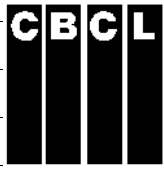


Municipality of Cumberland



CBCL LIMITED

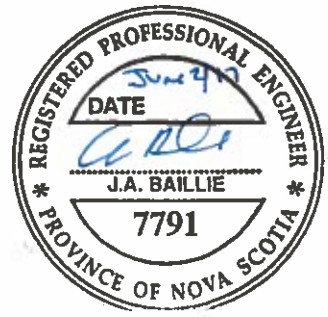
Consulting Engineers

Parrsboro Wastewater System – Treatment Plant

Issued for Tender

June 2017
Contract No. 161039

Parrsboro Wastewater System – Treatment Plant

Issued for Tender		June 2/17	
Issued for Approval	DT	May 23/17	JAB
<i>Issue or Revision</i>	<i>Reviewed By:</i>	<i>Date</i>	<i>Issued By:</i>
			

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1. GENERAL
- .1 The project is located in the community of Parrsboro, Nova Scotia.
- .2 The Work involves but is not necessarily limited to: construction of new access road, concrete tanks, and building. The Work also includes, all support services such as process mechanical, building mechanical, electrical, structural, civil, controls, commissioning and separator draining all as specified herein and as shown of the Project Drawings.

2. LIST OF
DRAWINGS

Dwg. No.

Title

-

Cover Sheet

Civil

C500

Overall Site Plan

C501

Access Road

C502

Access Road

C503

Plan and Profiles

C504

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C505

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C506

Details 1

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A002

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S001

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S004

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P002

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P003

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P004

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P005

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WWTP Tankage Sections

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<u>Dwg. No.</u>	<u>Title</u>
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E207	Schedules
E208	Cabling Diagram (Sheet 1 of 2)
E209	Cabling Diagram (Sheet 2 of 2)
E210	Schematics
E211	Schematics and Details

1. A complete Tender is comprised of the following:
 - a) The Tender Form in its entirety, with all pages and spaces for entry of information by Tenderers filled in as instructed.
 - b) Addenda received by the Tenderer during the tendering period.
 - c) Tender Security (refer to clause 12 herein).
2. The tender shall be submitted in a sealed envelope marked as follows:

TENDER FOR:

Municipality of Cumberland
Parrsboro Wastewater System - Treatment Plant
Contract 161039.00

and must be delivered to:

Municipality of Cumberland
1395 Blair Lake Road
Upper Nappan, NS B4H 3Y4

Attention: Justin Waugh-Cress, P.Eng.
Direct of Engineering and Operations

up until 2:00 p.m., local time, on Friday, June 16th, 2017 hereinafter referred to as the Tender Closing.
3. Tender opening will occur immediately following tender closing. Tender opening will be public.
4. Before tendering, Tenderers shall have examined the site of the work and shall have satisfied themselves as to the working conditions, including labour conditions and labour rules, the nature and kind of work to be done, any special risks associated therewith and all other matters which may be necessary in order to form a proper conception under which the work will be required to be performed. Tenderers shall not be entitled to claim at any time after execution of the Contract that there was any misunderstanding in regard to all such conditions.
5. When forming their estimates and preparing their tenders, Tenderers shall take full cognizance of the content of all the Tender Documents listed in Section 00 41 10.
6. Any ambiguities, inconsistencies, or uncertainties in the Contract Documents which may become apparent to Tenderers when tendering shall be advised IN WRITING to the Consultant, CBCL Limited, 1489 Hollis Street, Halifax, NS B3J 2R7, Attention: Aaron Baillie, P.Eng., at aaronb@cbcl.ca or Fax: (902)423-3938, not less than three (3) working days before Tender closing. Tenderers will be advised simultaneously of any decisions on such matters as necessary by means of addenda (which will

be serially numbered) and all addenda issued shall be incorporated into the Tender Documents. Addenda will be posted on the NS Procurement site as well as the Owner's procurement webpage. Plan takers will be solely responsible to obtain and acknowledge the receipt of all addenda. Failure to acknowledge addenda on the tender form will result in the disqualification of bid.

7. The Tenderer shall fill in the Completion Time and is notified that the completion date based on this may be taken into account in considering the tenders.
8. All tenders shall be valid for acceptance for sixty (60) calendar days from the Closing Date.
9. The Agreement is included in the Contract Documents at the time of tendering only for information and shall not be completed at the time of tendering.
10. The appending of any qualifying clauses to the tender or failure to comply with these instructions and with all other relevant provisions contained in the documents in the completing of any tender renders such tender liable to disqualification.
11. Contract Price to exclude HST. Harmonized sales tax shall be indicated as a separate amount and included in the Total Amount Payable.
12. Each tender shall be accompanied by Tender Security in the amount of ten percent (10%) of the Total Amount Payable in evidence of the bona fide nature of the tender. This Tender Security shall be in favour of the Owner and shall be in the form of a Certified Cheque, irrevocable Letter of Credit or a Bid Bond which shall guarantee to the Owner that in the event of the successful Tenderer declining to enter into a formal agreement with the Owner as called for in the Tender Documents, or declining or neglecting to provide the Insurance or Contract Security required by the Contract Documents, then the Owner will be reimbursed the additional cost of accepting another tender or Tender Security amount, whichever is the lesser.
 - .1 The bonds shall be issued by a company whose guarantee bonds are acceptable to the Government of Canada. Use latest edition of CCDC Form 220.
13. The Tender Security of the unsuccessful Tenderers will be returned to them after the Owner enters into a formal agreement with the successful Tenderer or the expiration of validity of their tenders, whichever is the sooner.
14. On the written acceptance by the Owner of a tender, that tender becomes the Contract and the Tenderer who has submitted it becomes the Contractor. The Contractor will be required to enter into a formal agreement with the Owner following receipt of a written notice of acceptance from the Owner. The written notice of acceptance forms a Contract Agreement until the formal "Agreement" is executed.

15. Within seven (7) days of written acceptance of a tender, tenderer will provide Contract Security in the amount and form as specified in GC 11.2 and as supplemented in Section 00 73 10, and Insurance as specified in GC 11.1.
16. Complete the Tender Form in ink and have corrections initialled by the individual signing the tender.
17. Where manufactured articles are described or specified in the Contract Documents by name, catalogue number of a manufacturer or supplier, Tenderers shall tender on the basis of using only such articles. Procedure concerning substitution of a specified article with another shall be in accordance with equivalents and alternates in Section 01 00 00.
18. The Owner will not defray any expenses whatsoever incurred by Tenderers in the preparation and submission of their tenders. The Owner reserves the right to waive any formality or technicality in any tender.
19. The Owner reserves the right to accept or to reject any or all tenders received, or to select a tender which is deemed by the Owner to be in its best interests. The tender with the lowest bid will not necessarily be accepted.
20. Tenders, which in the opinion of the Owner are considered to be informal or unbalanced, may be rejected.
21. Tenders may be amended or withdrawn by letter, or facsimile, (902)423-3938, or email (tenders@cbcl.ca) prior to Tender Closing. Amendments shall not disclose either original or revised total price.
 - .1 Head amendment or withdrawal as follows:
"[Amendment]/[Withdrawal] of Tender for the Municipality of Cumberland, Parrsboro Wastewater System - Treatment Plant, Contract No. 161039.00". Sign and seal as required for tender, and submit at address given for receipt of tenders. All Submissions must be received prior to Tender Closing.
22. A geotechnical investigation has been carried out for the Site. Geotechnical Report titled Geotechnical Investigation - Proposed Wastewater Treatment Plant, North Site Parrsboro, NS dated March 10, 2017 will be provided as a download upon request to the Consultant. Any interpretation or extrapolation of its contents are at sole discretion of the Contractor and the Consultant will be held liable from such interpretations and extrapolations.

TO: Municipality of Cumberland

FROM:

The undersigned Tenderer, having carefully read and examined the undermentioned Tender Documents, prepared by CBCL Limited for the completion of the Parrsboro Wastewater System - Treatment Plant, Contract No. 161039.00, comprised of the following documents:

Description of Work and List of Drawings
Information to Tenderers
Agreement Between Owner and Contractor
Definitions
General Conditions of the Stipulated Price Contract - CCDC 2-2008
Supplementary General Conditions
Specifications
Drawings
Addendum/Addenda

hereby accepts the same as part and parcel of the Contract herein referred to, and having carefully examined the locality and site of Work and having full knowledge of the work required and of the materials to be furnished and used, does hereby Tender and offer to enter into a contract to perform and complete, the whole of the said Work and provide all necessary labour, plant, tools, materials and equipment and pay all applicable taxes, as set forth and in strict accordance with the Specifications, Drawings and other Contract Documents and to do all therein called for on the terms and conditions and under the provisions therein set forth as follows.

ESTIMATED CONTRACT PRICE (A)	\$ _____
PRE-SELECTED EQUIPMENT ALLOWANCE (B)*	\$ <u>800,000.00</u>
SUBTOTAL (A + B)	\$ _____
ADD HST (15% OF SUBTOTAL)	\$ _____
TOTAL AMOUNT PAYABLE	\$ _____

Tenderer's HST Registration No. _____

see payment terms in Quotation Documents provided in the Appendices herein

ALTERNATIVE PRICES

Alternative Prices requested and expressed as a credit or an extra to the Contract Price shall be used in calculation of the Total Amount Payable consistent with their acceptance or rejection by the Owner.

The Alternative Prices required are as follows:

Item Description	Alternative Price (\$), excluding HST	
	Credit	Extra
Cost for PVC watermain along Access Rd. and Service Connection to Building		
Remove well pump, piping, pressure tank and controls from scope		
TOTAL		

SEPARATE PRICES FOR EXTRA WORK

Separate Prices requested shall not be included in the Contract Price. Consistent with their acceptance or rejection by the Owner they will be carried in the Agreement as an amount separate from the Contract Price, or in the separate agreement.

The Separate Prices required are as follows:

1. Excavation of unsuitable material and replacement with suitable approved onsite material or type II granulars beyond the limits of excavation shown on the Project Drawings as directed by the Engineer.

\$ _____ /m³

COMPLETION TIME

1. Tenderer agrees to obtain Substantial Performance of the Work before **March 31, 2018.**

The Undersigned Tenderer:

- (1) Declares that this tender is valid for acceptance until _____, 201____ (being sixty (60) calendar days from the Tender Closing).
- (2) Declares that the Contract Price set forth in the Tender Form has been correctly computed for the purposes of this tender and that it includes and covers all duties, and handling charges; transportation; and all

other charges. Harmonized sales tax is not to be included in the Contract Price.

- (3) Hands you herewith by way of Tender Security a Bid Bond or Certified Cheque or irrevocable Letter of Credit in the amount of ten percent (10%) of the Total Amount Payable on the understanding that in the event of this tender not being accepted by you, then this Tender Security will be returned to the undersigned Tenderer either at the time that the Contract is entered into with some other Tenderer, or at the expiration of validity of this tender, whichever is the sooner.
- (4) Undertakes, in the event of your acceptance of this tender, to execute a formal agreement in the form hereto attached, within seven (7) days of written acceptance and further agrees to provide the Contract Security in the amount and for as specified in GC 11.2 and as supplemented in Section 00 73 10, and Insurance as specified in GC 11.1
- (5) Undertakes, in the event of your acceptance of the Tender, to achieve Substantial Performance of the Work within the number of weeks of written notification of Award indicated above.
- (6) Agrees that in the event of failing or neglecting either to provide the Contract Security and Insurance and/or to execute the Agreement in the manner herein before undertaken, then the Tender Security shall be forfeited.
- (7) Agrees that unless and until a formal agreement is prepared and executed, this tender together with your written acceptance thereof shall constitute a binding Contract between both parties.
- (8) Understands and agrees that the Owner is not bound to accept the lowest or any tender which they may receive.
- (9) Agrees to provide, maintain and pay for the insurance coverages specified in the Contract Documents. One copy of all insurance policies of the Contractor and two copies of certificates of insurance, certifying to the issuance of all insurance policies, shall be furnished to the Owner. Each and every insurance policy shall name the Contractor, Owner and Consultant as being insured in the full amount of the insurance.
- (10) Declares to have personal knowledge of the location of the proposed Work and is informed as to the actual conditions and requirements, including labour conditions and labour rules and shall not claim at any time after execution of the Agreement that there was any misunderstanding in regard to such conditions and requirements.
- (11) Declares to have carefully examined the documents and Addenda No. ____ to ____ referred to in the first paragraph of this Tender Form, and the Tenderer hereby accepts and agrees to the same as forming a part of the Contract.
- (12) Understands that in the event that the tendered Contract Price is not

within the project budget, the Owner has the right to negotiate the Contract with the selected Tenderer or reject all tenders received.

- (13) Agrees that the Warranty Period defined in the Contract Documents shall be for a period of one (1) year from the date of Substantial Performance of the Work.
- (14) Understands that Substantial Performance of the Work will be established in accordance with General Conditions of the Contract.
- (15) Understands that after the issuance of the certificate of Substantial Performance of the Work by the Consultant, provided that the Contractor has relieved the Owner from any and all claims, demands and lien claims for and in respect of the Contract, and has completed all outstanding items and corrected all deficiencies, the Contractor shall submit an application for Final Payment and the Consultant will thereafter prepare the Final Certificate for payment in accordance with the General Conditions of the Contract.
- (16) Understands that the payment of holdback will be in accordance with the General Conditions of the Contract and subject to the provisions of the lien legislation applicable to the Place of Work.
- (17) Understands the occupational Health and Safety Legislation and any Workers or Workplace compensation legislation applicable to the Place of the Work and declares that they are in good standing and have all necessary certification as required by such legislation.
- (18) Agrees that time shall be construed as being of the essence of the Contract.

Municipality of Cumberland
Parrsboro Wastewater System -
Treatment Plant
Contract No. 161039.00

TENDER FORM

Section 00 41 10

Page 5

June 2017

DATED THIS _____ DAY OF _____, 201____.

[Seal]

Name of Firm Tendering

Signature of Signing Officer

Witness

Name and Title (Printed)

Witness

Signature of Signing Officer

Name and Title (Printed)

Company Address

Telephone No.

Fax No.

*NOTE: Tenders submitted by or on behalf of any Corporation must be signed and sealed in the name of such Corporation by a duly authorized officer or agent.

END

Municipality of Cumberland
Parrsboro Wastewater System -
Treatment Plant
Contract No. 161039.00

Section 00 50 00

June 2017

STIPULATED PRICE CONTRACT
CCDC 2-2008

CCDC 2

stipulated price contract

2008

[Name of the Project]

Apply a CCDC 2 copyright seal here. The application of the seal demonstrates the intention of the party proposing the use of this document that it be an accurate and unamended form of CCDC 2 – 2008 except to the extent that any alterations, additions or modifications are set forth in supplementary conditions.

CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE
CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE

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The Canadian Construction Documents Committee (CCDC) is a national joint committee responsible for the development, production and review of standard Canadian construction contracts, forms and guides. Formed in 1974 the CCDC is made up of volunteer representatives from:

- Public Sector Owners
- Private Sector Owners
- Canadian Bar Association (Ex-Officio)
- * The Association of Canadian Engineering Companies
- * The Canadian Construction Association
- * Construction Specifications Canada
- * The Royal Architectural Institute of Canada

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AGREEMENT BETWEEN OWNER AND CONTRACTOR

For use when a stipulated price is the basis of payment.

This Agreement made on the _____ day of _____ in the year _____.

by and between the parties

hereinafter called the "Owner"

and

hereinafter called the "Contractor"The *Owner* and the *Contractor* agree as follows:**ARTICLE A-1 THE WORK**The *Contractor* shall:

- 1.1 perform the *Work* required by the *Contract Documents* for

located at*insert above the name of the Work*_____
for which the Agreement has been signed by the parties, and for which*insert above the Place of the Work*_____
is acting as and is hereinafter called the "*Consultant*" and*insert above the name of the Consultant*

- 1.2 do and fulfill everything indicated by the *Contract Documents*, and
- 1.3 commence the *Work* by the _____ day of _____ in the year _____ and, subject to adjustment in *Contract Time* as provided for in the *Contract Documents*, attain *Substantial Performance of the Work*, by the _____ day of _____ in the year _____.

ARTICLE A-2 AGREEMENTS AND AMENDMENTS

- 2.1 The *Contract* supersedes all prior negotiations, representations or agreements, either written or oral, relating in any manner to the *Work*, including the bidding documents that are not expressly listed in Article A-3 of the Agreement - CONTRACT DOCUMENTS.
- 2.2 The *Contract* may be amended only as provided in the *Contract Documents*.

ARTICLE A-3 CONTRACT DOCUMENTS

3.1 The following are the *Contract Documents* referred to in Article A-1 of the Agreement - THE WORK:

- Agreement between *Owner* and *Contractor*
 - Definitions
 - The General Conditions of the Stipulated Price Contract
- *

* (Insert here, attaching additional pages if required, a list identifying all other *Contract Documents* e.g. supplementary conditions; information documents; specifications, giving a list of contents with section numbers and titles, number of pages and date; material finishing schedules; drawings, giving drawing number, title, date, revision date or mark; addenda, giving title, number, date)

ARTICLE A-4 CONTRACT PRICE

4.1 The *Contract Price*, which excludes *Value Added Taxes*, is:

_____/100 dollars \$ _____

4.2 *Value Added Taxes* (of _____ %) payable by the *Owner* to the *Contractor* are:

_____/100 dollars \$ _____

4.3 Total amount payable by the *Owner* to the *Contractor* for the construction of the *Work* is:

_____/100 dollars \$ _____

4.4 These amounts shall be subject to adjustments as provided in the *Contract Documents*.

4.5 All amounts are in Canadian funds.

ARTICLE A-5 PAYMENT

5.1 Subject to the provisions of the *Contract Documents*, and in accordance with legislation and statutory regulations respecting holdback percentages and, where such legislation or regulations do not exist or apply, subject to a holdback of _____ percent (_____ %), the *Owner* shall:

- .1 make progress payments to the *Contractor* on account of the *Contract Price* when due in the amount certified by the *Consultant* together with such *Value Added Taxes* as may be applicable to such payments, and
- .2 upon *Substantial Performance of the Work*, pay to the *Contractor* the unpaid balance of the holdback amount when due together with such *Value Added Taxes* as may be applicable to such payment, and
- .3 upon the issuance of the final certificate for payment, pay to the *Contractor* the unpaid balance of the *Contract Price* when due together with such *Value Added Taxes* as may be applicable to such payment.

5.2 In the event of loss or damage occurring where payment becomes due under the property and boiler insurance policies, payments shall be made to the *Contractor* in accordance with the provisions of GC 11.1 – INSURANCE.

5.3 Interest

- .1 Should either party fail to make payments as they become due under the terms of the *Contract* or in an award by arbitration or court, interest at the following rates on such unpaid amounts shall also become due and payable until payment:
 - (1) 2% per annum above the prime rate for the first 60 days.
 - (2) 4% per annum above the prime rate after the first 60 days.Such interest shall be compounded on a monthly basis. The prime rate shall be the rate of interest quoted by

(Insert name of chartered lending institution whose prime rate is to be used)

for prime business loans as it may change from time to time.

- .2 Interest shall apply at the rate and in the manner prescribed by paragraph 5.3.1 of this Article on the settlement amount of any claim in dispute that is resolved either pursuant to Part 8 of the General Conditions – DISPUTE RESOLUTION or otherwise, from the date the amount would have been due and payable under the *Contract*, had it not been in dispute, until the date it is paid.

ARTICLE A-6 RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING

- 6.1 *Notices in Writing* will be addressed to the recipient at the address set out below. The delivery of a *Notice in Writing* will be by hand, by courier, by prepaid first class mail, or by facsimile or other form of electronic communication during the transmission of which no indication of failure of receipt is communicated to the sender. A *Notice in Writing* delivered by one party in accordance with this *Contract* will be deemed to have been received by the other party on the date of delivery if delivered by hand or courier, or if sent by mail it shall be deemed to have been received five calendar days after the date on which it was mailed, provided that if either such day is not a *Working Day*, then the *Notice in Writing* shall be deemed to have been received on the *Working Day* next following such day. A *Notice in Writing* sent by facsimile or other form of electronic communication shall be deemed to have been received on the date of its transmission provided that if such day is not a *Working Day* or if it is received after the end of normal business hours on the date of its transmission at the place of receipt, then it shall be deemed to have been received at the opening of business at the place of receipt on the first *Working Day* next following the transmission thereof. 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.

Owner

*name of Owner**

address

facsimile number

email address

Contractor

*name of Contractor**

address

facsimile number

email address

Consultant

*name of Consultant**

address

facsimile number

email address

** If it is intended that the notice must be received by a specific individual, that individual's name shall be indicated.*

ARTICLE A-7 LANGUAGE OF THE CONTRACT

- 7.1 When the *Contract Documents* are prepared in both the English and French languages, it is agreed that in the event of any apparent discrepancy between the English and French versions, the English / French # language shall prevail.
Complete this statement by striking out inapplicable term.
- 7.2 This Agreement is drawn in English at the request of the parties hereto. La présente convention est rédigée en anglais à la demande des parties.

ARTICLE A-8 SUCCESSION

8.1 The *Contract* shall enure to the benefit of and be binding upon the parties hereto, their respective heirs, legal representatives, successors, and assigns.

In witness whereof the parties hereto have executed this Agreement by the hands of their duly authorized representatives.

SIGNED AND DELIVERED
in the presence of:

WITNESS

signature

name of person signing

signature

name of person signing

WITNESS

signature

name of person signing

signature

name of person signing

OWNER

name of owner

signature

name and title of person signing

signature

name and title of person signing

CONTRACTOR

name of Contractor

signature

name and title of person signing

signature

name and title of person signing

N.B. Where legal jurisdiction, local practice or Owner or Contractor requirement calls for:
(a) proof of authority to execute this document, attach such proof of authority in the form of a certified copy of a resolution naming the representative(s) authorized to sign the Agreement for and on behalf of the corporation or partnership; or
(b) the affixing of a corporate seal, this Agreement should be properly sealed.

DEFINITIONS

The following Definitions shall apply to all *Contract Documents*.

1. **Change Directive**
A *Change Directive* is a written instruction prepared by the *Consultant* and signed by the *Owner* directing the *Contractor* to proceed with a change in the *Work* within the general scope of the *Contract Documents* prior to the *Owner* and the *Contractor* agreeing upon adjustments in the *Contract Price* and the *Contract Time*.
2. **Change Order**
A *Change Order* is a written amendment to the *Contract* prepared by the *Consultant* and signed by the *Owner* and the *Contractor* stating their agreement upon:
 - a change in the *Work*;
 - the method of adjustment or the amount of the adjustment in the *Contract Price*, if any; and
 - the extent of the adjustment in the *Contract Time*, if any.
3. **Construction Equipment**
Construction Equipment means all machinery and equipment, either operated or not operated, that is required for preparing, fabricating, conveying, erecting, or otherwise performing the *Work* but is not incorporated into the *Work*.
4. **Consultant**
The *Consultant* is the person or entity engaged by the *Owner* and identified as such in the Agreement. The *Consultant* is the Architect, the Engineer or entity licensed to practise in the province or territory of the *Place of the Work*. The term *Consultant* means the *Consultant* or the *Consultant's* authorized representative.
5. **Contract**
The *Contract* is the undertaking by the parties to perform their respective duties, responsibilities and obligations as prescribed in the *Contract Documents* and represents the entire agreement between the parties.
6. **Contract Documents**
The *Contract Documents* consist of those documents listed in Article A-3 of the Agreement - CONTRACT DOCUMENTS and amendments agreed upon between the parties.
7. **Contract Price**
The *Contract Price* is the amount stipulated in Article A-4 of the Agreement - CONTRACT PRICE.
8. **Contract Time**
The *Contract Time* is the time stipulated in paragraph 1.3 of Article A-1 of the Agreement - THE WORK from commencement of the *Work* to *Substantial Performance of the Work*.
9. **Contractor**
The *Contractor* is the person or entity identified as such in the Agreement. The term *Contractor* means the *Contractor* or the *Contractor's* authorized representative as designated to the *Owner* in writing.
10. **Drawings**
The *Drawings* are the graphic and pictorial portions of the *Contract Documents*, wherever located and whenever issued, showing the design, location and dimensions of the *Work*, generally including plans, elevations, sections, details, and diagrams.
11. **Notice in Writing**
A *Notice in Writing*, where identified in the *Contract Documents*, is a written communication between the parties or between them and the *Consultant* that is transmitted in accordance with the provisions of Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.
12. **Owner**
The *Owner* is the person or entity identified as such in the Agreement. The term *Owner* means the *Owner* or the *Owner's* authorized agent or representative as designated to the *Contractor* in writing, but does not include the *Consultant*.
13. **Place of the Work**
The *Place of the Work* is the designated site or location of the *Work* identified in the *Contract Documents*.
14. **Product**
Product or *Products* means material, machinery, equipment, and fixtures forming the *Work*, but does not include *Construction Equipment*.

15. **Project**
The *Project* means the total construction contemplated of which the *Work* may be the whole or a part.
16. **Provide**
Provide means to supply and install.
17. **Shop Drawings**
Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, *Product* data, and other data which the *Contractor* provides to illustrate details of portions of the *Work*.
18. **Specifications**
The *Specifications* are that portion of the *Contract Documents*, wherever located and whenever issued, consisting of the written requirements and standards for *Products*, systems, workmanship, quality, and the services necessary for the performance of the *Work*.
19. **Subcontractor**
A *Subcontractor* is a person or entity having a direct contract with the *Contractor* to perform a part or parts of the *Work* at the *Place of the Work*.
20. **Substantial Performance of the Work**
Substantial Performance of the Work is as defined in the lien legislation applicable to the *Place of the Work*. If such legislation is not in force or does not contain such definition, or if the *Work* is governed by the Civil Code of Quebec, *Substantial Performance of the Work* shall have been reached when the *Work* is ready for use or is being used for the purpose intended and is so certified by the *Consultant*.
21. **Supplemental Instruction**
A *Supplemental Instruction* is an instruction, not involving adjustment in the *Contract Price* or *Contract Time*, in the form of *Specifications*, *Drawings*, schedules, samples, models or written instructions, consistent with the intent of the *Contract Documents*. It is to be issued by the *Consultant* to supplement the *Contract Documents* as required for the performance of the *Work*.
22. **Supplier**
A *Supplier* is a person or entity having a direct contract with the *Contractor* to supply *Products*.
23. **Temporary Work**
Temporary Work means temporary supports, structures, facilities, services, and other temporary items, excluding *Construction Equipment*, required for the execution of the *Work* but not incorporated into the *Work*.
24. **Value Added Taxes**
Value Added Taxes means such sum as shall be levied upon the *Contract Price* by the Federal or any Provincial or Territorial Government and is computed as a percentage of the *Contract Price* and includes the Goods and Services Tax, the Quebec Sales Tax, the Harmonized Sales Tax, and any similar tax, the collection and payment of which have been imposed on the *Contractor* by the tax legislation.
25. **Work**
The *Work* means the total construction and related services required by the *Contract Documents*.
26. **Working Day**
Working Day means a day other than a Saturday, Sunday, statutory holiday, or statutory vacation day that is observed by the construction industry in the area of the *Place of the Work*.

GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

PART 1 GENERAL PROVISIONS

GC 1.1 CONTRACT DOCUMENTS

- 1.1.1 The intent of the *Contract Documents* is to include the labour, *Products* and services necessary for the performance of the *Work* by the *Contractor* in accordance with these documents. It is not intended, however, that the *Contractor* shall supply products or perform work not consistent with, not covered by, or not properly inferable from the *Contract Documents*.
- 1.1.2 Nothing contained in the *Contract Documents* shall create any contractual relationship between:
 - .1 the *Owner* and a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.
 - .2 the *Consultant* and the *Contractor*, a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.
- 1.1.3 The *Contract Documents* are complementary, and what is required by any one shall be as binding as if required by all.
- 1.1.4 Words and abbreviations which have well known technical or trade meanings are used in the *Contract Documents* in accordance with such recognized meanings.
- 1.1.5 References in the *Contract Documents* to the singular shall be considered to include the plural as the context requires.
- 1.1.6 Neither the organization of the *Specifications* nor the arrangement of *Drawings* shall control the *Contractor* in dividing the work among *Subcontractors* and *Suppliers*.
- 1.1.7 If there is a conflict within the *Contract Documents*:
 - .1 the order of priority of documents, from highest to lowest, shall be
 - the Agreement between the *Owner* and the *Contractor*,
 - the Definitions,
 - Supplementary Conditions,
 - the General Conditions,
 - Division 1 of the *Specifications*,
 - technical *Specifications*,
 - material and finishing schedules,
 - the *Drawings*.
 - .2 *Drawings* of larger scale shall govern over those of smaller scale of the same date.
 - .3 dimensions shown on *Drawings* shall govern over dimensions scaled from *Drawings*.
 - .4 later dated documents shall govern over earlier documents of the same type.
- 1.1.8 The *Owner* shall provide the *Contractor*, without charge, sufficient copies of the *Contract Documents* to perform the *Work*.
- 1.1.9 *Specifications*, *Drawings*, models, and copies thereof furnished by the *Consultant* are and shall remain the *Consultant's* property, with the exception of the signed *Contract* sets, which shall belong to each party to the *Contract*. All *Specifications*, *Drawings* and models furnished by the *Consultant* are to be used only with respect to the *Work* and are not to be used on other work. These *Specifications*, *Drawings* and models are not to be copied or altered in any manner without the written authorization of the *Consultant*.
- 1.1.10 Models furnished by the *Contractor* at the *Owner's* expense are the property of the *Owner*.

GC 1.2 LAW OF THE CONTRACT

- 1.2.1 The law of the *Place of the Work* shall govern the interpretation of the *Contract*.

GC 1.3 RIGHTS AND REMEDIES

- 1.3.1 Except as expressly provided in the *Contract Documents*, the duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights, and remedies otherwise imposed or available by law.
- 1.3.2 No action or failure to act by the *Owner*, *Consultant* or *Contractor* shall constitute a waiver of any right or duty afforded any of them under the *Contract*, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

GC 1.4 ASSIGNMENT

- 1.4.1 Neither party to the *Contract* shall assign the *Contract* or a portion thereof without the written consent of the other, which consent shall not be unreasonably withheld.

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.1 AUTHORITY OF THE CONSULTANT

- 2.1.1 The *Consultant* will have authority to act on behalf of the *Owner* only to the extent provided in the *Contract Documents*, unless otherwise modified by written agreement as provided in paragraph 2.1.2.
- 2.1.2 The duties, responsibilities and limitations of authority of the *Consultant* as set forth in the *Contract Documents* shall be modified or extended only with the written consent of the *Owner*, the *Contractor* and the *Consultant*.
- 2.1.3 If the *Consultant's* employment is terminated, the *Owner* shall immediately appoint or reappoint a *Consultant* against whom the *Contractor* makes no reasonable objection and whose status under the *Contract Documents* shall be that of the former *Consultant*.

GC 2.2 ROLE OF THE CONSULTANT

- 2.2.1 The *Consultant* will provide administration of the *Contract* as described in the *Contract Documents*.
- 2.2.2 The *Consultant* will visit the *Place of the Work* at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work and to determine if the *Work* is proceeding in general conformity with the *Contract Documents*.
- 2.2.3 If the *Owner* and the *Consultant* agree, the *Consultant* will provide at the *Place of the Work*, one or more project representatives to assist in carrying out the *Consultant's* responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in writing to the *Contractor*.
- 2.2.4 The *Consultant* will promptly inform the *Owner* of the date of receipt of the *Contractor's* applications for payment as provided in paragraph 5.3.1.1 of GC 5.3 – PROGRESS PAYMENT.
- 2.2.5 Based on the *Consultant's* observations and evaluation of the *Contractor's* applications for payment, the *Consultant* will determine the amounts owing to the *Contractor* under the *Contract* and will issue certificates for payment as provided in Article A-5 of the Agreement - PAYMENT, GC 5.3 - PROGRESS PAYMENT and GC 5.7 - FINAL PAYMENT.
- 2.2.6 The *Consultant* will not be responsible for and will not have control, charge or supervision of construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs required in connection with the *Work* in accordance with the applicable construction safety legislation, other regulations or general construction practice. The *Consultant* will not be responsible for the *Contractor's* failure to carry out the *Work* in accordance with the *Contract Documents*. The *Consultant* will not have control over, charge of or be responsible for the acts or omissions of the *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or any other persons performing portions of the *Work*.
- 2.2.7 Except with respect to GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER, the *Consultant* will be, in the first instance, the interpreter of the requirements of the *Contract Documents*.
- 2.2.8 Matters in question relating to the performance of the *Work* or the interpretation of the *Contract Documents* shall be initially referred in writing to the *Consultant* by the party raising the question for interpretations and findings and copied to the other party.
- 2.2.9 Interpretations and findings of the *Consultant* shall be consistent with the intent of the *Contract Documents*. In making such interpretations and findings the *Consultant* will not show partiality to either the *Owner* or the *Contractor*.
- 2.2.10 The *Consultant's* interpretations and findings will be given in writing to the parties within a reasonable time.
- 2.2.11 With respect to claims for a change in *Contract Price*, the *Consultant* will make findings as set out in GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.
- 2.2.12 The *Consultant* will have authority to reject work which in the *Consultant's* opinion does not conform to the requirements of the *Contract Documents*. Whenever the *Consultant* considers it necessary or advisable, the *Consultant* will have authority to require inspection or testing of work, whether or not such work is fabricated, installed or completed. However, neither the authority of the *Consultant* to act nor any decision either to exercise or not to exercise such authority shall give rise to any duty or responsibility of the *Consultant* to the *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or other persons performing any of the *Work*.

- 2.2.13 During the progress of the *Work* the *Consultant* will furnish *Supplemental Instructions* to the *Contractor* with reasonable promptness or in accordance with a schedule for such instructions agreed to by the *Consultant* and the *Contractor*.
- 2.2.14 The *Consultant* will review and take appropriate action upon *Shop Drawings*, samples and other *Contractor's* submittals, in accordance with the *Contract Documents*.
- 2.2.15 The *Consultant* will prepare *Change Orders* and *Change Directives* as provided in GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 2.2.16 The *Consultant* will conduct reviews of the *Work* to determine the date of *Substantial Performance of the Work* as provided in GC 5.4 - SUBSTANTIAL PERFORMANCE OF THE WORK.
- 2.2.17 All certificates issued by the *Consultant* will be to the best of the *Consultant's* knowledge, information and belief. By issuing any certificate, the *Consultant* does not guarantee the *Work* is correct or complete.
- 2.2.18 The *Consultant* will receive and review written warranties and related documents required by the *Contract* and provided by the *Contractor* and will forward such warranties and documents to the *Owner* for the *Owner's* acceptance.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

- 2.3.1 The *Owner* and the *Consultant* shall have access to the *Work* at all times. The *Contractor* shall provide sufficient, safe and proper facilities at all times for the review of the *Work* by the *Consultant* and the inspection of the *Work* by authorized agencies. If parts of the *Work* are in preparation at locations other than the *Place of the Work*, the *Owner* and the *Consultant* shall be given access to such work whenever it is in progress.
- 2.3.2 If work is designated for tests, inspections or approvals in the *Contract Documents*, or by the *Consultant's* instructions, or by the laws or ordinances of the *Place of the Work*, the *Contractor* shall give the *Consultant* reasonable notification of when the work will be ready for review and inspection. The *Contractor* shall arrange for and shall give the *Consultant* reasonable notification of the date and time of inspections by other authorities.
- 2.3.3 The *Contractor* shall furnish promptly to the *Consultant* two copies of certificates and inspection reports relating to the *Work*.
- 2.3.4 If the *Contractor* covers, or permits to be covered, work that has been designated for special tests, inspections or approvals before such special tests, inspections or approvals are made, given or completed, the *Contractor* shall, if so directed, uncover such work, have the inspections or tests satisfactorily completed, and make good covering work at the *Contractor's* expense.
- 2.3.5 The *Consultant* may order any portion or portions of the *Work* to be examined to confirm that such work is in accordance with the requirements of the *Contract Documents*. If the work is not in accordance with the requirements of the *Contract Documents*, the *Contractor* shall correct the work and pay the cost of examination and correction. If the work is in accordance with the requirements of the *Contract Documents*, the *Owner* shall pay the cost of examination and restoration.
- 2.3.6 The *Contractor* shall pay the cost of making any test or inspection, including the cost of samples required for such test or inspection, if such test or inspection is designated in the *Contract Documents* to be performed by the *Contractor* or is designated by the laws or ordinances applicable to the *Place of the Work*.
- 2.3.7 The *Contractor* shall pay the cost of samples required for any test or inspection to be performed by the *Consultant* or the *Owner* if such test or inspection is designated in the *Contract Documents*.

GC 2.4 DEFECTIVE WORK

- 2.4.1 The *Contractor* shall promptly correct defective work that has been rejected by the *Consultant* as failing to conform to the *Contract Documents* whether or not the defective work has been incorporated in the *Work* and whether or not the defect is the result of poor workmanship, use of defective products or damage through carelessness or other act or omission of the *Contractor*.
- 2.4.2 The *Contractor* shall make good promptly other contractors' work destroyed or damaged by such corrections at the *Contractor's* expense.
- 2.4.3 If in the opinion of the *Consultant* it is not expedient to correct defective work or work not performed as provided in the *Contract Documents*, the *Owner* may deduct from the amount otherwise due to the *Contractor* the difference in value between the work as performed and that called for by the *Contract Documents*. If the *Owner* and the *Contractor* do not agree on the difference in value, they shall refer the matter to the *Consultant* for a determination.

