent sampling point(s);

17. "Influent" means flows to the Sewage Treatment Plant from the collection system;

18. "Limited Operational Flexibility" (LOF) means the conditions that the Owner shall follow in order to undertake any modification that is pre-authorized as part of this Approval;

19. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

20. "Monthly Average Effluent Concentration" is the mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured during a calendar month, calculated and reported as per the methodology specified in Schedule F;

21. "Monthly Average Daily Effluent Flow" means the cumulative total Final Effluent discharged during a calendar month divided by the number of days during which Final Effluent was discharged that month;

22. "Monthly Average Daily Effluent Loading" means the value obtained by multiplying the Monthly Average Effluent Concentration of a contaminant by the Monthly Average Daily Effluent Flow over the same calendar month;

23. "Monthly Geometric Mean Density" is the mean of all Single Sample Results of *E. coli* measurement in the samples taken during a calendar month, calculated and reported as per the methodology specified in Schedule F;

24. "Normal Operating Condition" means the condition when all unit process(es), excluding Preliminary Treatment System, in a treatment train is operating within its design capacity;

25. "Operating Agency" means the Owner or the entity that is authorized by the Owner for the management, operation, maintenance, or alteration of the Works in accordance with this Approval;

26. "Overflow" means a discharge to the environment from the Works at designed location(s) other than the approved effluent disposal facilities or via the effluent disposal facilities downstream of the Final Effluent sampling point;

27. "Owner" means The Corporation of the Municipality of Brighton and its successors and assignees;

28. "OWRA" means the *Ontario Water Resources Act*, R.S.O. 1990, c. O.40, as amended;

29. "Preliminary Treatment System" means all facilities in the Sewage Treatment Plant associated with screening and grit removal;

30. "Professional Engineer" means a person entitled to practice as a Professional Engineer in the Province of Ontario under a license issued under the Professional Engineers Act;

31. "Proposed Works" means those portions of the Works included in the Approval that are under construction or to be constructed;

32. "Rated Capacity" means the Annual Average Daily Influent Flow for which the Sewage Treatment Plant is designed to handle;

33. "Sewage Treatment Plant" means all the facilities related to sewage treatment within the sewage treatment plant site excluding the Final Effluent disposal facilities;

34. "Single Sample Result" means the test result of a parameter in the effluent discharged on any day, as measured by a probe, analyzer or in a composite or grab sample, as required;

35. "Works" means the approved sewage works, and includes Proposed Works, Existing Works and modifications made under Limited Operational Flexibility.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

TERMS AND CONDITIONS

1.

GENERAL PROVISIONS

2. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the terms and conditions herein

and shall take all reasonable measures to ensure any such person complies with the same.

3. The Owner shall design, construct, operate and maintain the Works in accordance with the conditions of this Approval.

4. Where there is a conflict between a provision of any document referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence.

5. **CHANGE OF OWNER AND OPERATING AGENCY**

6. The Owner shall, within thirty (30) calendar days of issuance of this Approval, prepare/update and submit to the District Manager the Municipal and Local Services Board Wastewater System Profile Information Form, as amended (Schedule G) under any of the following situations:

a. the form has not been previously submitted for the Works;
b. this Approval is issued for extension, re-rating or process treatment upgrade of the Works;
c. when a notification is provided to the District Manager in compliance with requirements of change of Owner or Operating Agency under this condition.

7. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

a. change of address of Owner;
b. change of Owner, including address of new owner;
c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act, R.S.O. 1990, c. B.17*, as amended, shall be included in the notification;
d. change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the *Corporations Information Act, R.S.O. 1990, c. C.39*, as amended, shall be included in the notification.

8. The Owner shall notify the District Manager, in writing, of any of the following changes within thirty (30) days of the change occurring:

a. change of address of Operating Agency;
b. change of Operating Agency, including address of new Operating Agency.

9. In the event of any change in ownership of the Works, the Owner shall notify the succeeding owner in writing, of the existence of this Approval, and forward a copy of the notice to the District Manager.

10. The Owner shall ensure that all communications made pursuant to this condition refer to the environmental compliance approval number.

11. **CONSTRUCTION OF PROPOSED WORKS / RECORD DRAWINGS**

12. All Proposed Works in this Approval shall be constructed and installed and must commence operation within five (5) years of issuance of this Approval, after which time the Approval ceases to apply in respect of any portions of the Works not in operation. In the event that the construction, installation and/or operation of any portion of the Proposed Works is anticipated to be delayed beyond the time period stipulated, the Owner shall submit to the Director an application to amend the Approval to extend this time period, at least six (6) months prior to the end of the period. The amendment application shall include the reason(s) for the delay and whether there is any design change(s).

13. Within thirty (30) days of commencement of construction, the Owner shall prepare and submit to the District Manager a schedule for the completion of construction and commissioning operation of the Proposed Works. The Owner shall notify the District Manager within thirty (30) days of the commissioning operation of any Proposed Works. Upon completion of construction of the Proposed Works, the Owner shall prepare and submit a statement to the District Manager, certified by a Professional Engineer, that the Proposed Works is constructed in accordance with this Approval.

14. Within one (1) year of completion of construction of the Proposed Works, a set of record drawings of the Works shall be prepared or updated. These drawings shall be kept up to date through revisions undertaken from time to time and a copy shall be readily accessible for reference at the Works.

15. **BYPASSES**

16. Any Bypass is prohibited, except:

a. an emergency Bypass when a structural, mechanical or electrical failure causes a temporary reduction in the capacity of a treatment process or when an unforeseen flow condition exceeds the design capacity of a treatment process that is likely to result in personal injury, loss of life, health hazard, basement flooding, severe property damage, equipment damage or treatment process upset, if a portion of the flow is not bypassed;
b. a planned Bypass that is a direct and unavoidable result of a planned repair and

maintenance procedure or other circumstance(s), the Owner having notified the District Manager in writing at least fifteen (15) days prior to the occurrence of Bypass, including an estimated quantity and duration of the Bypass, an assessment of the impact on the quality of the Final Effluent and the mitigation measures if necessary, and the District Manager has given written consent of the Bypass;

c. a designed Bypass under the following flow conditions:
    i. Bypass of MBBR treatment system when flow rate to this system exceeds 12,000 m^3/d and there is flow over the weir in the Effluent Outfall Structure;

17. Notwithstanding the exceptions given in Paragraph 1, the Operating Agency shall undertake everything practicable to maximize the flow through the downstream treatment process(es) prior to bypassing.

18. At the beginning of a Bypass Event, the Owner shall immediately notify the Spills Action Centre (SAC) and the local Medical Officer of Health. This notice shall include, at a minimum, the following information:

a. the type of the Bypass as indicated in Paragraph 1 and the reason(s) for the Bypass;
b. the date and time of the beginning of the Bypass;
c. the treatment process(es) gone through prior to the Bypass and the treatment process(es) bypassed;
d. the effort(s) done to maximize the flow through the downstream treatment process(es) and the reason(s) why the Bypass was not avoided.

19. Upon confirmation of the end of a Bypass Event, the Owner shall immediately notify the Spills Action Centre (SAC) and the local Medical Officer of Health. This notice shall include, at a minimum, the following information:

a. the date and time of the end of the Bypass;
b. the estimated or measured volume of Bypass.

20. For any Bypass Event, the Owner shall collect daily sample(s) of the Final Effluent, inclusive of the Event and analyze for all effluent parameters outlined in Compliance Limits condition that require composite samples, following the same protocol specified in the Monitoring and Recording condition for the regular samples. The sample(s) shall be in addition to the regular Final Effluent samples required under the monitoring and recording condition. If the Event occurs on a scheduled monitoring day, the regular sampling requirements prevail. If representative sample for the effluent parameter(s) that require grab sample cannot be obtained, they shall be collected after the Event at

the earliest time when situation returns to normal.

21. The Owner shall submit a summary report of the Bypass Event(s) to the District Manager on a quarterly basis, no later than each of the following dates for each calendar year: February 15, May 15, August 15, and November 15. The summary reports shall contain, at a minimum, the types of information set out in Paragraphs (3), (4) and (5) and either a statement of compliance or a summary of the non-compliance notifications submitted as required under Paragraph 1 of Condition 11. If there is no Bypass Event during a quarter, a statement of no occurrence of Bypass is deemed sufficient.

22. The Owner shall develop a notification procedure in consultation with the District Manager and SAC and notify the public and downstream water users that may be adversely impacted by any Bypass Event.

23. **OVERFLOWS**

24. Any Overflow is prohibited, except:

a. an emergency Overflow in an emergency situation when a structural, mechanical or electrical failure causes a temporary reduction in the capacity of the Works or when an unforeseen flow condition exceeds the design capacity of the Works that is likely to result in personal injury, loss of life, health hazard, basement flooding, severe property damage, equipment damage or treatment process upset, if a portion of the flow is not overflowed;
b. a planned Overflow that is a direct and unavoidable result of a planned repair and maintenance procedure or other circumstance(s), the Owner having notified the District Manager in writing at least fifteen (15) days prior to the occurrence of Overflow, including an estimated quantity and duration of the Overflow, an assessment of the impact on the environment and the mitigation measures if necessary, and the District Manager has given written consent of the Overflow;

25. Notwithstanding the exceptions given in Paragraph 1, the Operating Agency shall undertake everything practicable to maximize the flow through the downstream treatment process(es) and Bypass(es) prior to overflowing.

26. At the beginning of an Overflow Event, the Owner shall immediately notify the Spills Action Centre (SAC) and the local Medical Officer of Health. This notice shall include, at a minimum, the following information:

a. the type of the Overflow as indicated in Paragraph 1 and the reason(s) for the Overflow;
b. the date and time of the beginning of the Overflow;

c. the point of the Overflow from the Works, the treatment process(es) gone through prior to the Overflow, the disinfection status of the Overflow and whether the Overflow is discharged through the effluent disposal facilities or an alternate location;

d. the effort(s) done to maximize the flow through the downstream treatment process(es) and Bypass(es) and the reason(s) why the Overflow was not avoided.

27. Upon confirmation of the end of an Overflow Event, the Owner shall immediately notify the Spills Action Centre (SAC) and the local Medical Officer of Health. This notice shall include, at a minimum, the following information:

a. the date and time of the end of the Overflow;

b. the estimated or measured volume of the Overflow.

28. For any Overflow Event

a. in the Sewage Treatment Plant, the Owner shall collect grab sample(s) of the Overflow, one near the beginning of the Event and one every eight (8) hours for the duration of the Event, and have them analyzed at least for CBOD5, total suspended solids, total phosphorus, total ammonia nitrogen, nitrate as N, nitrite as N, total Kjeldahl nitrogen, *E. coli.*, except that raw sewage and primary treated effluent Overflow shall be analyzed for BOD5, total suspended solids, total phosphorus and total Kjeldahl nitrogen only.

29. The Owner shall submit a summary report of the Overflow Event(s) to the District Manager on a quarterly basis, no later than each of the following dates for each calendar year: February 15, May 15, August 15, and November 15. The summary report shall contain, at a minimum, the types of information set out in Paragraphs (3), (4) and (5). If there is no Overflow Event during a quarter, a statement of no occurrence of Overflow is deemed sufficient.

30. The Owner shall develop a notification procedure in consultation with the District Manager and SAC and notify the public and downstream water users that may be adversely impacted by any Overflow Event.

31. **DESIGN OBJECTIVES**

32. The Owner shall design and undertake everything practicable to operate the Sewage Treatment Plant in accordance with the following objectives:

a. Final Effluent parameters design objectives listed in the table(s) included in **Schedule B**.

b. Final Effluent is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film or sheen or foam or discolouration on the receiving waters.

c. Annual Average Daily Influent Flow is within the Rated Capacity of the Sewage Treatment Plant.

33. **COMPLIANCE LIMITS**

1. The Owner shall operate and maintain the Sewage Treatment Plant such that compliance limits for the Final Effluent parameters listed in the table(s) included in **Schedule C** are met.

34.

OPERATION AND MAINTENANCE

1. The Owner shall ensure that, at all times, the Works and the related equipment and appurtenances used to achieve compliance with this Approval are properly operated and maintained. Proper operation and maintenance shall include effective performance, adequate funding, adequate staffing and training, including training in all procedures and other requirements of this Approval and the OWRA and regulations, adequate laboratory facilities, process controls and alarms and the use of process chemicals and other substances used in the Works.

2. The Owner shall update/maintain the operations manual for the Works within six (6) months of completion of construction of the Proposed Works, that includes, but not necessarily limited to, the following information:

a. operating procedures for the Works under Normal Operating Conditions;

b. inspection programs, including frequency of inspection, for the Works and the methods or tests employed to detect when maintenance is necessary;

c. repair and maintenance programs, including the frequency of repair and maintenance for the Works;

d. procedures for the inspection and calibration of monitoring equipment;

e. operating procedures for the Works to handle situations outside Normal Operating Conditions and emergency situations such as a structural, mechanical or electrical failure, or an unforeseen flow condition, including procedures to minimize Bypasses and Overflows;

f. a spill prevention and contingency plan, consisting of procedures and contingency plans, including notification to the District Manager, to reduce the risk of spills of

pollutants and prevent, eliminate or ameliorate any adverse effects that result or may result from spills of pollutants;

g. procedures for receiving, responding and recording public complaints, including recording any followup actions taken.

3. The Owner shall maintain the operations manual up-to-date and make the manual readily accessible for reference at the Works.

4. The Owner shall ensure that the Operating Agency fulfills the requirements under O. Reg. 129/04, as amended for the Works, including the classification of facilities, licensing of operators and operating standards.

35. **MONITORING AND RECORDING**

36. The Owner shall, upon commencement of operation of the Works, carry out a scheduled monitoring program of collecting samples at the required sampling points, at the frequency specified or higher, by means of the specified sample type and analyzed for each parameter listed in the tables under the monitoring program included in **Schedule D** and record all results, as follows:

a. all samples and measurements are to be taken at a time and in a location characteristic of the quality and quantity of the sewage stream over the time period being monitored.

b. definitions and preparation requirements for each sample type are included in document referenced in Paragraph 3.b.

c. definitions for frequency:
    i. Weekly means once every week; and
    ii. Monthly means once every month;

37. In addition to the scheduled monitoring program required in Paragraph 1, the Owner shall collect daily sample(s) of the Final Effluent, on any day when there is any situation outside Normal Operating Conditions, and analyze for all effluent parameters outlined in Compliance Limits condition that require composite samples, following the same protocol specified in this condition for the regular samples. If the Event occurs on a scheduled monitoring day, the regular sampling requirements prevail. If representative sample for the effluent parameter(s) that require grab sample cannot be obtained, they shall be collected after the Event at the earliest time when situation returns to normal.

38. The methods and protocols for sampling, analysis and recording shall conform, in order of precedence, to the methods and protocols specified in the following documents and all analysis shall be conducted by a laboratory accredited to the ISO/IEC:17025

standard or as directed by the District Manager:

a. the Ministry's Procedure F-10-1, “Procedures for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only), as amended;
b. the Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater Version 2.0" (January 2016), PIBS 2724e02, as amended;
c. the publication "Standard Methods for the Examination of Water and Wastewater", as amended.

39. The Owner shall monitor and record the flow rate and daily quantity using flow measuring devices or other methods of measurement as approved below calibrated to an accuracy within plus or minus 15 per cent (+/- 15%) of the actual flowrate of the following:

a. Influent flow to the Sewage Treatment Plant by continuous flow measuring devices and instrumentations;
b. Final Effluent discharged from the Sewage Treatment Plant by continuous flow measuring devices and instrumentations; and
c. each type of Imported Sewage received for co-treatment at the Sewage Treatment Plant by flow measuring devices/pumping rates/haul truck manifests.

40. The Owner shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the monitoring activities required by this Approval.

41.

LIMITED OPERATIONAL FLEXIBILITY

1. The Owner may make pre-authorized modifications to the Sewage Treatment Plant in Works in accordance with the document "Limited Operational Flexibility - Protocol for Pre-Authorized Modifications to Municipal Sewage Works" (**Schedule E**), as amended, subject to the following:

a. the modifications will not involve the addition of any new treatment process or the removal of an existing treatment process, including chemical systems, from the liquid or solids treatment trains as originally designed and approved.
b. the scope and technical aspects of the modifications are in line with those

delineated in **Schedule E** and conform with the Ministry's publication "Design Guidelines for Sewage Works 2008", as amended, Ministry's regulations, policies, guidelines, and industry engineering standards;

c. the modifications shall not negatively impact on the performance of any process or equipment in the Works or result in deterioration in the Final Effluent quality;

d. where the pre-authorized modification requires notification, a "Notice of Modifications to Sewage Works" **(Schedule E)**, as amended shall be completed with declarations from a Professional Engineer and the Owner and retained on-site prior to the scheduled implementation date. All supporting information including technical memorandum, engineering plans and specifications, as applicable and appropriate to support the declarations that the modifications conform with LOF shall remain on-site for future inspection.

2. The following modifications are not pre-authorized under Limited Operational Flexibility:

a. Modifications that involve addition or extension of process structures, tankages or channels;

b. Modifications that involve relocation of the Final Effluent outfall or any other discharge location or that may require reassessment of the impact to the receiver or environment;

c. Modifications that involve addition of or change in technology of a treatment process or that may involve reassessment of the treatment train process design;

d. Modifications that require changes to be made to the emergency response, spill prevention and contingency plan; or

e. Modifications that are required pursuant to an order issued by the Ministry.

42. **REPORTING**

1. The Owner shall report to the District Manager orally as soon as possible any non-compliance with the compliance limits, and in writing within seven (7) days of non-compliance.

2. The Owner shall, within fifteen (15) days of occurrence of a spill within the meaning of Part X of the EPA, submit a full written report of the occurrence to the District Manager describing the cause and discovery of the spill, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation, in addition to fulfilling the requirements under the EPA and O. Reg. 675/98 "Classification and Exemption of Spills and Reporting of Discharges".

3.

The Owner shall, upon request, make all manuals, plans, records, data, procedures and supporting documentation available to Ministry staff.

4. The Owner shall prepare performance reports on a calendar year basis and submit to the District Manager by March 31 of the calendar year following the period being reported upon. The reports shall contain, but shall not be limited to, the following information pertaining to the reporting period:

a. a summary and interpretation of all Influent monitoring data, and a review of the historical trend of the sewage characteristics and flow rates;

b. a summary and interpretation of all Final Effluent monitoring data, including concentration, flow rates, loading and a comparison to the design objectives and compliance limits in this Approval, including an overview of the success and adequacy of the Works;

c. a summary of all operating issues encountered and corrective actions taken;

d. a summary of all normal and emergency repairs and maintenance activities carried out on any major structure, equipment, apparatus or mechanism forming part of the Works;

e. a summary of any effluent quality assurance or control measures undertaken;

f. a summary of the calibration and maintenance carried out on all Influent and Final Effluent monitoring equipment to ensure that the accuracy is within the tolerance of that equipment as required in this Approval or recommended by the manufacturer;

g. a summary of efforts made to achieve the design objectives in this Approval, including an assessment of the issues and recommendations for pro-active actions if any are required under the following situations:
    i. when any of the design objectives is not achieved more than 50% of the time in a year, or there is an increasing trend in deterioration of Final Effluent quality;
    ii. when the Annual Average Daily Influent Flow reaches 80% of the Rated Capacity;

h. a tabulation of the measured volume of sludge accumulated in the lagoon cells in five year intervals and the estimated volume in the interim years and when sludge was disposed of during the reporting period, a summary of disposal locations and volumes of sludge disposed at each location;

i. a summary of any complaints received and any steps taken to address the complaints;

j. a summary of all Bypasses, Overflows, other situations outside Normal Operating

Conditions and spills within the meaning of Part X of EPA and abnormal discharge events;

k. a summary of all Notice of Modifications to Sewage Works completed under Paragraph 1.d. of Condition 10, including a report on status of implementation of all modification;

l. a summary of efforts made to achieve conformance with Procedure F-5-1 including but not limited to projects undertaken and completed in the sanitary sewer system that result in overall Bypass/Overflow elimination including expenditures and proposed projects to eliminate Bypass/Overflows with estimated budget forecast for the year following that for which the report is submitted; and

m. any changes or updates to the schedule for the completion of construction and commissioning operation of major process(es) / equipment groups in the Proposed Works.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 regarding general provisions is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted.

2. Condition 2 regarding change of Owner and Operating Agency is included to ensure that the Ministry records are kept accurate and current with respect to ownership and Operating Agency of the Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

3. Condition 3 regarding construction of Proposed Works/record drawings is included to ensure that the Works are constructed in a timely manner so that standards applicable at the time of Approval of the Works are still applicable at the time of construction to ensure the ongoing protection of the environment and also ensure that the Works are constructed in accordance with the Approval and that record drawings of the Works "as constructed" are updated and maintained for future references.

4. Condition 4 regarding Bypasses is included to indicate that Bypass is prohibited, except in circumstances where the failure to Bypass could result in greater damage to the environment than the Bypass itself. The notification and documentation requirements allow the Ministry to take action in an informed manner and will ensure the Owner is aware of the extent and frequency of Bypass Events.

5. Condition 5 regarding Overflows is included to indicate that Overflow of untreated or partially treated sewage to the receiver is prohibited, except in circumstances where the

failure to Overflow could result in greater damage to the environment than the Overflow itself. The notification and documentation requirements allow the Ministry to take action in an informed manner and will ensure the Owner is aware of the extent and frequency of Overflow Events.

6. Condition 6 regarding design objectives is imposed to establish non-enforceable design objectives to be used as a mechanism to trigger corrective action proactively and voluntarily before environmental impairment occurs.

7. Condition 7 regarding compliance limits is imposed to ensure that the Final Effluent discharged from the Works to the environment meets the Ministry's effluent quality requirements.

8. Condition 8 regarding operation and maintenance is included to require that the Works be properly operated, maintained, funded, staffed and equipped such that the environment is protected and deterioration, loss, injury or damage to any person or property is prevented. As well, the inclusion of a comprehensive operations manual governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the Owner. Such a manual is an integral part of the operation of the Works. Its compilation and use should assist the Owner in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for Ministry staff when reviewing the Owner's operation of the Works.

9. Condition 9 regarding monitoring and recording is included to enable the Owner to evaluate and demonstrate the performance of the Works, on a continual basis, so that the Works are properly operated and maintained at a level which is consistent with the design objectives and compliance limits.

10. Condition 10 regarding Limited Operational Flexibility is included to ensure that the Works are constructed, maintained and operated in accordance with the Approval, and that any pre-approved modification will not negatively impact on the performance of the Works.

11. Condition 11 regarding reporting is included to provide a performance record for future references, to ensure that the Ministry is made aware of problems as they arise, and to provide a compliance record for this Approval.

12.

Schedule A

1. Field Alert Number 4073-9XKJTL, created on June 17, 2015, by Ms. Viktoria Light, Drinking Water Inspector, MOECC, Peterborough Office;

2. Existing ECA # 3560-8A8LEY, issued on November 17, 2010; and
3. Application for Environmental Compliance Approval dated October 21, 2016 signed by Bill Watson, P.Eng., CAO of the Corporation of the Municipality of Brighton, with supporting documentation.
4. Application for Environmental Compliance Approval dated July 9, 2019 and received on July 11, 2019, including design report titled "Brighton WPCP MBBR Addition - Municipality of Brighton", and final plans and specifications prepared by GHD Limited, Waterloo, Ontario.
5. Memorandum from Victor Castro, Surface Water Specialist, Technical Support Section, Eastern Region, MECP to V. Mitchell, Environmental Assessment Coordinator, Technical Support Section, Eastern Region, MECP dated July 13, 2017 Re: Municipality of Brighton, Brighton Wastewater Treatment System, Municipal Class Environmental Assessment Phase 2 Report (Draft).
1.

Schedule B

Final Effluent Design Objectives

Location: Upstream of the Constructed Wetland and Downstream of Where MBBR and Stabilization Lagoon Overflow Combine

Final Effluent Parameter	Averaging Calculator	Objective (milligrams per litre unless otherwise indicated)
CBOD5	Annual Average Effluent Concentration	15.0
Total Suspended Solids	Annual Average Effluent Concentration	15.0
Total Phosphorus	Monthly Average Effluent Concentration	0.8
Ammonia + Ammonium Nitrogen from May 01 to October 31 from November 01 to April 30	Monthly Average Effluent Concentration Monthly Average Effluent Concentration	10.0 15.0
E. coli	Monthly Geometric Mean Density	*200 CFU/100 mL
pH	Single Sample Result	6.5 - 9.0 inclusive

*If the MPN method is utilized for *E.coli* analysis the objective shall be 100 MPN/100 mL

Schedule C

Final Effluent Compliance Limits

Location: Upstream of the Constructed Wetland and Downstream of Where MBBR and Stabilization Lagoon Overflow Combine

Final Effluent Parameter	Averaging Calculator	Limit (milligrams per litre unless otherwise indicated)
CBOD5	Annual Average Effluent Concentration	30.0
Total Suspended Solids	Annual Average Effluent Concentration	40.0
Total Phosphorus	Monthly Average Effluent Concentration	1.0
Ammonia + Ammonium Nitrogen from May 01 to October 31 from November 01 to April 30	Monthly Average Effluent Concentration Monthly Average Effluent Concentration	14.0 17.0
pH	Single Sample Result	between 6.0 - 9.5 inclusive

Final Effluent Loading Limits

Location: Upstream of the Constructed Wetland and Downstream of Where MBBR and Stabilization Lagoon Overflow Combine

Final Effluent Parameter	Averaging Calculator	Limit (kilograms per day unless otherwise indicated)
CBOD5	Annual Average Daily Effluent Loading	138.0
Total Suspended Solids	Annual Average Daily Effluent Loading	184.0
Total Phosphorus	Monthly Average Daily Effluent Loading	4.6
Ammonia + Ammonium Nitrogen from May 01 to October 31 from November 01 to April 30	Monthly Average Daily Effluent Loading Monthly Average Daily Effluent Loading	64.4 78.2

Schedule D

Monitoring Program

Influent Monitoring

Sampling Location: MBBR Influent Inlet Structure

Parameters	Sample Type	Minimum Frequency
BOD5	Grab	Monthly
Total Suspended Solids	Grab	Monthly
Total Phosphorus	Grab	Monthly
Total Kjeldahl Nitrogen	Grab	Monthly

Final Effluent Monitoring

Sampling Location: Upstream of the Constructed Wetland and Downstream of Where MBBR and Stabilization Lagoon Overflow Combine

Parameters	Sample Type	Minimum Frequency
CBOD5	Grab	Weekly
Total Suspended Solids	Grab	Weekly
Total Phosphorus	Grab	Weekly
Total Kjeldahl Nitrogen	Grab	Weekly
Total Ammonia Nitrogen	Grab	Weekly
Nitrate Nitrogen	Grab	Weekly
Nitrite Nitrogen	Grab	Weekly
E. coli	Grab	Monthly
pH*	Grab	Weekly
Temperature*	Grab	Weekly

*pH and temperature of the Final Effluent shall be determined in the field at the time of sampling for Total Ammonia Nitrogen.

Schedule E

Limited Operational Flexibility

Protocol for Pre-Authorized Modifications to Municipal Sewage Works

1. **General**

2. Pre-authorized modifications are permitted only where Limited Operational Flexibility has already been granted in the Approval and only permitted to be made at the pumping stations and sewage treatment plant in the Works, subject to the conditions of the Approval.

3. Where there is a conflict between the types and scope of pre-authorized modifications listed in this document, and the Approval where Limited Operational Flexibility has been granted, the Approval shall take precedence.

4. The Owner shall consult the District Manager on any proposed modifications that may fall within the scope and intention of the Limited Operational Flexibility but is not listed explicitly or included as an example in this document.

5. The Owner shall ensure that any pre-authorized modifications will not:

f. adversely affect the hydraulic profile of the Sewage Treatment Plant or the performance of any upstream or downstream processes, both in terms of hydraulics and treatment performance;

g. result in new Overflow or Bypass locations, or any potential increase in frequency or quantity of Overflow(s) or Bypass(es).

h. result in a reduction in the required Peak Flow Rate of the treatment process or equipment as originally designed.

9. **Modifications that do not require pre-authorization:**

10. Sewage works that are exempt from Ministry approval requirements;

11. Modifications to the electrical system, instrumentation and control system.

12. **Pre-authorized modifications that do not require preparation of “Notice of Modification to Sewage Works”**

13. Normal or emergency maintenance activities, such as repairs, renovations, refurbishments and replacements with Equivalent Equipment, or other improvements to an existing approved piece of equipment of a treatment process do not require pre-authorization. Examples of these activities are:

a. Repairing a piece of equipment and putting it back into operation, including replacement of minor components such as belts, gear boxes, seals, bearings;

b. Repairing a piece of equipment by replacing a major component of the equipment

such as motor, with the same make and model or another with the same or very close power rating but the capacity of the pump or blower will still be essentially the same as originally designed and approved;

c. Replacing the entire piece of equipment with Equivalent Equipment.

14. Improvements to equipment efficiency or treatment process control do not require pre-authorization. Examples of these activities are:

a. Adding variable frequency drive to pumps;

b. Adding on-line analyzer, dissolved oxygen probe, ORP probe, flow measurement or other process control device.

15. **Pre-Authorized Modifications that require preparation of "Notice of Modification to Sewage Works"**

16. Pumping Stations

q. Replacement, realignment of existing sewers including manholes, valves, gates, weirs and associated appurtenances provided that the modifications will not add new influent source(s) or result in an increase in flow from existing sources as originally approved.

r. Extension or partition of wetwell to increase retention time for emergency response and improve station maintenance and pump operation;

s. Replacement or installation of inlet screens to the wetwell;

t. Replacement or installation of flowmeters, construction of station bypass;

u. Replacement, reconfiguration or addition of pumps and modifications to pump suctions and discharge pipings including valve, gates, motors, variable frequency drives and associated appurtenances to maintain firm pumping capacity or modulate the pump rate provided that the modifications will not result in a reduction in the firm pumping capacity or discharge head or an increase in the peak pumping rate of the pumping station as originally designed;

v. Replacement, realignment of existing forcemain(s) including valves, gates, and associated appurtenances provided that the modifications will not reduce the flow capacity or increase the total dynamic head and transient in the forcemain.

23. Sewage Treatment Plant

24. Sewers and appurtenances

a. Replacement, realignment of existing sewers (including pipes and channels) or construction of new sewers, including manholes, valves, gates, weirs and associated appurtenances within the a sewage treatment plant, provided that the modifications will not add new influent source(s) or result in an increase in flow from existing sources as originally approved and that the modifications will remove hydraulic bottlenecks or improve the conveyance of sewage into and through the Works.

25. Flow Distribution Chambers/Splitters

a. Replacement or modification of existing flow distribution chamber/splitters or construction of new flow distribution chamber/splitters, including replacements or installation of sluice gates, weirs, valves for distribution of flows to the downstream process trains, provided that the modifications will not result in a change in flow distribution ratio to the downstream process trains as originally designed.

26. Imported Sewage Receiving Facility

a. Replacement, relocation or installation of loading bays, connect/disconnect hook-up systems and unloading/transferring systems;
b. Replacement, relocation or installation of screens, grit removal units and compactors;
c. Replacement, relocation or installation of pumps, such as dosing pumps and transfer pumps, valves, piping and appurtenances;
d. Replacement, relocation or installation of storage tanks/chambers and spill containment systems;
e. Replacement, relocation or installation of flow measurement and sampling equipment;
f. Changes to the source(s) or quantity from each source, provided that changes will not result in an increase in the total quantity and waste loading of each type of Imported Sewage already approved for co-treatment.