PART 3 EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

- 3.1.1 The *Contractor* shall have total control of the *Work* and shall effectively direct and supervise the *Work* so as to ensure conformity with the *Contract Documents*.
- 3.1.2 The *Contractor* shall be solely responsible for construction means, methods, techniques, sequences, and procedures and for co-ordinating the various parts of the *Work* under the *Contract*.

GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

- 3.2.1 The *Owner* reserves the right to award separate contracts in connection with other parts of the *Project* to other contractors and to perform work with own forces.
- 3.2.2 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner's* own forces, the *Owner* shall:
- .1 provide for the co-ordination of the activities and work of other contractors and *Owner's* own forces with the *Work* of the *Contract*;
 - .2 assume overall responsibility for compliance with the applicable health and construction safety legislation at the *Place of the Work*;
 - .3 enter into separate contracts with other contractors under conditions of contract which are compatible with the conditions of the *Contract*;
 - .4 ensure that insurance coverage is provided to the same requirements as are called for in GC 11.1 - INSURANCE and co-ordinate such insurance with the insurance coverage of the *Contractor* as it affects the *Work*; and
 - .5 take all reasonable precautions to avoid labour disputes or other disputes on the *Project* arising from the work of other contractors or the *Owner's* own forces.
- 3.2.3 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner's* own forces, the *Contractor* shall:
- .1 afford the *Owner* and other contractors reasonable opportunity to store their products and execute their work;
 - .2 cooperate with other contractors and the *Owner* in reviewing their construction schedules; and
 - .3 promptly report to the *Consultant* in writing any apparent deficiencies in the work of other contractors or of the *Owner's* own forces, where such work affects the proper execution of any portion of the *Work*, prior to proceeding with that portion of the *Work*.
- 3.2.4 Where the *Contract Documents* identify work to be performed by other contractors or the *Owner's* own forces, the *Contractor* shall co-ordinate and schedule the *Work* with the work of other contractors and the *Owner's* own forces as specified in the *Contract Documents*.
- 3.2.5 Where a change in the *Work* is required as a result of the co-ordination and integration of the work of other contractors or *Owner's* own forces with the *Work*, the changes shall be authorized and valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 3.2.6 Disputes and other matters in question between the *Contractor* and other contractors shall be dealt with as provided in Part 8 of the General Conditions - DISPUTE RESOLUTION provided the other contractors have reciprocal obligations. The *Contractor* shall be deemed to have consented to arbitration of any dispute with any other contractor whose contract with the *Owner* contains a similar agreement to arbitrate.

GC 3.3 TEMPORARY WORK

- 3.3.1 The *Contractor* shall have the sole responsibility for the design, erection, operation, maintenance, and removal of *Temporary Work*.
- 3.3.2 The *Contractor* shall engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform those functions referred to in paragraph 3.3.1 where required by law or by the *Contract Documents* and in all cases where such *Temporary Work* is of such a nature that professional engineering skill is required to produce safe and satisfactory results.

- 3.3.3 Notwithstanding the provisions of GC 3.1 - CONTROL OF THE WORK, paragraphs 3.3.1 and 3.3.2 or provisions to the contrary elsewhere in the *Contract Documents* where such *Contract Documents* include designs for *Temporary Work* or specify a method of construction in whole or in part, such designs or methods of construction shall be considered to be part of the design of the *Work* and the *Contractor* shall not be held responsible for that part of the design or the specified method of construction. The *Contractor* shall, however, be responsible for the execution of such design or specified method of construction in the same manner as for the execution of the *Work*.

GC 3.4 DOCUMENT REVIEW

- 3.4.1 The *Contractor* shall review the *Contract Documents* and shall report promptly to the *Consultant* any error, inconsistency or omission the *Contractor* may discover. Such review by the *Contractor* shall be to the best of the *Contractor's* knowledge, information and belief and in making such review the *Contractor* does not assume any responsibility to the *Owner* or the *Consultant* for the accuracy of the review. The *Contractor* shall not be liable for damage or costs resulting from such errors, inconsistencies or omissions in the *Contract Documents*, which the *Contractor* did not discover. If the *Contractor* does discover any error, inconsistency or omission in the *Contract Documents*, the *Contractor* shall not proceed with the work affected until the *Contractor* has received corrected or missing information from the *Consultant*.

GC 3.5 CONSTRUCTION SCHEDULE

- 3.5.1 The *Contractor* shall:
- .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 the major activities of the *Work* and provides sufficient detail of the critical events and their inter-relationship to demonstrate the *Work* will be performed in conformity with the *Contract Time*;
 - .2 monitor the progress of the *Work* relative to the construction schedule and update the schedule on a monthly basis or as stipulated by the *Contract Documents*; and
 - .3 advise the *Consultant* of any revisions required to the schedule as the result of extensions of the *Contract Time* as provided in Part 6 of the General Conditions - CHANGES IN THE WORK.

GC 3.6 SUPERVISION

- 3.6.1 The *Contractor* shall provide all necessary supervision and appoint a competent representative who shall be in attendance at the *Place of the Work* while work is being performed. The appointed representative shall not be changed except for valid reason.
- 3.6.2 The appointed representative shall represent the *Contractor* at the *Place of the Work*. Information and instructions provided by the *Consultant* to the *Contractor's* appointed representative shall be deemed to have been received by the *Contractor*, except with respect to Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.

GC 3.7 SUBCONTRACTORS AND SUPPLIERS

- 3.7.1 The *Contractor* shall preserve and protect the rights of the parties under the *Contract* with respect to work to be performed under subcontract, and shall:
- .1 enter into contracts or written agreements with *Subcontractors* and *Suppliers* to require them to perform their work as provided in the *Contract Documents*;
 - .2 incorporate the terms and conditions of the *Contract Documents* into all contracts or written agreements with *Subcontractors* and *Suppliers*; and
 - .3 be as fully responsible to the *Owner* for acts and omissions of *Subcontractors*, *Suppliers* and of persons directly or indirectly employed by them as for acts and omissions of persons directly employed by the *Contractor*.
- 3.7.2 The *Contractor* shall indicate in writing, if requested by the *Owner*, those *Subcontractors* or *Suppliers* whose bids have been received by the *Contractor* which the *Contractor* would be prepared to accept for the performance of a portion of the *Work*. Should the *Owner* not object before signing the *Contract*, the *Contractor* shall employ those *Subcontractors* or *Suppliers* so identified by the *Contractor* in writing for the performance of that portion of the *Work* to which their bid applies.
- 3.7.3 The *Owner* may, for reasonable cause, at any time before the *Owner* has signed the *Contract*, object to the use of a proposed *Subcontractor* or *Supplier* and require the *Contractor* to employ one of the other subcontract bidders.
- 3.7.4 If the *Owner* requires the *Contractor* to change a proposed *Subcontractor* or *Supplier*, the *Contract Price* and *Contract Time* shall be adjusted by the differences occasioned by such required change.

- 3.7.5 The *Contractor* shall not be required to employ as a *Subcontractor* or *Supplier*, a person or firm to which the *Contractor* may reasonably object.
- 3.7.6 The *Owner*, through the *Consultant*, may provide to a *Subcontractor* or *Supplier* information as to the percentage of the *Subcontractor's* or *Supplier's* work which has been certified for payment.

GC 3.8 LABOUR AND PRODUCTS

- 3.8.1 The *Contractor* shall provide and pay for labour, *Products*, tools, *Construction Equipment*, water, heat, light, power, transportation, and other facilities and services necessary for the performance of the *Work* in accordance with the *Contract*.
- 3.8.2 Unless otherwise specified in the *Contract Documents*, *Products* provided shall be new. *Products* which are not specified shall be of a quality consistent with those specified and their use acceptable to the *Consultant*.
- 3.8.3 The *Contractor* shall maintain good order and discipline among the *Contractor's* employees engaged on the *Work* and shall not employ on the *Work* anyone not skilled in the tasks assigned.

GC 3.9 DOCUMENTS AT THE SITE

- 3.9.1 The *Contractor* shall keep one copy of current *Contract Documents*, submittals, reports, and records of meetings at the *Place of the Work*, in good order and available to the *Owner* and the *Consultant*.

GC 3.10 SHOP DRAWINGS

- 3.10.1 The *Contractor* shall provide *Shop Drawings* as required in the *Contract Documents*.
- 3.10.2 The *Contractor* shall provide *Shop Drawings* to the *Consultant* to review in orderly sequence and sufficiently in advance so as to cause no delay in the *Work* or in the work of other contractors.
- 3.10.3 Upon request of the *Contractor* or the *Consultant*, they shall jointly prepare a schedule of the dates for provision, review and return of *Shop Drawings*.
- 3.10.4 The *Contractor* shall provide *Shop Drawings* in the form specified, or if not specified, as directed by the *Consultant*.
- 3.10.5 *Shop Drawings* provided by the *Contractor* to the *Consultant* shall indicate by stamp, date and signature of the person responsible for the review that the *Contractor* has reviewed each one of them.
- 3.10.6 The *Consultant's* review is for conformity to the design concept and for general arrangement only.
- 3.10.7 *Shop Drawings* which require approval of any legally constituted authority having jurisdiction shall be provided to such authority by the *Contractor* for approval.
- 3.10.8 The *Contractor* shall review all *Shop Drawings* before providing them to the *Consultant*. The *Contractor* represents by this review that:
- .1 the *Contractor* has determined and verified all applicable field measurements, field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so, and
 - .2 the *Contractor* has checked and co-ordinated each *Shop Drawing* with the requirements of the *Work* and of the *Contract Documents*.
- 3.10.9 At the time of providing *Shop Drawings*, the *Contractor* shall expressly advise the *Consultant* in writing of any deviations in a *Shop Drawing* from the requirements of the *Contract Documents*. The *Consultant* shall indicate the acceptance or rejection of such deviation expressly in writing.
- 3.10.10 The *Consultant's* review shall not relieve the *Contractor* of responsibility for errors or omissions in the *Shop Drawings* or for meeting all requirements of the *Contract Documents*.
- 3.10.11 The *Contractor* shall provide revised *Shop Drawings* to correct those which the *Consultant* rejects as inconsistent with the *Contract Documents*, unless otherwise directed by the *Consultant*. The *Contractor* shall notify the *Consultant* in writing of any revisions to the *Shop Drawings* other than those requested by the *Consultant*.
- 3.10.12 The *Consultant* will review and return *Shop Drawings* in accordance with the schedule agreed upon, or, in the absence of such schedule, with reasonable promptness so as to cause no delay in the performance of the *Work*.

GC 3.11 USE OF THE WORK

- 3.11.1 The *Contractor* shall confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and operations of employees and *Subcontractors* to limits indicated by laws, ordinances, permits, or the *Contract Documents* and shall not unreasonably encumber the *Place of the Work*.
- 3.11.2 The *Contractor* shall not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety of the *Work*.

GC 3.12 CUTTING AND REMEDIAL WORK

- 3.12.1 The *Contractor* shall perform the cutting and remedial work required to make the affected parts of the *Work* come together properly.
- 3.12.2 The *Contractor* shall co-ordinate the *Work* to ensure that the cutting and remedial work is kept to a minimum.
- 3.12.3 Should the *Owner*, the *Consultant*, other contractors or anyone employed by them be responsible for ill-timed work necessitating cutting or remedial work to be performed, the cost of such cutting or remedial work shall be valued as provided in GC 6.1 – OWNER’S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 3.12.4 Cutting and remedial work shall be performed by specialists familiar with the *Products* affected and shall be performed in a manner to neither damage nor endanger the *Work*.

GC 3.13 CLEANUP

- 3.13.1 The *Contractor* shall maintain the *Work* in a safe and tidy condition and free from the accumulation of waste products and debris, other than that caused by the *Owner*, other contractors or their employees.
- 3.13.2 Before applying for *Substantial Performance of the Work* as provided in GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK, the *Contractor* shall remove waste products and debris, other than that resulting from the work of the *Owner*, other contractors or their employees, and shall leave the *Place of the Work* clean and suitable for use or occupancy by the *Owner*. The *Contractor* shall remove products, tools, *Construction Equipment*, and *Temporary Work* not required for the performance of the remaining work.
- 3.13.3 Prior to application for the final payment, the *Contractor* shall remove any remaining products, tools, *Construction Equipment*, *Temporary Work*, and waste products and debris, other than those resulting from the work of the *Owner*, other contractors or their employees.

PART 4 ALLOWANCES

GC 4.1 CASH ALLOWANCES

- 4.1.1 The *Contract Price* includes the cash allowances, if any, stated in the *Contract Documents*. The scope of work or costs included in such cash allowances shall be as described in the *Contract Documents*.
- 4.1.2 The *Contract Price*, and not the cash allowances, includes the *Contractor's* overhead and profit in connection with such cash allowances.
- 4.1.3 Expenditures under cash allowances shall be authorized by the *Owner* through the *Consultant*.
- 4.1.4 Where the actual cost of the *Work* under any cash allowance exceeds the amount of the allowance, the *Contractor* shall be compensated for the excess incurred and substantiated plus an amount for overhead and profit on the excess as set out in the *Contract Documents*. Where the actual cost of the *Work* under any cash allowance is less than the amount of the allowance, the *Owner* shall be credited for the unexpended portion of the cash allowance, but not for the *Contractor's* overhead and profit on such amount. Multiple cash allowances shall not be combined for the purpose of calculating the foregoing.
- 4.1.5 The *Contract Price* shall be adjusted by *Change Order* to provide for any difference between the amount of each cash allowance and the actual cost of the work under that cash allowance.
- 4.1.6 The value of the work performed under a cash allowance is eligible to be included in progress payments.
- 4.1.7 The *Contractor* and the *Consultant* shall jointly prepare a schedule that shows when the *Consultant* and *Owner* must authorize ordering of items called for under cash allowances to avoid delaying the progress of the *Work*.

GC 4.2 CONTINGENCY ALLOWANCE

- 4.2.1 The *Contract Price* includes the contingency allowance, if any, stated in the *Contract Documents*.
- 4.2.2 The contingency allowance includes the *Contractor's* overhead and profit in connection with such contingency allowance.
- 4.2.3 Expenditures under the contingency allowance shall be authorized and valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 4.2.4 The *Contract Price* shall be adjusted by *Change Order* to provide for any difference between the expenditures authorized under paragraph 4.2.3 and the contingency allowance.

PART 5 PAYMENT

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

- 5.1.1 The *Owner* shall, at the request of the *Contractor*, before signing the *Contract*, and promptly from time to time thereafter, furnish to the *Contractor* reasonable evidence that financial arrangements have been made to fulfill the *Owner's* obligations under the *Contract*.
- 5.1.2 The *Owner* shall give the *Contractor Notice in Writing* of any material change in the *Owner's* financial arrangements to fulfill the *Owner's* obligations under the *Contract* during the performance of the *Contract*.

GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

- 5.2.1 Applications for payment on account as provided in Article A-5 of the Agreement - PAYMENT may be made monthly as the *Work* progresses.
- 5.2.2 Applications for payment shall be dated the last day of each payment period, which is the last day of the month or an alternative day of the month agreed in writing by the parties.
- 5.2.3 The amount claimed shall be for the value, proportionate to the amount of the *Contract*, of *Work* performed and *Products* delivered to the *Place of the Work* as of the last day of the payment period.
- 5.2.4 The *Contractor* shall submit to the *Consultant*, at least 15 calendar days before the first application for payment, a schedule of values for the parts of the *Work*, aggregating the total amount of the *Contract Price*, so as to facilitate evaluation of applications for payment.
- 5.2.5 The schedule of values shall be made out in such form and supported by such evidence as the *Consultant* may reasonably direct and when accepted by the *Consultant*, shall be used as the basis for applications for payment, unless it is found to be in error.
- 5.2.6 The *Contractor* shall include a statement based on the schedule of values with each application for payment.
- 5.2.7 Applications for payment for *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall be supported by such evidence as the *Consultant* may reasonably require to establish the value and delivery of the *Products*.

GC 5.3 PROGRESS PAYMENT

- 5.3.1 After receipt by the *Consultant* of an application for payment submitted by the *Contractor* in accordance with GC 5.2 - APPLICATIONS FOR PROGRESS PAYMENT:
 - .1 the *Consultant* will promptly inform the *Owner* of the date of receipt of the *Contractor's* application for payment,
 - .2 the *Consultant* will issue to the *Owner* and copy to the *Contractor*, no later than 10 calendar days after the receipt of the application for payment, a certificate for payment in the amount applied for, or in such other amount as the *Consultant* determines to be properly due. If the *Consultant* amends the application, the *Consultant* will promptly advise the *Contractor* in writing giving reasons for the amendment,
 - .3 the *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement - PAYMENT on or before 20 calendar days after the later of:
 - receipt by the *Consultant* of the application for payment, or
 - the last day of the monthly payment period for which the application for payment is made.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

- 5.4.1 When the *Contractor* considers that the *Work* is substantially performed, or if permitted by the lien legislation applicable to the *Place of the Work* a designated portion thereof which the *Owner* agrees to accept separately is substantially performed, the *Contractor* shall, within one *Working Day*, deliver to the *Consultant* and to the *Owner* a comprehensive list of items to be completed or corrected, together with a written application for a review by the *Consultant* to establish *Substantial Performance of the Work* or substantial performance of the designated portion of the *Work*. Failure to include an item on the list does not alter the responsibility of the *Contractor* to complete the *Contract*.
- 5.4.2 The *Consultant* will review the *Work* to verify the validity of the application and shall promptly, and in any event, no later than 20 calendar days after receipt of the *Contractor's* list and application:
- .1 advise the *Contractor* in writing that the *Work* or the designated portion of the *Work* is not substantially performed and give reasons why, or
 - .2 state the date of *Substantial Performance of the Work* or a designated portion of the *Work* in a certificate and issue a copy of that certificate to each of the *Owner* and the *Contractor*.
- 5.4.3 Immediately following the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor*, in consultation with the *Consultant*, shall establish a reasonable date for finishing the *Work*.

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

- 5.5.1 After the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor* shall:
- .1 submit an application for payment of the holdback amount,
 - .2 submit CCDC 9A 'Statutory Declaration' to state that all accounts for labour, subcontracts, *Products*, *Construction Equipment*, and other indebtedness which may have been incurred by the *Contractor* in the *Substantial Performance of the Work* and for which the *Owner* might in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified amount in dispute.
- 5.5.2 After the receipt of an application for payment from the *Contractor* and the statement as provided in paragraph 5.5.1, the *Consultant* will issue a certificate for payment of the holdback amount.
- 5.5.3 Where the holdback amount required by the applicable lien legislation has not been placed in a separate holdback account, the *Owner* shall, 10 calendar days prior to the expiry of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*, place the holdback amount in a bank account in the joint names of the *Owner* and the *Contractor*.
- 5.5.4 In the common law jurisdictions, the holdback amount authorized by the certificate for payment of the holdback amount is due and payable on the first calendar day following the expiration of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*. Where lien legislation does not exist or apply, the holdback amount shall be due and payable in accordance with other legislation, industry practice or provisions which may be agreed to between the parties. The *Owner* may retain out of the holdback amount any sums required by law to satisfy any liens against the *Work* or, if permitted by the lien legislation applicable to the *Place of the Work*, other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.
- 5.5.5 In the Province of Quebec, the holdback amount authorized by the certificate for payment of the holdback amount is due and payable 30 calendar days after the issuance of the certificate. The *Owner* may retain out of the holdback amount any sums required to satisfy any legal hypothecs that have been taken, or could be taken, against the *Work* or other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.

GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

- 5.6.1 In the common law jurisdictions, where legislation permits and where, upon application by the *Contractor*, the *Consultant* has certified that the work of a *Subcontractor* or *Supplier* has been performed prior to *Substantial Performance of the Work*, the *Owner* shall pay the *Contractor* the holdback amount retained for such subcontract work, or the *Products* supplied by such *Supplier*, on the first calendar day following the expiration of the holdback period for such work stipulated in the lien legislation applicable to the *Place of the Work*. The *Owner* may retain out of the holdback amount any sums required by law to satisfy any liens against the *Work* or, if permitted by the lien legislation applicable to the *Place of the Work*, other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.

- 5.6.2 In the Province of Quebec, where, upon application by the *Contractor*, the *Consultant* has certified that the work of a *Subcontractor* or *Supplier* has been performed prior to *Substantial Performance of the Work*, the *Owner* shall pay the *Contractor* the holdback amount retained for such subcontract work, or the *Products* supplied by such *Supplier*, no later than 30 calendar days after such certification by the *Consultant*. The *Owner* may retain out of the holdback amount any sums required to satisfy any legal hypothecs that have been taken, or could be taken, against the *Work* or other third party monetary claims against the *Contractor* which are enforceable against the *Owner*.
- 5.6.3 Notwithstanding the provisions of the preceding paragraphs, and notwithstanding the wording of such certificates, the *Contractor* shall ensure that such subcontract work or *Products* are protected pending the issuance of a final certificate for payment and be responsible for the correction of defects or work not performed regardless of whether or not such was apparent when such certificates were issued.

GC 5.7 FINAL PAYMENT

- 5.7.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall submit an application for final payment.
- 5.7.2 The *Consultant* will, no later than 10 calendar days after the receipt of an application from the *Contractor* for final payment, review the *Work* to verify the validity of the application and advise the *Contractor* in writing that the application is valid or give reasons why it is not valid.
- 5.7.3 When the *Consultant* finds the *Contractor's* application for final payment valid, the *Consultant* will promptly issue a final certificate for payment.
- 5.7.4 Subject to the provision of paragraph 10.4.1 of GC 10.4 - WORKERS' COMPENSATION, and any lien legislation applicable to the *Place of the Work*, the *Owner* shall, no later than 5 calendar days after the issuance of a final certificate for payment, pay the *Contractor* as provided in Article A-5 of the Agreement - PAYMENT.

GC 5.8 WITHHOLDING OF PAYMENT

- 5.8.1 If because of climatic or other conditions reasonably beyond the control of the *Contractor*, there are items of work that cannot be performed, payment in full for that portion of the *Work* which has been performed as certified by the *Consultant* shall not be withheld or delayed by the *Owner* on account thereof, but the *Owner* may withhold, until the remaining portion of the *Work* is finished, only such an amount that the *Consultant* determines is sufficient and reasonable to cover the cost of performing such remaining work.

GC 5.9 NON-CONFORMING WORK

- 5.9.1 No payment by the *Owner* under the *Contract* nor partial or entire use or occupancy of the *Work* by the *Owner* shall constitute an acceptance of any portion of the *Work* or *Products* which are not in accordance with the requirements of the *Contract Documents*.

PART 6 CHANGES IN THE WORK

GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

- 6.1.1 The *Owner*, through the *Consultant*, without invalidating the *Contract*, may make:
- .1 changes in the *Work* consisting of additions, deletions or other revisions to the *Work* by *Change Order* or *Change Directive*, and
 - .2 changes to the *Contract Time* for the *Work*, or any part thereof, by *Change Order*.
- 6.1.2 The *Contractor* shall not perform a change in the *Work* without a *Change Order* or a *Change Directive*.

GC 6.2 CHANGE ORDER

- 6.2.1 When a change in the *Work* is proposed or required, the *Consultant* will provide the *Contractor* with a written description of the proposed change in the *Work*. The *Contractor* shall promptly present, in a form acceptable to the *Consultant*, a method of adjustment or an amount of adjustment for the *Contract Price*, if any, and the adjustment in the *Contract Time*, if any, for the proposed change in the *Work*.
- 6.2.2 When the *Owner* and *Contractor* agree to the adjustments in the *Contract Price* and *Contract Time* or to the method to be used to determine the adjustments, such agreement shall be effective immediately and shall be recorded in a *Change Order*. The value of the work performed as the result of a *Change Order* shall be included in the application for progress payment.

GC 6.3 CHANGE DIRECTIVE

- 6.3.1 If the *Owner* requires the *Contractor* to proceed with a change in the *Work* prior to the *Owner* and the *Contractor* agreeing upon the corresponding adjustment in *Contract Price* and *Contract Time*, the *Owner*, through the *Consultant*, shall issue a *Change Directive*.
- 6.3.2 A *Change Directive* shall only be used to direct a change in the *Work* which is within the general scope of the *Contract Documents*.
- 6.3.3 A *Change Directive* shall not be used to direct a change in the *Contract Time* only.
- 6.3.4 Upon receipt of a *Change Directive*, the *Contractor* shall proceed promptly with the change in the *Work*.
- 6.3.5 For the purpose of valuing *Change Directives*, changes in the *Work* that are not substitutions or otherwise related to each other shall not be grouped together in the same *Change Directive*.
- 6.3.6 The adjustment in the *Contract Price* for a change carried out by way of a *Change Directive* shall be determined on the basis of the cost of the *Contractor's* actual expenditures and savings attributable to the *Change Directive*, valued in accordance with paragraph 6.3.7 and as follows:
- .1 If the change results in a net increase in the *Contractor's* cost, the *Contract Price* shall be increased by the amount of the net increase in the *Contractor's* cost, plus the *Contractor's* percentage fee on such net increase.
 - .2 If the change results in a net decrease in the *Contractor's* cost, the *Contract Price* shall be decreased by the amount of the net decrease in the *Contractor's* cost, without adjustment for the *Contractor's* percentage fee.
 - .3 The *Contractor's* fee shall be as specified in the *Contract Documents* or as otherwise agreed by the parties.
- 6.3.7 The cost of performing the work attributable to the *Change Directive* shall be limited to the actual cost of the following:
- .1 salaries, wages and benefits paid to personnel in the direct employ of the *Contractor* under a salary or wage schedule agreed upon by the *Owner* and the *Contractor*, or in the absence of such a schedule, actual salaries, wages and benefits paid under applicable bargaining agreement, and in the absence of a salary or wage schedule and bargaining agreement, actual salaries, wages and benefits paid by the *Contractor*, for personnel
 - (1) stationed at the *Contractor's* field office, in whatever capacity employed;
 - (2) engaged in expediting the production or transportation of material or equipment, at shops or on the road;
 - (3) engaged in the preparation or review of *Shop Drawings*, fabrication drawings, and coordination drawings; or
 - (4) engaged in the processing of changes in the *Work*.
 - .2 contributions, assessments or taxes incurred for such items as employment insurance, provincial or territorial health insurance, workers' compensation, and Canada or Quebec Pension Plan, insofar as such cost is based on wages, salaries or other remuneration paid to employees of the *Contractor* and included in the cost of the *Work* as provided in paragraph 6.3.7.1;
 - .3 travel and subsistence expenses of the *Contractor's* personnel described in paragraph 6.3.7.1;
 - .4 all *Products* including cost of transportation thereof;
 - .5 materials, supplies, *Construction Equipment*, *Temporary Work*, and hand tools not owned by the workers, including transportation and maintenance thereof, which are consumed in the performance of the *Work*; and cost less salvage value on such items used but not consumed, which remain the property of the *Contractor*;
 - .6 all tools and *Construction Equipment*, exclusive of hand tools used in the performance of the *Work*, whether rented from or provided by the *Contractor* or others, including installation, minor repairs and replacements, dismantling, removal, transportation, and delivery cost thereof;
 - .7 all equipment and services required for the *Contractor's* field office;
 - .8 deposits lost;
 - .9 the amounts of all subcontracts;
 - .10 quality assurance such as independent inspection and testing services;
 - .11 charges levied by authorities having jurisdiction at the *Place of the Work*;
 - .12 royalties, patent licence fees and damages for infringement of patents and cost of defending suits therefor subject always to the *Contractor's* obligations to indemnify the *Owner* as provided in paragraph 10.3.1 of GC 10.3 - PATENT FEES;
 - .13 any adjustment in premiums for all bonds and insurance which the *Contractor* is required, by the *Contract Documents*, to purchase and maintain;
 - .14 any adjustment in taxes, other than *Value Added Taxes*, and duties for which the *Contractor* is liable;
 - .15 charges for long distance telephone and facsimile communications, courier services, expressage, and petty cash items incurred in relation to the performance of the *Work*;
 - .16 removal and disposal of waste products and debris; and
 - .17 safety measures and requirements.

- 6.3.8 Notwithstanding any other provisions contained in the General Conditions of the *Contract*, it is the intention of the parties that the cost of any item under any cost element referred to in paragraph 6.3.7 shall cover and include any and all costs or liabilities attributable to the *Change Directive* other than those which are the result of or occasioned by any failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor's* attention to the *Work*. Any cost due to failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor's* attention to the *Work* shall be borne by the *Contractor*.
- 6.3.9 The *Contractor* shall keep full and detailed accounts and records necessary for the documentation of the cost of performing the *Work* attributable to the *Change Directive* and shall provide the *Consultant* with copies thereof when requested.
- 6.3.10 For the purpose of valuing *Change Directives*, the *Owner* shall be afforded reasonable access to all of the *Contractor's* pertinent documents related to the cost of performing the *Work* attributable to the *Change Directive*.
- 6.3.11 Pending determination of the final amount of a *Change Directive*, the undisputed value of the *Work* performed as the result of a *Change Directive* is eligible to be included in progress payments.
- 6.3.12 If the *Owner* and the *Contractor* do not agree on the proposed adjustment in the *Contract Time* attributable to the change in the *Work*, or the method of determining it, the adjustment shall be referred to the *Consultant* for determination.
- 6.3.13 When the *Owner* and the *Contractor* reach agreement on the adjustment to the *Contract Price* and to the *Contract Time*, this agreement shall be recorded in a *Change Order*.

GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

- 6.4.1 If the *Owner* or the *Contractor* discover conditions at the *Place of the Work* which are:
- .1 subsurface or otherwise concealed physical conditions which existed before the commencement of the *Work* which differ materially from those indicated in the *Contract Documents*; or
 - .2 physical conditions, other than conditions due to weather, that are of a nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the *Contract Documents*,
- then the observing party shall give *Notice in Writing* to the other party of such conditions before they are disturbed and in no event later than 5 *Working Days* after first observance of the conditions.
- 6.4.2 The *Consultant* will promptly investigate such conditions and make a finding. If the finding is that the conditions differ materially and this would cause an increase or decrease in the *Contractor's* cost or time to perform the *Work*, the *Consultant*, with the *Owner's* approval, will issue appropriate instructions for a change in the *Work* as provided in GC 6.2 - CHANGE ORDER or GC 6.3 - CHANGE DIRECTIVE.
- 6.4.3 If the *Consultant* finds that the conditions at the *Place of the Work* are not materially different or that no change in the *Contract Price* or the *Contract Time* is justified, the *Consultant* will report the reasons for this finding to the *Owner* and the *Contractor* in writing.
- 6.4.4 If such concealed or unknown conditions relate to toxic and hazardous substances and materials, artifacts and fossils, or mould, the parties will be governed by the provisions of GC 9.2 - TOXIC AND HAZARDOUS SUBSTANCES, GC 9.3 - ARTIFACTS AND FOSSILS and GC 9.5 – MOULD.

GC 6.5 DELAYS

- 6.5.1 If the *Contractor* is delayed in the performance of the *Work* by an action or omission of the *Owner*, *Consultant* or anyone employed or engaged by them directly or indirectly, contrary to the provisions of the *Contract Documents*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.
- 6.5.2 If the *Contractor* is delayed in the performance of the *Work* by a stop work order issued by a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or any person employed or engaged by the *Contractor* directly or indirectly, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.

- 6.5.3 If the *Contractor* is delayed in the performance of the *Work* by:
- .1 labour disputes, strikes, lock-outs (including lock-outs decreed or recommended for its members by a recognized contractors' association, of which the *Contractor* is a member or to which the *Contractor* is otherwise bound),
 - .2 fire, unusual delay by common carriers or unavoidable casualties,
 - .3 abnormally adverse weather conditions, or
 - .4 any cause beyond the *Contractor's* control other than one resulting from a default or breach of *Contract* by the *Contractor*,
- then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The extension of time shall not be less than the time lost as the result of the event causing the delay, unless the *Contractor* agrees to a shorter extension. The *Contractor* shall not be entitled to payment for costs incurred by such delays unless such delays result from actions by the *Owner*, *Consultant* or anyone employed or engaged by them directly or indirectly.
- 6.5.4 No extension shall be made for delay unless *Notice in Writing* of the cause of delay is given to the *Consultant* not later than 10 *Working Days* after the commencement of the delay. In the case of a continuing cause of delay only one *Notice in Writing* shall be necessary.
- 6.5.5 If no schedule is made under paragraph 2.2.13 of GC 2.2 - ROLE OF THE CONSULTANT, then no request for extension shall be made because of failure of the *Consultant* to furnish instructions until 10 *Working Days* after demand for such instructions has been made.

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

- 6.6.1 If the *Contractor* intends to make a claim for an increase to the *Contract Price*, or if the *Owner* intends to make a claim against the *Contractor* for a credit to the *Contract Price*, the party that intends to make the claim shall give timely *Notice in Writing* of intent to claim to the other party and to the *Consultant*.
- 6.6.2 Upon commencement of the event or series of events giving rise to a claim, the party intending to make the claim shall:
- .1 take all reasonable measures to mitigate any loss or expense which may be incurred as a result of such event or series of events, and
 - .2 keep such records as may be necessary to support the claim.
- 6.6.3 The party making the claim shall submit within a reasonable time to the *Consultant* a detailed account of the amount claimed and the grounds upon which the claim is based.
- 6.6.4 Where the event or series of events giving rise to the claim has a continuing effect, the detailed account submitted under paragraph 6.6.3 shall be considered to be an interim account and the party making the claim shall, at such intervals as the *Consultant* may reasonably require, submit further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.
- 6.6.5 The *Consultant's* findings, with respect to a claim made by either party, will be given by *Notice in Writing* to both parties within 30 *Working Days* after receipt of the claim by the *Consultant*, or within such other time period as may be agreed by the parties.
- 6.6.6 If such finding is not acceptable to either party, the claim shall be settled in accordance with Part 8 of the General Conditions - DISPUTE RESOLUTION.

PART 7 DEFAULT NOTICE

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

- 7.1.1 If the *Contractor* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Contractor's* insolvency, or if a receiver is appointed because of the *Contractor's* insolvency, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, terminate the *Contractor's* right to continue with the *Work*, by giving the *Contractor* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.
- 7.1.2 If the *Contractor* neglects to prosecute the *Work* properly or otherwise fails to comply with the requirements of the *Contract* to a substantial degree and if the *Consultant* has given a written statement to the *Owner* and *Contractor* that sufficient cause exists to justify such action, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, give the *Contractor Notice in Writing* that the *Contractor* is in default of the *Contractor's* contractual obligations and instruct the *Contractor* to correct the default in the 5 *Working Days* immediately following the receipt of such *Notice in Writing*.

- 7.1.3 If the default cannot be corrected in the 5 *Working Days* specified or in such other time period as may be subsequently agreed in writing by the parties, the *Contractor* shall be in compliance with the *Owner's* instructions if the *Contractor*:
- .1 commences the correction of the default within the specified time, and
 - .2 provides the *Owner* with an acceptable schedule for such correction, and
 - .3 corrects the default in accordance with the *Contract* terms and with such schedule.
- 7.1.4 If the *Contractor* fails to correct the default in the time specified or in such other time period as may be subsequently agreed in writing by the parties, without prejudice to any other right or remedy the *Owner* may have, the *Owner* may:
- .1 correct such default and deduct the cost thereof from any payment then or thereafter due the *Contractor* provided the *Consultant* has certified such cost to the *Owner* and the *Contractor*, or
 - .2 terminate the *Contractor's* right to continue with the *Work* in whole or in part or terminate the *Contract*.
- 7.1.5 If the *Owner* terminates the *Contractor's* right to continue with the *Work* as provided in paragraphs 7.1.1 and 7.1.4, the *Owner* shall be entitled to:
- .1 take possession of the *Work* and *Products* at the *Place of the Work*; subject to the rights of third parties, utilize the *Construction Equipment* at the *Place of the Work*; finish the *Work* by whatever method the *Owner* may consider expedient, but without undue delay or expense, and
 - .2 withhold further payment to the *Contractor* until a final certificate for payment is issued, and
 - .3 charge the *Contractor* the amount by which the full cost of finishing the *Work* as certified by the *Consultant*, including compensation to the *Consultant* for the *Consultant's* additional services and a reasonable allowance as determined by the *Consultant* to cover the cost of corrections to work performed by the *Contractor* that may be required under GC 12.3 - WARRANTY, exceeds the unpaid balance of the *Contract Price*; however, if such cost of finishing the *Work* is less than the unpaid balance of the *Contract Price*, the *Owner* shall pay the *Contractor* the difference, and
 - .4 on expiry of the warranty period, charge the *Contractor* the amount by which the cost of corrections to the *Contractor's* work under GC 12.3 - WARRANTY exceeds the allowance provided for such corrections, or if the cost of such corrections is less than the allowance, pay the *Contractor* the difference.
- 7.1.6 The *Contractor's* obligation under the *Contract* as to quality, correction and warranty of the work performed by the *Contractor* up to the time of termination shall continue after such termination of the *Contract*.

GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

- 7.2.1 If the *Owner* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Owner's* insolvency, or if a receiver is appointed because of the *Owner's* insolvency, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.
- 7.2.2 If the *Work* is suspended or otherwise delayed for a period of 20 *Working Days* or more under an order of a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or of anyone directly or indirectly employed or engaged by the *Contractor*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* *Notice in Writing* to that effect.
- 7.2.3 The *Contractor* may give *Notice in Writing* to the *Owner*, with a copy to the *Consultant*, that the *Owner* is in default of the *Owner's* contractual obligations if:
- .1 the *Owner* fails to furnish, when so requested by the *Contractor*, reasonable evidence that financial arrangements have been made to fulfill the *Owner's* obligations under the *Contract*, or
 - .2 the *Consultant* fails to issue a certificate as provided in GC 5.3 - PROGRESS PAYMENT, or
 - .3 the *Owner* fails to pay the *Contractor* when due the amounts certified by the *Consultant* or awarded by arbitration or court, or
 - .4 the *Owner* violates the requirements of the *Contract* to a substantial degree and the *Consultant*, except for GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER, confirms by written statement to the *Contractor* that sufficient cause exists.
- 7.2.4 The *Contractor's* *Notice in Writing* to the *Owner* provided under paragraph 7.2.3 shall advise that if the default is not corrected within 5 *Working Days* following the receipt of the *Notice in Writing*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, suspend the *Work* or terminate the *Contract*.
- 7.2.5 If the *Contractor* terminates the *Contract* under the conditions set out above, the *Contractor* shall be entitled to be paid for all work performed including reasonable profit, for loss sustained upon *Products* and *Construction Equipment*, and such other damages as the *Contractor* may have sustained as a result of the termination of the *Contract*.

PART 8 DISPUTE RESOLUTION

GC 8.1 AUTHORITY OF THE CONSULTANT

- 8.1.1 Differences between the parties to the *Contract* as to the interpretation, application or administration of the *Contract* or any failure to agree where agreement between the parties is called for, herein collectively called disputes, which are not resolved in the first instance by findings of the *Consultant* as provided in GC 2.2 - ROLE OF THE CONSULTANT, shall be settled in accordance with the requirements of Part 8 of the General Conditions - DISPUTE RESOLUTION.
- 8.1.2 If a dispute arises under the *Contract* in respect of a matter in which the *Consultant* has no authority under the *Contract* to make a finding, the procedures set out in paragraph 8.1.3 and paragraphs 8.2.3 to 8.2.8 of GC 8.2 - NEGOTIATION, MEDIATION AND ARBITRATION, and in GC 8.3 - RETENTION OF RIGHTS apply to that dispute with the necessary changes to detail as may be required.
- 8.1.3 If a dispute is not resolved promptly, the *Consultant* will give such instructions as in the *Consultant's* opinion are necessary for the proper performance of the *Work* and to prevent delays pending settlement of the dispute. The parties shall act immediately according to such instructions, it being understood that by so doing neither party will jeopardize any claim the party may have. If it is subsequently determined that such instructions were in error or at variance with the *Contract Documents*, the *Owner* shall pay the *Contractor* costs incurred by the *Contractor* in carrying out such instructions which the *Contractor* was required to do beyond what the *Contract Documents* correctly understood and interpreted would have required, including costs resulting from interruption of the *Work*.

GC 8.2 NEGOTIATION, MEDIATION AND ARBITRATION

- 8.2.1 In accordance with the Rules for Mediation of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing, the parties shall appoint a Project Mediator
- .1 within 20 *Working Days* after the *Contract* was awarded, or
 - .2 if the parties neglected to make an appointment within the 20 *Working Days*, within 10 *Working Days* after either party by *Notice in Writing* requests that the Project Mediator be appointed.
- 8.2.2 A party shall be conclusively deemed to have accepted a finding of the *Consultant* under GC 2.2 - ROLE OF THE CONSULTANT and to have expressly waived and released the other party from any claims in respect of the particular matter dealt with in that finding unless, within 15 *Working Days* after receipt of that finding, the party sends a *Notice in Writing* of dispute to the other party and to the *Consultant*, which contains the particulars of the matter in dispute and the relevant provisions of the *Contract Documents*. The responding party shall send a *Notice in Writing* of reply to the dispute within 10 *Working Days* after receipt of such *Notice in Writing* setting out particulars of this response and any relevant provisions of the *Contract Documents*.
- 8.2.3 The parties shall make all reasonable efforts to resolve their dispute by amicable negotiations and agree to provide, without prejudice, frank, candid and timely disclosure of relevant facts, information and documents to facilitate these negotiations.
- 8.2.4 After a period of 10 *Working Days* following receipt of a responding party's *Notice in Writing* of reply under paragraph 8.2.2, the parties shall request the Project Mediator to assist the parties to reach agreement on any unresolved dispute. The mediated negotiations shall be conducted in accordance with the Rules for Mediation of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing.
- 8.2.5 If the dispute has not been resolved within 10 *Working Days* after the Project Mediator was requested under paragraph 8.2.4 or within such further period agreed by the parties, the Project Mediator shall terminate the mediated negotiations by giving *Notice in Writing* to the *Owner*, the *Contractor* and the *Consultant*.
- 8.2.6 By giving a *Notice in Writing* to the other party and the *Consultant*, not later than 10 *Working Days* after the date of termination of the mediated negotiations under paragraph 8.2.5, either party may refer the dispute to be finally resolved by arbitration under the Rules for Arbitration of Construction Disputes as provided in CCDC 40 in effect at the time of bid closing. The arbitration shall be conducted in the jurisdiction of the *Place of the Work*.
- 8.2.7 On expiration of the 10 *Working Days*, the arbitration agreement under paragraph 8.2.6 is not binding on the parties and, if a *Notice in Writing* is not given under paragraph 8.2.6 within the required time, the parties may refer the unresolved dispute to the courts or to any other form of dispute resolution, including arbitration, which they have agreed to use.

- 8.2.8 If neither party, by *Notice in Writing*, given within 10 *Working Days* of the date of *Notice in Writing* requesting arbitration in paragraph 8.2.6, requires that a dispute be arbitrated immediately, all disputes referred to arbitration as provided in paragraph 8.2.6 shall be
- .1 held in abeyance until
 - (1) *Substantial Performance of the Work*,
 - (2) the *Contract* has been terminated, or
 - (3) the *Contractor* has abandoned the *Work*,whichever is earlier; and
 - .2 consolidated into a single arbitration under the rules governing the arbitration under paragraph 8.2.6.

GC 8.3 RETENTION OF RIGHTS

- 8.3.1 It is agreed that no act by either party shall be construed as a renunciation or waiver of any rights or recourses, provided the party has given the *Notice in Writing* required under Part 8 of the General Conditions - DISPUTE RESOLUTION and has carried out the instructions as provided in paragraph 8.1.3 of GC 8.1 – AUTHORITY OF THE CONSULTANT.
- 8.3.2 Nothing in Part 8 of the General Conditions - DISPUTE RESOLUTION shall be construed in any way to limit a party from asserting any statutory right to a lien under applicable lien legislation of the jurisdiction of the *Place of the Work* and the assertion of such right by initiating judicial proceedings is not to be construed as a waiver of any right that party may have under paragraph 8.2.6 of GC 8.2 – NEGOTIATION, MEDIATION AND ARBITRATION to proceed by way of arbitration to adjudicate the merits of the claim upon which such a lien is based.

PART 9 PROTECTION OF PERSONS AND PROPERTY

GC 9.1 PROTECTION OF WORK AND PROPERTY

- 9.1.1 The *Contractor* shall protect the *Work* and the *Owner's* property and property adjacent to the *Place of the Work* from damage which may arise as the result of the *Contractor's* operations under the *Contract*, and shall be responsible for such damage, except damage which occurs as the result of:
- .1 errors in the *Contract Documents*;
 - .2 acts or omissions by the *Owner*, the *Consultant*, other contractors, their agents and employees.
- 9.1.2 Before commencing any work, the *Contractor* shall determine the location of all underground utilities and structures indicated in the *Contract Documents* or that are reasonably apparent in an inspection of the *Place of the Work*.
- 9.1.3 Should the *Contractor* in the performance of the *Contract* damage the *Work*, the *Owner's* property or property adjacent to the *Place of the Work*, the *Contractor* shall be responsible for making good such damage at the *Contractor's* expense.
- 9.1.4 Should damage occur to the *Work* or *Owner's* property for which the *Contractor* is not responsible, as provided in paragraph 9.1.1, the *Contractor* shall make good such damage to the *Work* and, if the *Owner* so directs, to the *Owner's* property. The *Contract Price* and *Contract Time* shall be adjusted as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

- 9.2.1 For the purposes of applicable legislation related to toxic and hazardous substances, the *Owner* shall be deemed to have control and management of the *Place of the Work* with respect to existing conditions.
- 9.2.2 Prior to the *Contractor* commencing the *Work*, the *Owner* shall,
- .1 take all reasonable steps to determine whether any toxic or hazardous substances are present at the *Place of the Work*, and
 - .2 provide the *Consultant* and the *Contractor* with a written list of any such substances that are known to exist and their locations.
- 9.2.3 The *Owner* shall take all reasonable steps to ensure that no person's exposure to any toxic or hazardous substances exceeds the time weighted levels prescribed by applicable legislation at the *Place of the Work* and that no property is damaged or destroyed as a result of exposure to, or the presence of, toxic or hazardous substances which were at the *Place of the Work* prior to the *Contractor* commencing the *Work*.
- 9.2.4 Unless the *Contract* expressly provides otherwise, the *Owner* shall be responsible for taking all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to dispose of, store or otherwise render harmless toxic or hazardous substances which were present at the *Place of the Work* prior to the *Contractor* commencing the *Work*.

- 9.2.5 If the *Contractor*
- .1 encounters toxic or hazardous substances at the *Place of the Work*, or
 - .2 has reasonable grounds to believe that toxic or hazardous substances are present at the *Place of the Work*, which were not brought to the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible and which were not disclosed by the *Owner* or which were disclosed but have not been dealt with as required under paragraph 9.2.4, the *Contractor* shall
 - .3 take all reasonable steps, including stopping the *Work*, to ensure that no person's exposure to any toxic or hazardous substances exceeds any applicable time weighted levels prescribed by applicable legislation at the *Place of the Work*, and
 - .4 immediately report the circumstances to the *Consultant* and the *Owner* in writing.
- 9.2.6 If the *Owner* and *Contractor* do not agree on the existence, significance of, or whether the toxic or hazardous substances were brought onto the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and the *Contractor*.
- 9.2.7 If the *Owner* and *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were not brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall promptly at the *Owner's* own expense:
- .1 take all steps as required under paragraph 9.2.4;
 - .2 reimburse the *Contractor* for the costs of all steps taken pursuant to paragraph 9.2.5;
 - .3 extend the *Contract* time for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in 9.2.6 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay; and
 - .4 indemnify the *Contractor* as required by GC 12.1 - INDEMNIFICATION.
- 9.2.8 If the *Owner* and *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Contractor* shall promptly at the *Contractor's* own expense:
- .1 take all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to safely remove and dispose the toxic or hazardous substances;
 - .2 make good any damage to the *Work*, the *Owner's* property or property adjacent to the place of the *Work* as provided in paragraph 9.1.3 of GC 9.1 – PROTECTION OF WORK AND PROPERTY;
 - .3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.2.6; and
 - .4 indemnify the *Owner* as required by GC 12.1 - INDEMNIFICATION.
- 9.2.9 If either party does not accept the expert's findings under paragraph 9.2.6, the disagreement shall be settled in accordance with Part 8 of the General Conditions - Dispute Resolution. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraph 9.2.7 or 9.2.8 it being understood that by so doing, neither party will jeopardize any claim that party may have to be reimbursed as provided by GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.

GC 9.3 ARTIFACTS AND FOSSILS

- 9.3.1 Fossils, coins, articles of value or antiquity, structures and other remains or things of scientific or historic interest discovered at the *Place or Work* shall, as between the *Owner* and the *Contractor*, be deemed to be the absolute property of the *Owner*.
- 9.3.2 The *Contractor* shall take all reasonable precautions to prevent removal or damage to discoveries as identified in paragraph 9.3.1, and shall advise the *Consultant* upon discovery of such items.
- 9.3.3 The *Consultant* will investigate the impact on the *Work* of the discoveries identified in paragraph 9.3.1. If conditions are found that would cause an increase or decrease in the *Contractor's* cost or time to perform the *Work*, the *Consultant*, with the *Owner's* approval, will issue appropriate instructions for a change in the *Work* as provided in GC 6.2 - CHANGE ORDER or GC 6.3 CHANGE DIRECTIVE.

GC 9.4 CONSTRUCTION SAFETY

- 9.4.1 Subject to paragraph 3.2.2.2 of GC 3.2 - CONSTRUCTION BY OWNER OR OTHER CONTRACTORS, the *Contractor* shall be solely responsible for construction safety at the *Place of the Work* and for compliance with the rules, regulations and practices required by the applicable construction health and safety legislation and shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the *Work*.

GC 9.5 MOULD

- 9.5.1 If the *Contractor* or *Owner* observes or reasonably suspects the presence of mould at the *Place of the Work*, the remediation of which is not expressly part of the *Work*,
- .1 the observing party shall promptly report the circumstances to the other party in writing, and
 - .2 the *Contractor* shall promptly take all reasonable steps, including stopping the *Work* if necessary, to ensure that no person suffers injury, sickness or death and that no property is damaged as a result of exposure to or the presence of the mould, and
 - .3 if the *Owner* and *Contractor* do not agree on the existence, significance or cause of the mould or as to what steps need be taken to deal with it, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and *Contractor*.
- 9.5.2 If the *Owner* and *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was caused by the *Contractor*'s operations under the *Contract*, the *Contractor* shall promptly, at the *Contractor*'s own expense:
- .1 take all reasonable and necessary steps to safely remediate or dispose of the mould, and
 - .2 make good any damage to the *Work*, the *Owner*'s property or property adjacent to the *Place of the Work* as provided in paragraph 9.1.3 of GC 9.1 - PROTECTION OF WORK AND PROPERTY, and
 - .3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.5.1.3, and
 - .4 indemnify the *Owner* as required by GC 12.1 - INDEMNIFICATION.
- 9.5.3 If the *Owner* and *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was not caused by the *Contractor*'s operations under the *Contract*, the *Owner* shall promptly, at the *Owner*'s own expense:
- .1 take all reasonable and necessary steps to safely remediate or dispose of the mould, and
 - .2 reimburse the *Contractor* for the cost of taking the steps under paragraph 9.5.1.2 and making good any damage to the *Work* as provided in paragraph 9.1.4 of GC 9.1 - PROTECTION OF WORK AND PROPERTY, and
 - .3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in paragraph 9.5.1.3 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay, and
 - .4 indemnify the *Contractor* as required by GC 12.1 - INDEMNIFICATION.
- 9.5.4 If either party does not accept the expert's finding under paragraph 9.5.1.3, the disagreement shall be settled in accordance with Part 8 of the General Conditions - DISPUTE RESOLUTION. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraphs 9.5.2 or 9.5.3, it being understood that by so doing neither party will jeopardize any claim the party may have to be reimbursed as provided by GC 9.5 - MOULD.

PART 10 GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

- 10.1.1 The *Contract Price* shall include all taxes and customs duties in effect at the time of the bid closing except for *Value Added Taxes* payable by the *Owner* to the *Contractor* as stipulated in Article A-4 of the Agreement - CONTRACT PRICE.
- 10.1.2 Any increase or decrease in costs to the *Contractor* due to changes in such included taxes and duties after the time of the bid closing shall increase or decrease the *Contract Price* accordingly.

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

- 10.2.1 The laws of the *Place of the Work* shall govern the *Work*.
- 10.2.2 The *Owner* shall obtain and pay for development approvals, building permit, permanent easements, rights of servitude, and all other necessary approvals and permits, except for the permits and fees referred to in paragraph 10.2.3 or for which the *Contract Documents* specify as the responsibility of the *Contractor*.
- 10.2.3 The *Contractor* shall be responsible for the procurement of permits, licences, inspections, and certificates, which are necessary for the performance of the *Work* and customarily obtained by contractors in the jurisdiction of the *Place of the Work* after the issuance of the building permit. The *Contract Price* includes the cost of these permits, licences, inspections, and certificates, and their procurement.
- 10.2.4 The *Contractor* shall give the required notices and comply with the laws, ordinances, rules, regulations, or codes which are or become in force during the performance of the *Work* and which relate to the *Work*, to the preservation of the public health, and to construction safety.

- 10.2.5 The *Contractor* shall not be responsible for verifying that the *Contract Documents* are in compliance with the applicable laws, ordinances, rules, regulations, or codes relating to the *Work*. If the *Contract Documents* are at variance therewith, or if, subsequent to the time of bid closing, changes are made to the applicable laws, ordinances, rules, regulations, or codes which require modification to the *Contract Documents*, the *Contractor* shall advise the *Consultant* in writing requesting direction immediately upon such variance or change becoming known. The *Consultant* will make the changes required to the *Contract Documents* as provided in GC 6.1 - OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.
- 10.2.6 If the *Contractor* fails to advise the *Consultant* in writing; and fails to obtain direction as required in paragraph 10.2.5; and performs work knowing it to be contrary to any laws, ordinances, rules, regulations, or codes; the *Contractor* shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations, or codes.
- 10.2.7 If, subsequent to the time of bid closing, changes are made to applicable laws, ordinances, rules, regulations, or codes of authorities having jurisdiction which affect the cost of the *Work*, either party may submit a claim in accordance with the requirements of GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.

GC 10.3 PATENT FEES

- 10.3.1 The *Contractor* shall pay the royalties and patent licence fees required for the performance of the *Contract*. The *Contractor* shall hold the *Owner* harmless from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor's* performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention by the *Contractor* or anyone for whose acts the *Contractor* may be liable.
- 10.3.2 The *Owner* shall hold the *Contractor* harmless against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor's* performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention in executing anything for the purpose of the *Contract*, the model, plan or design of which was supplied to the *Contractor* as part of the *Contract Documents*.

GC 10.4 WORKERS' COMPENSATION

- 10.4.1 Prior to commencing the *Work*, 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, the *Contractor* shall provide evidence of compliance with workers' compensation legislation at the *Place of the Work*, including payments due thereunder.
- 10.4.2 At any time during the term of the *Contract*, when requested by the *Owner*, the *Contractor* shall provide such evidence of compliance by the *Contractor* and *Subcontractors*.

PART 11 INSURANCE AND CONTRACT SECURITY

GC 11.1 INSURANCE

- 11.1.1 Without restricting the generality of GC 12.1 - INDEMNIFICATION, the *Contractor* shall provide, maintain and pay for the following insurance coverages, the minimum requirements of which are specified in CCDC 41 – CCDC Insurance Requirements in effect at the time of bid closing except as hereinafter provided:
- .1 General liability insurance in the name of the *Contractor* and include, or in the case of a single, blanket policy, be endorsed to name, the *Owner* and the *Consultant* as insureds but only with respect to liability, other than legal liability arising out of their sole negligence, arising out of the operations of the *Contractor* with regard to the *Work*. General liability insurance shall be maintained from the date of commencement of the *Work* until one year from the date of *Substantial Performance of the Work*. Liability coverage shall be provided for completed operations hazards from the date of *Substantial Performance of the Work*, as set out in the certificate of *Substantial Performance of the Work*, on an ongoing basis for a period of 6 years following *Substantial Performance of the Work*.
 - .2 Automobile Liability Insurance from the date of commencement of the *Work* until one year after the date of *Substantial Performance of the Work*.
 - .3 Aircraft or Watercraft Liability Insurance when owned or non-owned aircraft or watercraft are used directly or indirectly in the performance of the *Work*
 - .4 "Broad form" property insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The "Broad form" property insurance shall be provided from the date of commencement of the *Work* until the earliest of:
 - (1) 10 calendar days after the date of *Substantial Performance of the Work*;

- (2) on the commencement of use or occupancy of any part or section of the *Work* unless such use or occupancy is for construction purposes, habitational, office, banking, convenience store under 465 square metres in area, or parking purposes, or for the installation, testing and commissioning of equipment forming part of the *Work*;
- (3) when left unattended for more than 30 consecutive calendar days or when construction activity has ceased for more than 30 consecutive calendar days.
- .5 Boiler and machinery insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The coverage shall be maintained continuously from commencement of use or operation of the boiler and machinery objects insured by the policy and until 10 calendar days after the date of *Substantial Performance of the Work*.
- .6 The "Broad form" property and boiler and machinery policies shall provide that, in the case of a loss or damage, payment shall be made to the *Owner* and the *Contractor* as their respective interests may appear. In the event of loss or damage:
 - (1) the *Contractor* shall act on behalf of the *Owner* for the purpose of adjusting the amount of such loss or damage payment with the insurers. When the extent of the loss or damage is determined, the *Contractor* shall proceed to restore the *Work*. Loss or damage shall not affect the rights and obligations of either party under the *Contract* except that the *Contractor* shall be entitled to such reasonable extension of *Contract Time* relative to the extent of the loss or damage as the *Consultant* may recommend in consultation with the *Contractor*;
 - (2) the *Contractor* shall be entitled to receive from the *Owner*, in addition to the amount due under the *Contract*, the amount which the *Owner's* interest in restoration of the *Work* has been appraised, such amount to be paid as the restoration of the *Work* proceeds in accordance with the progress payment provisions. In addition the *Contractor* shall be entitled to receive from the payments made by the insurer the amount of the *Contractor's* interest in the restoration of the *Work*; and
 - (3) to the *Work* arising from the work of the *Owner*, the *Owner's* own forces or another contractor, the *Owner* shall, in accordance with the *Owner's* obligations under the provisions relating to construction by *Owner* or other contractors, pay the *Contractor* the cost of restoring the *Work* as the restoration of the *Work* proceeds and as in accordance with the progress payment provisions.
- .7 *Contractors' Equipment Insurance* from the date of commencement of the *Work* until one year after the date of *Substantial Performance of the Work*.
- 11.1.2 Prior to commencement of the *Work* and upon the placement, renewal, amendment, or extension of all or any part of the insurance, the *Contractor* shall promptly provide the *Owner* with confirmation of coverage and, if required, a certified true copy of the policies certified by an authorized representative of the insurer together with copies of any amending endorsements applicable to the *Work*.
- 11.1.3 The parties shall pay their share of the deductible amounts in direct proportion to their responsibility in regards to any loss for which the above policies are required to pay, except where such amounts may be excluded by the terms of the *Contract*.
- 11.1.4 If the *Contractor* fails to provide or maintain insurance as required by the *Contract Documents*, then the *Owner* shall have the right to provide and maintain such insurance and give evidence to the *Contractor* and the *Consultant*. The *Contractor* shall pay the cost thereof to the *Owner* on demand or the *Owner* may deduct the cost from the amount which is due or may become due to the *Contractor*.
- 11.1.5 All required insurance policies shall be with insurers licensed to underwrite insurance in the jurisdiction of the *Place of the Work*.
- 11.1.6 If a revised version of CCDC 41 – INSURANCE REQUIREMENTS is published, which specifies reduced insurance requirements, the parties shall address such reduction, prior to the *Contractor's* insurance policy becoming due for renewal, and record any agreement in a *Change Order*.
- 11.1.7 If a revised version of CCDC 41 – INSURANCE REQUIREMENTS is published, which specifies increased insurance requirements, the *Owner* may request the increased coverage from the *Contractor* by way of a *Change Order*.
- 11.1.8 A *Change Directive* shall not be used to direct a change in the insurance requirements in response to the revision of CCDC 41 – INSURANCE REQUIREMENTS.

GC 11.2 CONTRACT SECURITY

- 11.2.1 The *Contractor* shall, prior to commencement of the *Work* or within the specified time, provide to the *Owner* any *Contract* security specified in the *Contract Documents*.

- 11.2.2 If the *Contract Documents* require surety bonds to be provided, such bonds shall be issued by a duly licensed surety company authorized to transact the business of suretyship in the province or territory of the *Place of the Work* and shall be maintained in good standing until the fulfillment of the *Contract*. The form of such bonds shall be in accordance with the latest edition of the CCDC approved bond forms.

PART 12 INDEMNIFICATION, WAIVER OF CLAIMS AND WARRANTY

GC 12.1 INDEMNIFICATION

- 12.1.1 Without restricting the parties' obligation to indemnify as described in paragraphs 12.1.4 and 12.1.5, the *Owner* and the *Contractor* shall each indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings whether in respect to losses suffered by them or in respect to claims by third parties that arise out of, or are attributable in any respect to their involvement as parties to this *Contract*, provided such claims are:
- .1 caused by:
 - (1) the negligent acts or omissions of the party from whom indemnification is sought or anyone for whose acts or omissions that party is liable, or
 - (2) a failure of the party to the *Contract* from whom indemnification is sought to fulfill its terms or conditions; and
 - .2 made by *Notice in Writing* within a period of 6 years from the date of *Substantial Performance of the Work* as set out in the certificate of *Substantial Performance of the Work* issued pursuant to paragraph 5.4.2.2 of GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK or within such shorter period as may be prescribed by any limitation statute of the province or territory of the *Place of the Work*.
- The parties expressly waive the right to indemnity for claims other than those provided for in this *Contract*.
- 12.1.2 The obligation of either party to indemnify as set forth in paragraph 12.1.1 shall be limited as follows:
- .1 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is to be provided by either party pursuant to GC 11.1 – INSURANCE, the general liability insurance limit for one occurrence as referred to in CCDC 41 in effect at the time of bid closing.
 - .2 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is not required to be provided by either party in accordance with GC 11.1 – INSURANCE, the greater of the *Contract Price* as recorded in Article A-4 – CONTRACT PRICE or \$2,000,000, but in no event shall the sum be greater than \$20,000,000.
 - .3 In respect to claims by third parties for direct loss resulting from bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, the obligation to indemnify is without limit. In respect to all other claims for indemnity as a result of claims advanced by third parties, the limits of indemnity set forth in paragraphs 12.1.2.1 and 12.1.2.2 shall apply.
- 12.1.3 The obligation of either party to indemnify the other as set forth in paragraphs 12.1.1 and 12.1.2 shall be inclusive of interest and all legal costs.
- 12.1.4 The *Owner* and the *Contractor* shall indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of their obligations described in GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.
- 12.1.5 The *Owner* shall indemnify and hold harmless the *Contractor* from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings:
- .1 as described in paragraph 10.3.2 of GC 10.3 – PATENT FEES, and
 - .2 arising out of the *Contractor's* performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the *Place of the Work*.
- 12.1.6 In respect to any claim for indemnity or to be held harmless by the *Owner* or the *Contractor*:
- .1 *Notice in Writing* of such claim shall be given within a reasonable time after the facts upon which such claim is based became known;
 - .2 should any party be required as a result of its obligation to indemnify another to pay or satisfy a final order, judgment or award made against the party entitled by this contract to be indemnified, then the indemnifying party upon assuming all liability for any costs that might result shall have the right to appeal in the name of the party against whom such final order or judgment has been made until such rights of appeal have been exhausted.

GC 12.2 WAIVER OF CLAIMS

- 12.2.1 Subject to any lien legislation applicable to the *Place of the Work*, as of the fifth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the *Contractor* waives and releases the *Owner* from all claims which the *Contractor* has or reasonably ought to have knowledge of that could be advanced by the *Contractor* against the *Owner* arising from the *Contractor*'s involvement in the *Work*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the date of *Substantial Performance of the Work*, except as follows:
- .1 claims arising prior to or on the date of *Substantial Performance of the Work* for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* no later than the sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*;
 - .2 indemnification for claims advanced against the *Contractor* by third parties for which a right of indemnification may be asserted by the *Contractor* against the *Owner* pursuant to the provisions of this *Contract*;
 - .3 claims for which a right of indemnity could be asserted by the *Contractor* pursuant to the provisions of paragraphs 12.1.4 or 12.1.5 of GC 12.1 – INDEMNIFICATION; and
 - .4 claims resulting from acts or omissions which occur after the date of *Substantial Performance of the Work*.
- 12.2.2 The *Contractor* waives and releases the *Owner* from all claims referenced in paragraph 12.2.1.4 except for those referred in paragraphs 12.2.1.2 and 12.2.1.3 and claims for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* within 395 calendar days following the date of *Substantial Performance of the Work*.
- 12.2.3 Subject to any lien legislation applicable to the *Place of the Work*, as of the fifth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the *Owner* waives and releases the *Contractor* from all claims which the *Owner* has or reasonably ought to have knowledge of that could be advanced by the *Owner* against the *Contractor* arising from the *Owner*'s involvement in the *Work*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the date of *Substantial Performance of the Work*, except as follows:
- .1 claims arising prior to or on the date of *Substantial Performance of the Work* for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* no later than the sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*;
 - .2 indemnification for claims advanced against the *Owner* by third parties for which a right of indemnification may be asserted by the *Owner* against the *Contractor* pursuant to the provisions of this *Contract*;
 - .3 claims for which a right of indemnity could be asserted by the *Owner* against the *Contractor* pursuant to the provisions of paragraph 12.1.4 of GC 12.1 - INDEMNIFICATION;
 - .4 damages arising from the *Contractor*'s actions which result in substantial defects or deficiencies in the *Work*. "Substantial defects or deficiencies" mean those defects or deficiencies in the *Work* which affect the *Work* to such an extent or in such a manner that a significant part or the whole of the *Work* is unfit for the purpose intended by the *Contract Documents*;
 - .5 claims arising pursuant to GC 12.3 - WARRANTY; and
 - .6 claims arising from acts or omissions which occur after the date of *Substantial Performance of the Work*.
- 12.2.4 The *Owner* waives and releases the *Contractor* from all claims referred to in paragraph 12.2.3.4 except claims for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* within a period of six years from the date of *Substantial Performance of the Work* should any limitation statute of the Province or Territory of the *Place of the Work* permit such agreement. If the applicable limitation statute does not permit such agreement, within such shorter period as may be prescribed by:
- .1 any limitation statute of the Province or Territory of the *Place of the Work*; or
 - .2 if the *Place of the Work* is the Province of Quebec, then Article 2118 of the Civil Code of Quebec.
- 12.2.5 The *Owner* waives and releases the *Contractor* from all claims referenced in paragraph 12.2.3.6 except for those referred in paragraph 12.2.3.2, 12.2.3.3 and those arising under GC 12.3 – WARRANTY and claims for which *Notice in Writing* has been received by the *Contractor* from the *Owner* within 395 calendar days following the date of *Substantial Performance of the Work*.
- 12.2.6 "Notice in Writing of claim" as provided for in GC 12.2 – WAIVER OF CLAIMS to preserve a claim or right of action which would otherwise, by the provisions of GC 12.2 – WAIVER OF CLAIMS, be deemed to be waived, must include the following:
- .1 a clear and unequivocal statement of the intention to claim;
 - .2 a statement as to the nature of the claim and the grounds upon which the claim is based; and
 - .3 a statement of the estimated quantum of the claim.
- 12.2.7 The party giving "Notice in Writing of claim" as provided for in GC 12.2 – WAIVER OF CLAIMS shall submit within a reasonable time a detailed account of the amount claimed.

- 12.2.8 Where the event or series of events giving rise to a claim made under paragraphs 12.2.1 or 12.2.3 has a continuing effect, the detailed account submitted under paragraph 12.2.7 shall be considered to be an interim account and the party making the claim shall submit further interim accounts, at reasonable intervals, giving the accumulated amount of the claim and any further grounds upon which it is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.
- 12.2.9 If a *Notice in Writing* of claim pursuant to paragraph 12.2.1.1 is received on the seventh or sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the period within which *Notice in Writing* of claim shall be received pursuant to paragraph 12.2.3.1 shall be extended to two calendar days before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*.
- 12.2.10 If a *Notice in Writing* of claim pursuant to paragraph 12.2.3.1 is received on the seventh or sixth calendar day before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*, the period within which *Notice in Writing* of claim shall be received pursuant to paragraph 12.2.1.1 shall be extended to two calendar days before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work*.

GC 12.3 WARRANTY

- 12.3.1 Except for extended warranties as described in paragraph 12.3.6, the warranty period under the *Contract* is one year from the date of *Substantial Performance of the Work*.
- 12.3.2 The *Contractor* shall be responsible for the proper performance of the *Work* to the extent that the design and *Contract Documents* permit such performance.
- 12.3.3 The *Owner*, through the *Consultant*, shall promptly give the *Contractor* *Notice in Writing* of observed defects and deficiencies which occur during the one year warranty period.
- 12.3.4 Subject to paragraph 12.3.2, the *Contractor* shall correct promptly, at the *Contractor's* expense, defects or deficiencies in the *Work* which appear prior to and during the one year warranty period.
- 12.3.5 The *Contractor* shall correct or pay for damage resulting from corrections made under the requirements of paragraph 12.3.4.
- 12.3.6 Any extended warranties required beyond the one year warranty period as described in paragraph 12.3.1, shall be as specified in the *Contract Documents*. Extended warranties shall be issued by the warrantor to the benefit of the *Owner*. The *Contractor's* responsibility with respect to extended warranties shall be limited to obtaining any such extended warranties from the warrantor. The obligations under such extended warranties are solely the responsibilities of the warrantor.

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CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE

CCDC 41 CCDC INSURANCE REQUIREMENTS

PUBLICATION DATE: JANUARY 21, 2008

1. General liability insurance shall be with limits of not less than \$5,000,000 per occurrence, an aggregate limit of not less than \$5,000,000 within any policy year with respect to completed operations, and a deductible not exceeding \$5,000. The insurance coverage shall not be less than the insurance provided by IBC Form 2100 (including an extension for a standard provincial and territorial form of non-owned automobile liability policy) and IBC Form 2320. To achieve the desired limit, umbrella or excess liability insurance may be used. Subject to satisfactory proof of financial capability by the *Contractor*, the *Owner* may agree to increase the deductible amounts.
2. 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*. Where the policy has been issued pursuant to a government-operated automobile insurance system, the *Contractor* shall provide the *Owner* with confirmation of automobile insurance coverage for all automobiles registered in the name of the *Contractor*.
3. 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 \$5,000,000 inclusive per occurrence for bodily injury, death and damage to property including loss of use thereof and limits of not less than \$5,000,000 for aircraft passenger hazard. Such insurance shall be in a form acceptable to the *Owner*.
4. "Broad form" property insurance shall have limits of not less than the sum of 1.1 times *Contract Price* and the full value, as stated in the *Contract*, of *Products* and design services that are specified to be provided by the *Owner* for incorporation into the *Work*, with a deductible not exceeding \$5,000. The insurance coverage shall not be less than the insurance provided by IBC Forms 4042 and 4047 (excluding flood and earthquake) or their equivalent replacement. Subject to satisfactory proof of financial capability by the *Contractor*, the *Owner* may agree to increase the deductible amounts.
5. Boiler and machinery insurance shall have limits of not less than the replacement value of the permanent or temporary boilers and pressure vessels, and other insurable objects forming part of the *Work*. The insurance coverage shall not be less than the insurance provided by a comprehensive boiler and machinery policy.
6. "Broad form" contractors' equipment insurance coverage covering *Construction Equipment* used by the *Contractor* for the performance of the *Work*, shall be in a form acceptable to the *Owner* and shall not allow subrogation claims by the insurer against the *Owner*. Subject to satisfactory proof of financial capability by the *Contractor* for self-insurance, the *Owner* may agree to waive the equipment insurance requirement.
7. Standard Exclusions
 - 7.1 In addition to the broad form property exclusions identified in IBC forms 4042(1995), and 4047(2000), the *Contractor* is not required to provide the following insurance coverage:
 - Asbestos
 - Cyber Risk
 - Mould
 - Terrorism

Association
of Canadian
Engineering
Companies

Canadian
Construction
Association

Construction
Specifications
Canada

The Royal
Architectural
Institute of Canada

These Supplementary Conditions amend Standard Construction Document - CCDC 2 - 2008. Where a portion of the Document is modified or deleted by these Supplementary General Conditions, the unaltered portions of the Document shall remain in effect.

DEFINITIONS

Page 6, Clause 13 - Place of Work, add the following sentence:

"Any reference within the Contract Documents to the term "Site" shall be considered interchangeable with the Definition: Place of Work".

Page 7, Add the following new Definitions:

27. Approved or Approval

"Approved" or "Approval" means acceptance by the Consultant in accordance with the Consultant's responsibilities described in Clause GC 2.2 ROLE OF THE CONSULTANT.

28. Total Amount Payable

Total Amount Payable means the sum of the Contract Price in the Tender Form, subject to adjustments made in accordance with the provisions of the Contract Documents plus the amount of Value Added Taxes.

29. Period of Delay

The period of time from the date stated in the Agreement and the actual date of Substantial Performance; if any.

GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

PART 1 - GENERAL PROVISIONS

GC 1.1 CONTRACT DOCUMENTS

Page 8, Clause 1.1.8, delete the words "sufficient copies" and replace with "three (3) copies".

PART 2 - ADMINISTRATION OF THE CONTRACT

GC 2.2 ROLE OF THE CONSULTANT

Page 9, in Clause 2.2.6, line 2, after "techniques," add "schedules,"

Page 9, Clause 2.2.9, add the following sentence at end of paragraph:

"The Owner and the Contractor shall waive any claims against the Consultant arising out of the making of such interpretations and findings."