27. Preliminary Treatment System

a. Replacement of existing screens and grit removal units with equipment of the same or higher process performance technology, including where necessary replacement or upgrading of existing screenings dewatering washing compactors, hydrocyclones, grit classifiers, grit pumps, air blowers conveyor system, disposal bins and other ancillary equipment to the screening and grit removal processes.

b. Replacement or installation of channel aeration systems, including air blowers, air supply main, air headers, air laterals, air distribution grids and diffusers.

28. Primary Treatment System

a. Replacement of existing sludge removal mechanism, including sludge chamber;
b. Replacement or installation of scum removal mechanism, including scum chamber;
c. Replacement or installation of primary sludge pumps, scum pumps, provided that:the modifications will not result in a reduction in the firm pumping capacity or discharge head that the primary sludge pump(s) and scum pump(s) are originally designed to handle.

29. Secondary Treatment System

1. Biological Treatment
    a. Conversion of complete mix aeration tank to plug-flow multi-pass aeration tank, including modifications to internal structural configuration;
    b. Addition of inlet gates in multi-pass aeration tank for step-feed operation mode;
    c. Partitioning of an anoxic/flip zone in the inlet of the aeration tank, including installation of submersible mixer(s);
    d. Replacement of aeration system including air blowers, air supply main, air headers, air laterals, air distribution grids and diffusers, provided that the modifications will not result in a reduction in the firm capacity or discharge pressure that the blowers are originally designed to supply or in the net oxygen transferred to the wastewater required for biological treatment as originally required.
2. Secondary Sedimentation
    a. Replacement of sludge removal mechanism, including sludge chamber;
    b. Replacement or installation of scum removal mechanism, including scum chamber;
    c. Replacement or installation of return activated sludge pump(s), waste activated sludge pump(s), scum pump(s), provided that the modifications will not result in a reduction in the firm pumping capacity or discharge head that the activated sludge pump(s) and scum pump(s) are originally designed to handle.

30. Post-Secondary Treatment System

a. Replacement of filtration system with equipment of the same filtration technology, including feed pumps, backwash pumps, filter reject pumps, filtrate extract pumps, holding tanks associated with the pumping system, provided that the modifications will not result in a reduction in the capacity of the filtration system as originally designed.

31. Disinfection System

1. UV Irradiation
    a. Replacement of UV irradiation system, provided that the modifications will not result in a reduction in the design capacity of the disinfection system or the radiation level as originally designed.

2. Chlorination/Dechlorination and Ozonation Systems
    a. Extension and reconfiguration of contact tank to increase retention time for effective disinfection and reduce dead zones and minimize short-circuiting;
    b. Replacement or installation of chemical storage tanks, provided that the tanks are provided with effective spill containment.

32. Supplementary Treatment Systems

1. Chemical systems
    a. Replacement, relocation or installation of chemical storage tanks for existing chemical systems only, provided that the tanks are sited with effective spill containment;
    b. Replacement or installation of chemical dosing pumps provided that the modifications will not result in a reduction in the firm capacity that the dosing pumps are originally designed to handle.
    c. Relocation and addition of chemical dosing point(s) including chemical feed pipes and valves and controls, to improve phosphorus removal efficiency;
    d. Use of an alternate chemical provided that it is a non-proprietary product and is a commonly used alternative to the chemical approved in the Works, provided that the chemical storage tanks, chemical dosing pumps, feed pipes and controls are also upgraded, as necessary..

33. Sludge Management System

1. Sludge Holding and Thickening
    a. Replacement or installation of sludge holding tanks, sludge handling pumps, such as transfer pumps, feed pumps, recirculation pumps, provided that

modifications will not result in reduction in the solids storage or handling capacities;

2. Sludge Digestion
    a. Replacement or installation of digesters, sludge handling pumps, such as transfer pumps, feed pumps, recirculation pumps, provided that modifications will not result in reduction in the solids storage or handling capacities;
    b. replacement of sludge digester covers.

3. Sludge Dewatering and Disposal
    a. Replacement of sludge dewatering equipment, sludge handling pumps, such as transfer pumps, feed pumps, cake pumps, loading pumps, provided that modifications will not result in reduction in solids storage or handling capacities.

4. Processed Organic Waste
    a. Changes to the source(s) or quantity from each source, provided that changes will not result in an increase in the total quantity already approved for co-processing.

34. Standby Power System

1. Replacement or installation of standby power system, including feed from alternate power grid, emergency power generator, fuel supply and storage systems, provided that the existing standby power generation capacity is not reduced.

35. Pilot Study

1. Small side-stream pilot study for existing or new technologies, alternative treatment process or chemical, provided:
    a. all effluent from the pilot system is hauled off-site for proper disposal or returned back to the sewage treatment plant for at a point no further than immediately downstream of the location from where the side-stream is drawn;
    b. no proprietary treatment process or propriety chemical is involved in the pilot study;
    c. the effluent from the pilot system returned to the sewage treatment plant does not significantly alter the composition/concentration of or add any new contaminant/inhibiting substances to the sewage to be treated in the downstream process;
    d. the pilot study will not have any negative impacts on the operation of the

sewage treatment plant or cause a deterioration of effluent quality;

e. the pilot study does not exceed a maximum of two years and a notification of completion shall be submitted to the District Manager within one month of completion of the pilot project.

36. Lagoons

a. installing baffles in lagoon provided that the operating capacity of the lagoon system is not reduced;

b. raise top elevation of lagoon berms to increase free-board;

c. replace or install interconnecting pipes and chambers between cells, provided that the process design operating sequence is not changed;

d. replace or install mechanical aerators, or replace mechanical aerators with diffused aeration system provided that the mixing and aeration capacity are not reduced;

e. removal of accumulated sludge and disposal to an approved location offsite.

37. Final Effluent Disposal Facilities

al. Replacement or realignment of the Final Effluent channel, sewer or forcemain, including manholes, valves and appurtenances from the end of the treatment train to the discharge outfall section, provided that the sewer conveys only effluent discharged from the Sewage Treatment Plant and that the replacement or re-aligned sewer has similar dimensions and performance criteria and is in the same or approximately the same location and that the hydraulic capacity will not be reduced.

This page contains an image of the form entitled "Notice of Modification to Sewage Works". A digital copy can be obtained from the District Manager.

Ontario

Ministry of the Environment, Conservation and Parks

Notice of Modification to Sewage Works

RETAIN COPY OF COMPLETED FORM AS PART OF THE ECA ON-SITE PRIOR TO THE SCHEDULED IMPLEMENTATION DATE.

Part 1 – Environmental Compliance Approval (ECA) with Limited Operational Flexibility

(Insert the ECA's owner, number and issuance date and notice number, which should start with "01" and consecutive numbers thereafter)

ECA Number	Issuance Date (mm/dd/yy)	Notice number (if applicable)

ECA Owner	Municipality

Part 2: Description of the modifications as part of the Limited Operational Flexibility

(Attach a detailed description of the sewage works)

Description shall include:
1. A detail description of the modifications and/or operations to the sewage works (e.g. sewage work component, location, size, equipment type/model, material, process name, etc.)
2. Confirmation that the anticipated environmental effects are negligible.
3. List of updated versions of, or amendments to, all relevant technical documents that are affected by the modifications as applicable, i.e. submission of documentation is not required, but the listing of updated documents is (design brief, drawings, emergency plan, etc.)

Part 3 – Declaration by Professional Engineer

I hereby declare that I have verified the scope and technical aspects of this modification and confirm that the design:
1. Has been prepared or reviewed by a Professional Engineer who is licensed to practice in the Province of Ontario;
2. Has been designed in accordance with the Limited Operational Flexibility as described in the ECA;
3. Has been designed consistent with Ministry's Design Guidelines, adhering to engineering standards, industry's best management practices, and demonstrating ongoing compliance with s.53 of the Ontario Water Resources Act; and other appropriate regulations.

I hereby declare that to the best of my knowledge, information and belief the information contained in this form is complete and accurate

Name (Print)	PEO License Number

Signature	Date (mm/dd/yy)

Name of Employer

Part 4 – Declaration by Owner

I hereby declare that:
1. I am authorized by the Owner to complete this Declaration;
2. The Owner consents to the modification; and
3. This modifications to the sewage works are proposed in accordance with the Limited Operational Flexibility as described in the ECA.
4. The Owner has fulfilled all applicable requirements of the *Environmental Assessment Act*.

I hereby declare that to the best of my knowledge, information and belief the information contained in this form is complete and accurate

Name of Owner Representative (Print)	Owner representative's title (Print)

Owner Representative's Signature	Date (mm/dd/yy)

Schedule F

Methodology for Calculating and Reporting

Monthly Average Effluent Concentration, Annual Average Effluent Concentration and Monthly Geometric Mean Density

1. Monthly Average Effluent Concentration

Step 1: Calculate the arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured during a calendar month and proceed as follows depending on the result of the calculation:

a. If the arithmetic mean does not exceed the compliance limit for the contaminant, then report and use this arithmetic mean as the Monthly Average Effluent Concentration for this parameter where applicable in this Approval;

b. If the arithmetic mean exceeds the compliance limit for the contaminant and there was no Bypass Event during the calendar month, then report and use this arithmetic mean as the Monthly Average Effluent Concentration for this parameter where applicable in this Approval;

c. If the arithmetic mean exceeds the compliance limit for the contaminant and there was Bypass Event(s) during the calendar month, then proceed to Step 2;

d. If the arithmetic mean does not exceed the compliance limit for the contaminant and there was Bypass Event(s) during the calendar month, the Owner may still elect to proceed to Step 2 calculation of the flow-weighted arithmetic mean.

Step 2: Calculate the flow-weighted arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured during a calendar month and proceed depending on the result of the calculation:

a. Group No Bypass Days (**NBPD**) data and Bypass Days (**BPD**) data during a calendar month separately;

b. Calculate the arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured on all NBPD during a calendar month and record it as **Monthly Average NBPD Effluent Concentration**;

c. Obtain the "**Total Monthly NBPD Flow**" which is the total amount of Final Effluent discharged on all NBPD during the calendar month;

d. Calculate the arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured on all BPD during a calendar month and record it as **Monthly Average BPD Effluent Concentration**;

e. Obtain the "**Total Monthly BPD Flow**" which is the total amount of Final Effluent discharged on all BPD during the calendar month;

f. Calculate the flow-weighted arithmetic mean using the following formula:

[(Monthly Average NBPD Effluent Concentration × Total Monthly NBPD Flow) + (Monthly Average BPD Effluent Concentration × Total Monthly BPD Flow)] ÷ (Total Monthly NBPD Flow + Total Monthly BPD Flow)

It should be noted that in this method, if there are no Bypass Event for the month, the calculated result would be the same as the non-flow-weighted arithmetic mean method;

g. Report and use the lesser of the flow-weighted arithmetic mean obtained in Step 2 and the arithmetic mean obtained in Step 1 as the Monthly Average Effluent Concentration for this parameter where applicable in this Approval.

2. Annual Average Effluent Concentration

Step 1: Calculate the arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured during a calendar year and proceed as follows depending on the result of the calculation:

a. If the arithmetic mean does not exceed the compliance limit for the contaminant, then report and use this arithmetic mean as the Annual Average Effluent Concentration for this parameter where applicable in this Approval;

b. If the arithmetic mean exceeds the compliance limit for the contaminant and there was no Bypass Event during the calendar year, then report and use this arithmetic mean as the Annual Average Effluent Concentration for this parameter where applicable in this Approval;

c. If the arithmetic mean exceeds the compliance limit for the contaminant and there was Bypass Event(s) during the calendar year, then proceed to Step 2;

d. If the arithmetic mean does not exceed the compliance limit for the contaminant and there was Bypass Event(s) during the calendar year, the

Owner may still elect to proceed to Step 2 calculation of the flow-weighted arithmetic mean.

Step 2: Calculate the flow-weighted arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured during a calendar year and proceed depending on the result of the calculation:

a. Group No Bypass Days (**NBPD**) data and Bypass Days (**BPD**) data during a calendar year separately;

b. Calculate the arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured on all NBPD during a calendar year and record it as **Annual Average NBPD Effluent Concentration**;

c. Obtain the "**Total Annual NBPD Flow**" which is the total amount of Final Effluent discharged on all NBPD during the calendar year;

d. Calculate the arithmetic mean of all Single Sample Results of the concentration of a contaminant in the Final Effluent sampled or measured on all BPD during a calendar year and record it as **Annual Average BPD Effluent Concentration**;

e. Obtain the "**Total Annual BPD Flow**" which is the total amount of Final Effluent discharged on all BPD during the calendar year;

f. Calculate the flow-weighted arithmetic mean using the following formula:

[(Annual Average NBPD Effluent Concentration × Total Annual NBPD Flow) + (Annual Average BPD Effluent Concentration × Total Annual BPD Flow)] ÷ (Total Annual NBPD Flow + Total Annual BPD Flow)

It should be noted that in this method, if there are no Bypass Event for the calendar year, the calculated result would be the same as the non-flow-weighted arithmetic mean method;

g. Report and use the lesser of the flow-weighted arithmetic mean obtained

in Step 2 and the arithmetic mean obtained in Step 1 as the Annual Average Effluent Concentration for this parameter where applicable in this Approval.

3. Monthly Geometric Mean Density

Geometric mean is defined as the n^{th} root of the product of *n* numbers. In the context of calculating Monthly Geometric Mean Density for *E. coli*, the following formula shall be used:

$$\sqrt[n]{x_1 x_2 x_3 \cdots x_n}$$

in which,

"*n*" is the number of samples collected during the calendar month; and

"*x*" is the value of each Single Sample Result.

For example, four weekly grab samples were collected and tested for *E. coli* during the calendar month. The *E. coli* densities in the Final Effluent were found below:

Sample Number	***E. coli* Densities* (CFU/100 mL)**
1	10
2	100
3	300
4	50

The Geometric Mean Density for these data:

$$\sqrt[4]{10 \times 100 \times 300 \times 50} = 62$$

*If a particular result is zero (0), then a value of one (1) will be substituted into the calculation of the Monthly Geometric Mean Density. If the MPN method is utilized for E. coli analysis, values in the table shall be MPN/100 mL.

Schedule G

Municipal and Local Services Board Wastewater System

Profile Information Form

(For reference only, images of the form are attached on the next four pages. A digital copy can be obtained from the District Manger.)

Ontario

Ministry of the Environment, Conservation and Parks

Municipal and Local Services Board Wastewater System Profile Information Form

The information in this form is necessary to administer the Ministry's approvals, compliance and enforcement programs with respect to wastewater treatment and collection systems owned by municipalities and local services boards. These programs are authorized under the *Ontario Water Resources Act*, the *Environmental Protection Act*, the *Nutrient Management Act* and their respective regulations.

Email the completed form to: waterforms@ontario.ca
For any questions call 1-866-793-2588.

[A] SYSTEM PROFILE INFORMATION

Wastewater System Number *(if assigned)*

☐ New Profile
☐ Update Existing Profile

Name of System

Name of Municipality or Local Services Board

Level of Treatment (select one*)
☐ Primary
☐ Secondary
☐ Tertiary
☐ Secondary Equivalent
☐ Other (specify):
*See Terms and Concepts on page 4

Population Served	Population (Design)	Type of System
		☐ Treatment & Collection System ☐ Collection System Only

Design Rated Capacity (m^3/day)	Peak Flow Rate (m^3/day)	Current Environmental Compliance Approval (ECA) Number	Current ECA Issue Date (yyyy/mm/dd):

The treatment plant receives sewage from: (Check all that applies.* If you have checked more than one option below, indicate the approximate %)

☐ Sanitary Sewer ☐ Combined Sewer
☐ Nominally Separated Sewer ☐ Partially Separated Sewer *See Terms and Concepts on page 4

[B] OWNER INFORMATION

Legal Name of Municipality or Local Services Board

Unit No	Street No.	Street Name.	Street Type (St, Rd, etc)	Street Direction (N,S,E,W)

PO Box	City/Town	Postal Code

☐ Dr ☐ Miss ☐ Mr ☐ Mrs ☐ Ms	Owner Contact First Name	Owner Contact Last Name	Owner Contact Job Title

Tel. No.	Fax Number	Email address
( ) - ext.	( ) -	

[C] OPERATING AUTHORITY ☐ Check if same as owner

Legal Name of Operator

Unit No	Street No.	Street Name.	Street Type (St, Rd, etc)	Street Direction (N,S,E,W)

PO Box	City/Town	Postal Code

☐ Dr ☐ Miss ☐ Mr ☐ Mrs ☐ Ms	Operator Contact First Name	Operator Contact Last Name	Operator Contact Job Title

Tel. No.	Fax Number	Email address
( ) - ext.	( ) -	

[D] 24/7 CONTACT

☐ Dr ☐ Miss ☒ Mr ☐ Mrs ☐ Ms	First Name	Last Name	Job Title

Tel. No.	Fax Number	Email address
( ) - ext.	( ) -	

[E] SYSTEM CIVIC LOCATION ADDRESS (I.E. ADDRESS OF TREATMENT PLANT)

Unit No	Street No.	Street Name.	Street Type (St, Rd, etc)	Street Direction (N,S,E,W)

PO Box	City/Town	Postal Code

If the Wastewater System has no street address

Geographical Township	Lot	Concession

Geographical Referencing (if known, enter the Geographical Reference Information for this Wastewater System)

Map Datum	Geo-Referencing Method	Accuracy Estimate	Location Reference	
Latitude	**Longitude**	**Zone**	**Easting**	**Northing**

[F] TREATMENT PROCESS

Preliminary	Primary	Secondary	Secondary Equivalent	Post-Secondary	Additional Treatment
☐ Screening	☐ Settling/sedimentation/ clarification	☐ Conventional Activated Sludge (CAS)	☐ Aerated Lagoon	☐ Filtration	☐ Phosphorous Removal ☐ Biological ☐ Chemical
☐ Shredding/ grinding	☐ Scum Removal	☐ Extended Aeration	☐ Facultative Lagoon	☐ Clarification	If chemical is used, specify:
☐ Grit Removal	☐ Polymer Addition	☐ Membrane Bioreactor (MBR)	☐ Anaerobic Lagoon	☐ Intermittent Sand Filter (after lagoons)	☐ Nitrification
☐ Other(specify):	☐ Other(specify):	☐ Sequencing Batch Reactor (SBR)	☐ Aerobic Lagoon	☐ Polishing Wetlands	☐ Denitrification
		☐ Rotating Biological Contactor (RBC)	☐ Other(specify):	☐ Polishing Lagoons	☐ Other(specify):
		☐ Trickling Filter (TF)		☐ Other(specify):	
		☐ Biological Aerated Filter (BAF)			
		☐ Other(specify):			

[G] DISINFECTION

Method of Disinfection	Disinfection Period
☐ Chlorination If you chlorinate, do you practice de-chlorination? ☐ Yes ☐ No	☐ Continuous ☐ Seasonal
☐ Ultraviolet Irradiation	☐ Continuous ☐ Seasonal
☐ Other (specify):	☐ Continuous ☐ Seasonal

[H] SLUDGE

Sludge Stabilization Process	Method of Sludge Disposal/Utilization
☐ Aerobic Digestion	☐ Agricultural
☐ Anaerobic Digestion	☐ Landfill
☐ Drying & Pelletization	☐ Incineration
☐ Lime Treatment	☐ Other (specify):
☐ Composting	
☐ Other (specify):	

Available Sludge Storage Capacity (m^3):

[I] EFFLUENT

Effluent Disposal Method	Effluent Discharge Frequency
☐ Surface Water Receiving Water Body Name:	☐ Continuous ☐ Seasonal
☐ Subsurface	☐ Continuous ☐ Seasonal
☐ Other (specify):	☐ Continuous ☐ Seasonal

Is the effluent discharged in a vulnerable area identified in the local source protection assessment report approved under the Clean Water Act, 2006?
☐ Yes ☐ No

[J] INFLUENT

Does the plant receive sewage from another municipality or local services board either through an interconnected collection system or hauled sewage?

☐ Yes ☐ No
(if yes, name(s) of other municipality or local services board):

Plant receives:
☐ Leachate (approximate annual volume in m^3):
☐ Septage (approximate annual volume in m^3):
☐ Industrial input (approximate annual volume in m^3):
or (approximate volume in %):

Terms and Concepts

The following Terms and Concepts are provided to assist you when completing Wastewater System Profile Information Form.

In order to determine the level of treatment that applies to the wastewater system, the effluent quality objectives that the wastewater treatment plant was designed to meet must be considered. The process based approach often used in the past has led to confusion and is open to interpretation due to recent developments and practices in the wastewater treatment industry. For example, a plant with a high rate filter (often referred to as a tertiary filter) after its secondary treatment was considered a tertiary treatment in the past since the filter was designed and operated to produce a tertiary quality effluent. However, secondary plants are now being constructed with these filters as a safeguard against any potential secondary clarifier performance degradation and not for the purpose of ensuring tertiary treatment performance. Also, new technologies have evolved that can produce tertiary quality effluent without having these high rate filters (e.g., membrane bioreactors). Lagoons were considered in the past as being capable of providing only secondary equivalent treatment. However, with add-on treatment after the lagoons (e.g. intermittent sand filters), many lagoon treatment systems are capable of producing secondary or tertiary quality effluent.

During the establishment of sewage works, site-specific effluent limits (including averaging periods) are provided by the Ministry's Regional Technical Support Section, considering the assimilative capacity of the receivers and the minimum treatment requirements provided in Procedure F-5-1. The designer of the sewage works then selects objective values that are acceptable to the Ministry and are less (i.e. more stringent) than the effluent limits , in order to provide an adequate safety factor based on the designer's confidence/experience with the technology chosen and other site-specific conditions. The sewage works are then designed (and operated) to meet these design objectives in a reliable and consistent manner. Therefore, the values that are to be used in the determination of the level of treatment that applies to the sewage works must be based on the design objectives, and not the effluent limits.

Two common parameters used in almost all sewage works designs and performance evaluations are $CBOD_5$ (carbonaceous biochemical oxygen demand) (BOD_5 – biochemical oxygen demand - for primary sewage works) and total suspended solids (TSS). Therefore, it is logical that the **objective values** of these two parameters are used to determine the level of treatment at the sewage works.

Level of Treatment:

Primary:
Wastewater treatment plants that have only settling/sedimentation (with or without chemical addition) and providing 30% and 50% or better reduction of BOD_5 and TSS respectively are considered primary plants (MOE Procedures F-5-1 and F-5-5).

Secondary:
Wastewater treatment plants that have biological processes (e.g. activated sludge process and its variations, fixed film processes) or physical-chemical processes producing an effluent quality of $CBOD_5$ and TSS of 15 mg/L or better are considered secondary plants (MOE Design Guidelines for Sewage Works, 2008).

Secondary Equivalent:
Wastewater treatment plants producing an effluent quality of $CBOD_5$ of 25 mg/L and TSS of 30 mg/L or better are considered as secondary equivalent plants.

Note: Wastewater treatment plants that provide only primary settling of solids and the addition of chemicals to improve the removal of TSS (and phosphorus) are not considered as secondary treatment plants or secondary equivalent plants (MOE Design Guidelines for Sewage Works, 2008).

Tertiary:
Wastewater treatment plants that have biological processes (e.g. activated sludge process and its variations, fixed film processes) and/or physical-chemical processes producing an effluent quality of $CBOD_5$ and TSS of 5 mg/L or better are considered tertiary plants.

Note: Biological processes such as nitrification, denitrification and enhanced biological phosphorus removal can be part of either a secondary or tertiary treatment plant. They may be described as secondary treatment plant with nitrification, secondary treatment plant with enhanced biological phosphorus removal, tertiary treatment plant with nitrification etc.

Sewer System Type:

Sanitary Sewers:
Pipes that convey sanitary sewage flows made up of wastewater discharges from residential, commercial, institutional and industrial establishments plus extraneous flow components from such sources as groundwater and surface run off.

Combined Sewers:
Pipes that convey both sanitary sewage and stormwater runoff through a single-pipe system.

Partially Separated Sewers:
Exist when either a portion of the combined sewer area was retrofitted to separate (sanitary and storm) sewers and/or a service area with combined sewers has had a new development area with separate sewers added to the service area; whatever the case may be, the final flows will be combined sewage.

Nominally Separated Sewers:
These sewers are constructed as separate sewers, but the sanitary sewers accept stormwater from roof and foundation drains (i.e., these are separated sewers in name only).

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). 3644-BWXRNN issued on January 15, 2021

In accordance with Section 139 of the *Environmental Protection Act,* you may by written

notice served upon me and the Ontario Land Tribunal within 15 days after receipt of this notice, require a hearing by the Tribunal. Section 142 of the *Environmental Protection Act* provides that the notice requiring the hearing ("the Notice") shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

Pursuant to subsection 139(3) of the *Environmental Protection Act,* a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

Registrar*
Ontario Land Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5
OLT.Registrar@ontario.ca

and

The Director appointed for the purposes of Part II.1 of the *Environmental Protection Act*
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

*** Further information on the Ontario Land Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349 or 1 (866) 448-2248, or** www.olt.gov.on.ca

The above noted activity is approved under s.20.3 of Part II.1 of the *Environmental Protection Act.*

DATED AT TORONTO this 21st day of April, 2022

Aziz Ahmed, P.Eng.
Director
appointed for the purposes of Part II.1 of the *Environmental Protection Act*

AN/
c: District Manager, MECP Peterborough
Heather Brewer, GHD Limited

Appendix E

Brighton Lagoon Sludge Survey Report

SLUDGE SURVEY METHODOLOGY – TOWN OF BRIGHTON – WASTEWATER LAGOONS

Single beam hydrographic survey:

Sludge Mapper uses a single beam echosounder and RTK GNSS positioning to map the sludge blanket. A perpendicular grid was surveyed using a single-beam echosounder on accessible areas of the Stabilization and Aeration Lagoons at the Town of Brighton wastewater facility.

Gridded interpolations of echosounder data are presented in the sludge survey report.

Sludge Survey Equipment:

Vessel: Inshore survey vessel (Commercial grade inflatable) outfitted with survey system and gas motor.

Positioning: Dual Frequency Multi-constellation (DFMC) RTK Base and Rover GNSS system

Control point – Sludge Mapper set a control point on top of the manhole structure, and processed base-collected static data using the NRCAN PPP service to compute higher accuracy positioning.

Map: Google satellite imagery.

Single beam echosounder: Echologger EU D32 (High Frequency at 200 kHz, Low Frequency at 30 kHz)

Sludge/liner measurement and sampling devices: Markland Infrared sludge interface detector, Ekman grab sampler, and GNSS-mounted metered survey rod.

Survey line spacing	3 m Aeration, 6m Stabilization Lagoons
Survey speed	< 2 m/s
Number of sludge samples collected per cell	4 samples (composited) per cell
Transducer settings	HF: 200 kHz, LF: 30 kHz.

Table 1 Sludge Survey Details

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	14-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Town of Brighton Lagoon Sludge Survey 2023 Supplement A – Methodology
Project Number	23013
Revision	0
Sheet	Page **1** of **4** — Sheet Print 11x17

SLUDGE SURVEY METHODOLOGY – LAGOON ECHOGRAM SAMPLE

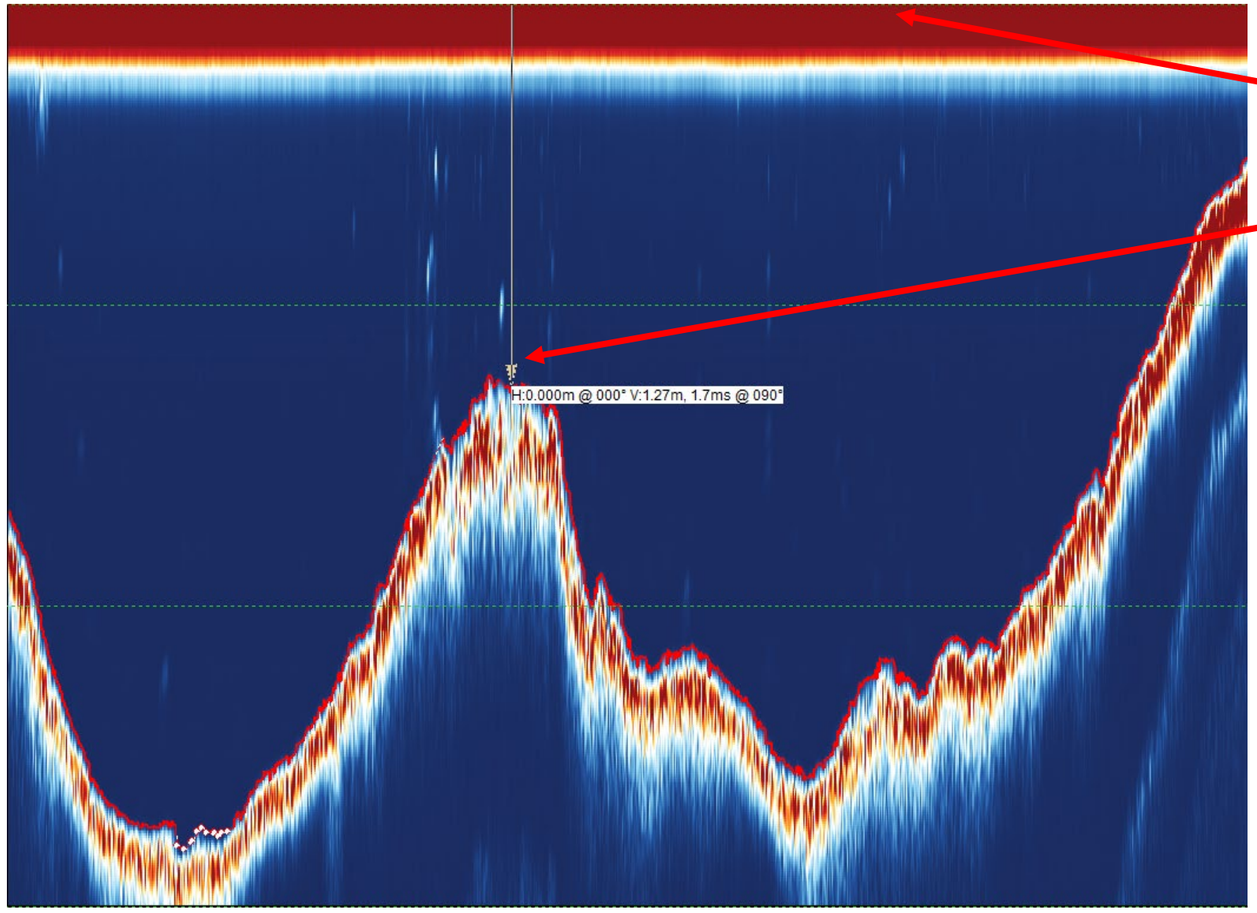


Figure 1 Aeration Lagoon sample echogram.

The single beam echosounder high frequency (200kHz) echogram image at left represents the cross section (elevation) view of a survey line taken in the Aeration Lagoon.

The waterline is at the top of the echogram.

Depth marker: The top of the sludge blanket is measured at approximately 1.27 m depth at this point.

The image below shows the survey line (denoted with red arrows) corresponding to the location of the echogram (image to the left) in the lagoon. The yellow crosshairs indicate the location of the depth marker.