PART 3 - EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

Page 11, Clause 3.1.2, after "techniques," add "schedules,"

GC 3.5 CONSTRUCTION SCHEDULE

Page 12, in Clause 3.5.1.1, delete "prior to the first application for payment" and replace with "not later than two (2) weeks after receipt of the Letter of Acceptance".

Page 12, add new Clause 3.5.1.4 as follows:

"3.5.1.4 Six (6) weeks prior to start-up and commissioning, provide a detailed plan, including a schedule of all start-up and commissioning related activities as specified in the Contract Documents."

GC 3.7 SUBCONTRACTORS AND SUPPLIERS

Page 13, Clause 3.7.6, delete "through the Consultant,"

GC 10 SHOP DRAWINGS

Page 13, delete Clause 3.10.3 and replace with the following:

"3.10.3 The Consultant will provide a shop drawing log listing all materials to provide shop drawings for. The Contractor shall prepare and submit to the Consultant for review, a schedule of the dates for provision, review and return of Shop Drawings. This submission shall be prior to the project Start-Up meeting."

Page 13, delete Clause 3.10.12 in its entirety, and add the following:

"3.10.12 The Consultant will review and return Shop Drawings in accordance with the schedule agreed in Clause 3.10.3."

GC 3.13 CLEANUP

Page 14, at the end of Clause 3.13.2, add new sentence as follows:

"The Consultant will inspect the Place of Work for acceptance before issuing the Certificate of Substantial Performance of the Work."

Page 14, at the end of Clause 3.13.3, add new sentence as follows:

"The Consultant will inspect the Place of Work for acceptance before evaluating the application for Final Payment."

PART 4 - ALLOWANCES

GC 4.1 CASH ALLOWANCES

Page 14, Delete Clause 4.1.7 and replace with the following:

"4.1.7 The Contractor shall prepare a schedule, acceptable to the Consultant, which shows when the Consultant and Owner must authorize ordering of items called for under cash allowances to avoid delaying the progress of the Work."

Page 14, add the following new Clause:

"4.1.8 The Owner reserves the right to call, or to have the Contractor call, for competitive bids for portions of the Work, to be paid for from cash allowances."

PART 5 - PAYMENT

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

Page 16, After Clause 5.4.1 add the following:

"5.4.1.1 Fifteen days before the Contractor submits his application for Substantial Performance of the Work, all Operations and Maintenance Manual materials shall be submitted in accordance with the Contract Documents. The Certificate of Substantial Performance will not be issued until this requirement is met."

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

Page 16, after Clause 5.5.1.2, add the following:

"5.5.1.3 submit a certificate by deed search to the Owner by a solicitor qualified to practice law in the Province of Nova Scotia, certifying that no lien associated with the Work exists against the Owner's property or Work;

5.5.1.4 submit a clearance letter from the Workers' Compensation Board; and

5.5.1.5 all such documents shall be dated not earlier than the expiry of the Lien Period."

Page 16, delete Clause 5.5.3 in its entirety.

Page 16, after Clause 5.5.4, add the following:

"5.5.4.1 If, within sixty (60) days after the issue of the Certificate of Substantial Performance, the Contractor has not corrected all the documented deficiencies, the Owner shall retain sufficient monies, as determined by the Consultant, to cover the cost of completing said deficiencies. These monies shall be held in addition to holdback monies retained in accordance with the provisions of the Contract and subject to the terms of the Builder's Lien legislation of Nova Scotia."

GC 5.7 FINAL PAYMENT

Page 17, after Clause 5.7.1, add the following:

- "5.7.1.1 Contractor's application for final payment will only be considered when the following have been performed:
- .1 Work has been completed and inspected for compliance with the Contract Documents, and the Consultant has agreed that all the requirements of the Contract have been fulfilled by the Contractor.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational, and written reports as outlined in the Contract Documents have been provided to the Consultant.
 - .4 Certificates required by utility companies, manufacturer's and inspectors have been submitted.
 - .5 Spare parts, maintenance materials, record drawings, warranties and bonds have been provided.
- 5.7.1.2 If, in the opinion of the Consultant, the above requirements are not complete, then the Consultant will not accept the application, and request resubmission.

Page 17, Clause 5.7.4, in line 2, change "5 calendar days" to "20 calendar days".

PART 6 - CHANGES IN THE WORK

GC 6.2 CHANGE ORDER

Page 17, after Clause 6.2.2, add the following:

- "6.2.3 The Consultant shall determine the amount, if any, to be added to the Contract Price in respect of any extra or additional work done, or deducted for work omitted by Consultant's order.
- 6.2.4 The prices for any extra or additional work or work method carried out by the Contractor shall be based on the sum of the following five items:
- (a) Direct basic wages and salaries, paid by the Contractor to their employee, for labour including machine operators and foremen (excluding on site or office supervisory staff) required to perform the work in accordance with directions and devoting their exclusive attention to this work.
 - (b) Forty (40) percent of item (a) which shall be considered to cover the cost of small tools, on site or office supervisory staff, Worker's Compensation, holiday pay, welfare fund payments, unemployment insurance, insurance premiums, and all other payroll overheads.
 - (c) The necessary cost to the Contractor of the material required for the Works as furnished by the Contractor and delivered to the Site.
 - (d) Ten (10) percent of the sum of items (a), (b), and (c), which shall be considered as covering the Contractor's overhead expense, profit, head office and site office overhead, including salaries of time keeping, clerical, accounting, warehousing and other administrative personnel and all costs associated therewith.
 - (e) Rental of construction equipment (including operators). The equipment rental rates shall be in accordance with equipment rental rates indicated in the latest edition of the Roadbuilder's Equipment Rates. In the absence of these rates, the Nova Scotia Department of Transportation and Infrastructure Renewal Rates shall govern.
- 6.2.5 The price for extra, additional or amended work shall be based on the sub-contractor's approved invoice plus ten percent (10%) of the amount of this invoice, which shall be considered as covering all the Contractor's expenses and profit. A Sub-Contractor who enters into an agreement with the Contractor to furnish labour and equipment and/or to perform work, which normally would be performed by the Contractor, shall not be considered as an approved Sub-Contractor for the purpose of evaluation of variations, and the Contractor shall not be entitled to ten percent (10%) of the that Sub-Contractor's invoice.
- 6.2.6 No compensation for extra work or material shall be allowed unless such work or material is ordered in writing by the Consultant.

- 6.2.7 Whenever any extra work or claim for extra work is in progress, the Contractor shall, each working day, report to the Consultant in writing and in full detail, the amount and cost of the labour and materials used in carrying out such work on the preceding working day and no claim for compensation for such work or materials shall be considered or allowed unless such report shall have been made. The Consultant shall not allow any compensation for the cost of repairs to equipment or in respect of construction equipment of any kind idle on the Site except as directed by the Consultant in writing or for damage to anything used in performing any such extra work or making any such alteration.
- 6.2.9 The price applicable to any work omitted from the Contract, which shall be deducted from the Contract Price, shall be mutually agreed upon by the Contractor and the Consultant in which case the price shall be comparable to prices quoted on work of similar nature."

GC 6.3 CHANGE DIRECTIVE

Page 19, Clause 6.3.12, add the following sentence at end of paragraph:

"If the Consultant's determination is not accepted by either party, then the matter shall be settled in accordance with the requirements of PART 8 DISPUTE RESOLUTION."

GC 6.5 DELAYS

Page 20, after Clause 6.5.5, add the following new Clauses:

- "6.5.6 Time shall be construed as being the essence of the Contract.
- 6.5.7 Should the Contractor fail to obtain Substantial Performance of the Work by the date indicated in Article A-1, Clause 1.3 in the AGREEMENT BETWEEN OWNER AND CONTRACTOR, the period of time from this agreed date to the actual Date on the Certificate of Substantial Performance of the Work as determined by the Consultant, shall be termed the Period of Delay.
- 6.5.8 In the event of there being a Period of Delay, the Contractor shall be liable for and shall pay to the Owner the cost of continuance of supervision during the Period of Delay, and all additional fees, disbursements and costs incurred by the Owner by reason of there being such Period of Delay for each and every day that the work or works remain unfinished after the time so specified. The Owner may deduct the amount of such delay charges from each progress payment following the event until the project reaches Substantial Performance as certified by the Consultant."
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GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

Page 20, delete Clause 6.6.5 in its entirety and add the following:

"6.6.5 The Consultant's findings, with respect to a claim made by either party, will be given by Notice in Writing to both parties within reasonable time after receipt of the claim information noted in Clause 6.6.3."

Page 20, add the following new Clause 6.6.7:

"6.6.7 The Owner may make claims arising out of the costs incurred for additional services provided by the Consultant resulting from the Contractor's failure to reasonably perform the Work in accordance with the terms and conditions of the Contract, including the Contractor's issuance of unnecessary Requests for Information (RFI's). The Consultant will notify the Owner and Contractor where it has been determined that additional services will be required or have been provided in order not to cause a delay. The Owner shall make claims based on the Consultant's invoices."

PART 9 - PROTECTION OF PERSONS AND PROPERTY

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

Page 24, Clause 9.2.7.4, after "Contractor", add "and Consultant"

GC 9.5 MOULD

Page 25, Clause 9.5.2.4, after "Owner", add "and Consultant"

Page 25, Clause 9.5.3.4, after "Contractor", add "and Consultant"

PART 10 - GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

Page 25, Clause 10.1.2, add the following at the end of paragraph:

"and in accordance with the Contract Documents"

Page 25, after Clause 10.1.2, add new Clause 10.1.3 as follows:

"10.1.3 The Contractor shall indicate on each application for payment as a separate amount, the appropriate Harmonized Sales Tax the Owner is legally obliged to pay. This amount will be paid to the Contractor in addition to the amount certified for payment under the Contract."

PART 11 - INSURANCE AND CONTRACT SECURITY

GC 11.2 CONTRACT SECURITY

Page 27, delete GC 11.2.1 in its entirety and replace with the following:

"11.2.1 The Contractor shall, prior to commencement of the Work, provide to the Owner a Performance Bond and a Labour and Materials Bond, each in the amount of 50% of the Total Amount Payable or an Irrevocable Letter of Credit in the amount of 20% of the Total Amount Payable. The Irrevocable Letter of Credit shall be issued by a certified financial institution and must be valid until the expiration of the warranty period. Include the cost of providing the Irrevocable Letter of Credit in Contract Price. Should it become apparent that the final cost of the project will exceed the Total Amount Payable by more than 10%, the Contractor shall arrange to have his bonds reissued, based on the projected final cost."

Page 28, add new clause GC 11.2.3 as follows:

"11.2.3 The Contract Security will be retained until the expiration of the Warranty Period."

PART 12 - INDEMNIFICATION, WAIVER OF CLAIMS AND WARRANTY

GC 12.1 INDEMNIFICATION

Page 28, Clause 12.1.1, in line 2, after "hold harmless the other" replace with "hold harmless the other and the Consultant."

GC 12.3 WARRANTY

Page 30, Clause 12.3.1 and replace with the following:

"12.3.1 The warranty period under the Contract is one (1) year from the date of Substantial Completion."

Page 30, delete Clause 12.3.4, add the following to end of paragraph:

"All work of repair or replacement carried out during the Warranty Period shall be maintained for a period of one (1) year from the date of the Consultant's acceptance of the work of repair or replacement notwithstanding that the Warranty Period expires before the expiration of the said year. This clause shall not apply to normal operation maintenance, which shall be carried out by the Owner."

PART 1 - GENERAL

<u>1.1 DESCRIPTION OF WORK</u>	.1	As stated in Section 00 21 00.
<u>1.2 DATUM</u>	.1	All levels shown on the Drawings are referred to the Canadian Geodetic Datum. Verify all elevations prior to commencing work.
<u>1.3 COST BREAKDOWN</u>	.1	Before submitting first progress claim and in accordance with Section 00 21 10, submit a detailed breakdown of Stipulated Price as directed by Consultant. After approval by Owner and Consultant, this cost breakdown will be used as the basis for progress payments.
<u>1.4 REFERENCES AND CODES</u>	.1	Perform Work in accordance with the National Building Code (NBC) 2010, National Fire Code (NFC) 2010, National Plumbing Code (NPC) 2010 and/or any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements governs.
	.2	Reference has been made to certain Domestic, National and International Standards throughout the various sections of the Specification contained herein. These Standards will be considered an integral part hereof and shall be read in conjunction with the Drawings and Specifications as if they were reproduced herein. Be completely familiar with their contents and requirements.
<u>1.5 DRAWINGS</u>	.1	The whole of the Work will agree in all particulars with the levels, measurements and details contained in the Drawings accompanying this Specification, and with such other drawings or information as may from time to time be supplied by the Consultant, or may be supplied by the Contractor and reviewed by the Consultant.

1.6 CONSTRUCTION
RESTRICTIONS

- .1 There will be no restriction of work hours for the duration of the Work.
- .2 The Site is currently unoccupied.

1.7 PROJECT
MANAGEMENT AND
COORDINATION

- .1 Start-up Meeting:
 - .1 Within five (5) working days after notification of intent to award a Contract, and before any Work commences onsite, Contractor is to request a meeting of parties to discuss and resolve administrative procedures and responsibilities.
 - .2 Owner's representative, the Consultant, the Contractor, and major subcontractors are to be the parties in attendance.
 - .3 Contractor to establish time and location of meeting.
 - .4 Contractor will bring to the meeting the Contract for execution.
 - .5 Agenda to include the following:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Establish project coordination meeting frequency and required attendees.
 - .3 Schedule of Work, showing key milestones such as equipment/material delivery dates and substantial completion date.
 - .4 Schedule of submission of shop drawings, samples and finish samples.
 - .5 Requirements for temporary facilities, site sign, office, storage sheds, utilities, fences and laydown area.
 - .6 Project Hazard Assessment Worksheet and Contractor Safety Policy will be reviewed and signed by the Contractor.
 - .7 Security requirements will be reviewed.
 - .8 Discuss administrative process for proposed changes, change orders, mark-up percentages permitted, time extensions, overtime and other administrative requirements.
 - .9 Owner Pre-selected products.
 - .10 Hot Work Checklist review.
 - .11 Nova Scotia Department of Labour and Advanced Education site visit procedures.
 - .12 Insurance certificates and Building Permit.
 - .13 Hours of Work and site supervision requirements.

1.8 SITE OFFICE

- .1 Consultant's Site Office:

1.8 SITE OFFICE
(Cont'd)

- .1 (Cont'd)
 - .1 Provide the Consultant a site office, as follows:
 - .1 Minimum floor area of ten square metres.
 - .2 Heat, air conditioning, light and internet connection. The Consultant will pay for long distance calls.
 - .3 Desk: 1.0 x 1.5m plan table, shelving and four-drawer lockable filing cabinet.
 - .2 Maintain in clean condition.
 - .3 Remove when no longer required by the Consultant but not later than attainment of Substantial Performance of the Work.

1.9 PROGRAM OF
WORKS AND WORK
SCHEDULES

- .1 Provide at the start-up meeting a program and construction schedule showing the order of procedure, significant Contract dates, and method in which the Contractor proposes to carry out and complete the Works within time period required by Contract Documents.
- .2 Construction Schedule to be standard "bar" type, showing commencement, duration and completion of activities of all trades and suppliers involved.
- .3 Construction Schedule is subject to review by Consultant and will be revised and resubmitted as directed.
- .4 Update schedules periodically and submit updated Construction Schedule in duplicate with each request for payment. Where work has fallen behind the original schedule times, indicate methods proposed to correct such loss of time, to maintain the stated Completion Time.

1.10 PHOTOGRAPHS

- .1 Prior to the commencement of Work, the Consultant may arrange for photographs to be taken of the Site of the Works and those properties adjacent to the Site of the Works. Be present or have an authorized representative present during the taking of photographs to make any comments on the conditions of the Site. These photographs, together with a written report on the existing conditions as determined by mutual agreement between the Contractor and Consultant, will be retained by the Consultant as a record of Site conditions prior to commencement of work.

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<u>1.11 ASSISTANCE TO THE CONSULTANT AND THE CONSULTANT'S REPRESENTATIVE</u>	.1	During the continuance of the Contract, provide necessary labour and tools to assist the Consultant and the Consultant's representative in measuring, checking, testing and examining the work and for the setting out and measurement of the Works, the cost of all such being deemed to be covered by and included in the Contract Price.
<u>1.12 SAMPLES</u>	.1	Submit samples of the sizes and quantities as required by the Specifications after award of the Contract, to the Consultant for review. Do not deliver materials to the Site for use until samples are approved in writing by the Consultant. Provide such samples without charge.
<u>1.13 SHOP DRAWINGS</u>	.1	Submit shop detail or working drawings and manufacturer's data for all items requiring fabrication, on or off the Site, and for all proprietary equipment to the Consultant for review before any such items or equipment are incorporated into the Works. This review of Shop Drawings by Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that Consultant approves the detailed design inherent in the Shop Drawings, responsibility for which remains with the Contractor submitting them, and such review does not relieve the Contractor of responsibility for errors or omissions in Shop Drawings or of responsibility for meeting all requirements of the Construction and Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the Work of all sub-trades.
	.2	Submit shop drawings and product data electronically as clearly legible PDF files. Resubmit submittals deemed unreadable by the Consultant. Where it is not practical to provide electronic copies and when approved by the Consultant, submit three (3) paper copies of shop drawings.
	.3	Submit shop drawings with such promptness as not to cause delay in this work, or of the works of any Sub-Contractors.
-

1.13 SHOP DRAWINGS
(Cont'd)

- .4 The information submitted must clearly show the dimensions, materials or construction, performance, finish, service and installation requirements and other characteristics in sufficient detail to permit the Consultant to evaluate the suitability of the articles for the use intended.
- .5 Make corrections required by the Consultant as noted, and resubmit corrected copies to the Consultant for review before fabrication.
- .6 The Consultant will not review shop drawings and other material involving a large amount of work in those instances where it is evident that the Contractor has not used all the information contained in, or where such details are obviously not consistent with the Contract Documents.

1.14 TESTING

- .1 Provide such assistance, labour and materials as are normally required for examining, measuring and testing the quality, weight or quantity. Supply samples of materials before incorporation in the Works for testing as may be selected and as specified.
- .2 Perform or arrange for the performance of all tests on all equipment in complete accordance with the relevant clauses of these Specifications and in the presence of the Consultant.
- .3 The Owner will cover the cost of testing however the provision of all assistance, samples, etc., for testing and arranging tests will be deemed to be covered by and included in the Contract Price unless noted otherwise, elsewhere in these Specifications.
- .4 The Contractor will have no claim against the Owner or the Consultant in respect of any financial loss which may be suffered from the rejection of any materials or equipment due to their failure to meet specified test requirements, and the Contractor must also bear the cost of remedying any defects such that the material or equipment will meet the specified tests, or failing this, of removing the material or equipment from the Site. The decision to repair or replace materials and equipment which have failed to meet test requirements will be made by the Consultant.

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<u>1.15 INSPECTION AND APPROVALS</u>	.1	Coordinate building inspections, permits, and electrical approvals. Owner will pay all building inspection fees directly to the Municipality.
<u>1.16 ACCOMMODATION OF PROPERTY OWNERS</u>	.1	Make adequate provision, at own expense, for accommodation and protection of traffic and pedestrians and the owners and occupiers of adjacent premises in the form of bridgeways, guards and fences. Should the Contractor have to divert traffic over any path which is not a travelled vehicular public way, protect same from damage, and repair damage at no additional cost to the Contract.
<u>1.17 NOISE AND VIBRATION</u>	.1	Operate construction equipment such that there is a minimum amount of noise and vibration. Should excessive noise and vibration be caused, at own expense, rectify the same to the approval of the Consultant.
<u>1.18 LIGHTING AND BARRICADES</u>	.1	Protect persons from injury and avoid property damage by providing barricades, construction signs, torches, flushers, and guards as required during the progress of the construction Work. Enclose and protect material piles, equipment, construction equipment which may serve as obstructions by fences or barricades and employ proper lights when the visibility is poor.
<u>1.19 EXISTING SERVICES</u>	.1	Where Work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.
	.2	Before commencing Work, establish location and extent of service lines in area of Work and notify the Consultant of findings.
	.3	Submit schedule to and obtain approval from the Consultant for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.
	.4	Where unknown services are encountered, immediately advise the Consultant and confirm findings in writing.
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1.19 EXISTING
SERVICES
(Cont'd)

- .5 Electrical power renovations will require a local power shut down of the power supply to affected panel boards. Schedule any shut down with the Owner and Consultant and obtain approval prior to any shutdown.

1.20 SAFETY

- .1 Observe construction safety measures of Provincial Government, including but not limited to the Occupational Health and Safety Act, Workers' Compensation Board and Municipal authority provided that in any case of conflict or discrepancy the more stringent requirement shall apply.
- .2 Submit to Consultant prior to commencement of Work printed information detailing means and methods so the following will be carried out:
 - .1 The health and safety of persons at or near the Work are preserved.
 - .2 The measures and procedures of the regulatory agencies specified are carried out.
 - .3 Every employee, self-employed person and employer performing Work under this Contract complies with the regulatory agencies specified.
- .3 Store volatile waste in closed containers and remove from premises daily.
- .4 WHMIS: 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 material safety data sheets acceptable to Labour Canada and Health and Welfare Canada.
- .5 Confirm pollution and environmental control of construction activities are exercised as specified and as required during the Work.
- .6 Hazardous material:
 - .1 Should material resembling hazardous materials other than those identified within the Contract Documents, including, but not limited to, spray or trowel applied asbestos, be encountered in course of work; stop work immediately. Do not proceed until written instructions have been received from Consultant.
 - .2 Where work entails use, storage, or disposal of toxic or hazardous materials, chemicals and or explosives, or otherwise creates a hazard to life, safety, health, or the environment; work shall be in accordance with the Jurisdictional Authority.

1.20 SAFETY
(Cont'd)

- .7 Confined spaces:
 - .1 Carry out Work in confined spaces in compliance with the Nova Scotia Occupational Health and Safety Act (OH&S), - Occupational Safety General Regulations, Part 12 - Confined Space Entry.
 - .2 Provide approved air monitoring equipment where workers are working in confined spaces and ensure any test equipment to be used is calibrated, in good working order and used by trained persons.
 - .3 Develop a confined space entry program specific to the nature of Work performed and in accordance with OH&S Act and Regulations and confirm supervisors and workers are trained in the confined space entry program.
 - .1 Confirm that personal protective equipment and emergency rescue equipment appropriate to the nature of the work being performed is provided and used.
 - .4 Provide and maintain training of workers, as required by the Federal and Provincial Legislation.
 - .5 Provide Consultant with a copy of an "Entry Permit" for each entry into the confined space to ensure compliance with Federal and Provincial Legislation.
- .8 Fire Safety: include fire safety plan in overall project safety plan. Include masonry as required by the authority having jurisdiction.

1.21 RECORD
INFORMATION

- .1 Record Drawings:
 - .1 After award of Contract, Consultant will provide a set of drawings for purpose of maintaining record drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by Consultant.
 - .2 Identify drawings as "Project Record Copy". Maintain in new condition and make available for inspection on site by Consultant.
 - .3 On completion of Work and prior to final inspection, submit as-built documents to Consultant.
- .2 Maintain record drawings on site as the Work progresses for all aspects of the Work.

1.22 DAMAGE AND
INJURY

- .1 Bear costs of repairing damage to the Site, property of others and injuries of persons resulting from the Contractor's operation under the Contract.

1.22 DAMAGE AND
INJURY
(Cont'd)

- .2 Immediately inform the Consultant of damage or injury to persons, property, services or materials.
- .3 Relocate, under the direction of a qualified provincial land surveyor, survey markers, monuments, and pins moved during the construction of the Works.

1.23 EXISTING
SYSTEMS

- .1 Do not operate valves, electrical, telephone or other controls on existing utility systems. Should it become necessary to operate such a control or make connection to such a system, do so only on the direct instruction of a representative of the utility concerned and shall carry out such work in accordance with the specific instructions of the said representative. When the construction work passes under and/or in close proximity to underground utility cables or utility poles, include in the unit price the cost for having a representative of the utility company present during the work.
- .2 The Contractor will be required, when instructed by the Consultant, to provide a letter from the owners of utilities, stating that all services damaged during construction of the Works have been repaired.

1.24 WATER AND
ELECTRICITY FOR
CONSTRUCTION

- .1 Once the power service is extended to the Site and the well is operational. Water and electricity for small tools and light activities will be available for use by the Contractor for construction. Until such installations are complete, provide water and electricity from own sources.

1.25 TEMPORARY
HEATING

- .1 Arrange and pay for temporary heat used during construction and during equipment storage, including cost of installation, fuel, operation, maintenance and removal of equipment.
- .2 Maintain temperatures of minimum 10°C and to the extent necessary to prevent condensation-forming conditions in areas where construction is in progress and in areas where materials and equipment are stored, unless indicated otherwise.
- .3 Ventilate heated areas and keep building free of exhaust or combustion gases.

1.26 FIRST AID

- .1 During the progress of the Works, provide and maintain at all times and in easily accessible positions on the Works adequate first aid kits equal to those required by the Worker's Compensation Act for the free use as necessary of all persons on the Site.

1.27 SANITATION

- .1 Provide and maintain, so long as any workers are employed on the Works, adequate sanitary conveniences for their use. Provide, maintain and remove sanitary conveniences in accordance with the requirements of all pertinent health regulations and to the approval of the Consultant.

1.28 MATERIALS AND
WORKMANSHIP

- .1 All equipment, materials and workmanship shall be the best of the respective kinds described in the contract and in accordance with the Consultant's instructions and shall be subjected from time to time to such standard tests as the Consultant may direct at the place of manufacture or fabrication or on the Site.
- .2 Inform the Consultant before ordering materials for incorporation into the Works of the source of the materials, except as regards to minor matters, no order for such materials will be given except with the authorization of the Consultant. Notwithstanding the fact that such authorization may have been given, the Consultant may forbid the use of any such materials, if upon delivery, they are found to be defective or unsuitable for incorporation in the Works. Keep the Consultant fully advised of the orders and delivery dates of materials.
- .3 All material and equipment required to be incorporated into the Work must be new and unused. Any material found during the progress of the work to have cracks, flaws, or other defects will be rejected by the Consultant.
- .4 Replace materials and equipment found defective in manufacturer or damaged in handling after delivery by the manufacturer. This includes the furnishing of all materials and labour required for the replacement of installed material and equipment discovered defective prior to the final acceptance of the Work.
-

1.29 HANDLING AND
STORAGE

- .1 Deliver and distribute materials furnished by or to the Contractor at the Site and load and unload so as to avoid shock or damage or dropping. If, however, any material is damaged, the repair or replacement will be made by the Contractor in a manner approved by the Consultant, at no additional cost to the Contract.
- .2 Adequately store materials and equipment intended for the Work until it has been incorporated in the completed project. Storage of materials and equipment shall be in accordance with the manufacturer's recommendations. Keep interior of pipe, fittings, and other accessories free from dirt and foreign matter at all times.

1.30 EQUIVALENTS
AND ALTERNATES

- .1 Where any particular brand of manufactured article is described or specified, it is to be regarded as a standard, but another brand equally as good may be accepted, at the discretion of the Consultant. No change in the Specification will be made prior to the acceptance of the tenders. If the Contractor wishes to make a substitution after the Contract has been awarded, make application, in writing, otherwise the Contractor will be held to the terms of the Specifications. No extra cost will be allowed for approved equivalents.
- .2 When the Owner is prepared to permit the use of a brand of manufactured article as an alternative to any specified brand of manufactured article even though such alternative may not be equivalent to that specified, it may be used at the discretion of the Consultant but only after price adjustments have been negotiated and approved by the Consultant.
- .3 If the alternative requires modifications, adjustments or additions to the specified works, submit to the Consultant, drawings and specifications for these modifications, adjustments or additions in the same detail as presented in the Contract. Approval in principle by the Consultant of these modifications, adjustments or additions in no way relieves the Contractor of obligations or liabilities under the Contract to provide for finished piece of work complete and operational in all essentials.
- .4 No change or substitution can be made without the written consent of the Consultant.

1.30 EQUIVALENTS
AND ALTERNATES
(Cont'd)

- .5 The Consultant will record the time required to evaluate equivalents and alternates proposed by the Contractor including making changes to the Contract Documents occasioned thereby. Whether or not the Consultant accepts a proposed substitute, reimburse the Owner for the charges of the Consultant for evaluating any proposed substitute.

1.31 OWNER PRE-
SELECTED EQUIPMENT

- .1 The following item has been pre-selected by the Owner:
- .1 WAS/sludge pumps.
 - .2 UV disinfection system.
 - .3 Screening equipment.
 - .4 Influent grinder.
 - .5 Sludge dewatering equipment.
 - .6 SBR aeration, decanter, and instrumentation.
 - .7 Blowers.
 - .8 Main Plant Control and system integration.
- .2 The Contractor is responsible for taking over the PO issued by the Owner and purchasing the equipment. An allowance has been provided in the tender form for this purchase. In addition to taking over the PO the Contractor will be responsible for the coordination of and delivery to the site, unloading, insuring, protecting, installing, erecting, coordinating start-up and commissioning of the equipment supplied by the Owner.
- .3 Copies of the equipment specifications, as well as any additional pertinent information will be available for review at the offices of the Consultant during the tendering period and will be made available to the successful bidder.
- .4 Coordinate the delivery of the pre-selected equipment with the Supplier as required. Confirm the equipment can be installed prior to arranging shipping. Pay for shipping from manufacturer to site at no additional cost to the Contract. Site storage and transportation to/from storage from site is the responsibility of the Contractor.

1.31 OWNER PRE-
SELECTED EQUIPMENT
(Cont'd)

- .5 The Contractor must become thoroughly familiar with all the requirements of the pre-selected equipment by careful study of the equipment specifications, review drawings, other pertinent information, and by direction communication with the named suppliers. No extra payment will be made to the Contractor for any additional Work in connection with the proper installation, testing and operation of pre-selected equipment, necessitate by the Contractor's failure to ascertain the requirements (both direct and ancillary) for this equipment prior to submission of the tender.
- .6 Ascertain from the equipment supplier the full extent of field work in accordance with the manufacturer's instructions and obtain all details, dimensions and other information necessary for the complete installation.

1.32 COMMISSIONING

- .1 General:
 - .1 The Commissioning objectives are:
 - .1 To bring the mechanical, electrical and other systems and components from a state of "static completion" to a state of "dynamic operation".
 - .2 To verify conformance to Contract requirements.
 - .3 To confirm the equipment meets the design intent of the Specifications and function in accordance with defined operational requirements.
 - .4 To ensure the completed facility meets user stated requirements.
 - .5 To provide all testing documents, certification and records.
 - .6 To fully train and equip personnel to operate, maintain and troubleshoot all systems.
- .2 Commissioning services will be as described herein and as specified in the individual Sections.
- .3 Submittals:
 - .1 Verification of the performance of the systems will be done by means of a commissioning process. Six (6) weeks prior to commissioning, provide commissioning plan including schedule of all commissioning-related activities as specified in individual sections.

1.32 COMMISSIONING
(Cont'd)

- .3 (Cont'd)
 - .2 Prior to start of Work, submit name of Equipment Supplier's personnel proposed to perform services. Submit documentation to confirm personnel compliance with quality assurance provision.
 - .3 Commissioning services to be as described herein and as specified in the individual specification sections.
- .4 Commissioning Plan, developed by the Contractor in collaboration with applicable equipment vendors, the Owner and the Consultant consists of:
 - .1 Roles and responsibilities of the commissioning team during all phases of commissioning.
 - .2 Description of systems, intended operation and performance details.
 - .3 Static testing and verification procedures.
 - .4 Functional performance testing procedures.
 - .5 Documentation requirements for test results.
 - .6 Seasonal or deferred commissioning.
 - .7 Training plan for operators.
 - .8 Preparation of the Final Commissioning Reports.
- .5 Contractor's responsibilities:
 - .1 Prepare commissioning plan, with input from equipment vendors, Owner and Consultant and manage commissioning.
 - .2 Confirm subcontractors, including equipment suppliers, carry out applicable tests, procedures prior to the Consultant's review.
 - .3 Arrange for walkthrough and commissioning reports, procedures and demonstration, after Work has been reviewed, tested and commissioned.
 - .4 Arrange for training sessions and schedule, including preparation and distribution of materials.
 - .5 Perform and document all preliminary tests, assembles manuals of completed test forms and verification forms.
 - .6 Provide assistance to equipment suppliers during start up to address installation concerns. Provide mechanical and/or electrical trades as required.
 - .7 Perform system start-up and testing.
 - .8 Fill out the commissioning data sheets and test forms/manual.
 - .9 Provide training and instruction and prepares Operating and Maintenance Manual for presentation to the operating and maintenance personnel.
 - .10 Is present for operation of system through tests with Consultant and Owner.
 - .11 Obtain all code required inspections and certifications and approvals.

1.32 COMMISSIONING
(Cont'd)

- .5 (Cont'd)
 - .12 Prepare as-built drawings and submit to Consultant for CAD drawing preparation.
 - .13 Obtain and submit all warranties to the Consultant.
 - .14 Organize and submit Operating and Maintenance Manual from the subcontractors, suppliers and manufacturers to the Consultant.
 - .15 Assemble and deliver all spare parts and special tools.
- .6 Consultant's responsibilities:
 - .1 Inspect installation.
 - .2 Certify completion of Contractors's commissioning.
 - .3 Receive all test reports from the Contractor and verify results.
 - .4 Participate in the equipment start-up testing conducted by the Contractor and verify results.
 - .5 Review shop drawings.
 - .6 Communicate apparent deviations from the specifications.
 - .7 Review the equipment operating and maintenance manuals prepared by the Contractor.
 - .8 Participate in the performance testing process.
 - .9 Review the as-built drawings.
 - .10 Provide technical assistance on plant operations to assist Contractor planning of Commissioning.
 - .11 Communicate requirement and coordinate activities relating to system integration work. The Consultant is carrying out system integration work as referenced in Section 40 91 00.
- .7 Owner's responsibilities:
 - .1 Making staff available at appointed times for training by manufacturer's representatives and providing labour to conduct work within facilities that is not included in this Contract.
 - .2 Test and commission chemical feed systems that are Owner-supplied and installed.
- .8 Equipment vendor's responsibilities:
 - .1 Perform and document all preliminary tests, assembles manuals of completed test forms and verification forms.
 - .2 Perform component start-up and testing with Contractors.
 - .3 Manage installation of the systems.
 - .4 Perform system start-up and testing.
 - .5 Arrange for training sessions schedule, including preparation and distribution of materials.

1.32 COMMISSIONING
(Cont'd)

- .8 (Cont'd)
- .6 Provide training and instruction and prepares Operating and Maintenance Manual for presentation to the operating and maintenance personnel.
 - .7 Is responsible for filling out the commissioning data sheets and test forms/manual.
 - .8 Provide training and instruction and prepares Operating and Maintenance Manual for presentation to the operating and maintenance personnel.
 - .9 Be present for operation of system through tests with Consultant, Owner and Contractors.
 - .10 Assemble and deliver all spare parts and special tools to the Owner.
- .9 Commissioning meetings: all parties to participate in routine on-site meetings, specific commissioning meetings throughout the period that commissioning is taking place or being planned. Commissioning meetings will be coordinated and chaired by the Contractor. The Contractor will take minutes and distribute minutes within three (3) working days of the subject meeting. Update and circulate the updated commissioning schedule one (1) working day prior to commissioning meetings.
- .10 The Contractor, Consultant and Owner will work together in a concerted effort to fully commission all systems in an organized manner and in a manner that will allow all to carry out their own obligations fully.

1.33 OPERATIONS AND
MAINTENANCE MANUALS

- .1 Provide the Owner before the issuance of the Certificate of Substantial Performance and before the Owner takes over the works from the Contractor unless otherwise directed by the Consultant in writing, certificates from the manufacturers of the equipment incorporated into the Works (or from their accredited agents) stating that their qualified representatives have tested the equipment which they supplied and have found everything to be satisfactorily installed and in proper working order.
- .2 Towards the completion of the Contract, prepare for the Owner a Manual of Operations and Maintenance. It will include details of all proprietary equipment incorporated into the Works. Provide one (1) electronic copy of the approved Operation and Maintenance manual to the Owner.

1.33 OPERATIONS AND
MAINTENANCE MANUALS
(Cont'd)

- .3 Fifteen (15) days before Substantial Performance provide for this purpose four (4) copies and one (1) electronic copy in pdf file format of all manufacturer's literature pertaining to such equipment and which shall include descriptions, drawings, specifications, assembly, wiring or other diagrams, material lists, parts lists, installation, operating and maintenance instructions, names and addresses of the manufacturer's local or nearest agency, and like information.
- .4 Provide four (4) hard copy sets and one (1) electronic file in pdf file format of operations, installation and maintenance information for each system. Provide two (2) of the sets to the Consultant not less than four (4) weeks prior to commissioning. Obtain additional copies of installation and start-up instructions as required at no additional expense to the Contract.
- .5 All such material must be new material. Photocopies of literature provided by manufacturers will not be accepted. Drawings to be unfolded and page size papers to be unperforated at the binding edge if possible.
- .6 The Certificate of Substantial Performance will not be issued until this material has been completely provided.

1.34 GUARANTEE

- .1 The Contract requires an operational combination of several components comprising the Works which are customarily guaranteed by their suppliers. Under this Contract, however, provide a guarantee for the Works for a period of one (1) year following the Date of Substantial Performance. The terms of the Guarantee will be as follows:
 - .1 Where failure or incipient failure of the material is apparent, the Contractor will actively commence repair or other remedy not more than twenty-four (24) hours after receiving due notice of trouble.