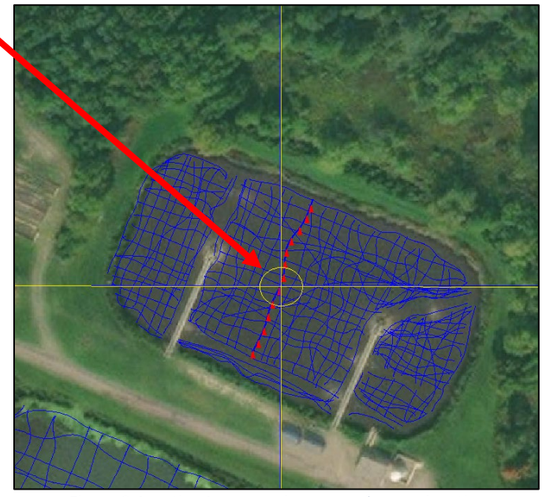


Figure 2 Aeration Lagoon echogram reference location

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	14-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Town of Brighton Lagoon Sludge Survey 2023 Supplement A – Methodology	
Project Number	23013	
Revision	0	
Sheet	Page **2** of **4**	Sheet Print 11x17

SURVEY METHODOLOGY – SITE IMAGES

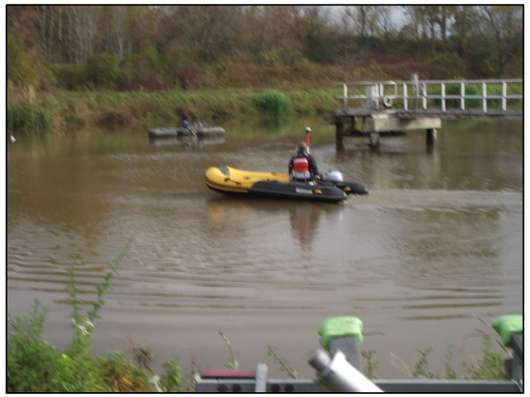


Figure 3 Sludge Mapper vessel and sonar system on the lagoon.

Figure 4 Sludge sample collection

Figure 5 Liner measurements taken using a GNSS-mounted survey rod.

Figure 6 Sludge Mapper Base location.

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	14-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Town of Brighton Lagoon Sludge Survey 2023 Supplement A – Methodology	
Project Number	23013	
Revision	0	
Sheet	Page **3** of **4**	Sheet Print 11x17

SURVEY METHODOLOGY – NORTH & SOUTH LAGOON LINERS

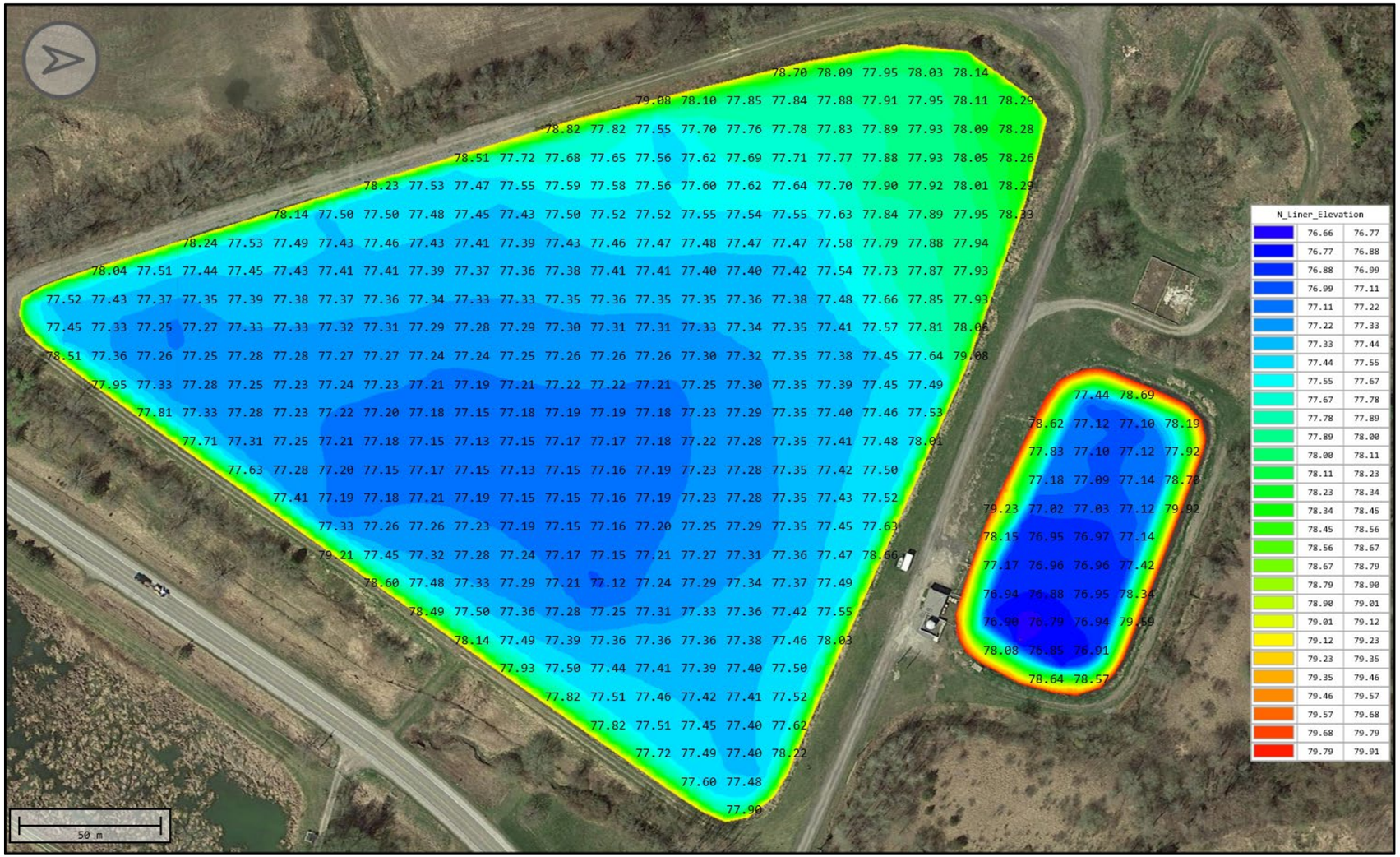


Figure 8 Stabilization & Aeration Lagoon liner elevations used for volume calculations (m)

This is not a legal or engineered survey document
Matrix depths and elevations are interpolated from field measurements
Depths are relative to water level at the time of the survey
Survey data collected on Oct 24 - 26, 2023.
Report any discrepancies in this report to Sludge Mapper Ltd.
Do not modify or use this report for purposes other than which it is intended
Satellite imagery is for reference purposes only

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	14-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Town of Brighton Lagoon Sludge Survey 2023 Supplement A – Methodology	
Project Number	23013	
Revision	0	
Sheet	Page **4** of **4**	Sheet Print 11x17

Town of Brighton, Sludge Survey Report 2023

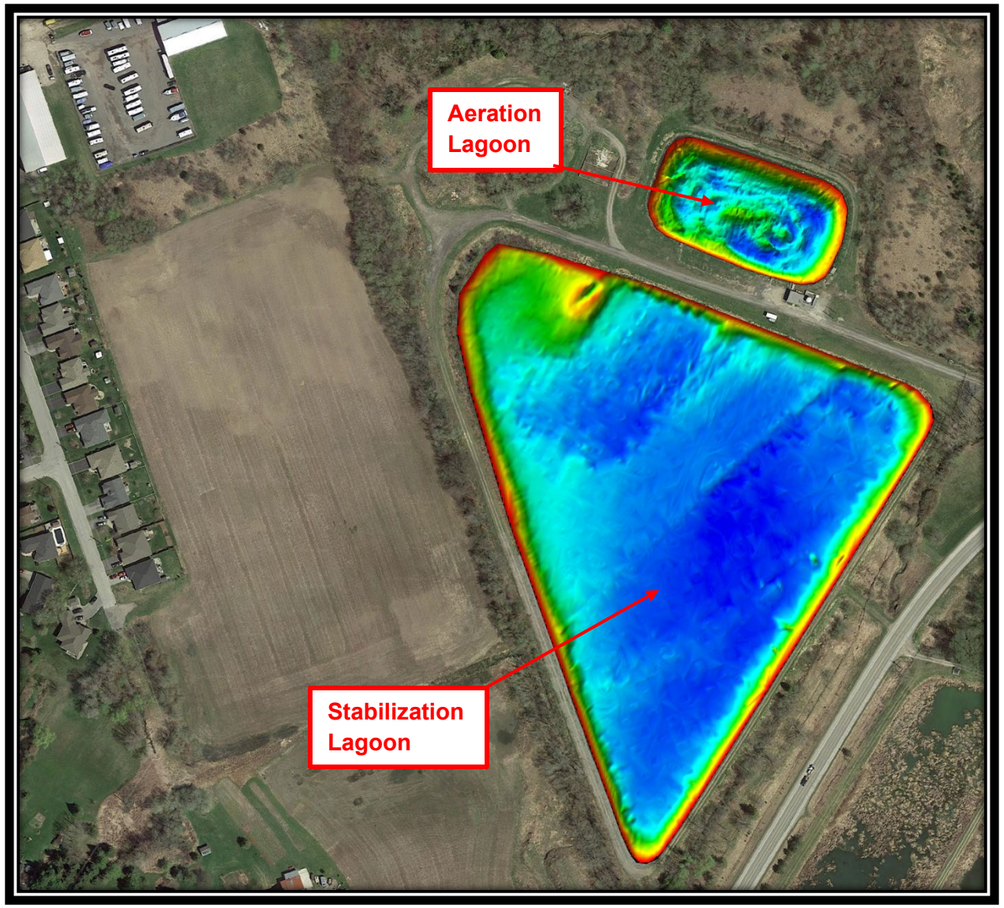


Figure 1 Brighton, ON Wastewater Lagoons Overview

Brighton, ON – Town of Brighton Wastewater Lagoons

This is not a legal survey document
Matrix depths and elevations are interpolated from field measurements
Depths are relative to water level at the time of the survey
Survey data collected on Oct 24 -26, 2023
Report any discrepancies in this report to Sludge Mapper Ltd.
Do not modify or use this report for purposes other than which it is intended
Satellite imagery is for reference purposes only

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Brighton, ON Wastewater Lagoons Sludge Survey 2023 Report
Project Number	23014
Revision	0
Sheet	Page **1** of **18** — Print Sheet 11x17

FIGURES & TABLES SUMMARY

List of Figures

List of Tables

List of Appendices

List of Supplements

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Brighton, ON Wastewater Lagoons Sludge Survey 2023 Report
Project Number	23014
Revision	0
Sheet	Page **2** of **18** — Print Sheet 11x17

EXECUTIVE SUMMARY

Sludge Mapper conducted a sludge survey at the Town of Brighton Wastewater Lagoon Facility, in Brighton, ON on October 24 - 26, 2023. The purpose of the sludge survey and this report is to map and quantify sludge accumulation in the Town of Brighton Wastewater Lagoons. The Town of Brighton Wastewater Lagoons were in service at the time of the survey.

Location	Water Body ID	Client	Client Contact	Date(s) of Survey	Map Grid Refernce	Vertical Datum	Control Points	Report Prepared by	Survyors
Brighton, ON	Stabilization Lagoon Aeration Lagoon	Town of Brighton	Adam Walraven	24/10/2023 - 26/10/2023	Horizontal Datum: CSRS NAD83 Projection: UTM, Zone 18N	CGVD2013	SMC1 Base Occupied static control point for processing with NRCAN PPP Service	M. Caffray	M. Caffray P. Ireland

Table 1 Summary of project details

Cell	Water Elevation CGVD2013 (m)	Maximum measured liner depth inside toe (m)	Current hydraulic capacity (m^3)	Estimated sludge volume (m^3)	Estimated bone dry tonnes (BDTs) of sludge to be removed	Percent of total cell volume occupied by sludge (at surveyed dimensions)
Stabilization	79.339	2.26	77,093	20,695	2,214	21%
Aeration	79.994	3.15	11,576	3,866	514	25%

Table 2 Summary of sludge survey data points

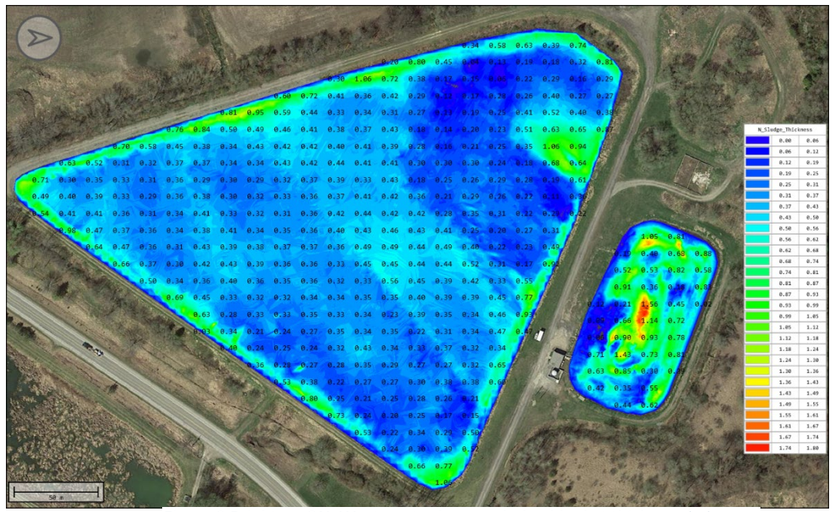


Figure 2 Brighton, ON, Wastewater lagoon sludge blanket thickness (m)

Figure 3 Brighton, ON, Wastewater lagoon liner elevations (m)

This is not a legal survey document
Matrix depths and elevations are interpolated from field measurements
Depths are relative to water level at the time of the survey
Survey data collected on Oct 24 -26, 2023
Report any discrepancies in this report to Sludge Mapper Ltd.
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Satellite imagery is for reference purposes only

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Brighton, ON Wastewater Lagoons Sludge Survey 2023 Report	
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AERATION LAGOON – TOP OF SLUDGE ELEVATIONS

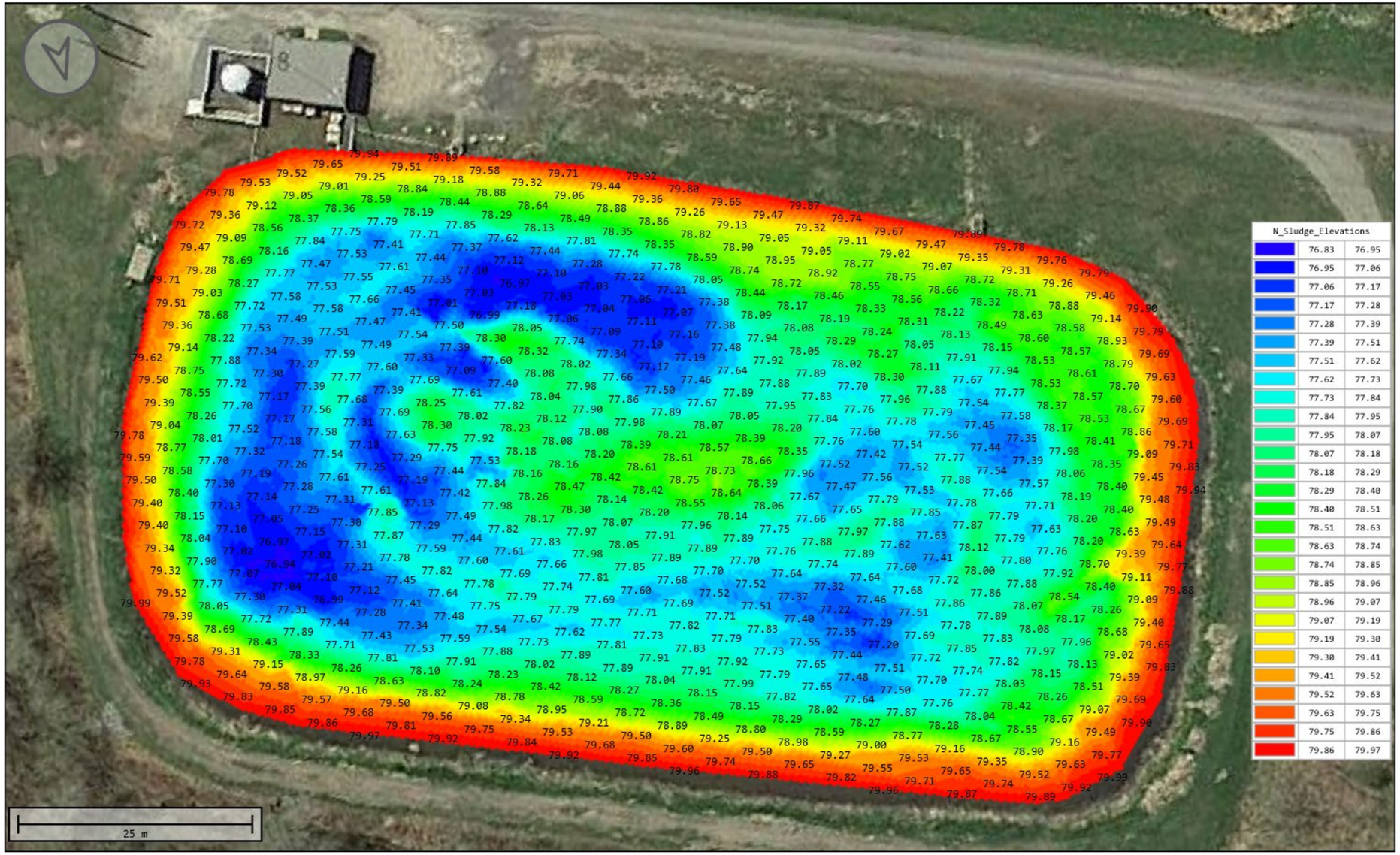

Figure 4 Aeration Lagoon top of sludge blanket elevations (m)