1.34 GUARANTEE
(Cont'd)

- .1 (Cont'd)
- .2 If the Contractor, on being notified, does not for any reason commence repairs within twenty-four (24) hours, the Owner will have the right to have repairs made by others as necessary to restore or continue service. The cost of such repairs by others will be borne by the Contractor. The Owner will at all times inform or attempt to inform the Contractor before hiring others to effect any repairs. It will, at all times, be the Contractor's right to be informed as soon as possible of difficulties and proposed remedial action by others, to make or where practical to complete such repairs at any other time of the guarantee period in preference to others.
- .3 The employment of some other person or persons for reasons set out will in no way affect the Contractor's obligation or liability hereunder or relieve the Contractor of the performance and fulfillment of any or all covenants, undertakings, obligations, or duties under the Contract.
- .4 After the acceptance by the Consultant and during the guarantee period, the burden of maintenance will fall upon the Owner. In the event of damage, failure or incipient failure of any part or parts directly attributable to inadequate or improper maintenance, the Contractor will be responsible for remedial action but the cost of all such repairs will be reimbursed by the Owner.
- .5 If the Contractor arranges that the manufacturer of some component, or some other party approved by the Consultant, provide the guarantee as his agent under the Contract, then due notice to the Agent will be taken as due notice to the Contractor. This will be a matter for Contractor's convenience only, and shall in no way affect the Contractor's obligations and liabilities hereunder or relieve the Contractor from the performance and fulfillment of any or all of his covenants, undertakings, or duties under this Contract.
- .2 The guarantee described in this section pertains specifically to those components that are both supplied and installed under this Contract.

1.35 SITE TO BE
CLEAN

- .1 Keep work, property, road surfaces, etc., in vicinity of the Works and in areas where Contractor's trucks will travel, in a clean and orderly condition, free from dirt, dust, snow, ice, rubbish, etc. at all times during the progress of the work.

1.35 SITE TO BE
CLEAN
(Cont'd)

- .2 Maintain trucks so that no spillage will occur. Before leaving the Site, trim loads and free wheels of accumulations of soil.
- .3 Keep Site free from accumulations of waste material and rubbish to prevent an unsightly or hazardous condition. On the completion of the Works clear away and remove from the Site all construction equipment, surplus materials, rubbish and temporary works of every kind and leave the whole of the Site and works clean and to the approval of the Consultant.
- .4 Do not dispose of volatile fluid wastes (such as mineral spirits, oil, or paint thinner) in storm or sanitary sewer systems or into streams or waterways.
- .5 Dispose of debris and waste materials in accordance with the latest regulations respecting Solid Waste Resource Management issued by Nova Scotia Environment, at no additional cost to the Contract.

1.36 CONSTRUCTION
WASTE MANAGEMENT
AND DISPOSAL

- .1 Dispose of all construction and demolition waste at an approved C&D waste disposal site.
- .2 Where possible, divert construction and demolition waste to the appropriate recycling facilities. Minimize waste generated by the Work.

1.37 DEMONSTRATION
AND TRAINING

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two (2) weeks prior to Date of Substantial Performance.
- .2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.
- .3 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.
- .4 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.37 DEMONSTRATION
AND TRAINING
(Cont'd)

- .5 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times.
- .6 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .7 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .8 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

1.38 PROJECT
CLOSEOUT

- .1 Documents:
 - .1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers.
 - .2 Submit material prior to final Application for Payment.
 - .3 Provide warranties fully executed and notarized.
 - .4 Execute transition of Performance, and Labour and Materials Payment Bond to warranty period requirements.
 - .5 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining due.
 - .6 Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.
- .2 Inspection/Takeover Procedures:
 - .1 Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete, defects are corrected and building is clean and in condition for occupancy. Notify Consultant in writing, of satisfactory completion of the Work and request an inspection.
 - .2 During Consultant inspection, a list of deficiencies and defects will be tabulated. Correct same.
 - .3 When the Consultant considers deficiencies and defects have been corrected and it appears requirements of Contract have been performed, make application for certificate of Substantial Performance.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED .1 Not applicable.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1 This section specifies the requirements for supplying, transporting and installing concrete formwork and falsework.
<u>1.2 RELATED SECTIONS</u>	.1 Concrete Reinforcement: Section 03 20 00 .2 Cast-In-Place Concrete: Section 03 30 00 .3 Excavating, Trenching and Backfilling: Section 31 23 10
<u>1.3 REFERENCES</u>	.1 CAN/CSA-S269.3-M92(R2013), Concrete Formwork. .2 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete. .3 CSA 086-14, Consolidation, Engineering Design in Wood. .4 CSA 0121-17, Douglas Fir Plywood. .5 CSA 0151-17, Canadian Softwood Plywood. .6 CSA 0153-13, Poplar Plywood. .7 CSA S269.1-16, Falsework and Formwork.
<u>1.4 WASTE MANAGEMENT AND DISPOSAL</u>	.1 Collect, separate and recycle all site generated waste materials in accordance with Section 01 00 00. .2 Place materials defined as hazardous or toxic waste in designated containers. .3 Seal and store emptied containers safely for disposal. .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.
-

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Formwork lumber:
 - .1 Plywood and wood formwork materials to CSA 0121, CSA 086, and CSA 0153.
 - .2 Use formwork materials in accordance to CAN/CSA A23.1.
- .2 Falsework materials: to CSA S269.1.
- .3 Form ties: use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface.
- .4 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms; having no adverse affect on paint, adhesives, waterproofing, or other treatments which are specified for application to concrete and containing no non-drying ingredients such as mineral oil. Use biodegradable form release agent with low VOC content.
 - .1 Acceptable products: DuoGuardII by W.R. Meadows, Crete-Lease BIO-TRU-XTRA by Cresset, Enviro-Form by IPA Systems, Bio-Nox by Nox-Crete, or approved equivalent.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Verify lines, levels and column centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain the Consultant's approval for use of earth forms.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.

3.1 ERECTION
(Cont'd)

- .7 Fabricate and erect formwork in accordance with CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.
- .8 Step/lower all foundations as indicated on drawings. Coordinate with process, plumbing and electrical contractors to step footings down as required to allow all underground piping, plumbing and electrical services to be sleeved through foundation walls or run above footings/zone of influence. Do not locate any services under foundations or their associate zone of influence without written approval from the Consultant.
- .9 All stepped footings shown on the drawings are approximate and all of the required stepped footings may not be shown. Review all of the foundations and building services and submit to the Consultant the proposed footing locations and elevations to allow all of the services to be sleeved through the foundation wall and/or provide the required frost cover. Submit the proposed stepped footing locations and elevations prior to commencing any foundation work.
- .10 Construction Joints:
 - .1 In general incorporate either horizontal or vertical construction joints in accordance with CAN/CSA-A23.1 and to the Consultant's approval. Submit proposed joint locations for review prior to start of formwork erection.
 - .2 Provide construction joints in concrete where work is left off at day's end. Run reinforcement continuously through joints and shear key unless indicated otherwise.
 - .3 Provide proper key and reinforcement. In beams, provide inclined shear bars as required.
 - .4 Immediately before next pour, clean construction joint and brush with grout of neat cement.
- .11 Coat formwork with form release agent before reinforcement, anchors or other accessories are placed, unless soaking with water during hot weather is acceptable. Do not coat plywood forms pre-coated with a chemical release agent.
- .12 Prior to the concrete pour, review and correct as necessary formwork tolerances and alignment, particularly where suspended slabs are located.

3.1 ERECTION
(Cont'd)

- .13 Align form joints and make watertight. Keep form joints to minimum.
- .14 Use 25mm chamfer strips or as indicated on external corners.
- .15 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .16 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .17 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

3.2 REMOVAL AND
RESHORING

- .1 Leave formwork in place until the concrete element has achieved at least 70% of the specified 28-day compressive strength for that element and a minimum of three (3) days. Additional cylinders to be cast for the purpose of early testing to verify 70% of compressive strength has been achieved.
- .2 Safely maintain structure, both before and after removal of the forms, until concrete has reached its specified 28 day strength.
- .3 Provide all necessary reshoring of members where early removals of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Space reshoring in each principal direction at not more than 3m apart.
- .5 Check all concrete formwork for alignment and levels prior to the placing of concrete in these forms. The Contractor shall again check the formwork for alignment and levels during and immediately after each concrete pour.

3.2 REMOVAL AND
RESHORING
(Cont'd)

- .6 Provide and maintain during the total duration on site, properly constructed guard rails and toe boards at all slab edges and around all slab openings. These are to be built in accordance with the Construction Safety Act and to the approval of the Consultant. When the work of this trade is complete, all guard rails and toe boards are to be left in proper condition and will become Owners property. The dismantling of same shall become the responsibility of subsequent contractors.
- .7 Re-use of formwork and falsework subject to requirements of CAN/CSA-A23.1.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for supplying, fabricating, shipping and placing the reinforcing as detailed on the drawings and as noted in these specifications.

1.2 RELATED
SECTIONS

- .1 Concrete Forms and Accessories: Section 03 10 00
- .2 Cast-in-Place Concrete: Section 03 30 00
- .3 Excavating, Trenching and Backfilling: Section 31 23 10

1.3 REFERENCES

- .1 AASHTO M32-09(R2013), Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ACI SP-66, ACI Detailing Manual, 2004.
 - .3 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .4 CSA A23.3-14, Design of Concrete Structures.
 - .5 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .6 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .7 CSA W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .8 Reinforcing Steel-Manual of Standard Practice, 4th Canadian Edition by the Reinforcing Steel Institute of Canada.
-

1.4 SOURCE QUALITY
CONTROL

- .1 Upon request, provide the Consultant with:
 - .1 Steel reinforcement - certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four (4) weeks prior to commencing reinforcing work. Mill test reports to include certification that reinforcing steel recycled steel content rating meets or exceeds 90%. Certification to also include a breakdown of the pre-consumer, post-industrial and post-consumer content percentages of recycled content.
- .2 Supply test reports at no additional cost to the Contract.
- .3 Upon request inform the Consultant of proposed source of material to be supplied.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings, including reinforcement placing in accordance with Section 01 00 00.
- .2 Indicate on shop drawing bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices (if approved by Consultant) with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
- .3 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated. Provide Class B tension lap to CAN/CSA-A23.3 unless otherwise indicated.
- .4 Reinforcement shop drawings must indicate the location of all concrete pour joints. Consultant's approval for location of joints is to be obtained prior to cutting and bending of reinforcement.

1.6 SUBSTITUTES

- .1 Substitute different size bars only if permitted in writing by the Consultant.

1.7 HANDLING

- .1 Deliver, store and handle reinforcing in accordance with manufacturer's recommendation.

1.8 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Collect, separate and recycle all site generated waste materials in accordance with Section 01 00 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Reinforcing steel: billet steel, Grade 400W (weldable), deformed bars to CSA G30.18, unless indicated otherwise.
- .2 Cold-drawn annealed steel wire ties: to AASHTO M32.
- .3 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .4 Mechanical splices: subject to approval of Consultant.
- .5 Plain round bars: to CSA G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2, ACI SP-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
 - .2 Obtain Consultant's approval for locations of reinforcement splices other than those shown on placing drawings.
 - .3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
 - .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
-

PART 3 - EXECUTION

3.1 PREPARATION

- .1 All steel reinforcing bars to have the necessary net sectional area and will be cut to the exact lengths, bent cold to the exact forms and dimensions, shown on the approved plans, or otherwise required, before being placed in position. Bending must be accurately done, in a bending machine and no welding or heating of any bars will be allowed, except with written approval from the Consultant.

3.2 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure (for steel reinforcement only).
- .3 Replace bars which develop cracks or splits.

3.3 PLACING
REINFORCEMENT

- .1 Examine formwork to ensure that it has been completed and adequately braced in place before starting reinforcement placing.
 - .2 Place reinforcing steel as indicated on drawings and in accordance with CSA A23.1 and as follows:
 - .1 Clean all reinforcing of millscale, oil grease, or other deleterious material before and after erection.
 - .2 Secure reinforcing steel rigidly in position with annealed wire or use approved clips at intersections supported on reinforcing chairs.
 - .3 Do not allow the position of the bars to alter during concreting and maintain the correct cover at all times.
 - .3 Prior to placing concrete, obtain the Consultant's approval of reinforcing material and placement. Provide Consultant with a minimum of 48 hours notice when reinforcing material will be installed and ready for inspection.
 - .4 Maintain cover to reinforcement during concrete pour. Cover to be as noted on Drawings.
-

3.3 PLACING
REINFORCEMENT
(Cont'd)

- .5 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one (1) coat of lead or asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .6 Place all reinforcing bars and hold rigidly in the exact positions in the forms as shown on the approved plans, or otherwise required, and there must be no displacement of the same by the placing and tamping of the concrete. Adjusting or moving the bars while the concrete is being placed will not be permitted unless specified on the plans. Protect concrete required for reinforcing steel in accordance with CSA A23.3. Tie all bars properly, brace to prevent displacement. Do not place concrete until the steel reinforcement, after being cleaned and placed in position, has been examined and approved by the Consultant.

3.4 STORAGE OF
REINFORCEMENT ON
SITE

- .1 Store reinforcing steel on site on blocks so that it is not in direct contact with the ground. Cover reinforcing steel stored on site with tarpaulins to protect it from rain and snow.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for providing all labour, tools, materials and equipment to perform all cast-in-place concrete work.

1.2 RELATED
SECTIONS

- .1 Concrete Forms and Accessories: Section 03 10 00
- .2 Concrete Reinforcing: Section 03 20 00
- .3 Sheet Membrane Air/Vapour Barrier: Section 07 27
- .4 Interior Waterproofing: Section 07 16 00
- .5 Insulation: Division 07 21 13
- .6 Excavating, Trenching and Backfilling: Section 31 23 10
- .7 Granular Base Materials: Section 31 37 10

1.3 REFERENCES

- .1 ACI 302.1R-15, Guide for Concrete Floor and Slab Construction.
 - .2 ASTM C109/C109M-16a, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 in. or 50 mm Cube Specimens).
 - .3 ASTM C260/C260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .4 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .5 ASTM C494/C494M-16, Standard Specification for Chemical Admixtures for Concrete.
 - .6 ASTM C827/C827M-16, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
 - .7 ASTM C939/C939M-16a, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
-

1.3 REFERENCES
(Cont'd)

- .8 ASTM D412-16, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
- .9 ASTM D624-00(R2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
- .10 ASTM D1653-13, Standard Test Methods for Water Vapour Transmission of Organic Coating Films.
- .11 ASTM D1709-16a, Standard Test Method for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- .12 ASTM D1751-04(R2013)e1, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .13 ASTM D2240-15, Standard Test Method for Rubber Property-Durometer Hardness.
- .14 ASTM E1155-14, Standard Test Method for Determining FF Floor Flatness and Floor Levelness Numbers.
- .15 ASTM E1745-11, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- .16 ASTM F1249-13, Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
- .17 CAN/CGSB 37.2-M88, Emulsified Asphalt, Mineral Coloid- Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
- .18 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .19 CSA A23.3-14, Design of Concrete Structures.
- .20 CSA A3000-13, Consolidation - Cementitious Materials Compendium.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 00.

1.4 SUBMITTALS
(Cont'd)

- .2 Minimum of four (4) weeks prior to commencing concrete work, submit shop drawings to Consultant for review containing the following for each concrete mix:
 - .1 Cement type.
 - .2 Minimum compressive strength at 28 days.
 - .3 Class of exposure.
 - .4 Nominal size of coarse aggregate.
 - .5 Air content.
 - .6 Slump at time and point of discharge.
 - .7 Admixtures.
 - .8 Engineer's stamp.
- .3 Provide two (2) copies of WHMIS MSDS.
- .4 Concrete pours: submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.

1.5 CERTIFICATES

- .1 Minimum of four (4) weeks prior to starting concrete Work, submit to the Consultant the manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Supplementary cementing materials:
 - .1 For fly ash, provide details of supply, supplier's quality control program, test data for at least three (3) samples from the previous month's supply and details of proposed quality control tests to be made between shipment to concrete supplier and use in the concrete.
 - .3 Grout.
 - .4 Admixtures.
 - .5 Aggregates.
 - .6 Water.
 - .7 Water stops.
 - .2 Provide certification that plant, equipment and materials to be used in concrete comply with requirements of CSA A23.1.
 - .3 Provide certification that mix proportions selected will produce concrete of specified quality, yield and strength which will comply with CSA A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems.
-

1.5 CERTIFICATES
(Cont'd)

- .4 Provide written confirmation from concrete supplier the percent replacement of mass of Portland cement for fly ash/supplementary cementing materials for all concrete mix designs.

1.6 QUALITY
ASSURANCE

- .1 Minimum of four (4) weeks prior to starting concrete work, submit proposed quality control procedures for review by the Consultant on following items:
- .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.

1.7 DELIVERY,
STORAGE AND
HANDLING

- .1 Concrete hauling time: deliver to site of Work and discharge within 120 minutes maximum after batching.
- .1 Do not modify maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2.
 - .2 Submit deviations for review by Consultant.
- .2 Prepare to implement alternative concrete supply and placement contingency plans in the event of concrete material supply issues, batch plant malfunction and/or transport and placement equipment malfunction.

1.8 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Separate waste materials for reuse and recycle in accordance with Section 01 00 00.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff.
- .4 Carefully coordinate the specified concrete work with weather conditions.
- .5 Seal and store emptied containers safely for disposal.
- .6 Choose least harmful, appropriate cleaning method which will perform adequately.

1.8 WASTE
MANAGEMENT AND
DISPOSAL
(Cont'd)

- .7 Prevent plasticizers, water-reducing agents, air-entraining/curing compounds from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Portland cement and supplementary cementing materials: to CSA A3000.
- .2 Water: to CSA A23.1.
- .3 Aggregates: to CSA A23.1. Coarse aggregates to be normal density.
- .4 Air entraining admixture: to ASTM C260.
- .5 Chemical admixtures: to ASTM C494. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .6 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
 - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
 - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
 - .4 Dry pack to manufacturer's requirements.
 - .3 Acceptable products: SikaGrout 212 as manufactured by Sika Canada Inc., Masterflow 928 as manufactured by BASF Corporation, or approved equivalent.

2.1 MATERIALS
(Cont'd)

- .7 Vapour Retarder Membrane: to be a 10mil (0.25mm) thick, polyolefin resin sheet in accordance with ASTM E1745 such as Perminator 10mil by W.R. Meadows Inc., or approved equivalent. Seal seams with a 100mm wide high density polyethylene tape with pressure sensitive adhesive to suit a 150mm wide sheet overlap in accordance with the manufacturer's written recommendations.
- .8 Curing compounds: to CSA A23.1 and to ASTM C309, Type 1-D with fugitive dye for hidden or exterior use and Type 1 for exposed concrete. Confirm compatibility with finish floor adhesives.
- .9 Premoulded concrete expansion joint filler:
 - .1 Closed-cell, polyethylene joint filler with peel-off tape such as Foam Tech as manufactured by NMW Inc., Deck-O-Foam by W.R. Meadows Inc., or approved equivalent, in accordance with ASTM D3575. For concrete surfaces in contact with hot asphalt, use Foam Tech H.
- .10 Joint sealer/filler:
 - .1 A two (2) component, polysulphide sealant, Duoflex SL (self-levelling) for slabs and Duoflex NS (non-sag) for walls as manufactured by Sika, or approved equivalent, complete with compatible foam back rod and primer.
- .11 Rigid insulation: as specified in Section 31 23 10 - Excavating, Trenching and Backfilling.
- .12 Waterstops:
 - .1 Ribbed waterstops: 10mm thick by 230mm high, extruded PVC.
 - .1 Acceptable product: Type 9380G by W.R. Meadows or approved equivalent.
 - .2 Hydrophilic, non-bentonite modified chloroprene rubber based concrete joint waterstop.
 - .1 Acceptable product: Hydrotite CJ-0725 by Greenstreak or approved equivalent.

2.2 CONCRETE MIXES

- .1 General: Where practically possible, for all concrete mixes listed below, except for concrete flat slab work, concrete supplier to maximize the amount Portland cement replaced with fly ash or another approved cementitious recycled material while maintaining the characteristics listed for each concrete mix listed as well as the workability of each mix. Concrete supplier to provide written confirmation of the percent replacement of Portland cement for fly ash/supplementary cementing materials for all mix designs.
- .2 Proportion normal density concrete in accordance with CSA A23.1 Alternative 1 to give the following properties for concrete in base slabs, tank walls and beams within the tanks:
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 35 MPa.
 - .3 Class of exposure: A-1.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 80 mm $\pm$ 30 mm.
 - .6 Air content: 5 to 8%.
 - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .3 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for concrete in building frost walls and footings:
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 25 MPa.
 - .3 Class of exposure: F-2.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 80 mm $\pm$ 30 mm.
 - .6 Air content: 4-7%.
 - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .4 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for concrete in slabs on grade within the building:
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 30 MPa.
 - .3 Class of exposure: N.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 80 mm $\pm$ 30 mm.

2.2 CONCRETE MIXES
(Cont'd)

- .4 (Cont'd)
 - .6 Air content: 3% maximum.
 - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .5 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for curbs and walkways.
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 32 MPa.
 - .3 Class of exposure: C-2.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 80 mm $\pm$ 30 mm.
 - .6 Air content: 5 to 8%.
 - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .6 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for concrete in mud slabs:
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 20 MPa.
 - .3 Class of exposure: N.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 80 mm $\pm$ 30 mm.
 - .6 Air content: 4 to 7%.
 - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .7 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for concrete filled cells of masonry units:
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 20MPa.
 - .3 Class of exposure: N.
 - .4 Nominal size of coarse aggregate: 10mm.
 - .5 Slump at time and point of discharge: maximum 250mm.
 - .6 Air content: 3% maximum.
- .8 Provide concrete mix designs based on trial mixes that have been designed and tested by a qualified professional engineer registered or licensed to practice in the Province of New Brunswick and submitted for review to Consultant.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Confirm founding material on which footings and other concrete work are to be placed are free from water. Place concrete only on frost-free ground. Remove previously frozen bearing surfaces.
- .2 Place a mud slab in the bottom of footing excavations to prevent softening of the in-situ foundation soils.
- .3 Confirm foundations bear on structural fill or mud slabs on structural fill in accordance with Section 31 23 10 and Section 31 37 10. All structural fill to be placed as directed by the Geotechnical engineer and in the presence of the Geotechnical engineer or one of their qualified representatives.
- .4 Inspect all foundation bearing surfaces and obtain approval from the Owner's geotechnical engineer prior to placing concrete. If bearing surfaces are deemed unacceptable because conditions do not meet those anticipated during design, make adjustments as directed.
- .5 Do not place plumbing and electrical conduit under foundations or their associated zone of influence. Coordinate with mechanical and electrical contractor and step/lower all foundations so that all services either sleeve through foundation walls or run above footings/zone of influence. Do not place plumbing or conduit under foundations or their associated zone of influence without written consent from the Consultant.

3.2 WORKMANSHIP

- .1 Obtain Consultant's approval before placing concrete. Provide 48 hours notice prior to placing of concrete.
 - .2 Pumping of concrete is permitted only after approval of equipment and mix.
 - .3 Confirm reinforcement and inserts are not disturbed during concrete placement.
 - .4 Prior to placing of concrete obtain the Consultant's approval of proposed method for protection of concrete during placing and curing.
-

3.2 WORKMANSHIP
(Cont'd)

- .5 Do not place load upon new concrete until authorized by the Consultant.
- .6 Concrete protective cover to reinforcement as noted on the drawings.
- .7 Support bars on plastic coated steel chairs to maintain exact cover requirements.
- .8 Confirm all concrete construction is moist cured using either an approved curing compound or burlap maintained in moist conditions. For walls of water retaining structures, leave forms in place for a minimum of three (3) days after placement of concrete. After three (3) days, forms can be stripped and concrete can be moist cured as described above.
- .9 In cold weather protect concrete work to CSA A23.1 and following:
 - .1 Cold weather is defined as a period when the mean air temperature drops below 5°C for more than three successive days.
 - .2 When air temperature is above 0°C and is forecast to remain so for 48 hours after placing, insulated tarps are acceptable protection provided concrete temperatures are monitored and comply with temperature limits specified in the following paragraph.
 - .3 For all other cold weather conditions protect concrete with a windproof enclosure of canvas or other material to allow free circulation of inside air around fresh concrete. At no point let walls of enclosure touch formwork and provide sufficient space for removal of formwork and for finishing. Supply approved heating equipment capable of keeping inside air at sufficiently curing temperatures:
 - .1 For an initial three days, at a temperature of not less than 15°C.
 - .2 Maintain concrete at temperatures of not less than 10°C for a total period of seven days plus the initial three days specified above.
 - .3 At no time shall concrete temperatures exceed 30°C at surfaces.
 - .4 Reduce enclosure air temperature at a rate not exceeding 10°C per day until outside air temperature has been reached.
 - .5 Take temperature readings both of air and of concrete surfaces at several points within area protected at start and at end of working day. Maintain complete records of temperature readings.

3.2 WORKMANSHIP
(Cont'd)

- .9 (Cont'd)
 - .4 Monitor concrete so it cures without suffering damage. When enclosure is provided, avoid rapid drying of the concrete.
- .10 In hot weather protect concrete Work to CAN/CSA A23.1 and following:
 - .1 When air temperature is at or above 25°C, do not use curing compounds and keep concrete surfaces moist continually during protection stage using burlap maintained in a moist condition.
 - .2 Regulate the generation of heat through hydration to control thermal gradients to prevent thermal cracking.
- .11 Monitor concrete temperature and moisture evaporation rates and provide appropriate hot weather protection as defined in clause 7 of CSA A23.1. Maintain records of all measurements during hot weather periods for review by the Consultant.
- .12 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

3.3 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CSA A23.1.
- .2 Concrete to be dense, homogenous and free of cold joints, voids and honeycombing. Concrete to be fully bonded to reinforcing steel, anchors and embedded parts.
- .3 Consolidate concrete using a mechanical form vibrator method complete with mechanical hand held vibrators, if required, and subject to the approval of Consultant.
- .4 Place concrete in consolidated lifts and keep approximately horizontal and evenly distributed throughout the formed assembly. The rate of placement to be such that each successive lift is vibrated into the preceding lift to achieve proper bonding.
- .5 Place concrete monolithically without any cold and/or construction joints unless noted otherwise on the drawings.

3.3 CONSTRUCTION
(Cont'd)

- .6 Concrete placement and vibrating activities to be in accordance with the formwork design data, limitations and parameters provided by the Contractor.
- .7 Foundations, sleeves and inserts:
 - .1 Set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100mm x 100mm not indicated, must be approved by the Consultant.
 - .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Consultant before placing of concrete.
 - .3 Check locations and sizes of foundations, sleeves and openings shown on drawings. Provide confirmation by qualified surveyor.
 - .4 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .8 Finishing:
 - .1 Finish concrete in accordance with CSA A23.1, and Part 3.7 Finishing of this section.
 - .2 Use procedures acceptable to Consultant or those noted in CAN/CSA-A23.1 to remove excess bleed water. Confirm surface is not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
 - .4 Cut back form ties and plug openings in a manner acceptable to Consultant.
 - .5 Repair holes and surface defects to the satisfaction of Consultant.
 - .6 Remove honeycombed or otherwise defective concrete and repair in a manner approved and to the satisfaction of Consultant.
 - .7 Confirm that all exposed concrete has neatly formed, 45 degree bevelled, 25mm chamfered edges where designated in accordance with Section 03 10 00 - Concrete Forms and Accessories.
- .9 Curing and protection:
 - .1 Do not use curing compounds where bond is required for subsequent topping or coating.
 - .2 Use approved curing compounds in accordance with the manufacturer's written instructions.
- .10 Anchor bolts:
 - .1 Place anchor bolts to templates under supervision of trade supplying anchors prior to placing concrete.

3.3 CONSTRUCTION
(Cont'd)

- .10 (Cont'd)
 - .2 Protect anchor bolt holes from water accumulations.
- .11 Core-drilling/cutting of holes in any concrete element is not permitted without written consent from the Consultant. All proposed core-drilling/cutting must be submitted to the Consultant for review prior to execution of work. Request for core- drilling/cutting must have 72 hours notice to allow Consultant adequate time to review proposed locations.

3.4 PLACING
CONCRETE

- .1 Place concrete as specified in CSA A23.1.
- .2 Inform Consultant at least 48 hours before each concrete placing operation. Do not place concrete until authorized by the Consultant and following satisfactory site review and observations of geotechnical base preparations, formwork, reinforcing steel and other associated concrete batching and placement operations.
- .3 Do not place concrete when it is raining or likely to rain. If rain begins after concrete is placed, protect with waterproof covers until set.
- .4 Do not permit vertical free fall of concrete mix to exceed 1500mm.
- .5 For exposed concrete, take special precautions when placing to prevent segregation of concrete, and to avoid cold joints, honeycombing or voids. Do not allow vibrator to touch formwork.
- .6 Use form vibrators only when sections are too narrow for internal type. Employ a sufficient number of vibrators to ensure complete consolidation of concrete throughout entire volume of each layer. Have available at least one extra vibrator on hand for emergency.
- .7 Do not use vibrators for interior and exterior concrete slabs on fill or for the use of moving concrete for concrete slabs.
- .8 Use only tools and handling equipment that are clear of rust or other harmful and foreign material to avoid efflorescence and staining of slabs or hardened concrete.

3.4 PLACING
CONCRETE
(Cont'd)

- .9 Use concrete pumps to place concrete only with approval of methods, equipment and mix design.
- .10 Provide continuous supervision during placement of concrete including concrete grout to ensure reinforcing steel is maintained in correct position.

3.5 PLACING GROUT

- .1 Grout where indicated using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

3.6 SAW CUTTING

- .1 Commence sawing as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and before all controlled shrinkage cracking occurs. Refer to clause 7.3.2 of CSA A23.1. Locate and complete all sawcuts in accordance with the Project Drawings and terminate all sawcuts at the face of columns, foundation walls and other control joints as shown on the Project Drawings.

3.7 FINISHING

- .1 Finish concrete in accordance with CSA A23.1 and in accordance with the drawings.
- .2 Use smooth form finish for all concrete surfaces. Use form facing material that will produce a smooth, hard, uniform texture on the concrete. Do not use material with raised grain, torn surfaces, worn edges, patches, dents or other defects that will impair the texture of the concrete surface. Patch the holes and defects. Completely remove fins.
- .3 Use a smooth, hard steel trowelled finish for the top of walls, columns, pedestals and sonotube foundations. Unless noted otherwise, the top surface of exterior slab/pads to have a light broom finish in even continuous strokes applied in the transverse or short direction. Do not power trowel slabs.
- .4 Rub exposed sharp edges of concrete with carborundum to produce 5mm radius edges unless otherwise indicated.
- .5 Apply curing compounds to concrete surfaces as required. Confirm in writing the compatibility of curing compound with the applied finish on each concrete surface.

3.7 FINISHING
(Cont'd)

- .6 Tolerance:
 - .1 All slabs/pads to have concrete surfaces finished to within 2mm in 1m as measured with a 1m straight edge placed on surface unless noted otherwise.
 - .2 All interior slabs in accordance with CSA A23.1, Classification B surfaces finished to suit slopes and grades. The transition to existing, adjacent surfaces to be smooth and continuous without hollows, bumps, ridges, or potential tripping hazards.
- .7 Elevation survey: if requested by Owner, carry out an elevation survey on finished slabs in accordance with the measurement procedures outlined in CSA A23.1, clause 7.5.1 to ensure all concrete slabs meet the specified surface finishes/tolerances.

3.8 PLACING GROUT

- .1 Grout where indicated using procedures in accordance with manufacturer's recommendations which results in 100% contact over grouted area.

3.9 WATERSTOPS

- .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops. Tie waterstops rigidly in place.
- .2 Use only straight heat sealed butt joints in field. Use factory or field welded corners and intersections unless otherwise approved by the Consultant.
- .3 Provide waterstops as required to provide continuous seal and as indicated on the drawings and at all construction joints in water-retaining structures. Not all waterstops are indicated on the Drawings.
- .4 Install expansion joint waterstops in accordance with manufacturer's directions.

3.10 REPAIRS

- .1 In the event that the post-finishing survey shows that the slab surface does not meet the specified tolerances, take corrective action within five (5) working days, or as directed by the Consultant.

3.10 REPAIRS
(Cont'd)

- .2 Submit proposed corrective action in writing, with complete details of methods, tools, and materials for the Consultant's approval. Upon acceptance of the proposed method, a test area is to be prepared, and upon acceptance, is to be the standard for the remainder of the repairs.
- .3 Grind down high points to a smooth surface conforming to the specifications and with a surface finish equal to the remainder of the slab. If cutting or chipping by hammer is required at high areas, then cut the area low with square saw cut edges and patched as noted below.
- .4 Fill low areas by patching with a bonded topping. Chip edges of patch areas and saw cut square a minimum of 25mm deep. Alternatively, the Consultant may approve feather edging if epoxy type topping is used and a properly bonded smooth finish can be removed before placing patch material. Patches are to be finished to a smooth surface equal to the finish on the remainder of the slab, and cured adequately. Do all patching procedures in strict accordance with the manufacturer's directions and to the approval of the Consultant.

3.11 SLAB-ON-GRADE
JOINTS

- .1 Provide construction joint between adjacent concrete pours.
- .2 Provide an isolation joint where the slab-on-grade abuts a vertical element.
- .3 Provide saw cut control joints as indicated on the drawings except at those locations where construction joints or isolation joints are provided.

3.12 VAPOUR
RETARDER MEMBRANE

- .1 Vapour retarder membrane:
 - .1 Install underslab vapour retarder membrane (Perminator, 10mil) under all concrete slabs-on-grade inside building, except for under the building base slab.
 - .2 Install membrane in strict accordance with membrane manufacturer's printed instructions.
 - .3 Lap underslab vapour retarder membrane minimum 150mm at joints and seals using high density polyethylene tape with pressure sensitive adhesive to create vapour and gas tight joints.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section specifies requirements for supplying and applying concrete floor hardener where indicated in Room Finish Schedules.
<u>1.2 RELATED WORK</u>	.1	Curing and tolerances: Section 03 30 00
<u>1.3 REFERENCES</u>	.1	CAN/CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
	.2	CAN/CGSB-25.20-95, Surface Sealer for Floors.
<u>1.4 PRODUCT AND MAINTENANCE DATA</u>	.1	Provide product and maintenance data for concrete floor finishes for incorporation into manual specified in Section 01 00 00.
	.2	Include application instructions for concrete hardener and curing compound.
	.3	Submit WHMIS MSDS-Material Safety Data Sheets. Indicate VOC content.
<u>1.5 ENVIRONMENTAL REQUIREMENTS</u>	.1	Temporary lighting: minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 m ² of floor being finished.
	.2	Ventilation: sufficient to prevent carbon monoxide or high levels of carbon dioxide and other injurious gases from affecting concrete.
	.3	Electrical power: sufficient to operate equipment normally used during construction.
	.4	Work area: water tight protection against rain and detrimental weather conditions.
	.5	Temperature: .1 Maintain ambient temperature of not less than 10°C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

- 1.5 ENVIRONMENTAL REQUIREMENTS (Cont'd)
- .5 (Cont'd)
 - .2 Maintain substrate temperature at 10°C minimum.
 - .6 Moisture:
 - .1 Ensure concrete substrate is within moisture limits prescribed by manufacturer.
 - .7 Safety:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Non-metallic floor hardener: premixed, quartz aggregate, dry shake surface hardener, coloured. Colour: French Grey.
 - .1 Standard of Acceptance: Coloured Floor Hardener Premix by CPD.
 - .2 Acceptable alternate: Colorplete by Sika Canada.
 - .2 Sealing compound:
 - .1 Surface sealer: to CAN/CGSB-25.20, Type 1 - solvent-based, colour - French Grey.
 - .1 Standard of Acceptance: Colored Concrete Sealer by CPD or approved equivalent.
 - .2 Mixing, ratios and application in accordance with manufacturers instructions.
 - .3 Use compatible additives, admixtures and hardeners.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- .1 Verify that slab surfaces are ready to receive work and elevations are as indicated on drawings and as instructed by manufacturer.
- 3.2 FLOOR FINISH
- .1 Finish concrete in accordance with CSA-A23.1, Classification B. Do not use curing and sealing compound in areas where an applied finish or adhesive is to be applied.

3.2 FLOOR FINISH
(Cont'd)

- .2 Do not sprinkle dry cement or dry cement and sand mixture over concrete surfaces.
- .3 Saw cut crack-control joints to CSA A23.1 only where indicated on the Drawings.
- .4 Apply floor hardener in two shakes for a total application of minimum 5 kg/m² to areas indicated in strict accordance with manufacturer's written instructions. Cure to manufacturer's recommendations.
- .5 Apply sealing compound in accordance with manufacturer's instructions.
- .6 Cure concrete in accordance with CSA-A23.1 except where specified otherwise.

3.3 PROTECTION

- .1 Protect finished installation until floor treatment has completely cured.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1 This Section specifies requirements for supplying, transporting and installing concrete unit masonry including masonry accessories, connectors, mortar and grout where indicated.
<u>1.2 RELATED WORK</u>	.1 Cast-in-Place Concrete: Section 03 30 00 .2 Metal Fabrications: Section 05 50 00 .3 Sheet Membrane Air/vapour Barrier: Section 07 27 00 .4 Insulation: Section 07 21 00 .5 Firestopping and Smoke Seals: Section 07 80 00 .6 Sealants: Section 07 92 00 .7 Hollow Metal Doors, Frames and Hardware: Section 08 11 14
<u>1.3 REFERENCE STANDARDS</u>	.1 AASHTO M32M/M32-2009, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement. .2 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware. .3 ASTM D1056-14, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber. .4 CAN/CSA A165 Series-14, CSA Standards on Concrete Masonry Units. .5 CSA-G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement. .6 CSA-S304-14, Design of Masonry Structures. .7 CSA-W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction. .8 CAN/CSA A179-14, Mortar and Grout for Unit Masonry. .9 CAN/CSA A370-14, Connectors for Masonry. .10 CAN/CSA A371-14, Masonry Construction for Buildings.

1.4 REQUIREMENTS OF
REGULATORY AGENCIES

- .1 Construct masonry work as required by jurisdictional authorities.
- .2 Before commencing masonry Work, verify site conditions will allow construction of masonry within required limitations of wall heights, wall thicknesses, openings, bond, anchorage, lateral support, and compressive strength of masonry units and mortars.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings for masonry reinforcement and connectors in accordance with Section 01 00 00.
- .2 Shop drawings consist of bar bending details, lists and placing drawings.
- .3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

1.6 PRODUCT
DELIVERY, STORAGE
AND HANDLING

- .1 Deliver materials to job site in dry condition.
- .2 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
- .3 Deliver products to the place on site as directed, and to meet installation schedule.

1.7 ENVIRONMENTAL
REQUIREMENTS

- .1 Cold weather requirements:
 - .1 Conduct all work in accordance with CSA-A371.
 - .2 Supplement Clause 5.15.2 of CSA-A371 with following requirements:
 - .1 Maintain temperature of mortar between 5°C and 50°C until batch is used.
- .2 Hot weather requirements:
 - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
 - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

1.8 PROTECTION

- .1 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
- .2 Provide temporary bracing of masonry work during and after erection until permanent lateral support system is in place.

PART 2 - PRODUCTS

2.1 MORTAR AND
GROUT MIXING

- .1 Mortar: to CSA-A179.
- .2 Concrete Grout: as specified in Section 03 30 00.
- .3 Use aggregate passing 1.18 mm sieve where 6 mm thick joints are indicated.
- .4 Colour: ground coloured natural aggregates or metallic oxide pigments unless indicated otherwise. Mortar for brick to match colour of brick of existing building.
 - .1 Acceptable product: Northern Pigment Company Ltd., Toronto, or approved equivalent.
- .5 Use same brands of materials and source of aggregate for entire project.
- .6 Mortar for all walls: Type S based on Proportion specifications of CSA-A179.

2.2 MASONRY
ACCESSORIES

- .1 Masonry reinforcing: horizontal joint reinforcing to CSA A370, welded, truss type, fabricated from 4.76 mm diameter steel wire to AASHTO M32, deformed for longitudinal wires and smooth for cross wires, with loops for box ties where faced with masonry veneer, hot dip galvanize after fabrication to ASTM A153/A 153M, Class B, 458 g/m³ zinc coating.
 - .1 Cavity wall, brick veneer: use extra heavy duty Blok-Trus II BL 37 truss type by Blok-Lok Ltd., which will be used in conjunction with the Wedge-Lok insulation fastener system.
 - .2 Load bearing interior masonry walls: use extra heavy duty Blok-Trus BL-30 truss type by Blok-Lok Limited for single wythe masonry walls.
 - .3 Non-Load bearing interior masonry walls: use standard duty BL-10 (ladder) or BL-30 (truss type) by Blok-Lok Limited for single wythe masonry walls.

2.2 MASONRY
ACCESSORIES
(Cont'd)

- .2 Reinforcing steel for core-filled masonry: to CAN/CSA-G30.18, Grade 400, and as specified in Section 03 20 00.
- .3 Control joint filler: purpose-made closed cell neoprene to ASTM D1056 of size and shape indicated, and backer rod and caulking as per section 07 92 00.
 - .1 Acceptable product: Dur-o-wal D/A 2015, or Blok-Lok Exp-Joint.
- .4 Lateral ties: Provide 152mm x 102mm x 7.9mm x 200mm long galvanized angle clips each side of all interior block walls. Clips spaced at 1200 mm centre to centre.
- .5 Masonry thru-wall flashing: purpose made rubberized base flashing, complete with primer/adhesive.
 - .1 Acceptable product: W.R. Grace Bituthene.
- .6 Weep hole vents: ultraviolet resistant polypropylene co-polymer, 13 mm wide x 90 mm deep x 100 mm high vent, colour to suit mortar.
 - .1 Acceptable product: Dur-o-wal DA1069, or Blok-Lok Cell-Vent.
- .7 Insulation wedges: impact resistant plastic clip to fasten insulation, installed at 400 mm o.c. vertical and 800 mm o.c. horizontal.
 - .1 Acceptable product: Blok-Lok Wedge-Lok System, or approved equivalent.
- .8 Dovetail anchor slots: as specified in Section 03 30 00.
- .9 Mortar mesh: Mor-Control by Block-Lok Ltd., Mortar Net by Mortar Net USA Ltd., or approved equivalent.

2.3 UNIT MASONRY

- .1 Standard concrete masonry units, type stretchers: to CSA A165 Series:
 - .1 Classification: H/15/A/M.
 - .2 Size: 200mm x 200mm x 400 mm (typical sized unit) and 250mm x 200mm x 400 mm, all nominal.
 - .3 Special shapes: provide purpose-made shapes for lintels and bond beams; at doors jamb openings.
- .2 Architectural concrete masonry units, type stretchers to CAN/CSA A165 Series, with chemical dry block mortar additive for all exterior masonry:
 - .1 Classification: S/25/A/M.
 - .2 Size: 100 x 200 x 400mm nominal, split faced Ashlar concrete block.

2.3 UNIT MASONRY
(Cont'd)

- .2 (Cont'd)
- .3 Special shapes: as indicated, including "L" corners and "Ledge block" at top of wall at soffit level, under windows and mechanical louvres, etc.
- .4 Colour and style: Tan (7126M Shaw code) for field, and Natural (7124M Shaw code) for accent banding, split faced, "L" corners, split face "Ledge block" at top of wall under windows and mechanical louvres, etc., and similar installations.
- .3 Acceptable manufacturers: Shaw Group, V.J. Rice, or approved equivalent.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Conduct Work in accordance with CSA-A371.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .4 Exercise care to provide full mortar joint coverage on all bearing surfaces of masonry. Replace masonry that does not meet above requirement.

3.2 TOLERANCES

- .1 Tolerances in notes to Clause 5.3 of CSA-A371 apply.

3.3 EXPOSED MASONRY

- .1 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

3.4 JOINTING

- .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, compressed, uniformly concave joints unless otherwise indicated.

3.5 BUILDING-IN

- .1 Verify accessories, frame anchors, guards, and such items specified in other Sections are available for building in before Work commences. Cooperate in the setting and aligning of built-in Work and provide for later installation of items which are included in the Work of other Sections, to avoid cutting, fitting, and patching.
- .2 Prevent displacement of built-in items during construction.

3.6 CUTTING

- .1 Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.
- .2 Make cuts straight, clean and free from uneven edges.

3.7 REINFORCEMENT
AND CONNECTORS

- .1 Fabrication:
 - .1 Fabricate reinforcement in accordance with CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
 - .2 Fabricate connectors in accordance with CSA-A370.
 - .3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.
 - .4 Upon approval of the Consultant, weld reinforcement in accordance with CSA W186.
 - .5 Ship reinforcement and connectors, clearly identified in accordance with drawings.
- .2 General:
 - .1 Supply and install masonry connectors and reinforcement in accordance with CSA-A370, CSA-A371, CSA-A23.1 and CSA-S304.1 unless indicated otherwise.
 - .2 Prior to placing concrete, mortar, or grout, obtain Consultant's approval of placement of reinforcement and connectors.
- .3 Movement joints:
 - .1 Reinforcement will not be continuous across movement joints unless otherwise indicated.
- .4 Field bending:
 - .1 Do not field bend reinforcement and connectors except where indicated or authorized by the Consultant.

3.7 REINFORCEMENT
AND CONNECTORS
(Cont'd)

- .4 (Cont'd)
 - .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.

3.8 LAYING MASONRY
UNITS

- .1 Bond: running.
- .2 Coursing heights: 200 mm for one block and one joint; 200 mm for three brick and three joints.
- .3 Jointing: concave where exposed or where paint coating is specified.
- .4 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.
- .5 Cut blocks as required to ensure coursing height aligns with intersecting and adjacent walls.

3.9 MASONRY
ACCESSORIES

- .1 Masonry reinforcing ties:
 - .1 Install ties in accordance with CSA A370 and CSA-A371. In case of conflict between these two standards, the more stringent requirements will apply.
 - .2 Place reinforcement continuously in horizontal joints at 400 mm o.c., beginning with course above bearing, unless otherwise specified or indicated.
 - .3 Place additional reinforcing at spacing of 200 mm o.c. in courses above and below openings, and extending 800 mm beyond jambs of openings.
- .2 Core-fill reinforcement:
 - .1 Install bars vertically and continuously in cores of hollow masonry units where indicated.
 - .2 Embed bars solidly in cores with concrete grout filling voids completely.
 - .3 Install reinforcing steel in core fills and bond beams where indicated.
- .3 Mortar mesh: place in the wall air space horizontally above the foundation walls and above all lintels.

3.9 MASONRY
ACCESSORIES
(Cont'd)

- .4 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 oc.

3.10 MORTAR AND
GROUT MIXING

- .1 Prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp workable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour nor more than 2 hour then remix with sufficient water to produce mortar of proper consistency for pointing.
- .2 Mix mortar in mechanical batch mixer using material proportions to produce specified strengths while keeping water-cement ratios to the minimum required to produce proper workability.
- .3 Mix grout to semi-fluid consistency to manufacturer's instructions.
- .4 Mix in dry block admix to mortar for exterior block work at the rate of 500 ml per 45 kg of cement.
- .5 Mix in mortar colour pigments.

3.11 SUPPORT OF
LOADS

- .1 Use 20 MPa concrete grout to Section 03 30 00 where concrete fill is used instead of solid units in core fills and lintels. Install grout in accordance with CSA-A371.
- .2 Install expanded metal mesh below voids to be filled with concrete or grout, keep mesh 25 mm back from faces of units.
- .3 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

3.12 PROVISION FOR
MOVEMENT

- .1 Caulk corner joints of all block work where walls butt into continuous walls, at dissimilar material intersections (concrete walls and columns) and at masonry wall intersection with floor slabs, caulking to be done before painting. Slightly rake the vertical mortar joint during installation so as to provide slight slot for caulking joint. Tie wall butting to intersecting wall with Flex-o-Lok anchor system with masonry screw anchors and ties at every second block course.

3.13 CLEANING

- .1 Clean concrete block and brick masonry as work progresses.
- .2 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.
- .3 Cleaning of concrete masonry:
 - .1 Clean 10 m² area wall designated by the Consultant as directed below and leave for one (1) week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work, and clean concrete masonry as follows:
 - .2 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
 - .3 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 concrete masonry manufacturer in accordance with manufacturer's directions.
 - .4 Repeat cleaning process as often as necessary to remove mortar and other stains.
 - .5 Use acid solution treatment only for difficult to clean concrete masonry as recommended by manufacturer.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for supplying, fabricating and erection of all structural steel. The section also specifies the requirement for the fabricator to design and detail all connections.

1.2 REFERENCES

- .1 ASTM A123/A123M-2013, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) Coatings on Iron and Steel Hardware.
- .3 ASTM A307-2014, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- .4 ASTM A325-2014, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .5 ASTM A449-2014, Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
- .6 ASTM A500/A500M-2013, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- .7 ASTM A572/A 572M-2013A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- .8 CISC/CPMA Standard 2-75, A Quick-Drying, Primer for Use on Structural Steel.
- .9 CISC/CPMA Standard 1-73a, A Quick Drying, One Coat Paint for Use on Structural Steel.
- .10 CSA G40.20-04/G40.21-2013, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
- .11 CSA S16-2014, Consolidation, Design of Steel Structures.

1.2 REFERENCES
(Cont'd)

- .12 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.
- .13 CSA W55.3-08 (R2013), Certification of Companies for Resistance Welding of Steel and Aluminum.
- .14 CSA W59-2013, Welded Steel Construction (Metal Arc Welding).

1.3 SOURCE QUALITY
CONTROL

- .1 Prior to commencing Work, submit two (2) certified copies of mill reports covering chemical and physical properties of steel used in this work.
- .2 Fabricator, as practicably as possible (preferably 90%+), to maximize amount of recycled content for all structural steel.

1.4 DESIGN OF
DETAILS AND
CONNECTIONS

- .1 Design and detail connections in accordance with requirements of CSA S16 and also to resist forces, moments and shears where indicated.
- .2 Where connection forces are not indicated, detail the connection to resist 50% of the total uniformly distributed factored load capacity of the members, and 75% of tensile capacity of bracing members.
- .3 For non-standard connections, submit sketches and design calculations stamped and signed by a qualified professional engineer registered in the Province of Prince Edward Island.
- .4 For standard connections, select details from CISC Handbook of Steel Construction to ensure structural adequacy. Submit all standard connections for each structural steel member size. Have all connections stamped and signed by a qualified professional engineer registered in the Province of Prince Edward Island.
- .5 Submit all connection designs and sketches as connections are available to review in order to expedite the review process.

1.5 SHOP DRAWINGS

- .1 Submit connection details and erection drawings in accordance with Section 01 00 00.

1.5 SHOP DRAWINGS
(Cont'd)

- .2 On erection drawings, indicate member size, base plate elevation, anchor bolt size and location and information necessary for assembly.
- .3 Submit shop details of all standard connections and non-standard connections to be used in the connection of structural steel members. Identify on erection drawings the location of all non-standard connections.
- .4 All submitted drawings to bear signature and seal of professional engineer registered in Province of Prince Edward Island for all fabricator designed assemblies, components and connections.
- .5 Indicate welds by welding symbols as defined in CSA W59.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Structural steel: to CSA G40.21 (Grade 345 MPa) and ASTM-A572 (Grade 350W) for columns, beams and channel shapes, Grade 300 W for angles, plates and bars, CSA G40.21 (Grade 350W) and/or ASTM A500 (Grade 345 MPa), Class C for hollow structural sections.
- .2 Anchor bolts: to ASTM A307 and to ASTM A449.
- .3 Bolts, nuts and washers: to ASTM A325.
- .4 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop paint primer: to CISC/CPMA 2.
- .6 Galvanizing: Hot-dip method with minimum zinc coating of 705 g/m² conforming to ASTM A123/A123M for all fabricated assemblies; ASTM A153/A15M for all hardware (average zinc coating of 381 g/m²).

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CSA S16 and in accordance with reviewed shop drawings.
- .2 Continuously weld connection joints of architecturally exposed steel and grind smooth and flush with adjacent surfaces.

2.2 FABRICATION
(Cont'd)

- .3 Provide holes for attachment of other work only when and where approved by the Consultant or as shown on the drawings.
- .4 Provide bearing plates with anchor bolts for steel beams unless otherwise indicated.
- .5 Where finished surfaces of steel are to be left exposed to view, fabricate to AISC specifications for architecturally exposed steel including straightness.
- .6 Remove mill marks, identification and surface imperfections of exposed steel by grinding smooth and flush with adjacent surfaces.
- .7 Exposed welds to be continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 SHOP PAINTING

- .1 Shop prime and paint all steel fabrications provided in the Work. Only touch ups will be required on site.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do welding in accordance with CSA W59.
- .2 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.
- .3 When requested by Consultant, provide certification that all welded joints are qualified by the Canadian Welding Bureau.

3.2 MARKING

- .1 Mark materials in accordance with CSA G40.20. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- .2 Match marking: shop mark for fit and match

3.3 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CSA S16 and in accordance with reviewed erection drawings.
- .2 Verify dimensions and conditions of existing work before commencing fabrication and report discrepancies or problems to the Consultant. Do not proceed until notified by Consultant.
- .3 Obtain written permission of Consultant prior to field cutting or altering of structural members.
- .4 Clean with mechanical brush and touch up shop primer to bolts, welds and burned or scratched surfaces at completion of erection.
- .5 Assume full responsibility for the integrity of structure during erection. Make necessary provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and installation of necessary permanent bracing and frames.
- .6 Set column base plates and loose bearing plates with steel shims to proper elevation, true and level, ready for grouting-in.
- .7 Restrict drifting during assembly to minimum required to bring parts into position without enlarging or distorting holes and without distorting, kinking or sharply bending metal of any unit. If, in the opinion of the Consultant, holes must be enlarged to admit bolts, they are to be reamed and larger size bolts used. Reamed holes not to exceed size of bolt used by more than 1/16 inch.

3.4 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Consultant.
- .2 Testing laboratory may use ultra-sonic testing procedures to verify soundness of some representative shop and field welds. In principal structural members, shop and field welds will be X-rayed. Representative bolted connections will be checked with torque wrench. Consultant will determine location and extent of all testing.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for furnishing all materials, labour, tools and equipment, and performing all operations necessary to complete all miscellaneous metal and fabricated items, as shown on the Drawings and specified in this Section.
- .2 The work generally includes the following categories and all related items of miscellaneous metal shown on the Drawings except where noted otherwise.
 - .1 Anchors, chemical anchors, bolts and inserts
 - .2 Miscellaneous steel
 - .3 Steel handrails, guardrails, and stairs.
- .3 Where not indicated in this Section, refer to drawings for number of items to be provided for each category.

1.2 RELATED WORK

- .1 Cast-in-Place Concrete: Section 03 30 00.
- .2 Painting: Section 09 91 23.
- .3 Process Equipment: Division 40.

1.3 REFERENCES

- .1 ASTM A53/A53M-2012, Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- .2 ASTM A123-13, Standard Specification for Zinc (hot Dipped Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A153-09, Standard Specification for Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
- .4 ASTM A307-14, Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- .5 ASTM F3125/F3125M-15a, 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.
- .6 ASTM A449-14, Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 Minimum Tensile Strength, General Use.

1.3 REFERENCES
(Cont'd)

- .7 ASTM A500-13, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- .8 ASTM A572-15, Standard Specification for High-Strength Low-Alloy Columbium Vanadium Structural Steel.
- .9 CSA G40.20/G40.21-2013, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .10 CSA S16-14, Limit States Design of Steel Structures.
- .11 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.
- .12 CSA W55.3-08(R2013), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .13 CSA W59-2013, Welded Steel Construction (Metal-arc Welding).

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Clearly indicate materials, core thicknesses, finishes, connections, joints, method of attachment, number of anchors, supports, reinforcement, details and accessories.
- .3 Provide stamp and signature of qualified professional engineer registered in the Province of New Brunswick for connection designs.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Label, tag or otherwise mark items supplied for installation by other sections to indicate its function, location, and shop drawing designation.

1.6 JOB CONDITIONS

- .1 Protection:
 - .1 Maintain protection of Work of this Section from time of installation until final finishes are applied.
 - .2 Protect galvanized surfaces from damage.

1.6 JOB CONDITIONS
(Cont'd)

- .1 (Cont'd)
- .3 Protect exposed surfaces of prefinished metal work which does not receive site finishing with protective coatings or wrappings. Use materials recommended by finishers or manufacturers of metals to ensure that method is sufficiently protective, easily removed, and harmless to the finish.

1.7 DESIGN OF
DETAILS AND
CONNECTIONS

- .1 Design details and connections in accordance with requirements of CSA-S16.
- .2 Unless noted otherwise, connections shall be detailed to resist 50% of the web capacity of the members.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Use new materials that are free from corrosion, rust, and millscale.
- .2 Steel angles and plates: to CSA-G40.21, 300W.
- .3 Rolled steel sections: to CSA-G40.21, (Grade 345 MPa) and ASTM A572 (Grade 350W).
- .4 Hollow structural sections: to CSA-G40.21 (350W) or ASTM A500 (Grade 345 MPa), Class C.
- .5 Steel pipe: to ASTM A53, schedule 40, standard weight, unless noted otherwise, galvanized.
- .6 Welding materials: to CSA-W59.
- .7 Anchor bolts: to ASTM A307 and to ASTM A449.
- .8 Bolts, nuts and washers: to ASTM F3125.
- .9 Galvanized primer: one component, ready-mixed zinc rich.
 - .1 Acceptable product: Catha-Coat 13034 by Devoe Coating, or approved equivalent.
- .10 Galvanizing: hot-dip method with minimum zinc coating of 705 g/m² conforming to ASTM A123/A123M for all fabricated assemblies; ASTM A153/A153M for all hardware (average zinc coating of 381 g/m²).

2.1 MATERIALS
(Cont'd)

- .11 Shop coat primer: to CISC/CPMA-2.
- .12 Chemical anchors: all threaded galvanized threaded rod anchor, nut, washer and adhesive capsule.
 - .1 Acceptable product: HY200 Adhesive System with HAS-E B7 ROD by Hilti or approved equivalent.
 - .2 Embedment as indicated on the Drawings or minimum embedment equal to the manufacturer's standard recommendations.
- .13 Grating: stair treads and landing to be sizes as indicated on drawings.
 - .1 Acceptable product: Flow force Type 19-4 by Fisher Ludlow or approved equal.

2.2 FABRICATION

- .1 Workmanship and finish must be equal to the best practice of modern shops for each item of work.
- .2 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .3 Confirm exposed surfaces have smooth finish and sharp, well defined lines and arises. Form sections to shape and size shown with sharp lines and angles.
- .4 Confirm castings have sharp corners and edges, and are clean, smooth and true to pattern.
- .5 Make exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.
- .6 Where possible, fit and shop assemble work, ready for installation.
- .7 Fabricate miscellaneous steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
- .8 When welding onsite, check with staff before grounding to ensure that this activity will not have adverse effects on the plant equipment.

2.3 SHOP PAINTING

- .1 Apply one (1) coat of primer to metal items, with exception of galvanized or concrete encased items.

2.3 SHOP PAINTING
(Cont'd)

- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.
- .3 Prime after fabrication and before damage to surface occurs from weather or other exposure.
- .4 Spray prime contact surfaces of field assembled, bolted, friction type joints with primer only. Do not brush primer after spraying.
- .5 Do not prime metal within 50 mm of edge to be welded. Give unprotected steel one coat of approved protective coating after shop fabrication is completed.
- .6 Protect machine finished or similar surfaces that are not to be coated, but that do required protection, with coating of rust inhibitive petroleum, molybdenum disulphide, or other coating approved by the Consultant.
- .7 Copy previous erection marks and weight marks on areas that have been shop primed.

2.4 MISCELLANEOUS
METALWORK ITEMS

- .1 Anchors, chemical adhesive anchors, bolts and inserts:
 - .1 Provide as required to fasten miscellaneous metal items to concrete or masonry.
 - .2 Where sizes, kinds and spacing of anchors are not indicated or specified, provide as necessary for the purpose as approved by Consultant.
 - .3 Hot-dip galvanize all anchors, bolts, washers and inserts.
- .2 Miscellaneous steel:
 - .1 Provide miscellaneous steel as required for equipment supports, angles, and steel framing to shape, size and details required.
 - .2 Galvanize miscellaneous steel items after fabrication.
- .3 Steel handrails, guardrails, and stairs:
 - .1 Fabricate handrails, guardrails, kickplates and stairs using member shapes and sizes shown on the Drawings.
 - .2 Make changes in direction with smooth radius curves. Mitre joints and weld flush.
 - .3 Fabricate posts from same material as rail. Space and attach posts as shown.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1 This Section specifies requirements for supplying, transporting and installing all items of rough carpentry.
<u>1.2 RELATED WORK</u>	.1 Insulation: Section 07 21 00 .2 Sealants: Section 07 92 00 .3 Painting: Section 09 91 23
<u>1.3 REFERENCES</u>	.1 CSA 080 Series-08(R2012), Wood Preservation. .2 CSA 086-2014, Engineering Design in Wood. .3 CSA 0112 Series-M1977(R2006), CSA Standards for Wood Adhesives. .4 CSA 0121-08(R2013), Douglas Fir Plywood. .5 CSA 0141-05(R2014), Softwood Lumber. .6 CSA 0151-09(R2014), Canadian Softwood Plywood. .7 CSA 0325.0-92(R2003), Construction Sheathing. .8 National Lumber Grades Owner (NLGA) Standard Grading Rules for Canadian Lumber 2014.
<u>1.4 QUALITY ASSURANCE</u>	.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board. .2 Plywood identification: by grade mark in accordance with applicable CSA standards.

PART 2 - PRODUCTS

<u>2.1 FRAMING AND STRUCTURAL MATERIALS</u>	.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:

2.1 FRAMING AND
STRUCTURAL
MATERIALS
(Cont'd)

- .1 (Cont'd)
 - .1 CAN/CSA-0141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Glued end-jointed (finger-jointed) lumber is not acceptable.
- .3 Machine stress-rated lumber is acceptable for all purposes.
- .4 Framing and Board members: in accordance with NBC 2010.
- .5 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 S2S or S4S is acceptable.
 - .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.
- .6 Lumber: unless specified otherwise, softwood kiln dried, spruce-pine-fir and cedar (where indicated) species, S4S, moisture content 15% or less in accordance with the following standards:
 - .1 CAN/CSA 0141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber 2014.
- .7 Pressure treat all lumber in contact with ground or concrete.

2.2 PANEL MATERIALS

- .1 Douglas fir plywood (DFP): to CSA 0121, standard construction, thickness indicated.
- .2 Canadian softwood plywood (CSP): to CSA 0151, standard construction, thickness indicated. Exterior grade.
- .3 Panel standards: type, grade and thickness as indicated and in accordance with the following standards:
 - .1 Canadian Softwood Plywood (CSP): to CAN/CSA 0151, standard construction.
- .4 Construction sheathing: to CSA 0325.
 - .1 Ceiling sheathing to be 16 mm exterior grade Douglas Fir plywood sheathing.

-
- 2.2 PANEL MATERIALS .4 (Cont'd)
(Cont'd) .2 Roof sheathing: 19 mm exterior grade tongue and groove plywood sheathing.
- 2.3 ACCESSORIES .1 Sealants: as specified in Section 07 92 00.
- .2 Nails, spikes and staples: galvanized for exterior work, plain finish for interior work.
- .3 Bolts: 12 mm 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, recommended for purpose by manufacturer.
- .5 General purpose adhesive to CSA-0112.
- .6 Sill gasket: purpose made compressible sill gasket by "TrueFoam", or approved equivalent.
- 2.4 FINISHES .1 Galvanizing: use galvanized fasteners for exterior work, interior highly humid areas and pressure-preservative treated lumber as indicated.
- 2.5 WOOD PRESERVATIVE .1 Surface-applied wood preservative: clear copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.
- .2 Use pressure preservative treated wood to CAN/CSA 080, water borne for stained finish, where indicated and as follows:
- .1 Treat plywood to CSA 080.9 using CCA or ACA preservative to obtain minimum net retention of 4.0 kg/m³ of wood.
- .2 Treat lumber to CSA 080.2 using CCA or ACA preservative to obtain minimum net retention of 4.0 kg/m³ of wood.
- .3 Following water-borne preservative treatment, kiln dry material.
-

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Treat cut surfaces of pressure preservative treated material with surface applied wood preservative, before installation, and as follows:
 - .1 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum three (3) minute soak on lumber and one (1) minute soak on plywood.
 - .2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
 - .3 Treat all material as indicated and as follows:
 - .1 Wood cants, backing, curbs, nailers on roof deck, and wall blocking.

3.2 INSTALLATION

- .1 Comply with requirements of NBC 2010, Division B, Part 9 supplemented by following paragraphs.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length.
- .4 Install spanning members with "crown-edge" up.
- .5 Install furring and blocking as required to space-out and support casework, cabinets, electrical equipment mounting boards, and other work as required.
- .6 Install furring to support siding applied vertically where there is no blocking.
 - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .7 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .8 Install wood cants, nailers, curbs and other wood supports as required and secure using galvanized or stainless steel fasteners.
- .9 Sheathing to be installed as and where indicated on the Drawings.

3.2 INSTALLATION
(Cont'd)

- .10 Cutting of holes by trades or splices in members not indicated are not be permitted.

3.3 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.
- .3 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.4 SCHEDULES

- .1 Sheathing:
 - .1 Plywood, DFP or CSP, exterior grade, pressure treated, square edge, thickness indicated.
 - .2 Interior and exterior applications as indicated on the Drawings.
- .2 Electrical equipment backboards: Canadian softwood plywood to CSA 0151, standard construction, CSP/S1S, 19 mm thick. Overall dimensions to suit equipment layout and arrangement. Install wood support framing as required. Painting of panel in Section 09 91 23.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This Section specifies requirements for design, supply, transporting and erecting pre-fabricated wood roof trusses where shown on the Drawings and as specified herein.
- 1.2 RELATED WORK .1 Rough carpentry: Section 06 10 00
- 1.3 REFERENCES .1 CSA-086-14, Engineering Design in Wood.
.2 CAN/CSA-0141-05 (R2014), Softwood Lumber.
.3 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel Structures.
.4 NLGA, Standard Grading Rules for Canadian Lumber, 2014.
- 1.4 DESIGN CRITERIA .1 Design trusses, bracing and bridging in accordance with CSA-086 and NBC 2010 , Part 4 requirements, Post Disaster building designation. Internal wind uplift pressures shall be determined in accordance with NBC 2010, Part 4 requirements, Category 3 building designation.
.2 Dead load and snow loads are indicated on the design drawings. Design trusses for point loads from suspended mechanical/electrical equipment as noted on plans.
.3 Limit combined live load and dead load deflections to 1/240th of span unless otherwise specified or indicated. Limit live load deflection to 1/360th of span unless otherwise specified or indicated.
.4 Design and supply all truss uplift anchors (truss tie downs), including girder truss tie downs, in accordance with CSA-086, to withstand the wind uplift loads shown on Drawings.
.5 At truss bearing points, where allowable compression perpendicular to the grain is exceeded, the truss manufacturer must provide bearing plates.

1.5 SOURCE QUALITY
CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.

1.6 QUALIFICATION
OF MANUFACTURERS

- .1 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.

1.7 SHOP DRAWINGS

- .1 Submit shop drawings and erection drawings in accordance with Section 01 00 00.
- .2 Each shop drawing submission showing connection details must bear signature and stamp of professional engineer registered or licensed in Nova Scotia.
- .3 Indicate species, sizes, and stress grades of all lumber used as structural members. Show pitch, span, camber, design heel height, configuration and spacing of members. Indicate connector types, thicknesses, sizes, locations and design value. Show bearing details. Indicate design load for each member.
- .4 Submit stress diagram or print-out of computer design indicating design load for each member. Indicate allowable load and stress increase.
- .5 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
- .6 Show lifting points for storage, handling and erection.
- .7 Show location of lateral bracing for compression members.

1.8 DELIVERY AND
STORAGE

- .1 Store members on job site in accordance with manufacturer's instructions. Provide bearing supports and bracings. Prevent bending, warping and overturning of members.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Lumber: SPF species, No. 1 grade, softwood, S4S, with maximum moisture content of 19% at time of fabrication and to following standards:
 - .1 CAN/CSA-0141.
 - .2 NLGA (National Lumber Grading Association), Standard Grading Rules for Canadian Lumber.
- .2 Fastenings: to CSA-086.
- .3 Tie-down anchors: prefabricated wood truss to top plate uplift anchors, galvanized, to resist uplift force calculated as per the National Building Code of Canada.

2.2 FABRICATION

- .1 Fabricate wood trusses in accordance with reviewed shop drawings.
- .2 Provide for design camber and roof slopes when positioning truss members.
- .3 Connect members using metal connector plates.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Erect wood trusses in accordance with reviewed erection drawings.
- .2 Indicated lifting points to be used to hoist trusses into position.
- .3 Make adequate provisions for handling and erection stresses.
- .4 Exercise care to prevent out-of-plane bending of trusses.
- .5 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed.
- .6 Install permanent bracing in accordance with reviewed shop drawings, prior to application of loads to trusses.

3.1 ERECTION
(Cont'd)

- .7 Do not cut or remove any truss material without approval of the Consultant.
- .8 Provide galvanized uplift anchor(s), at each truss bearing point, to resist uplift force, calculated as per National Building Code of Canada.
- .9 Have all truss tie downs (uplift anchors), including girder truss tie downs, designed, supplied and installed by truss supplier.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section specifies requirements for dampproofing under slabs as specified and where indicated on the Drawings.
<u>1.2 RELATED WORK</u>	.1	Insulation: Section 07 21 00
	.2	Sealants: Section 07 92 00
<u>1.3 STORAGE AND HANDLING</u>	.1	Provide and maintain dry, off-ground weatherproof storage, at temperatures above freezing, free from contact with cold or frozen surfaces.
	.2	Store materials on supports to prevent deformation.
	.3	Remove only in quantities required for same day use.
	.4	Store materials in accordance with manufacturers written instructions.
<u>1.4 ENVIRONMENTAL REQUIREMENTS</u>	.1	Do not proceed with work when wind chill effect would tend to set bitumen before proper curing takes place.
	.2	Maintain air temperature and substrate temperature at dampproofing installation area above 5°C for 24 hours before, during and 24 hours after installation.
	.3	Do not apply dampproofing in wet weather.
	.4	Provide forced air circulation during installation and curing periods for enclosed applications.

PART 2 - PRODUCTS

<u>2.1 MATERIALS</u>	.1	Under slab dampproofing vapour barrier: "Moiststop" sheet membrane, reinforced polyethylene, complete with lapped/sealed joints.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Under slabs:
 - .1 Install sheet membrane of reinforced poly dampproofing/vapour barrier below concrete floor slab and extend 100mm up vertical face of concrete walls.
 - .2 Lap joints of sheet dampproofing/vapour barrier 150mm minimum and apply a continuous heavy bead of acoustic sealant or Building Wrap Tape, to seal joints.
 - .3 After concrete slab has been poured, install continuous perimeter caulked joint between foundation wall and slab.

PART 1 - GENERAL

- 1.1 WORK INCLUDED
- .1 This Section specifies requirements for furnishing all materials, labour, tools and equipment necessary to complete batt insulation and rigid insulation as indicated and as specified herein.
- 1.2 RELATED WORK
- .1 Rough Carpentry: Section 06 10 00
- .2 Dampproofing: Section 07 11 13
- .3 Hollow Metal Doors and Frames: Section 08 11 14
- .4 Excavating, Trenching and Backfilling: Section 31 23 10
- 1.3 REFERENCES
- .1 CAN/ULC-S701-2011, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .2 CAN/ULC-S702-2009, Thermal Insulation, Mineral Fibre, for Buildings.
- .3 CGSB 71-GP-24M-83, Adhesive, Flexible for Bonding Cellular Polystyrene Insulation.
- .4 ASTM C1289-16, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING
- .1 Package insulation materials and label them to designate manufacturer, type, density and insulation value, and reference standard specification number if applicable.
- .2 Store insulation materials in dry areas, protected from wetting and traffic.
- .3 Store insulation board flat, on a flat surface, to prevent edge damage and placing of materials on top of stored boards.
- .4 Store insulation board and adhesives at a minimum temperature of 4°C for 12 hours before installation, and store freezable adhesives only at temperatures above 0°C at all times.

1.5 JOB CONDITIONS

- .1 Install insulation materials subject to damage by water, freezing, sunlight or similar adverse environmental conditions with adequate protection against damage.
- .2 Protect polystyrene insulation from sunlight at all times until permanent cover is installed.

1.6 PROTECTION

- .1 Ventilate area to receive spray applied polyurethane insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
- .2 Provide temporary enclosures to prevent spray applied polyurethane insulation from contaminating air beyond application area.
- .3 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Confirm all materials of an insulation system and the construction with which it is in contact are compatible.
- .2 Inform others whose Work is affected of the thickness and installation methods of insulation to be installed.

2.2 MATERIALS

- .1 Batt insulation: to CAN/ULC-S702, Type 1.
- .2 Rigid board wall insulation:
 - .1 Above grade: closed cell, cellular foamed polystyrene to CAN/ULC S701, Type 2, thickness indicated, (based on 50mm equal to RSI 1.761) shiplapped edges.
 - .1 Acceptable product: Styrofoam Cavitymate SC by Dow Chemical Canada Inc., Celfort 200 as manufactured by Owens Corning, TrueBoard type 2 by TrueFoam or approved equivalent.

2.2 MATERIALS
(Cont'd)

- .2 (Cont'd)
 - .2 Below grade insulation: extruded, closed cell, cellular foamed polystyrene to CAN/ULC S701, Type 3, thickness indicated, shiplapped edges. Cover exposed perimeter wall insulation to a minimum of 300mm below grade with 12.5mm thick cementitious board cladding.
 - .1 Acceptable product: Styrofoam SM by Dow Chemical Canada Inc., Celfort 300 as manufactured by Owens Corning, or approved equivalent.
 - .3 Vapour barrier type adhesive: to CGSB 71-GP-24, Type 2, Class as recommended by manufacturer and compatible with polystyrene insulation.
 - .4 Attic ventilation baffle: expanded polystyrene to CAN/ULC S701, 1200 LG. Acceptable product: TrueVent by TrueFoam, or approved equivalent.