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

SludgeMapper

Project Title	Brighton, ON Wastewater Lagoons Sludge Survey 2023 Report
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Unless otherwise specified all dimensions are in meters

STABILIZATION LAGOON – TOP OF SLUDGE ELEVATIONS

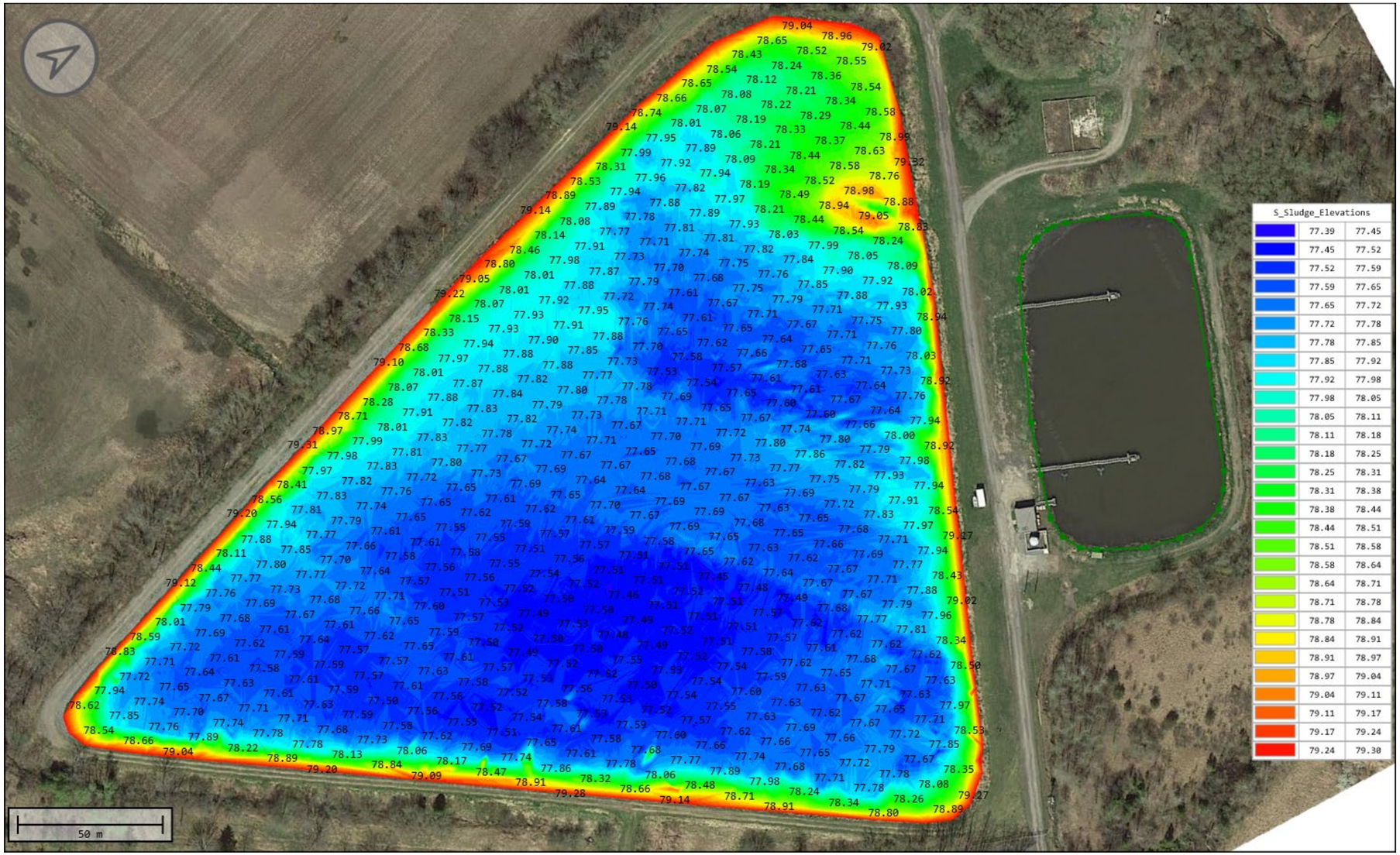

Figure 5 Stabilization Lagoon top of sludge elevations (m).

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Reviewed by:	MC	11-11-2023

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SludgeMapper

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AERATION LAGOON – SLUDGE BLANKET THICKNESS

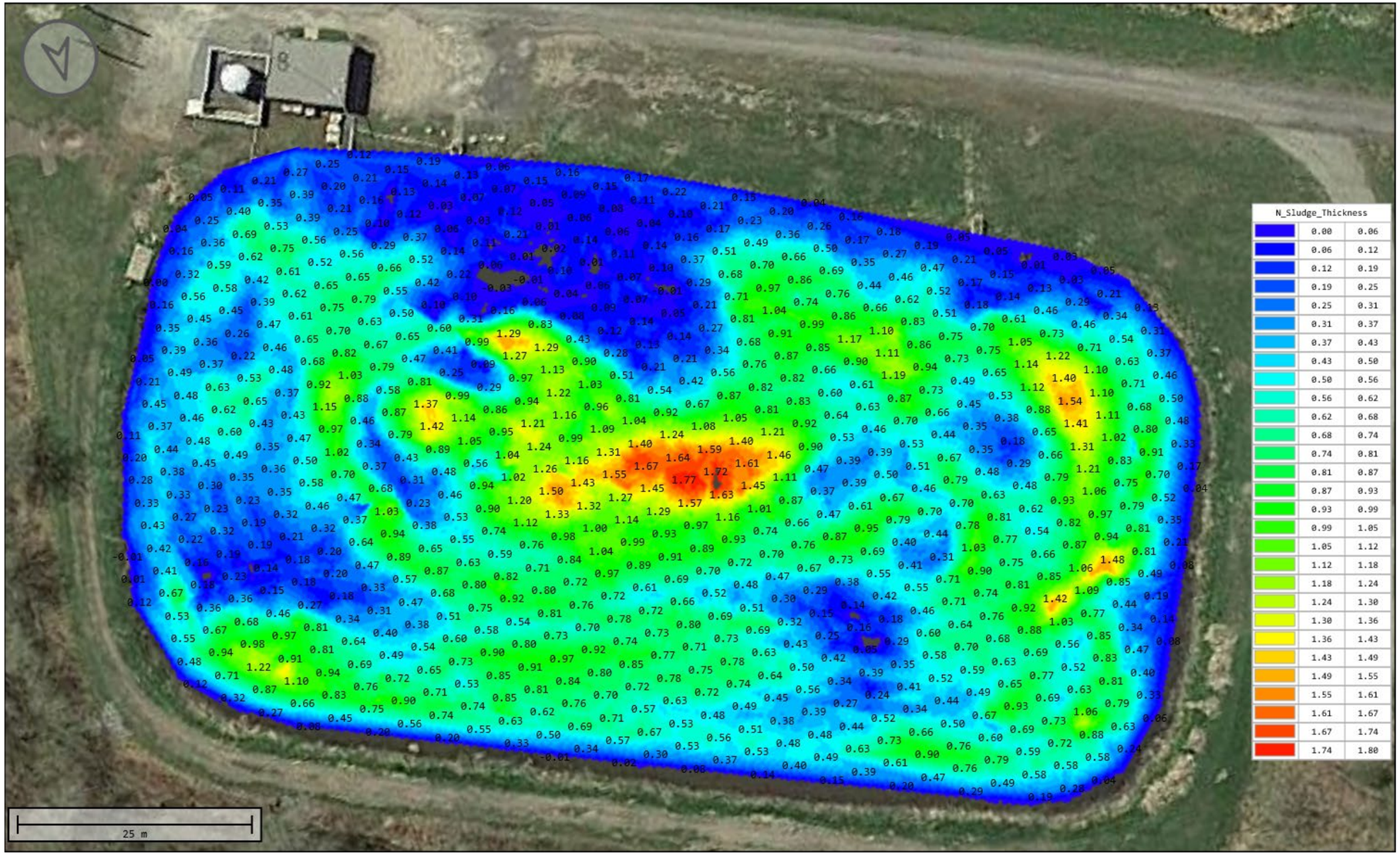

Figure 6 Aeration Lagoon sludge blanket thickness (m)

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023
Unless otherwise specified all dimensions are in meters		

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STABILIZATION LAGOON – SLUDGE BLANKET THICKNESS

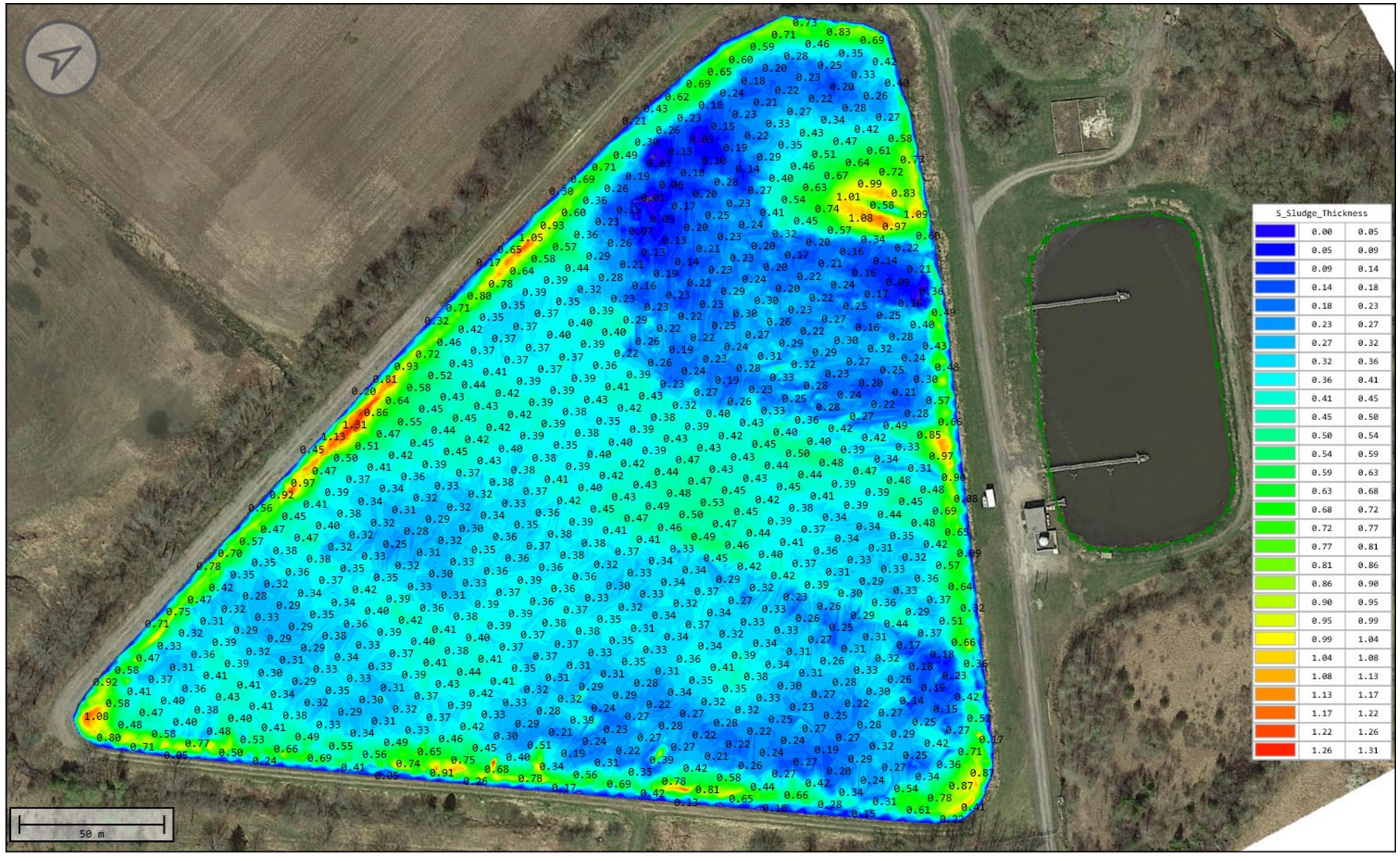

Figure 7 Stabilization sludge blanket thickness (m)

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AERATION LAGOON – TOP OF SLUDGE DEPTHS

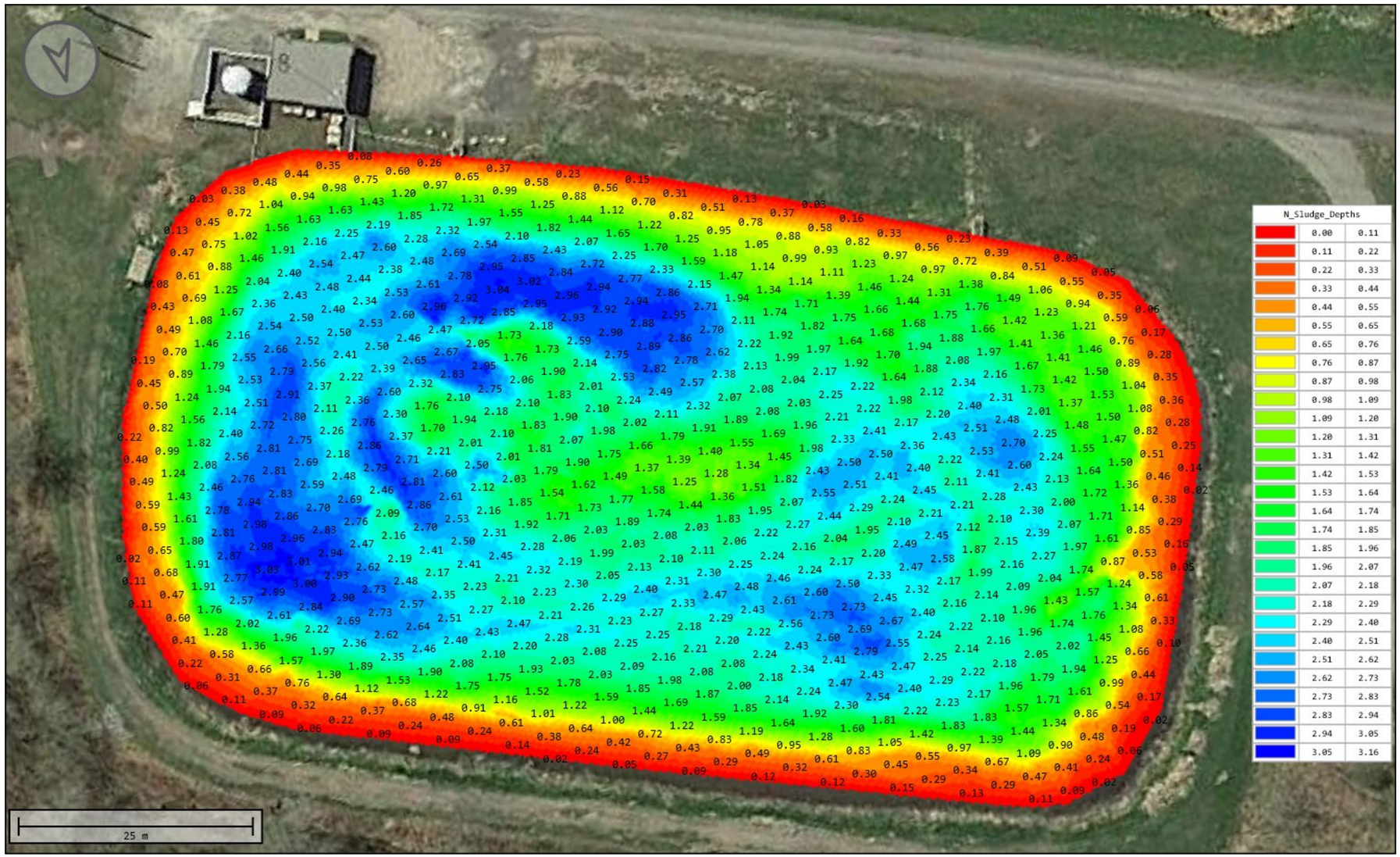

Figure 8 Aeration Lagoon top of sludge depths (m)