2.3 COMPATIBILITY

- .1 Confirm all materials that come in contact with insulation board adhesive are compatible. Provide proof of compatibility if requested.

2.4 PERFORMANCE
REQUIREMENTS

- .1 Fit insulation within construction elements and dimensions indicated on Drawings, without compression.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Install insulation after building substrate materials are dry.
- .2 Verify all surfaces to which board insulation is applied are clean, reasonably smooth with no abrupt changes in plane, free of grease and with protruding fins of mortar or concrete removed, and that the surfaces are otherwise acceptable for board insulation application as specified.
- .3 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .4 Fit insulation tightly around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and other protrusions.

3.1 WORKMANSHIP
(Cont'd)

- .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 Do not enclose insulation until it has been inspected and approved by the Consultant.

3.2 EXAMINATION

- .1 Examine substrates and immediately inform Consultant in writing of defects.
- .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.
 - .2 Surfaces have not been coated with releasing agents, and other contaminants which would affect positive bonding of polyurethane insulation.
- .3 Report, in writing, to Consultant defects or conditions which would affect work. Do not proceed with work until conditions have been rectified.

3.3 PERIMETER
FOUNDATION
INSULATION

- .1 Install insulation boards vertically at 600 mm o.c. from top of foundation footings to underside of concrete floor slab, and for overhead door locations extend boards 600mm horizontally in from the foundation wall and 600mm past overhead door openings at each side (Lay boards on level, compacted fill).
- .2 Exterior application: extend boards as indicated on exterior face of the perimeter foundation wall with adhesive.
- .3 Cover exposed perimeter rigid foundation insulation with cementitious board to a minimum of 300mm below grade.

3.4 BATT INSULATION
INSTALLATION

- .1 Pack insulation in door frames as indicated.
- .2 Install batt insulation in wood framed construction where indicated on Drawings, in a neat and tight fashion.
- .3 Install batt insulation in two (2) layers, with first layer and thickness parallel to the joints or

3.4 BATT INSULATION
(Cont'd)

trusses, and the second layer perpendicular to the first layer.

3.5 ATTIC
VENTILATION
INSULATION
INSTALLATION

- .1 Install attic vent insulation at soffits to underside of roof sheathing using two vents per 610 mm o.c./truss space.

3.6 RIGID BOARD
WALL INSULATION
INSTALLATION

- .1 Apply full bed of Type 2 vapour barrier adhesive to polystyrene insulation board edges by trowel, to fill any gaps between joints of sheets and any penetrations.
- .2 Install pressure-treated wood strapping vertically at 400 o.c. over insulation and exterior wall building wrap.

3.7 ADJUSTMENT AND
CLEANING

- .1 Remove adhesive and clean surfaces without marring or damaging surface.
- .2 Clean off polyurethane insulation from surfaces not intended to receive spray applied insulation.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements for providing sheet membrane air/vapour barrier where indicated on Drawings.
- 1.2 RELATED WORK .1 Masonry: Section 04 20 00
.2 Insulation: Section 07 21 00
.3 Sealants: Section 07 92 00
.4 Hollow Metal Doors, Frames and Hardware: Section 08 11 14
- 1.3 SUBMITTALS .1 Manufacturer's Installation Instructions: indicate preparation, installation requirements and techniques, product storage and handling criteria.
.2 Prior to commencing the Work, submit manufacturers complete set of standard details for air barrier.
- 1.4 QUALIFICATIONS .1 Applicator: Company specializing in performing work of this section with minimum five (5) years documented experience approved by materials' manufacturers.
- 1.5 QUALITY ASSURANCE .1 Submit in writing, a document stating that the applicator of the primary air 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 printed requirements of the air barrier manufacturer and this specification.
.3 Maintain one (1) copy of manufacturer instructions on site.
-

1.5 QUALITY
ASSURANCE
(Cont'd)

- .4 At the beginning of the Work and at all times during the execution of the Work, allow access to Work site by the air barrier membrane manufacturers' representative.
- .5 Components used in this section shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics, and adhesives.

1.6 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 role materials on end in original packaging.
- .3 Store adhesives and primers at temperatures of 5°C and above to facilitate handling.
- .4 Keep solvent away from open flame or excessive heat.
- .5 Protect rolls from direct sunlight until ready for use.

1.7 SEQUENCING

- .1 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.8 COORDINATION

- .1 Coordinate work of this section with all sections referencing this Section.
- .2 Promote continuity of the air seal throughout.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

- .1 Specifications for this Section are based on Perma-barrier sheet membrane air/vapour barrier membrane and accessories supplied by Grace Membrane Systems and Bakor Blueskin WP200 Air/Vapour Barrier Membrane or approved equivalent.
- .2 Self-adhering, cold-applied, composite sheet membrane minimum thickness 1.016 mm (40 mils).

2.2 ACCESSORIES

- .1 Substrate cleaner: non-corrosive type recommended by sealant manufacturer.
- .2 Primer: rubber based, dispersed in solvent, recommended by air/vapour barrier manufacturer.
- .3 Tape: minimum 0.762 mm thick, self-adhering type, compatible with sheet material.
- .4 Wall flashing membranes: minimum 0.762 mm thick, self-adhering type, compatible with sheet material.
- .5 Mastic: single component rubber based mastic.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify surfaces and conditions are ready to accept the Work of this Section. Notify the Consultant in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared surfaces.

3.2 PREPARATION

- .1 All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spalled areas in substrate to provide an even plane.
- .2 Cure all new concrete for a minimum of 14 days. Concrete must be dry before air barrier membranes are applied.

3.3 PRIMER

- .1 Prime all surfaces to receive membrane applied by means of roller or spray at a rate recommended by manufacturer.
- .2 Allow primer to dry adequately before proceeding with the membrane.
- .3 To avoid excess pickup of air borne dust, prime only as much area as can be covered with membrane the same working day. If not covered in the same working day, reprime.

3.4 INSTALLATION

- .1 Apply membrane horizontally to primed blockwork between projecting masonry reinforcing beginning at base of wall area.
- .2 Install each length of membrane such that its upper edge runs continuously along the underside of the line of masonry reinforcing. Overlap subsequent sheets applied over the sheet below an average of 50 mm immediately below the line of reinforcing. Provide minimum overlap of 38 mm. Minimum edge lap in accordance with manufacturer's written instructions.
- .3 Press membrane firmly into place by means of a hand roller. Confirm continuous contact with the substrate.
- .4 Membrane installation to interface with other elements designated as integral to the overall air/vapour barrier system. Confirm the compatibility with those components.

3.5 DETAILS

- .1 Confirm the integrity of membrane installation at the base of tie wire locations by applying mastic to seal voids caused in fitting the membrane around projections.
- .2 Fit membrane tightly around all penetrations through it and seal using mastic.
- .3 Continue the membrane into all openings in the wall area, such as windows and doors, and terminate at a point that will ensure that it will not be visible from the interior.
- .4 Tie the membrane installation into and make continuous with all framed openings, including any mechanical and electrical penetrations through walls and roof.
- .5 Co-ordinate installation of membrane with roofing to ensure continuity of air/vapour barrier membrane with roofing system.
- .6 At the end of each working day, assuming a wall area has been only partially covered, apply a bead of mastic along top edge of membrane at its termination to prevent the vertical drainage of precipitation from running in behind the membrane. Tool mastic to ensure that it is worked into the surface of the block work.

3.5 DETAILS
(Cont'd)

- .7 Before covering membrane with cavity insulation, inspect and repair punctures, damaged areas or inadequately lapped seams. Make repairs using the membrane sized to extend a minimum of 100 mm in all directions from the perimeter of the affected area.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section specifies requirements for providing all labour tools, equipment and materials to complete installation of all cement board siding components including horizontal siding, corner and frieze boards and openings trim, trim accessories and integral flashings.
<u>1.2 RELATED WORK</u>	.1	Masonry: Section 04 20 00
	.2	Rough Carpentry: Section 06 10 00
<u>1.3 QUALITY ASSURANCE</u>	.1	Submittals: .1 Submit three (3) 150 mm x 150 mm pieces of plank trim and siding. .2 Submit three copies of specifications, installation data and other pertinent manufacturers literature.
<u>1.4 DELIVERY, STORAGE PRODUCT HANDLING</u>	.1	Stack claddings on edge or lay flat on a smooth, level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.
<u>1.5 ENVIRONMENTAL AND SAFETY REQUIREMENTS</u>	.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 material safety data sheets acceptable to Labour Canada.

PART 2 - PRODUCTS

<u>2.1 PLANK AND PANEL SIDING AND TRIM</u>	.1	Non-asbestos fiber-cement siding to comply with ASTM Standard Specification C1186 Grade II, Type A.

2.1 PLANK AND PANEL
SIDING AND TRIM
(Cont'd)

- .2 Type: Select Cedarmill, prefinished (to be selected from manufacturer's standard colour range), 127 mm to weather. Horizontal lap joint siding (James Hardie, "Hardiplank").
- .3 Trim Type: "Harditrim" planks, prefinished (Arctic White) XLD smooth (32 mm thick) texture, nom. 150 mm wide for corner boards, nom. 100 mm wide for door and window trim, nom. 200 mm wide for baseboards and frieze boards.
- .4 Siding and trim are to be pre-primed with the "PrimePlus" sealer and primer system of the manufacturer, then prefinished with the "ColorPlus" baked-on colour process of the manufacturer.
- .5 Allow 3 mm gap between trim and siding.
- .6 Seal gap with high quality, paintable caulk.
- .7 Shim baseboards and frieze boards as required to align with corner trim.
- .8 Flashing Trim and Accessories:
 - .1 Utility sheet aluminium, minimum 0.8 mm thick, factory pre-finished to CAN/CGSB-93.1, Type 1, Class F1S.
 - .2 Fasteners: of same material as flashing of length and thickness suitable for metal flashing application, colour-matched.
 - .3 Touch-up paint: as recommended by metal flashing and trim manufacturer.
 - .4 Fabricate metal flashings to profiles required and other sheet metal work in accordance with applicable CRCA 'FL' series specifications and as indicated.
 - .5 Form pieces in 2500 mm maximum lengths. Make allowance for expansion at joints.
 - .6 Hem exposed edges on underside 12.5 mm. Mitre and seal corners with sealant.
 - .7 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

2.2 INSTALLATION-
PLANK SIDING

- .1 Starting: install a minimum 6 mm thick lath starter strip at the bottom of the wall. Apply planks horizontally with minimum 32 mm wide laps at the top. The bottom edge of the first plank overlaps the starter strip and base metal flashing over baseboards.

2.2 INSTALLATION-
PLANK SIDING
(Cont'd)

- .2 Allow minimum 25 mm vertical clearance between roofing and bottom edge of siding.
- .3 Align vertical joints of the planks over framing members.
- .4 Maintain clearance between siding and adjacent finished grade.
- .5 Locate splices at least on stud cavity away from window and door openings.
- .6 Wind resistance: where a specified level of wind resistance is required "Hardiplank" lap siding is installed to framing members and secured with fasteners described in Table 2 in National Evaluation Service Report No. NER-405.

2.3 FINISHING

- .1 Touch-up paint finish of all prefinished lap siding and trim with minimum one coat high quality, 100% acrylic exterior grade paint after installation. Follow paint manufacturer's written product recommendation and written application instructions, as per James Hardie Siding Products.

PART 3 - EXECUTION

3.1 SURFACE
CONDITIONS

- .1 Correct conditions detrimental to timely and proper completion of work.

3.2 INSTALLATION -
TRIM

- .1 Install flashing around all wall openings.
- .2 Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 19 mm or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.
- .3 Place fasteners no closer than 19 mm and no further than 50 mm from side edge of trim board and no closer than 25 mm from end. Fasten maximum 400 mm on center.
- .4 Maintain clearance between trim and adjacent finished grade.

3.2 INSTALLATION -
TRIM

(Cont'd)

- .5 Trim inside corner with single board.
- .6 Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten trim board to trim board.

3.3 JOB CONDITIONS

- .1 Nominal 32 mm x 100 mm pressure-treated wood selected for minimal shrinkage and strapping mechanically screw fastened to concrete block walls, above air barrier and rigid insulation. Provide solid blocking around all openings.
- .2 Install claddings to dry surfaces.
- .3 Protect siding from other trades.

3.4 WARRANTY
(MANUFACTURER TO
PROVIDE)

- .1 Product warranty against manufacturing defects in siding and trim for 15 years.
- .2 Product warranty for colour stay-fast peeling, chipping or cracking for 15 year finish warranty.
- .3 Workmanship: application limited warranty for 1 year.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section includes requirements for providing sloped metal roofing on Water Treatment Building as indicated on the Drawings and as specified herein.
- 1.2 RELATED WORK .1 Metal Fabrications Section 05 50 00
.2 Sealants: Section 07 92 00
- 1.3 REFERENCES .1 ASTM A653/653M-15, Standard Application for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
.2 Canadian Sheet Steel Building Institute (CSSBI).
- 1.4 SAMPLES .1 Submit samples in accordance with Section 01 00 00.
.2 Submit duplicate 300 x 300 mm samples of roofing material, of colour and profile specified.
- 1.5 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 00 00.
.2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, metal furring, and related work.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Prefinished steel roofing: factory-formed, lappable, exposed fastener steel roofing system, nominal core thickness of 28 ga, Z275 galvanized sheet steel conforming to ASTM A653M, prefinished to CSSBI 40.7, Series 8000 finish, profile and color to match existing roof.
.1 Acceptable product: VICWEST, or approved equivalent.
.2 Roof Underlayment:

2.1 MATERIALS
(Cont'd)

- .2 (Cont'd)
 - .1 40 mil thick SBS modified bitumen self adhesive membrane.
 - .1 Acceptable Products: SOPREMA Lastobond Shield, Blueskin PE 200HT or approved equivalent.
 - .2 Primer: composed of SBS synthetic rubbers and adhesive enhancing resins.
 - .1 Acceptable product: SOPREMA Elastocol Stick, Blueskin adhesive or approved equivalent.
 - .3 Joint Sealing: solvent-based mastic containing SBS modified bitumen, fibres and mineral fillers.
 - .1 Acceptable product: SOPREMA Sopramastic, Bakor 570-05 Polybitume Sealant or approved equivalent.
 - .3 Prefinished sheet metal flashings, ridge vents, foam and metal closures, and trim: factory precoated sheet steel of same material, thickness and finish as exterior roofing.
 - .4 Sealants: in accordance with Section 07 92 00, colour selected by the Consultant.
 - .5 Snow guard: 6061-T6 aluminum extrusions, mechanically attached with clamps, colour to match steel roofing.
 - .1 Acceptable product: S-5 ColorGard by Metal Roof Innovations Ltd., or approved equivalent.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Protect metal surfaces in contact with concrete, mortar, or other cementitious surface with isolation coating.
- .2 Have waterproofing membrane/flashings in place prior to installing curved/sloped metal roofing.
- .3 Touch up roofing and flashings with matching paint at abrasions of screw fasteners.

3.2 INSTALLATION -
ROOFING

- .1 Install roofing over support system in accordance with manufacturer's instructions.
- .2 Install exterior corners, fillers and closures with individually formed and profiled work.

3.2 INSTALLATION -
ROOFING
(Cont'd)

- .3 Maintain joints true to line, tight fitting.
- .4 Seal in accordance with Section 07 92 00.

3.3 INSTALLATION -
FLASHINGS

- .1 Install prefinished flashings in accordance with applicable CRCA FL Series specifications.
- .2 Install flashing to form weathertight junction.
Caulk flashings in accordance with Section 07 92 00.

PART 1 - GENERAL

<u>1.1 RELATED WORK</u>	.1 Rough Carpentry: Section 06 10 00 .2 Sealants: Section 07 92 00
<u>1.2 REFERENCES</u>	.1 ASTM D523-2014 Test Method for Specular Gloss. .2 CAN/CGSB-51.32-M77 Sheathing, Membrane, Breather Type. .3 CAN/CGSB-93.1-M85 Sheet, Aluminum Alloy, Prefinished, Residential. .4 Aluminum Association Aluminum Sheet Metal Work in Building Construction. .5 Canadian Roofing Contractors Association (CRCA) Manual.
<u>1.3 SUBMITTALS</u>	.1 Submit duplicate 50 mm x 50 mm samples of each type of sheet metal material, colour and finish. .2 Submit shop drawings in accordance with Section 01 00 00.

PART 2 - PRODUCTS

<u>2.1 PREFINISHED STEEL SHEET FLASHING</u>	.1 Prefinished steel, with factory applied silicone modified polyester. .1 Class F1S. .2 Colour to match existing building. .3 Specular gloss: 30 units +/- 5 in accordance with ASTM D523. .4 Thickness - 0.76 mm (22 gauge).
<u>2.2 ALUMINUM SHEET</u>	.1 Base sheet: proprietary utility sheet, plain, 0.60 mm (24 gauge) minimum thickness. .2 Finish: factory applied coating to CAN/CGSB-93.1 supplemented and amended as follows: .1 Type 1 - postforming sheet.

2.2 ALUMINUM SHEET
(Cont'd)

- .2 (Cont'd)
- .2 Class F1S - finish coated one side.
- .3 Colour of coating: to be commercially uniform and match the colour of the existing building.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Underlay for metal flashing: dry sheathing to CAN/CGSB-51.32.
- .3 Sealants: as per Section 07 92 00.
- .4 Cleats: of same material as flashing specified, and temper as sheet metal, minimum 50 mm wide. Thickness 0.76 mm (22 gauge).
- .5 Fasteners: of same material as sheet metal, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .6 Washers: of same material as sheet metal, with rubber packings.

2.4 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with Aluminum Association Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm. Miter and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL CAP
FLASHINGS

- .1 Form flashings, copings and fascias to profiles of prefinished steel.
- .2 Form flashings in accordance with CRCA FL series details. Provide slotted fixing holes and steel/plastic washer fasteners. Cover face and ends with plastic tape.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details, Aluminum Sheet Metal Work in Building Construction.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .7 Insert metal flashing into reglets under cap flashing to form weathertight junction.
- .8 Caulk flashing at reglet cap flashing with sealant.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements for supplying and applying firestopping and smoke seal material as required for wall/floor/ceilings in areas/rooms which are fire-rated, as noted in the Room Finish Schedule.
- 1.2 RELATED WORK .1 Firestopping and smoke seals within electrical assemblies (i.e. inside conduits) are specified in Division 26.
- 1.3 REFERENCES .1 ASTM E2174-2014B, Standard Practice for On-site Inspection of Installed Fire Stops.
.2 ULC S115-2011, Method of Fire Tests of Firestop Systems.
.3 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
.4 National Building Code, 2010.
- 1.4 SAMPLES .1 Submit samples in accordance with Section 01 00 00.
.2 Submit duplicate 300 x 300 mm samples showing actual firestop material proposed for project.
- 1.5 SUBMITTALS .1 Submit shop drawings and product and safety data in accordance with Section 01 00 00.
.2 Submit shop drawings to show proposed material, including composition and limitations, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
.3 Provide manufacturer's engineering judgments identification number and drawing details when no ULC or UL system are available for an application. Engineered judgments must include both project name and contractor's name who will install firestop system as described in drawing.

<u>1.5 SUBMITTALS</u> <u>(Cont'd)</u>	.4 Submit material safety data sheets provided with product delivered to job site.

PART 2 - PRODUCTS

<u>2.1 MATERIALS</u>	.1 Firestopping and smoke seal systems: in accordance with ULC-S115. .1 Asbestos-free materials and systems capable of maintaining an effective barrier in compliance with requirements of ULC-S115 and not to exceed opening sizes for which they are intended. .2 Firestop system rating: F. .2 Service penetration assemblies: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No. 40 U19. .3 Service penetration firestop components: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC. .4 Fire-resistance rating of installed firestopping assembly in accordance with NBC. .5 Firestopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal. .6 Firestopping 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 Acceptable manufacturers:

<u>2.1 MATERIALS</u> <u>(Cont'd)</u>	.11 (Cont'd) .1 Hilti Canada Corporation .2 3M .3 A/D Fire Protection Systems

PART 3 - EXECUTION

<u>3.1 PREPARATION</u>	.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Confirm substrates and surfaces are clean, dry and frost free. .2 Prepare surfaces in contact with firestopping 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.
<u>3.2 COORDINATION</u>	.1 Coordinate location and proper selection of cast-in-place firestop devices with trade responsible for the work. Install device before placement of concrete. .2 Provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interference.
<u>3.3 INSTALLATION</u>	.1 Install firestopping material and components in accordance with ULC certification and manufacturer's instructions. .2 Install firestopping and smoke seal material and components at all walls, floors and ceilings in fire rated rooms as noted on Room Finish Schedule on Drawings and also for all floor to floor penetrations. .3 Install firestopping and smoke seal on both sides of wall or slab where penetration or opening exists in fire rated rooms.

3.3 INSTALLATION
(Cont'd)

- .4 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.
- .5 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .6 Tool or trowel exposed surfaces to a neat finish.
- .7 Remove excess compound promptly as work progresses and upon completion.

3.4 INSPECTION

- .1 Notify the Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.5 SCHEDULE

- .1 Firestop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, and concrete partitions and walls.
 - .2 Top of fire-resistance rated masonry and gypsum board partitions.
 - .3 Intersection of fire-resistance rated masonry partitions.
 - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
 - .6 Openings and sleeves installed for future use through fire separations.
 - .7 Around mechanical and electrical assemblies penetrating fire separations.
 - .8 Rigid ducts (greater than 129 cm²): fire stopping to consist of bead of firestopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.6 FIELD QUALITY
CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Perform inspection of through-penetration firestopping in accordance with ASTM E2174.

3.6 FIELD QUALITY
CONTROL
(Cont'd)

- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .5 Install a warning card that is clearly visible adjacent to all large and medium openings that may be re-penetrated. This card should contain the following information:
 - .1 Warning that the opening has been firestop protected.
 - .2 Indicate the firestop system used (ULC).
 - .3 F rating or FT rating.
 - .4 Firestop product(s) used.
 - .5 Person to contact and phone number in case of modification or new penetration of firestop system.

3.7 CLEAN UP

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application.
- .2 Remove temporary dams after initial set of firestopping and smoke seal materials.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This Section specifies requirements for supplying, and applying sealants as indicated.
<u>1.2 RELATED WORK</u>	.1	Cast-in-place Concrete: Section 03 30 00
	.2	Hollow Metal Doors and Frames: Section 08 11 14
<u>1.3 REFERENCES</u>	.1	ASTM C920-2014, Specification for Elastomeric Joint Sealants.
	.2	CAN/CGSB-19.13-M87 Sealing Compound, One Component, Elastomeric, Chemical Curing.
	.3	CAN/CGSB-19.24-M90 Multi-component, Chemical Curing Sealing Compound.
<u>1.4 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver and store materials in original wrappings and containers with manufacturer's seals and labels intact. Protect from freezing, moisture and water.
<u>1.5 ENVIRONMENTAL AND SAFETY REQUIREMENTS</u>	.1	Sealant and substrate materials to be minimum 5°C.
	.2	Should it become necessary to apply sealants below 5°C, consult sealant manufacturer and follow their recommendations.
	.3	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 material safety data sheets acceptable to Labour Canada.
	.4	Conform to manufacturer's recommended temperatures, relative humidity and substrate moisture content for application and curing of sealants including special conditions governing use.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Primers: type recommended by sealant manufacturer.
- .2 Joint fillers:
 - .1 General: compatible with primers and sealants, outsized 30 to 50%.
 - .2 Polyethylene, urethane, neoprene or vinyl: extruded closed cell foam, Shore A hardness 20.
- .3 Bond breaker: pressure sensitive plastic tape, which will not bond to sealants.
- .4 Sealants:
 - .1 Interior and exterior caulking around perimeter of pressed steel frames and to base of frames to flooring: to CAN/CGSB-19.13, one-component, moisture curing, modified polyurethane, paintable, normal temperature range dry conditions, movement range to 10%.
 - .1 Acceptable product: DyMonic by Tremco Limited, or approved equivalent.
 - .2 Interior control and expansion joints: to CAN/CGSB-19.24 multi-component sealant, self levelling, for joint movement up to 25%.
 - .1 Acceptable product: Duoflex SL by Sternson Division of Sika Canada Inc., THC-900 for horizontal joints and THC-901 for vertical joints by Tremco Limited, or approved equivalent.
 - .3 Interior locations including: at corner joints where masonry walls butt into continuous walls, at masonry walls and concrete floor slabs, and at equipment pads to floor slabs, except where another sealant is specified: to CGSB 19.13.
 - .1 Acceptable product: DyMonic by Tremco Limited, or approved equivalent.
 - .4 Mildew resistant silicone sealant for use around sinks and washroom fixtures:
 - .1 Acceptable product: Tremsil 200 with mildew resistant properties by Tremco or approved equivalent.
- .5 Joint cleaner: xylol, methylethyleketon or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Remove by brushing, scrubbing, scraping or grinding loose mortar, dust, oil, grease, oxidation, mill scale, coatings and all other materials affecting bond of compounds from surfaces to which sealant compounds must adhere, except for painted surfaces.
- .3 Clean down caulked metal surfaces with clean cellulose sponges or rags soaked in solvent recommended by sealant manufacturer, and wipe dry with clean cloths. Confirm solvent is not injurious to painted surfaces.
- .4 Confirm releasing agents, coatings or other treatments have either not been applied to joint surfaces, or that they are entirely removed.
- .5 Confirm joint surfaces are dry and frost free.

3.2 APPLICATION

- .1 Apply sealant products where indicated on the drawings and as outlined in Clause 2.1 of this Section.
- .2 Where necessary to prevent staining, mask adjacent surfaces before priming and caulking.
- .3 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.
- .4 Apply sealants, primers, joint fillers, and bond breaker if required, to manufacturer's instructions. Apply sealant using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
- .5 Form surfaces of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.

3.3 CURING

- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealant until proper curing has taken place.

3.4 CLEANING

- .1 Clean adjacent surfaces immediately and leave work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.
- .4 Do not use chemicals, scrapers, or other tools which would damage surfaces of caulked materials when excess compounds or droppings are removed. Repair work damaged by cleaning.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This Section specifies requirements for supplying and installing interior and exterior hollow metal doors, frames, and hardware as indicated.
- 1.2 RELATED WORK .1 Caulking of joints between frames and other building components: Section 07 92 00
- .2 Painting: Section 09 91 23
- 1.3 REFERENCES .1 Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA).
- .1 CSDFMA, Specifications for Commercial Steel Doors and Frames.
- .2 CSDFMA, Recommended Selection and Usage Guide for Commercial Steel Doors.
- .3 CSDFMA, Recommended Locations for Hardware for Steel Doors and Frames.
- .2 National Fire Protection Association (NFPA):
- .1 NFPA 80-2016, Fire Doors and Windows.
- .2 NFPA 252-2012, Methods of Fire Test of Door Assemblies.
- .3 ASTM A653/A653M-2015, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-dip Process.
- .4 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .5 CSA G40.21-2013, Structural Quality Steel.
- .6 ULC S104-2010, Fire Test of Door Assemblies.
- 1.4 SHOP DRAWINGS .1 Submit shop drawings and hardware schedule in accordance with Section 01 00 00 using D.H.I. (Door and Hardware Institute) formats.
- .2 Indicate type of door and frame, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, finishes and fire ratings.

1.4 SHOP DRAWINGS
(Cont'd)

- .3 Indicate proposed hardware including make, model, material, function, finish and all other pertinent information.

1.5 PRODUCT
DELIVERY, STORAGE
AND HANDLING

- .1 Brace frame units to prevent distortion in shipment and protect finished surfaces by sturdy protective wrapping.
- .2 Store doors and finishing hardware in a secure, dry location. Remove wrappings when finally stored in location, secure from damage. Store doors vertically with blocking between to allow air to circulate.
- .3 Repair damage to finishes immediately after it occurs to prevent rusting. Use primer for painted surfaces and zinc primer for galvanized surfaces.
- .4 Package each item of hardware separately or in like groups of hardware, label each package as to item definition and location.
- .5 Maintain inventory list with hardware schedule.

1.6 REQUIREMENTS OF
REGULATORY AGENCIES

- .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with ULC S104M and NFPA 252 for ratings specified or indicated.

PART 2 - PRODUCTS

2.1 DOOR MATERIAL

- .1 Sheet steel: 1.2 mm base thickness, commercial grade steel to ASTM A653, hot dipped galvanized, coating designation Z275 for exterior doors.
- .2 Door Core:
 - .1 Exterior hollow steel: vertically stiffened with steel ribs and all voids filled with semi-rigid fibrous insulation minimum density 1.5 pcf.
 - .2 Interior honeycomb: structural core consisting of Kraft paper having 24.5mm cell size to thickness indicated.
- .3 Exterior doors to have caps at top of door.

2.2 FRAME MATERIAL

- .1 Sheet steel: commercial grade steel to ASTM A653, hot dipped galvanized, coating designation Z275 for exterior frames.
 - .1 Frames: 1.6 mm base steel thickness.
 - .2 Floor anchors, channel spreaders and wall anchors: minimum 1.6 mm base steel thickness.
 - .3 Guard boxes: minimum 0.8 mm base steel thickness.
 - .4 Hinge reinforcements: minimum 2.6 mm base steel thickness.
- .2 Top and bottom reinforcing channels: to CSA G40.21-M, type 300W.
- .3 Door bumpers: black neoprene single stud, three for each single door, and two for each double door.
- .4 Frames for exterior doors to be thermally broken and must accommodate expansion and contraction with surface temperature range of -34 deg.C to 76 deg.C. Deflection must not exceed 1/175th of span under wind loads for building locality in accordance with the National Building Code, 2010. Pack frames with fibreglass insulation and/or polyurethane insulation.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4 PRIMER

- .1 Touch up primer for doors and frames to CAN/CGSB-1.181.

2.5 DOOR AND FRAME
FABRICATION

- .1 The following fabricators are approved to perform work of this section: S.W. Fleming & Co. Ltd., Daybar, Apex Doors and Frames.
- .2 Steel doors to be 45 mm thick unless otherwise indicated.
- .3 Interior frames to be 145 mm butt-mounted; exterior frames to be thermally broken, 146 mm butt mounted; unless otherwise noted on the drawings.

2.5 DOOR AND FRAME
FABRICATION
(Cont'd)

- .4 Fabricate steel doors and frames as detailed, in accordance with Steel Door and Frame Manufacturers' Association, "Canadian Manufacturing Specifications for Steel Doors and Frames".
- .5 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided by finish hardware supplier.
- .6 Shop prime cold rolled steel sheet.
- .7 Touch up doors and frames at factory with primer where galvanized finish damaged during fabrication.
- .8 Cut mitres and joints of frames accurately and weld continuously on inside of frame profile.
- .9 Grind welded corners and joints of frames to flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .10 Prepare doors and frames for installation of hardware. Provide all steel reinforcements. Drill and tap to template information.
- .11 Reinforce all doors and frames for door closers whether closers are scheduled or not.
- .12 Install three (3) door bumpers on strike jamb for each single door at head for double doors.
- .13 Reinforce heads of frames wider than 1200 mm.
- .14 Provide floor anchors, adjustable tee anchors, and steel anchors in accordance with Canadian Steel Door and Frame Manufacturers Association. Weld floor anchors to frame.
- .15 Close tops and bottoms of doors with recessed spot welded channel and closures. Mechanically interlock longitudinal edges.
- .16 Install galvanized steel top caps for all exterior doors.
- .17 Construct thermally broken frames using steel core, separating exterior portion of frame from interior portion with polyvinyl chloride thermal break.
- .18 Insulate exterior frame components with polyurethane insulation.

2.6 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.

2.7 HARDWARE
MATERIAL

- .1 See Section 08 71 10 for hardware product specifications.

PART 3 - EXECUTION

3.1 DOOR
INSTALLATION

- .1 Install doors in accordance with manufacturer's instructions.
- .2 Fit doors with 6 mm clearance at jambs and head of frame, and 10 mm clearance over threshold.

3.2 HARDWARE
INSTALLATION

- .1 Install hardware in accordance with Section 08 71 10.

3.3 ADJUSTMENT

- .1 Adjust hinged doors to swing freely and easily, to remain stationary at any point of swing, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.

3.4 DOOR & HARDWARE
SCHEDULE

- .1 Door: sizes and materials as shown on Drawings.
- .2 Hardware: as shown on Drawings.

3.5 FINISH REPAIRS

- .1 Touch up finishes damaged during installation.

3.5 FINISH REPAIRS
(Cont'd)

- .2 Fill exposed frame anchors, and surfaces with imperfections, marks/scratches/dents, etc with metallic paste filler and sand to a uniform smooth finish. Prime areas affected.
- .3 Finish paint doors and frames as specified in section 09 91 23.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Section 05 50 00 - Metal Fabrications.
- .2 Section 09 91 13 - Exterior Painting.
- .3 Section 08 80 50 - Glazing.

1.2 REFERENCES

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 ASTM International
 - .1 ASTM A123-15, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A1008/A1008M-16, 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 ASTM D523-14, Standard Test Method for Specular Gloss.
 - .4 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.105-M91, Quick-Drying Primer.
 - .2 CAN/CGSB-1.213-04, Etch Primer (Pretreatment Coating or Tie Coat) for Steel and Aluminum.
 - .3 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coatings.
- .4 Underwriters Laboratories (UL)
 - .1 UL 2760-2011, Standard for Sustainability for Surface Coatings: Recycled Water-borne
 - .2 UL 2761-2011, Standard for Sustainability for Sealants and Caulking Compounds

1.3 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 00 - Submittal Procedures.

1.3 ACTION AND
INFORMATIONAL
SUBMITTALS
(Cont'd)

- .2 Indicate sizes, service rating, types, materials, operating mechanisms, glazing locations and details, hardware and accessories, required clearances and electrical connections.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .5 Manufacturers Reports:
 - .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

1.4 CLOSEOUT
SUBMITTALS

- .1 Submit in accordance with Section 01 00 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for sectional metal doors for incorporation into manual.

1.5 MAINTENANCE
MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 00 00 - Closeout Submittals.
- .2 Spare parts:
 - .1 Supply spare parts for sectional metal doors as follows:
 - .1 Door panels: 4.
 - .2 Door rollers: 8.
 - .3 Weatherstripping: 1 set.
 - .2 Store where directed. Identify each part and reference to appropriate door.

1.6 QUALITY
ASSURANCE

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 DELIVERY,
STORAGE AND
HANDLING

- .1 Deliver, store and handle materials in accordance with the 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 sectional metal doors, hardware and accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.8 WARRANTY

- .1 For sectional metal doors the warranty period is extended from the date of Substantial Performance as follows:
 - .1 Provide manufacturer's standard five (5) year warranty against separation or delamination of the polyurethane foam from the skin of the panel.
 - .2 Standard manufacturer's ten (10) year warranty against cracking, splitting, or deterioration of the finish.
 - .3 Provide a written warranty, signed and issued in the name of owner, on materials and workmanship.
 - .4 Warranty includes that all door and insulation to be free from defects in material, workmanship and operation.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- .1 Design exterior door assembly to withstand wind load of 2.2 kPa with a maximum horizontal deflection of 1/240 of opening width.
- .2 Design door panel assemblies with thermal insulation factor of RSI 3.15.
- .3 Design door assembly to withstand minimum 5 000 cycles per annum, and 20 years total life cycle.

2.2 OPERATION

- .1 Operation Sequence - Entrance Doors:

2.2 OPERATION
(Cont'd)

- .1 (Cont'd)
 - .1 Vehicle approaches door.
 - .2 Exterior detection loop signals door operator to open door when vehicles pass over loop.
 - .3 Door operator opens door and holds it in open position for a preset time ("timer-to-close"). Timer-to-close is user-programmable.
 - .4 When timer-to-close time has elapsed, and if entrapment protection photo sensors are not signalling an obstruction, door operator closes door.
 - .5 If entrapment protection devices are triggered while door is closing, the operator will reverse and return door to open position.
 - .6 Doors also operated by wall-mounted pushbutton controller.
- .2 Operation Sequence - Exit Doors:
 - .1 Vehicle operator uses radio remote control to signal door operator to open door.
 - .2 Door operator opens door and holds it in open position for a preset time ("timer-to-close"). Timer-to-close is user-programmable.
 - .3 When timer-to-close time has elapsed, and if entrapment protection photo sensors are not signalling an obstruction, door operator closes door.
 - .4 If entrapment protection devices are triggered while door is closing, the operator will reverse and return door to open position.
 - .5 Doors also operated by wall-mounted pushbutton controller.

2.3 MATERIALS

- .1 Galvanized steel sheet: to ASTM A123, commercial quality Z275 zinc coating.
- .2 Aluminum sheet: mill finish plain utility sheet.
- .3 Anodized aluminum sheet: plain anodizing quality aluminum sheet.
- .4 Aluminum extrusions: Aluminum Association alloy AA 6063-T5.
- .5 Insulation: to meet design requirements and to CCD-016.
- .6 Glazing: double glazed insulating units Type G6, by Section 08 80 50.
- .7 Cable: multi-strand galvanized steel aircraft cable.