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

Unless otherwise specified all dimensions are in meters

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STABILIZATION LAGOON – TOP OF SLUDGE DEPTHS

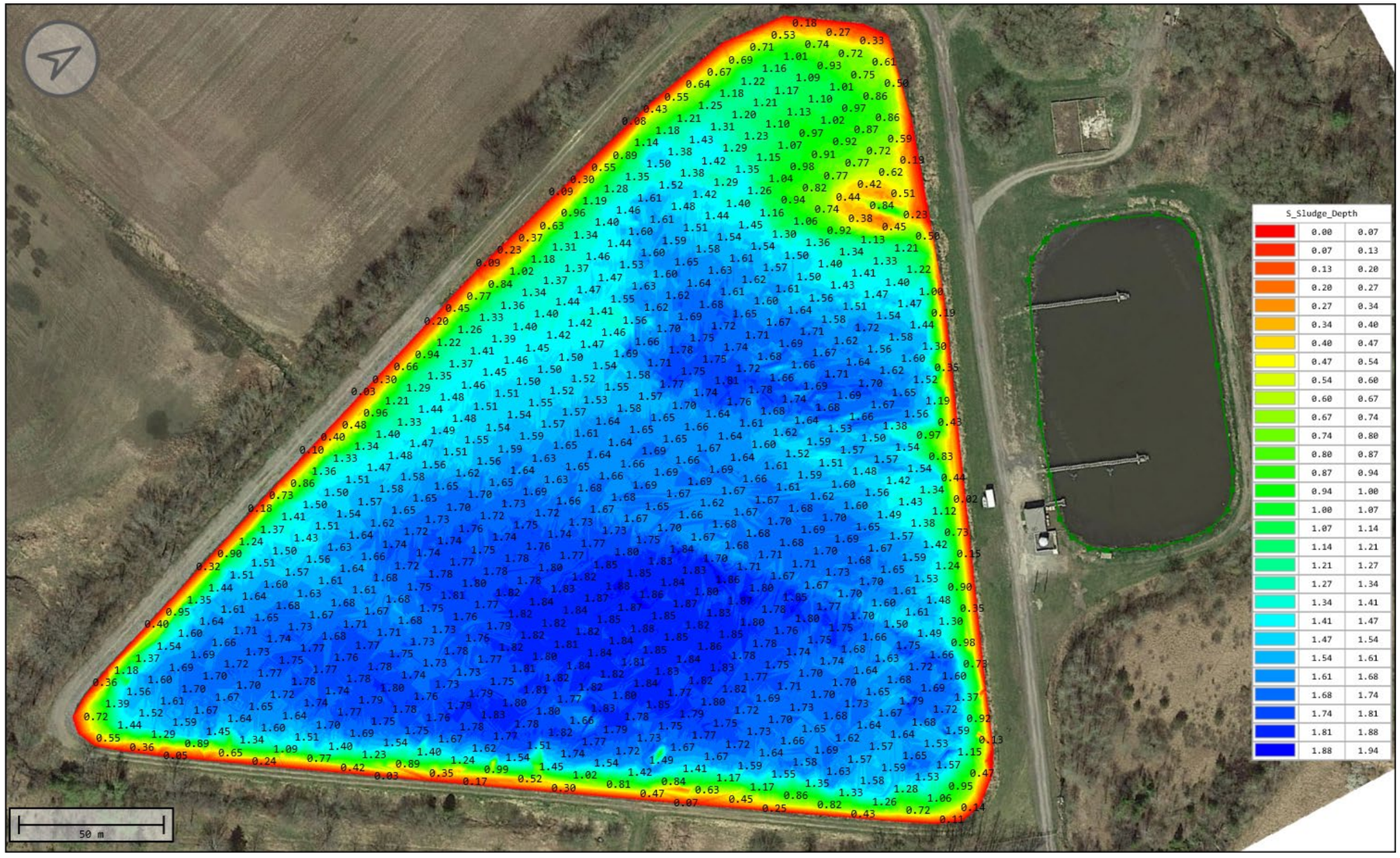

Figure 9 Stabilization Lagoon top of sludge depths (m)

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AERATION LAGOON – TRANSPARENT SLUDGE THICKNESS

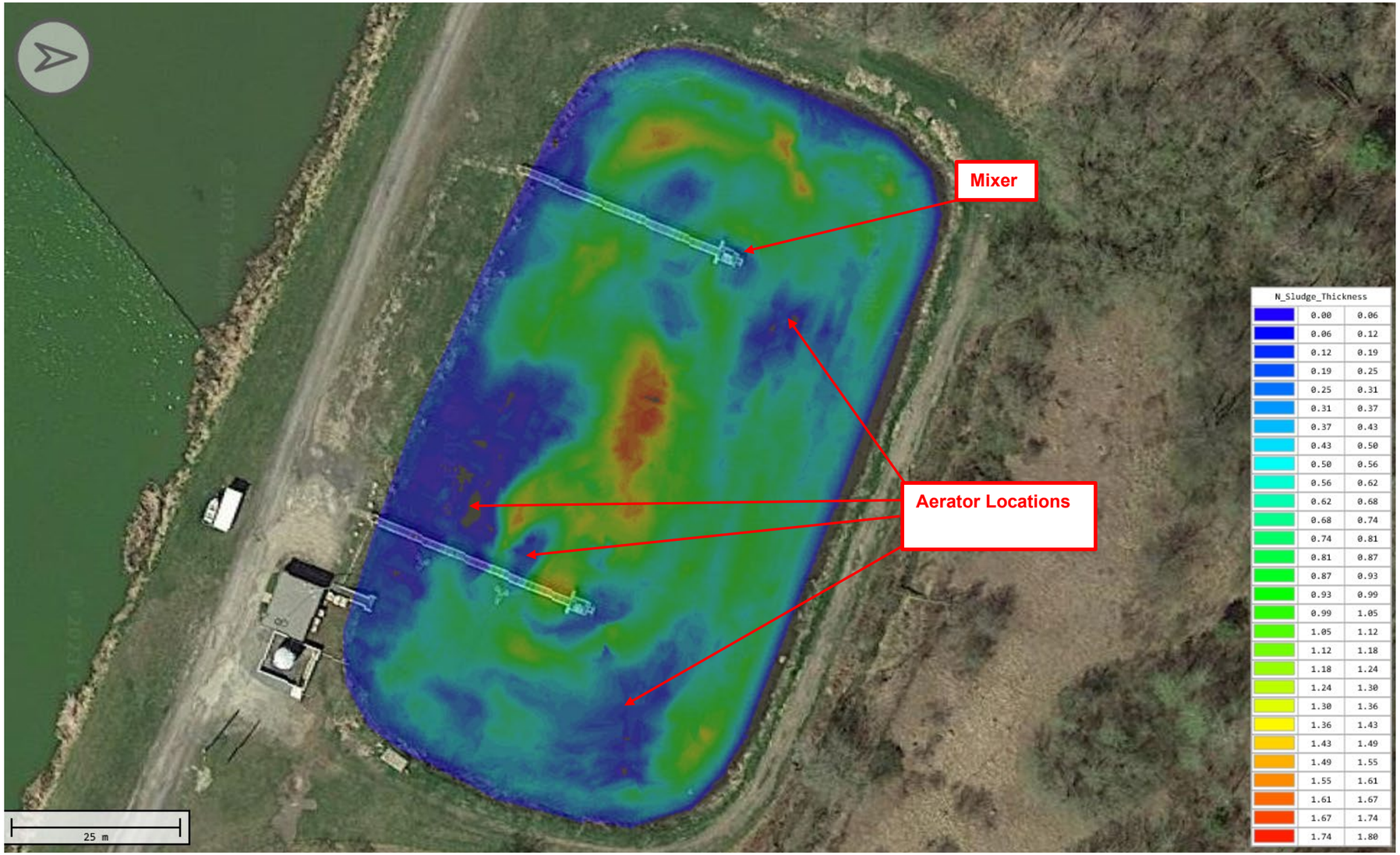

Figure 10 Aeration Lagoon transparent sludge thickness.

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

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Project Number	23014
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STABILIZATION LAGOON – TRANSPARENT SLUDGE THICKNESS

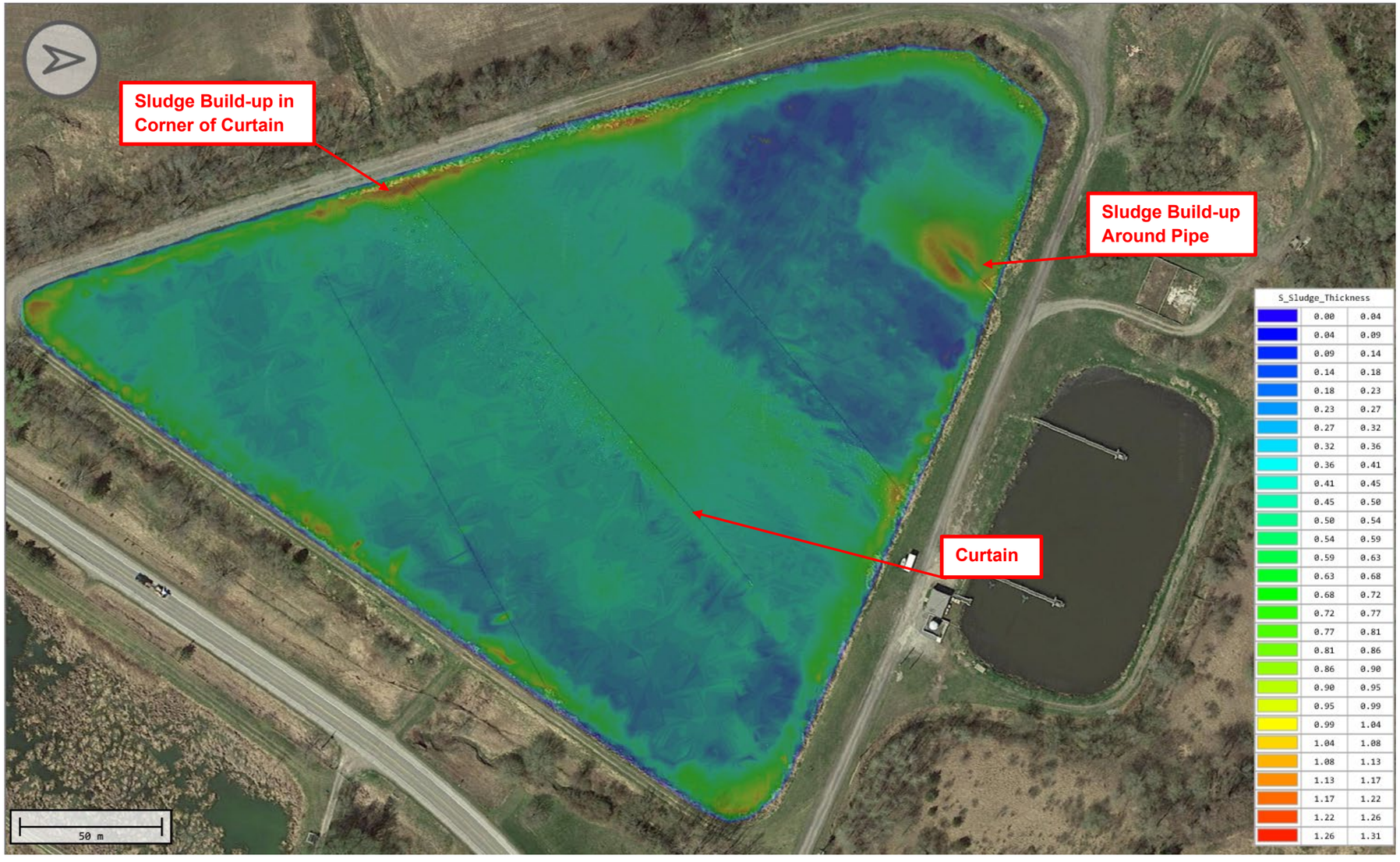

Figure 11 Stabilization Lagoon transparent sludge thickness.

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

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AERATION LAGOON VOLUMES

AERATION LAGOON ESTIMATED SLUDGE QUANTITY

Estimated sludge volume is calculated using software that compares the measured and interpolated sludge depths with the depths of the lagoon liner obtained from engineered drawings and/or field measurements. A sludge sample is taken for lab analysis to determine total solids and total volatile solids and to obtain dry volume.

CELL :

TOTAL ESTIMATED VOLUME OF SLUDGE TO BE REMOVED (WET) =	**3,866**	**m^3**
TOTAL ESTIMATED VOLUME OF SLUDGE TO BE REMOVED (DRY) =	**499**	**m^3**
SPECIFIC GRAVITY (DRY AS SAMPLED) =	**1.03**	
TOTAL ESTIMATED MASS OF SLUDGE TO BE REMOVED =	**514**	**BDT (Bone Dry Tonnes)**
TOTAL ESTIMATED VOLATILE SOLIDS QUANTITY (DRY) =	**1,465**	**m^3**

NORTH CELL HYDRAULIC CAPACITY AT PRESENT SLUDGE LOADING

Hydraulic capacity calculations for each lagoon are performed by comparing the water level at the time of survey to the sludge profile with results shown below.

ESTIMATED HYDRAULIC CAPACITY - WATER LEVEL @ 79.994 m = **11,576 m^3**

REMAINING CAPACITY OF CELL BASED ON SURVEYED SLUDGE VOLUME

Stage	Depth (m)	Volume (m^3)	Area (m^2)
1	0.0	11,576	6,689
2	1.0	5,729	5,180
3	2.0	1,358	3,218
4	3.0	2	39

Figure 12 Aeration Lagoon volumes

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

Unless otherwise specified all dimensions are in meters

SludgeMapper

Project Title	Brighton, ON Wastewater Lagoons Sludge Survey 2023 Report
Project Number	23014
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STABILIZATION LAGOON VOLUMES

STABILIZATION LAGOON ESTIMATED SLUDGE QUANTITY

Estimated sludge volume is calculated using software that compares the measured and interpolated sludge depths with the depths of the lagoon liner obtained from engineered drawings and/or field measurements. A sludge sample is taken for lab analysis to determine total solids and total volatile solids and to obtain dry volume.

CELL :

TOTAL ESTIMATED VOLUME OF SLUDGE TO BE REMOVED (WET) =	**20,695**	**m^3**
TOTAL ESTIMATED VOLUME OF SLUDGE TO BE REMOVED (DRY) =	**2,070**	**m^3**
SPECIFIC GRAVITY (DRY AS SAMPLED) =	**1.07**	
TOTAL ESTIMATED MASS OF SLUDGE TO BE REMOVED =	**2,214**	**BDT (Bone Dry Tonnes)**
TOTAL ESTIMATED VOLATILE SOLIDS QUANTITY (DRY) =	**6,271**	**m^3**

SOUTH CELL HYDRAULIC CAPACITY AT PRESENT SLUDGE LOADING

Hydraulic capacity calculations for each lagoon are performed by comparing the water level at the time of survey to the sludge profile with results shown below.

ESTIMATED HYDRAULIC CAPACITY - WATER LEVEL @ 79.339 m = **77,093 m^3**

REMAINING CAPACITY OF CELL BASED ON SURVEYED SLUDGE VOLUME

Stage	Depth (m)	Volume (m^3)	Area (m^2)
1	0.0	77,093	53,957
2	0.5	51,011	50,200
3	1.0	27,003	45,426
4	1.5	6,299	33,937

Figure 13 Stabilization Lagoon volumes.

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

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SludgeMapper

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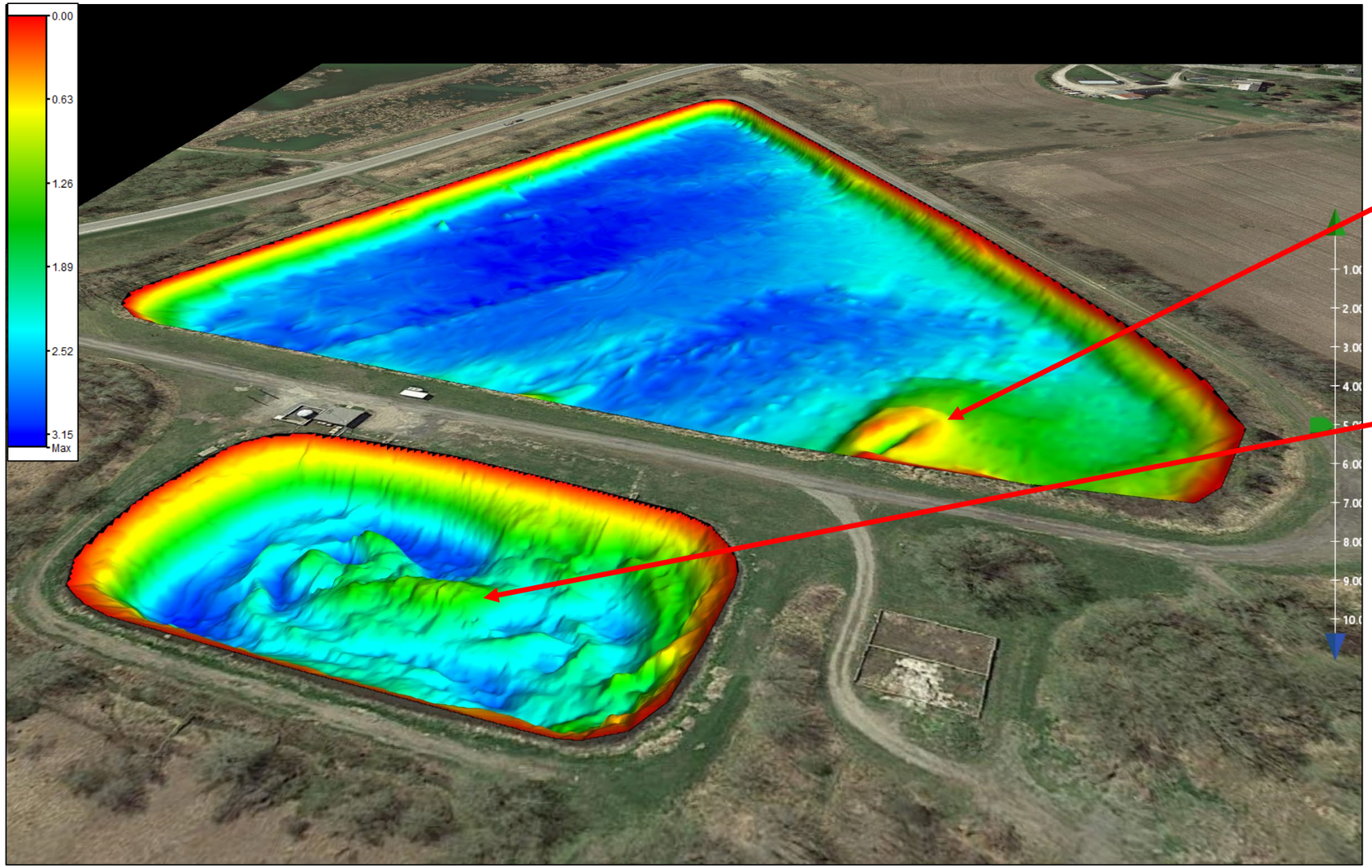
Sheet	Page **13** of **18** — Print Sheet 11x17

LAGOONS – TOP OF SLUDGE 3D PROFILE



A 5x vertical exaggeration has been applied to the 3D isometric drawing to highlight bottom features.

There is significant sludge build-up around the pipe in the Stabilization Lagoon.

There is sludge build-up in the centre of the Aeration Lagoon.

Figure 14 Town of Brighton Lagoons top of sludge 3D isometric drawing – From N looking S.

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

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SludgeMapper

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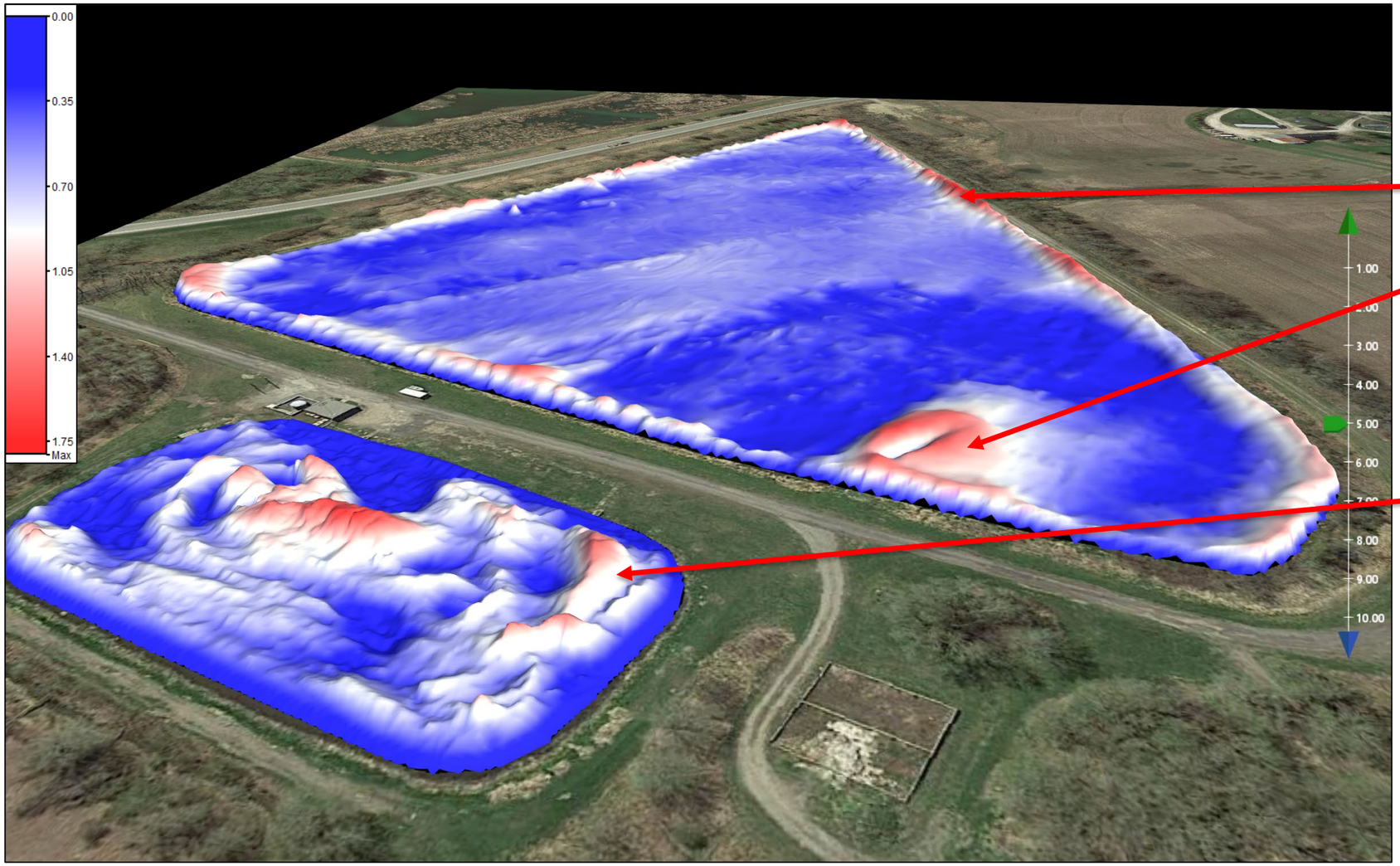
LAGOONS –SLUDGE THICKNESS 3D PROFILE



A 5x vertical exaggeration has been applied to the 3D isometric representation to highlight bottom features.

Sludge accumulation in the corners of the curtains.

Inlet pipe sludge build-up.

Sludge accumulation in the corner and the centre of the Aeration Lagoon.

Figure 15 Town of Brighton Lagoons sludge blanket thickness 3D isometric drawing – N looking S, red denotes levels of sludge build-up

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APPENDIX A – GLOSSARY

Bone dry tonnes (BDT): The in-situ sludge volume reduced to an ideal dry mass in metric tonnes (all moisture removed).

CGVD2013: Canadian Geodetic Vertical Datum of 2013

CGVD28: Canadian Geodetic Vertical Datum of 1928

Echogram: A visualization of acoustic returns displayed as a vertical cross-section (elevation view) or 'slice' of the entire water column (waterline down to sludge) that shows the bottom profile and basic underwater features.

Floating crust: A layer of material (made up of biosolids and synthetic debris) which is less dense and therefore floats on the surface of the effluent and forms a crust.

Sludge accumulation: The amount of sludge (in-depth or volume) that accumulates over a period of time.

Sludge blanket thickness: The amount of sludge and sediment that has accumulated on the bottom of the pond.

Sludge volume: The in-situ sludge volume that exists between the liner and the top of sludge surfaces.

Top of sludge depths: The vertical measurement from the water surface down to the top of the sludge layer, corrected for changing pond levels.

Top of sludge elevations: The elevations mapped at the top of the sludge layer. By tracking these elevations over time sludge accumulation can be accurately monitored or dredging progress can be assessed even with varying pond levels.

Water volume / hydraulic capacity: Volume of water/effluent in the pond at the time of survey. This value represents the hydraulic capacity on top of the settled sludge blanket.

APPENDIX B – A NOTE ON VOLUME CALCULATIONS

This Sludge Survey Report has been prepared by Sludge Mapper Ltd. (“SM”) for Town of Brighton (herein collectively referred to as the “Client”). It is intended to provide the Client with an estimate of sludge quantity and pond hydraulic capacity.

This report is based on data and information obtained by measuring pond depths with the single beam echosounder, or infrared sludge interface detector and verified using manual checks. Estimated sludge volumes and dry tonne amounts are calculated using software that creates interpolations between the sounding lines measured in the field.

The Client recognizes and acknowledges that estimated sludge volumes will vary from actual sludge volumes and that this report should be used only as a general guideline for planning maintenance desludging or dredging and should not be assumed to be an exact quantification of sludge volume. SM shall not be liable for any damages resulting from any difference between estimated sludge volumes and actual sludge volumes.

Furthermore, the liability of SM to the Client and to all third parties shall be limited to injury or loss caused by the negligent acts, errors or omissions of SM. Notwithstanding the foregoing, the total aggregate liability of SM shall not exceed the lesser of the actual damages incurred, or the total fee of SM for services rendered on this project.

The Client agrees to defend, indemnify, and hold harmless SM, its affiliates, officers, directors, employees, and agents from any and all liabilities, in excess of the limits of SM’s entire liability set out above, incurred by SM or any other party, in connection with the services provided. Such indemnity shall include the costs of the time spent and expenses incurred by SM and its affiliates in connection with the defence of any claims.

	Name	Date
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Reviewed by:	MC	11-11-2023

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Sheet	Page **17** of **18**	Print Sheet 11x17

APPENDIX C – TOWN OF BRIGHTON SLUDGE SAMPLE TEST RESULTS

	Name	Date
Prepared by:	MC	13-11-2023
Reviewed by:	MC	11-11-2023

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SludgeMapper

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E3 Laboratories Inc.
SS#4, 360 York Rd., Unit 10, Niagara-on-the-Lake, Ontario L0S 1J0
Email: info@e3labs.ca
Tel: (905) 641-9000, Fax: (905) 641-9001

CERTIFICATE OF ANALYSIS

Sludge Mapper Ltd.
Mark Caffray
373 Downs Road
Quinte West
K8V 5R9
Tel: Fax:
Email: mark@sludgemapper.ca

Work Order No.:2653513
Received : 2023-10-30
PO Number:
Reported: 2023-11-01
Project Name: 23014 Town of Brighton
Chain of Custody No.: 2653513

Client Sample ID	Sample Date	Lab ID	Parameter	Result	Unit	RDL	Date Analyzed	Method
23014 Brighton North Pond	2023-10-25	**776379**	Specific Gravity	1.03		N/A	2023-10-31	AWWA B100-96
			TS (Total Solids)	12.9	%	0.1	2023-10-30	APHA 2540 B mod
			VS (Dry Weight)	37.9	%	0.1	2023-10-30	APHA 2540E,G (GRAV)
23014 Brighton South Pond	2023-10-24	**776380**	Specific Gravity	1.07		N/A	2023-10-31	AWWA B100-96
			TS (Total Solids)	10.0	%	0.1	2023-10-30	APHA 2540 B mod
			VS (Dry Weight)	30.3	%	0.1	2023-10-30	APHA 2540E,G (GRAV)

Reported by:

Nilou Ghazi, Ph.D.,P.Eng.
Laboratory Manager

E3 Laboratories Inc.
SS#4, 360 York Rd., Unit 10, Niagara-on-the-Lake, Ontario L0S 1J0
Email: info@e3labs.ca
Tel: (905) 641-9000, Fax: (905) 641-9001

CERTIFICATE OF ANALYSIS

Sludge Mapper Ltd.
Mark Caffray
373 Downs Road
Quinte West
K8V 5R9
Tel: Fax:
Email: mark@sludgemapper.ca

Work Order No.:2653513
Received : 2023-10-30
PO Number:
Reported: 2023-11-01
Project Name: 23014 Town of Brighton
Chain of Custody No.: 2653513

Quality Control Summary

Lab ID	Analyte	QC Recovery	QC limits	Spike Recovery	Spike Limits	Dup RPD	Dup Limits	Blank
776379	Specific Gravity							
	TS (Total Solids)	102	80-120	N/A	N/A	2	0-20	<0.1
	VS (Dry Weight)	92	80-120	N/A	N/A	0	0-20	<0.1
776380	Specific Gravity							
	TS (Total Solids)	102	80-120	N/A	N/A	2	0-20	<0.1
	VS (Dry Weight)	92	80-120	N/A	N/A	0	0-20	<0.1

Ottawa
343 Preston Street
Tower II, Suite 1000
Ottawa ON Canada
K1S 1N4
613-728-3571
ottawa@jlrichards.ca

Kingston
203-863 Princess Street
Kingston ON Canada
K7L 5N4
613-544-1424
kingston@jlrichards.ca

Sudbury
314 Countryside Drive
Sudbury ON Canada
P3E 6G2
705-522-8174
sudbury@jlrichards.ca

Timmins
834 Mountjoy Street South
Timmins ON Canada
P4N 7C5
705-360-1899
timmins@jlrichards.ca

North Bay
555-501 Oak Street East
North Bay ON Canada
P1B 8E3
705-495-7597
northbay@jlrichards.ca

Guelph
107-450 Speedvale Avenue West
Guelph ON Canada
N1H 7Y6
519-763-0713
guelph@jlrichards.ca

London
380 Wellington Street
Tower B, 6th Floor
London ON Canada
N6A 5B5
226-700-5127
london@jlrichards.ca

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