2.4 DOORS

- .1 Fabricate 50 mm thick insulated flush doors of interlocking roll formed aluminum sections. Sections to be aluminum/polyurethane/aluminum sandwich-type construction with integral thermal break.
- .2 Interior and exterior skins: 1.3 mm aluminum, anodized or shop-painted finish as selected by the Consultant.
- .3 Seal and reinforce ends of sections with 2 mm thick galvanized steel end caps.
- .4 Reinforcement: provide galvanized steel backup plates at all hardware attachment points.
- .5 Oblong widnows: insulating glazing units in high-impact 2-piece polycarbonate frames with round corners, as indicated.

2.5 HEAVY DUTY
INDUSTRIAL HARDWARE

- .1 Track: standard lift, high lift, and partial high lift hardware, as indicated, with 75 mm size, 2.75 mm core thickness, galvanized steel track.
- .2 Track Supports: 2.75 mm core thickness continuous galvanized steel angle track supports.
- .3 Spring counter balance: heavy duty oil tempered torsion spring with manufacturers standard brackets.
 - .1 Drum: 200 mm diameter die cast aluminum.
 - .2 Shaft: 32 mm diameter solid steel.
- .4 Weighted counterbalance system: if required to meet 5,000 cycles per annum, and 20 years total life cycle for door assembly, provide weighted counterbalance system.
 - .1 Counterweight: comprised of modular weights to permit manual disassembly and re-assembly during maintenance, cast iron or steel, suspended from chain or cable with spring damper to prevent jarring.
 - .2 Enclosure: provide 6 mm painted steel enclosure for counterweight mechanism to height of maximum rise of counterweight, enclosure to be removable for inspection or repair.
- .5 Top roller carrier: galvanized Steel 3.04 mm thick adjustable.
- .6 Rollers: full floating grease packed hardened steel, ball bearing 75 mm diameter solid steel tire.

2.5 HEAVY DUTY
INDUSTRIAL HARDWARE
(Cont'd)

- .7 Roller brackets: double roller brackets, adjustable, minimum 2.75 mm galvanized steel.
- .8 Hinges: heavy duty, 3.04 mm thick galvanized.
- .9 Cable: 6 mm diameter galvanized steel aircraft cable.

2.6 ACCESSORIES

- .1 Overhead horizontal track and operator supports: 51mm x 51mm x 3.2mm structural steel angle, to suit installation, shop primed.
- .2 Track guards: 5 mm thick formed sheet 1,500 mm high track guards.
- .3 Pusher springs.
- .4 Handles:
 - .1 Flat bar door latch with night latch and electric interlock switch.
- .5 Two horizontal sliding lock bolts on interior.
- .6 Weatherstripping:
 - .1 Sills: double contact bulb type full width extruded polychloroprene ("neoprene") weatherstrip. Colour: yellow.
 - .2 Jambs and head: extruded aluminum and arctic grade vinyl weatherstrip to manufacturer's standard.
 - .3 Between door sections: factory-applied co-polymer joint seal.
- .7 Finish ferrous hardware items with minimum zinc coating of 300 g/m² to ASTM A123.
- .8 Concealed steel items:
 - .1 Apply one (1) coat of bituminous paint to concealed steel surfaces in contact with aluminum, cementitious, or dissimilar materials.

2.7 ALUMINUM
FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.
 - .1 As fabricated anodized finish: designation AA-M10C20A41.

2.8 ELECTRICAL
OPERATOR - ENTRANCE
DOORS

- .1 Electrical jack shaft type operator, side mounted.
 - .2 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval with CSA enclosure type
 - .3 Power supply: 574 V, 3 phase, 60 Hz.
 - .1 Motor: 1 Horsepower.
 - .4 Controller units with integral motor reversing starter, electric solenoid-actuated brake capable of stopping and holding a door at any position, three (3) heater elements for overload protection, including pushbuttons and control relays as applicable.
 - .5 Operation:
 - .1 Remote pushbutton stations: surface mounted, on vertical surface with "OPEN-STOP-CLOSE" designations on pushbuttons in English and French: one (1) per door.
 - .2 Loop detector: pre-formed, flexible, pave-over style vehicle sensing loop: 1 per door.
 - .6 Primary Entrapment Protection Safety Devices:
 - .1 Safety switch limit switches for full length of bottom rail of bottom section of door, to reverse to open position when coming in contact with object on closing cycle.
 - .2 Non-contact, infrared beam photo sensor system with NEMA 4 watertight enclosure, shall, in conjunction with the operator, return a closing door to the full open position when an obstruction is sensed. Photo sensors mounted at 150 mm and 1 500 mm above finished floor.
 - .7 For jack shaft operators:
 - .1 Provide floor level disconnect device to allow for manual operation in event of power failure.
 - .2 Equip Operator with:
 - .1 Electrical interlock switch to disconnect power to operator when in manual operation.
 - .2 Built-in chain hoist for manual operation in event of power failure.
 - .8 Door speed: 300 mm per second.
 - .9 Control transformer: for 24 VAC control voltage.
 - .10 Mounting brackets: for mounting of operator to mounting plate: galvanized steel, size and gauge to suit conditions.
-

- .1 Electrical jack shaft type operator, side mounted.
- .2 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval with CSA enclosure type 3R per CSA C22.1HB-09.
- .3 Power supply: 574 V, 3 phase, 60 Hz.
 - .1 Motor: 1 Horsepower.
- .4 Controller units with integral motor reversing starter, electric solenoid-actuated brake capable of stopping and holding a door at any position, 3 heater elements for overload protection, including pushbuttons and control relays as applicable.
- .5 Operation:
 - .1 Remote pushbutton stations: surface mounted, on vertical surface with "OPEN-STOP-CLOSE" designations on pushbuttons in English and French: 1 per door.
 - .2 Loop detector: pre-formed, flexible, pave-over style vehicle sensing loop: 1 per door
 - .3 Remote control: 3-button remote control, includes OPEN, CLOSE, and STOP functions: 12 per door.
- .6 Primary Entrapment Protection Safety Devices:
 - .1 Safety switch limit switches for full length of bottom rail of bottom section of door, to reverse to open position when coming in contact with object on closing cycle.
 - .2 Non-contact, infrared beam photo sensor system with NEMA 4 watertight enclosure, shall, in conjunction with the operator, return a closing door to the full open position when an obstruction is sensed. Photo sensors mounted at 150 mm and 1 500 mm above finished floor.
- .7 For jack shaft operators:
 - .1 Provide floor level disconnect device to allow for manual operation in event of power failure.
 - .2 Equip Operator with:
 - .1 Electrical interlock switch to disconnect power to operator when in manual operation.

2.9 ELECTRICAL
OPERATOR - EXIT
DOORS
(Cont'd)

- .7 (Cont'd)
- .2 (Cont'd)
- .2 Built-in chain hoist for manual operation in event of power failure.
- .8 Door speed: 300 mm per second.
- .9 Control transformer: for 24 VAC control voltage.
- .10 Mounting brackets: for mounting of operator to mounting plate: galvanized steel, size and gauge to suit conditions.
- .11 Mounting plate: 6 mm thick steel plate, dimensions to suit door operator, shop primed.

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 metal doors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform the 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 the Consultant.

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 secure to supporting structure.
- .4 Rigidly support operator mounting plate and secure to supporting structure.

3.2 INSTALLATION
(Cont'd)

- .5 Touch-up steel components with primer where galvanized finish damaged during fabrication or installation.
- .6 Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.
- .7 Install vehicle detection loops in existing asphalt services by saw cutting. Fill saw cuts with grout after installing loops.
- .8 Lubricate and adjust door operating components to ensure smooth opening and closing of doors.
- .9 Adjust weatherstripping to form a weather tight seal.
- .10 Adjust doors for smooth operation.

3.3 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 within three (3) days of review.
 - .2 Submit 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 Ensure manufacturer's representative is present before and during critical periods of installation and testing.
 - .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends 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.

3.4 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

- 3.4 CLEANING
(Cont'd)
- .2 (Cont'd)
- .1 Remove traces of primer; clean doors and frames.
- .2 Clean glass and glazing materials with approved non-abrasive cleaner.
- 3.5 PROTECTION
- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by sectional metal door installation.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This Section specifies requirements for supplying, transporting and installing aluminum fixed and operable double/double hung type exterior windows, complete with glazing and caulking.
<u>1.2 RELATED WORK</u>	.1	Masonry: Section 04 20 00
	.2	Insulation: Section 07 21 00
	.3	Sealants: Section 07 92 00
<u>1.3 REFERENCE</u>	.1	CAN/CSA-A440-11, North American Fenestration Standard/Specification for Windows, Doors and Skylights.
	.2	CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
	.3	CAN/CGSB-12.8-M97 "AMEND", Insulating Glass Units.
	.4	CAN/CGSB-79.1-M91, Insect Screens.
<u>1.4 SHOP DRAWINGS</u>	.1	Submit shop drawings in accordance with Section 01 00 00.
	.2	Clearly indicate materials and large scale details for head, jamb and sill, profiles of components, elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes and fasteners.
<u>1.5 MAINTENANCE DATA</u>	.1	Provide maintenance data for cleaning and maintenance of aluminum windows for incorporation into maintenance manual specified in Section 01 00 00.
<u>1.6 PRODUCT DELIVERY, STORAGE AND HANDLING</u>	.1	Package or crate units for shipment and storage before installation.

1.6 PRODUCT
DELIVERY, STORAGE
AND HANDLING
(Cont'd)

- .2 Provide methods for lifting or hoisting units into place without causing damage.
- .3 Protect prefinished surfaces of metal work with protective coating or wrappings to remain in place until construction completion. Use materials recommended by finishers or manufacturers of metals to ensure that method is sufficiently protective, easily removed and harmless to finish.
- .4 Remove all protective coatings and wrappings upon completion of work.

PART 2 - PRODUCT

2.1 WINDOWS

- .1 Units: thermally broken unit to CAN/CSA-A440, Classification A3, B7, C5, I53 constructed of minimum extruded aluminum alloy 6063-T5, minimum 1.6 mm thick. Rigid insulation strips to be installed in frame voids and caulked-in-place.
- .2 Type: Fixed units with 152 deep frames complete with insulating glass.
 - .1 Acceptable products: Alumicor Shadowline 970 Series, 152 mm deep, Fulton 5100 Series, Anotec 80 Series, Kawneer 518 Series, or approved equivalent.
- .3 Type: double/double hung units with 152 deep frames with high performance drainage sill and flyscreens mounted between the glazing sashes. Acceptable products: Alumicor 260 Series, Fulton 5100 Series Style "A", Anotec 170 Series, or approved equivalent.
- .4 Provide all windows from the same manufacturer.

2.2 MATERIALS

- .1 Extruded aluminum: Aluminum Association alloy AA6063-T5, minimum 1.6 mm wall thickness. Exposed surfaces of aluminum shall be free of die marks, blisters, "leave-off" marks, or other blemishes. Rigid insulation strips to be installed in frame voids and caulked-in-place.
- .2 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes, finish and colour to match the existing building.

2.2 MATERIALS
(Cont'd)

- .3 Sealants: in accordance with Section 07 92 00, colour to match window frames.
- .4 Isolation coating: alkali resistant bituminous paint.
- .5 Glazing to Section 08 80 50.
- .6 Wood blocking, furring, etc: S2S; standard or better grade, pressure preservative treated.
- .7 Fasteners: corrosion resistant stainless steel.
- .8 Flyscreens meeting CAN/CGSB-79.1 and CAN/CSA-A440, rating heavy duty having extruded aluminum frame and screen cloth of 18 x 14 fiberglass mesh. Flyscreens mounted between exterior and interior glazing sashes for double/double hung units and removable from interior of building.

2.3 FABRICATION

- .1 Window Members:
 - .1 Fabricate generally to dimensions and profiles indicated on Drawings and to meet specified requirements. Maintain sight lines indicated and clearances to other construction components.
- .2 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.
- .3 Thermal Movement: fabricate window units and assemblies to provide for expansion and contraction of component members and between window units when subjected to surface temperatures from -24 deg.C to 82 deg.C.
- .4 Air Vapour Retarder: caulking with backer rod, to provide the air/vapour barrier seal on interior side and similarly on exterior side for weather sealing to building.
- .5 Dissimilar Materials:
 - .1 Protect material from electrolytic action when dissimilar metals are in contact with one another.
 - .2 Protect aluminum concealed in contact with masonry with a heavy coating of bituminous paint. Where exposed to view, use lacquer.

2.3 FABRICATION
(Cont'd)

- .6 Anchors: incorporate anchorage to structure for window units at sills, heads and jambs to suit masonry coursing, and to support window adequately when subjected to specified loads.
- .7 Sills and interior trim:
 - .1 Fabricate sills and interior trim of extruded aluminum as indicated on Drawings and finish as specified for frames.
 - .2 Include cover plates at joints between lengths and jamb deflectors.
 - .3 Fabricate sills and interior trim in continuous length from corner to corner.
 - .4 Incorporate concealed anchorage of sills, and means for adjustment of level and position during installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 General:
 - .1 Install windows plumb, level and in accordance with shop drawings, and fabricator's instructions.
 - .2 Do not force window units into place, nor superimpose on them loads for which they were not designed.
 - .3 Provide for thermal movement to take place between window and adjacent construction.
 - .4 Secure windows by non-corrosive and inorganic anchorage materials.
 - .5 Conceal anchors, clips, blocking, and all other attachments.
 - .6 Install reinforcing and supporting members as specified or indicated as part of the Work of this Section.
 - .7 Seal metal-to-metal joints between components included in the Work of this Section to ensure a weathertight assembly, and in accordance with sealant manufacturer's specifications.
 - .8 Fill voids between frames and rough openings, with spray applied polyurethane insulation each side after filling voids with batt insulation as specified in Section 07 21 00.
 - .9 Support metal sills throughout their length, bed in place and level.
- .2 Caulking:
 - .1 Caulk between window unit and adjacent construction at openings (each face), as a part of the Work of this Section and in accordance with Section 07 92 00.

3.2 ADJUSTMENT AND
CLEANING

- .1 Cleaning on completion of installation:
.1 Remove deposits which affect appearance or operation of window units.
.2 Clean interior and exterior surfaces by washing with clear water; or with water, and soap or detergent; followed by a clear water rinse.
.3 Clean and restore stained metal surfaces in accordance with manufacturer's recommendations. Replace if cleaning is impossible.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1 This Section specifies requirements for supplying and installing finish hardware in the locations indicated in the hardware schedule and as specified herein.
<u>1.2 RELATED WORK</u>	.1 Hollow Metal Doors and Frames: Section 08 11 14. .2 Rough Carpentry: Section 06 10 00.
<u>1.3 REFERENCE STANDARDS</u>	.1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturer's Association. .2 ANSI/BHMA A156.1-2016, Butts and Hinges. .3 ANSI/BHMA A156.2-2011, Bored and Pre-assembled Locks and Latches. .4 ANSI/BHMA A156.4-2013, Door Controls (Closers). .5 ANSI/BHMA A156.5-2014, Auxiliary Locks and Associated Products. .6 ANSI/BHMA A156.7-2016, Template Hinge Dimensions. .7 ANSI/BHMA A156.18-2016, Materials and Finishes.
<u>1.4 REQUIREMENTS OF REGULATORY AGENCIES</u>	.1 Install only ULC/ULI listed hardware for fire rated doors and frames. Provide latching devices and closing devices where necessary. .2 All hardware must comply with all applicable fire, building, life safety, and barrier free codes. .3 Hardware for doors in fire separations exit doors certified by ULC, accredited by Standards Council of Canada.
<u>1.5 SAMPLES</u>	.1 Submit samples in accordance with Section 01 00 00.
-

1.5 SAMPLES
(Cont'd)

- .2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
- .3 After approval samples will be returned for incorporation in the Work.
- .4 Upon award of Contract, check the schedule of hardware and all applicable drawings and specifications and furnish promptly to the applicable trades all templates and information required for proper preparation and application of hardware, in ample time to facilitate the progress of work.
- .5 Submit maintenance, operating, and installation instructions for installation purposes and to incorporate in project data book.

1.6 DELIVERY AND
STORAGE

- .1 Clearly itemize and label each item of hardware in accordance with the schedule and deliver in the original manufacturer's containers.
- .2 Arrange delivery time and date, to the job site, of all hardware so that all work may progress without delay or interruptions.
- .3 Store and protect all hardware.

1.7 CERTIFICATION

- .1 Have the Hardware Supplier provide a qualified Architectural Hardware Specialist who will cooperate with the installer and clarify the location and/or installation methods of particular items.
 - .2 Have the Architectural Hardware Specialist make periodic inspections of the hardware installations and report improper or unsatisfactory conditions to the Consultant and expedite the replacement of faulty hardware. Have this Specialist attend job site meetings when so requested.
 - .3 After installation, have a regular member of the Architectural Hardware Consultants (AHC) inspect and certify in writing that all items and their installation are in accordance with specified requirements.
-

1.8 HARDWARE LIST

- .1 Submit contract hardware list in accordance with Door and Hardware Institute vertical format.
- .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .3 Prepare and supply and complete itemized hardware schedule for review. Schedule to list all doors by number (in sequence) and location, with complete details of the hardware supplied, including installation heights and special instructions. Format of schedule to be Door and Hardware Institute (DHI) formula.
- .4 Allow for checking all changes to the work of this Section that may be issued and revise the reviewed hardware schedule accordingly. All revisions to the Hardware Schedule shall be submitted for approval.

1.9 EXAMINATION

- .1 Examine the plans and schedules to determine the dimensions, size and quantity of required hardware items and confirm the hardware listed will fit and operate properly. Report all unsatisfactory conditions before ordering.

PART 2 - PRODUCTS

2.1 HARDWARE ITEMS

- .1 Only door locksets and latchsets listed on CGSB Qualified Products List are acceptable for use on this project.
 - .2 Use a single manufacturer's products for all similar product groups.
 - .3 Furnish warranty for all hardware items for a period of one(1) year from date of acceptance of the installation. Ten (10) year warranty for closers and two (2) year warranty on handicap operators.
 - .4 All hardware applied to metal doors and frames must be made to templates together with instructions necessary for door and frame preparation.
 - .5 Hardware of same materials must have consistent colour and finish throughout project.
-

2.1 HARDWARE ITEMS
(Cont'd)

- .6 Provide a warranty that expressly covers all hardware for a period of one (1) year from date of substantial completion. The warranty must expressly state that all hardware will be replaced on the doors and frames at no cost to the Owner in event of breakage or other defect occurring, willful damage, or defective installation excluded.

2.2 MANUFACTURERS

- .1 Certain manufacturer's catalogue numbers are used in the schedule of Finishing Hardware, but it is not the intent that these items are specified exclusively. The manufacturer's numbers are used to indicate quality, style, design, function, finish, and features.
- .2 Other manufacturers will be considered, providing the items meet or exceed the performance, function, and quality requirements of those specified, and are approved by the Consultant.

2.3 DOOR HARDWARE

- .1 Locks and latches:
.1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2, series 4000 bored lock, grade 1, designed for function and keyed as stated in Hardware Schedule. Thru-bolted mechanism. Concealed mounting screws. ULC listed for 3 hour doors. Backset : 70 mm throughout. Standard of Acceptance: Sargent 8 Line, Orbit as listed in Schedule Finished to C26D, Satin Chromium plated. (Sargent 10 Line used with lever handles also.)
.2 Mortise locks and latches: Series 1000 mortise lock, grade 1, designed for function and keyed as stated in Hardware Schedule. Standard of acceptance: Sargent 8200 Mortise knob lock, Orbit design, C26D finish.
- .2 Butts and Hinges: to ANSI/BHMA A156.1 designated by numeral identifiers, followed by size and finish, listed in Hardware Schedule. Use NRP feature on exterior hinges and for reverse swing locked doors. Use anti-friction bearing as noted.
.1 Hinges: apply hinges to manufacturer's guidelines, supply ball bearing hinges, size as per manufacturer's guidelines. Supply NRP hinges for all locked out-swing doors and non-ferrous hinges in wet or corrosive areas.
.1 Two (2) hinges on doors up to 1500 mm high.

2.3 DOOR HARDWARE
(Cont'd)

- .2 (Cont'd)
 - .1 (Cont'd)
 - .2 Three (3) hinges on doors 1500 mm to 2250 mm high.
 - .3 Four (4) hinges on doors 2250 mm to 3000 mm high.
 - .3 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4, designated by numeral identifiers listed in Hardware Schedule, factory sized, finished to EN. Provide the product of one manufacturer for closer units throughout the Work. Full rack and pinion type cylinder with removable non-ferrous case and cast iron body. Double heat treated pinion shaft, single piece forged piston, chrome-silicon steel spring. Forged steel main arm. Units stamped with date of manufacture. Ten (10) year warranty on all closers.
 - .2 Door controls - overhead holders/stops finished to C26D.
 - .4 Door bottom seal: heavy-duty door seal of extruded aluminum frame and brush seal, clear anodized finish.
 - .5 Thresholds: 108 mm and 127 mm wide x full width of frame opening, extruded aluminum, mill finish, serrated surface, with thermal break of rigid PVC.
 - .6 Weatherstripping:
 - .1 Head and Jamb seal: Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.
 - .7 Bolts: lock inactive leaf of pair of non-egress doors with lever extension flush bolts. Supply automatic flush bolts for fire rated egress doors. Apply to edge of door.
 - .8 Locks: heavy duty cylindrical, function as listed in the Hardware Schedule. Knobs in all areas, except for lever design in assisted handicap areas, finished in C26D.
 - .1 Acceptable products:
 - .1 Sargent 8/10 series, OB/LL trim
 - .2 Schlage D series Orbit/Sparta trim
 - .3 Best 8K/9K series, 4C/14D trim
 - .9 Push/pull trim: where pull is scheduled on one side of the door and push plate on the other side, supply fastening devices and install so pull can be secured through the door from reverse side. Install push plate to cover fasteners finished to C26D.

2.3 DOOR HARDWARE
(Cont'd)

- .10 Closing devices: door closers to be modern type, with covers, rack and pinion with compression spring adjusting, closing speed, latching speed, backcheck, to be controlled by separate valves. Provide all plates, spacers and brackets for proper mount. Factory sized with field adjustability, application as per Hardware Legend, 10 year warranty. Cast iron bodies.
 - .1 Acceptable products: Sargent 350 series/1430 series; LCN 4000 series.
- .11 Kickplates: kickplates to be satin, clear anodized aluminum, 1.3 mm (.050") thick, 305 mm high, and 50 mm less than door width.
- .12 Stops: provide dome, wall or overhead type to stop the door as listed in the Hardware Schedule, finished to C26D.
- .13 Weatherseal: supply aluminum extruded threshold width to the door opening width. Weatherstripping fixed head and jamb. Astragal full height of door. Door bottom full width of door.

2.4 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 materials through which they pass.
- .4 Supply all hardware complete with all necessary screws, bolts or other fastening of suitable size and type to anchor the hardware in position neatly and properly in accordance with the best practices and to the Consultant's approval.
- .5 All fasteners must harmonize with the hardware as to material and finish.

2.5 KEYING

- .1 All exterior locks and cylinders to be keyed alike.
- .2 Provide three (3) keys for each different keyed lock/cylinder.

PART 3 - EXECUTION

3.1 INSTALLATION
INSTRUCTIONS

- .1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .2 Furnish manufacturers' instructions for proper installation of each hardware component.
- .3 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .4 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .5 Install hardware to standard location dimensions in accordance with Canadian Guide for Doors and Frames.
- .6 Only use tradesmen competent in the installation of Finishing Hardware for this project.
- .7 Accurately locate and adjust hardware to meet manufacturer's instructions. Use special tools and jigs as recommended.
- .8 Locate top hinges with top 125 mm below door top, bottom hinges with bottom 250 mm from floor, and intermediate hinges equidistant between top and bottom hinges.
- .9 Locate door stops to contact doors 75 mm from latch edge.
- .10 Install hardware and trim square and plumb to doors.
- .11 Replace missing hardware to ensure specified installation at time of building completion.
- .12 After installation, replace wrappings for hardware provided by manufacturer.
- .13 Safeguard keys to keep them out of unauthorized hands, tag them with opening number, and deliver them to person designated by the Owner at building completion.

3.2 HARDWARE
SCHEDULE

- .1 Provide all hardware listed on the Finishing Hardware Schedule.
- .2 The Finishing Hardware Schedule is furnished as a guide to the type of hardware to be used, but is not intended to be a complete schedule of quantities. Examine the Drawings and Specifications, and supply all hardware to complete the work.

3.4 ADJUSTMENT AND
CLEANING

- .3 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by supplier's instructions.
- .4 Clean hardware after installation in accordance with supplier's instructions.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements to supply and install acoustic tile ceiling and suspension system where indicated on the Drawings and as specified herein.
- 1.2 RELATED WORK .1 Mechanical fixtures: Divisions 21, 22 & 23
.2 Electrical fixtures: Division 26
- 1.3 REFERENCES .1 ASTM C635-13a, Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
.2 ASTM C636-13, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- 1.4 DESIGN CRITERIA .1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.
- 1.5 SAMPLES .1 Submit samples in accordance with Section 01 00 00.
.2 Submit one (1) representative model of each type ceiling suspension system and each type of acoustical tile.
.3 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.
- 1.6 ENVIRONMENTAL CONDITIONS .1 Permit wet work to dry before commencement of installation. Do not start work if further installation of damp materials is contemplated.
.2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.
-

1.6 ENVIRONMENTAL
CONDITIONS
(Cont'd)

- .3 Store materials in work area 48 hours prior to installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Intermediate duty system to ASTM C635.
- .2 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1.
.1 Type: mineral fibreboard, non-fire rated.
.2 Flame spread rating: 25 or less.
.3 Ceiling Attenuation Class (CAC) range: 35 to 39.
.4 Noise reduction coefficient (NRC) designation: 0.5 to 0.6.
.5 Edge type: Square.
.6 Colour: white.
.7 Size: 610 x 610 x 19 mm thick.
.8 Shape: flat.
.9 Accessories: corrosion resistant retention clips, 2/panel in entry areas only.
.10 Acceptable products: Radar Climaplus by CGC, or Cortega 769 by Armstrong or approved equivalent.
- .3 Basic materials for suspension system: commercial quality cold rolled steel.
- .4 Suspension system: two directional exposed tee bar grid, non-fire rated.
.1 Acceptable product: Prelude as manufactured by Armstrong, DX as manufactured by CGC, or approved equivalent.
- .5 Exposed tee bar grid components: shop painted satin sheen white baked vinyl enamel. Components die cut. Main tee with double web, rectangular bulb and 25 mm 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.
- .6 Hanger wire: 2.6 mm diameter galvanized soft annealed steel wire.
- .7 Hanger inserts: purpose made.

2.1 MATERIALS
(Cont'd)

- .8 Accessories: splices, clips, wire ties, retainers and wall moulding flush and reveal, to complement suspension system components, as recommended by system manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install suspension system in accordance with ASTM C636 except where specified otherwise.
- .2 Do not erect ceiling suspension system or install tiles until work above ceiling has been inspected by the Consultant.
- .3 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, radiant heating panels, and diffusers, to be built into acoustical ceiling components.
- .4 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
- .5 Install hangers to adequately support suspension system.
- .6 Coordinate suspension system with location of related components.
- .7 Install wall mould to provide correct ceiling height.
- .8 Completed suspension system to support super-imposed loads, such as lighting fixtures diffusers, and grilles.
- .9 Support at light fixtures, radiant heating panels and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .10 Interlock cross member to main runner to provide rigid assembly.
- .11 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .12 Install clips in entrance/exit areas for wind uplift.

3.2 ACOUSTICAL
UNITS

- .1 Install acoustical tiles in ceiling suspension system.

3.3 CLEANING

- .1 Touch up scratches, abrasions, voids and other defects in painted surfaces, in acoustical tiles where minor repair is acceptable, and similarly on tee-bar grid.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section specifies requirements to supply and install resilient tile and rubber base where indicated on the Drawings.
<u>1.2 RELATED WORK</u>	.1	Cast-in-Place Concrete: Section 03 30 00
<u>1.3 REFERENCES</u>	.1	ASTM F 1066-04(R2014) Vinyl Composition Floor Tile.
<u>1.4 SAMPLES</u>	.1	Submit duplicate tile in size specified, and 300 mm of base.
<u>1.5 ENVIRONMENTAL REQUIREMENTS</u>	.1	Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hours before, during and for 48 hours after installation.

PART 2 - PRODUCTS

<u>2.1 MATERIALS</u>	.1	Vinyl composition tile: to ASTM F1066, non-asbestos containing, Composition 1, Class 2, 3 mm thick, 305 x 305 mm size, using several colours (field with accent coloured tiles). .1 Acceptable products: Armstrong Premium Excelon Canvas, Tarkett Colorworks Basic Structures, or approved equivalent.
	.2	Resilient base: rubber, cove, minimum 1200 mm long, 100 mm high x 3 mm thick. Colour as selected by Consultant. .1 Acceptable products: Johnsonite, Amtico, or approved equivalent.
	.3	Primers and adhesives: waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
-

2.1 MATERIALS
(Cont'd)

- .4 Sub-floor filler and leveller: Portland cement based latex type filler as recommended by flooring manufacturer for use with their product.
- .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 Sealer and wax: type recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

- .1 Confirm concrete floors are dry, by using test methods recommended by tile manufacturer.

3.2 SUB-FLOOR
TREATMENT

- .1 Remove sub-floor ridges and bumps. Fill low spots, joints, holes and other defects with sub-floor filler.
- .2 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .3 Prime concrete to flooring manufacturer's printed instructions.

3.3 FLOORING
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 vinyl tile flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
- .3 Install vinyl tile flooring with pattern grain parallel for all units and parallel to width of room.
- .4 As installation progresses, and after installation, roll flooring in two (2) directions in accordance to manufacturer's instructions, with roller to ensure full adhesion.

3.3 FLOORING
APPLICATION
(Cont'd)

- .5 Cut flooring neatly around fixed objects.
- .6 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .7 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 BASE
APPLICATION

- .1 Lay out base to keep number of joints at minimum. Base joints at maximum length available.
- .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 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 formed straight base material for external corners, minimum 300 mm each leg.

3.5 INITIAL
CLEANING AND WAXING

- .1 Remove excess adhesive from floor, base and wall surfaces without damage.
- .2 Clean, seal and wax floor and base surface to flooring manufacturer's instructions.

3.6 PROTECTION OF
FINISHED WORK

- .1 Protect new floors from time of final set of adhesive until final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.

PART 1 - GENERAL

- 1.1 WORK INCLUDED
- .1 This Section specifies requirements for providing all labour, tools, equipment and materials to complete all painting including preparation, painting and touch-up.
 - .2 Coordinate painting work for piping and equipment as specified under Division 40.
- 1.2 RELATED WORK
- .1 Manufacturer's coatings of mechanical equipment: Divisions 23 and 44
 - .2 Plant piping valves and appurtenances: Section 40 05 10.
- 1.3 REFERENCES
- .1 Canadian Painting Contractors' Architectural (CPCA).
 - .1 Painting Specifications Manual 1998.
 - .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.146-99, Cold Curing, Glass Epoxy Coating.
 - .2 CAN/CGSB-1.38-2000, Interior Enamel Undercoat.
 - .3 CAN/CGSB-1.57-03, Interior Alkyd Semigloss Enamel.
 - .4 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.
 - .5 CAN/CGSB-1.81-M90 CORR, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
 - .6 CAN/CGSB-1.188-04, Emulsion Type Filler Masonry Block.
 - .7 CAN/CGSB-1.195-99, Interior Latex Semigloss Paint.
 - .8 CAN/CGSB-1.213-04, Etch Primer (Pretreatment Coating or Tie Coat) for Steel and Aluminium.
 - .9 CAN/CGSB-85.100-93, Painting.
 - .10 CAN/CGSB-85.10-99, Protective Coatings for Metals.
 - .3 CAN/CSA 1.119-2000, Interior Latex Primer-Sealer.
- 1.4 QUALITY ASSURANCE
- .1 Provide affidavits stating only "first-line" products have been used on this Contract.

1.4 QUALITY
ASSURANCE
(Cont'd)

- .2 Paint manufacturer must be represented by a qualified technical representative, trained as a paint inspector, with a minimum five (5) years experience.
- .3 The manufacturer's technical representative will make a minimum of one (1) inspection prior to and during application to ensure proper application.
- .4 After inspection the manufacturer's representative will provide a written report to the Consultant within five (5) working days.

1.5 SURFACE AND
ENVIRONMENTAL
CONDITIONS

- .1 Apply paint finish only 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 Do not apply exterior paint finishes in unsuitable weather conditions.
- .3 Do not apply paint finishes when relative humidity exceeds 85%, when condensation has formed or is likely to form, or immediately following rain, frost, or formation of dew.
- .4 Provide adequate ventilation or isolation measures to protect against toxic fumes.
- .5 Apply paint only to adequately prepared surfaces.
- .6 Apply paint only when previous coat of paint is dry or adequately cured.
- .7 Additional Interior Application Requirements:
 - .1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

1.6 DELIVERY,
HANDLING AND
STORAGE

- .1 Deliver, store and handle materials in accordance with the manufacturer's written instructions.
- .2 Labels to clearly indicate:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.

1.6 DELIVERY,
HANDLING AND
STORAGE
(Cont'd)

- .2 (Cont'd)
 - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Provide and maintain dry, temperature controlled, secure storage.
- .5 Observe manufacturer's recommendations for storage and handling.
- .6 Store materials and supplies away from heat generating devices.
- .7 Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.
- .8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.
- .10 Remove paint materials from storage only in quantities required for same day use.
- .11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
- .12 Fire Safety Requirements:
 - .1 Provide 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 the National Fire Code of Canada.

1.7 SUBMITTALS

- .1 Submit product data and manufacturer's installation/application instructions for each paint and coating product to be used in accordance with Section 01 00 00.

1.7 SUBMITTALS
(Cont'd)

- .2 Submit the names of paint manufacturers and local supplier. Confirm painting requirements and submit colour schedule for approval as per Section 01 00 00 prior to ordering of products
- .3 Upon completion, submit records of products used. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 Manufacturer's Material Safety Data Sheets (MSDS).

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Paint products as manufactured by Glidden/Devoe Coating, and Pittsburgh Paint Ltd (PPG) or approved equivalent.
- .2 Use only "first line" products produced by the manufacturer. Use only products of manufacturer whose best quality lines meet or exceed CGSB specifications for finishing materials as specified in the Paint Formulae, except where otherwise specified.
- .3 Paint materials for each coating formula to be products of a single manufacturer.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Apply paint in strict accordance with the recommendation of the applicable CGSB Standards, manufacturer's instructions and subject to the approval of the Consultant.
- .2 Do not paint when temperature is below 10°C.
- .3 Before painting equipment mask manufacturer's name plates and any other name plates carrying informational data pertaining to equipment. Do not paint nameplates.

3.1 WORKMANSHIP
(Cont'd)

- .4 Keep paint well mixed and stirred while applying. Do not thin paint unless approved by the Consultant, and only with such materials and to such extent as not to damage paint.
- .5 Spread paint to coverage not greater than that recommended by paint manufacturer.
- .6 Force paint into pores, angles and crevices of well cleaned surfaces and in such manner as will assure a continuous even coat making contact with all parts of the surface and producing a film free of air bubbles, skips and thin spots.
- .7 Paint thickness for each coat to be minimum as recommended by the applicable CGSB specifications or as recommended by the manufacturer of the material subject to approval of the Consultant.
- .8 Defective painting and finishing Work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the Work of this Section.

3.2 PREPARATION OF
SURFACES

- .1 In general:
 - .1 Vacuum clean interior areas immediately before finishing Work commences.
 - .2 Remove from surfaces grease, oil, dirt, dust, ridges, and other soil and materials that would adversely affect the adhesion or appearance of finish coatings.
 - .3 Remove rust on surfaces primed under Work of other Sections and the areas reprimed under the Work of those Sections.
 - .4 Finish, patch and smooth surfaces to remove cracks, holes, ridges, and similar blemishes.
 - .5 Touch up damaged prime coats on shop primed metals with same priming material.
 - .6 Neutralize high alkaline surfaces to receive latex paints. Remove residue before painting.
 - .7 Scrub mildewed surfaces with a bleach solution and rinse with clean water.
 - .8 In the case of existing coatings, hand tool clean to remove all loose flaking paint and rust and feather sand edges.
 - .9 Degloss existing paint coatings by scuff sanding.

3.2 PREPARATION OF
SURFACES
(Cont'd)

- .2 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.
- .3 Touch up shop paint primer on steel with same type primer as originally used.
- .4 Prepare galvanized steel and zinc coated surfaces to CAN/CGSB-85-10.
- .5 Equipment pads, concrete floor surfaces preparation: clean and etch with muriatic acids.
- .6 PVC piping surfaces preparation: scuff sand, clean soiled surfaces, and remove dust and dirt.
- .7 Interior steel, ductwork, piping:
 - .1 Vacuum clean to remove all dust, dirt and other contaminants from all surfaces.
 - .2 Remove from surfaces grease, oil, dirt, dust, ridges and other soil and materials that would adversely affect the adhesion or appearance of finish coating.
 - .3 Hand tool clean SSPC-SP2 to remove any, dirt, rust, loose paint, etc.
 - .4 In all areas where rust is encountered, use a rust inhibitor covering prior to applying finish coat.
 - .5 Prepare and prime black iron piping (i.e. Sprinkler lines, mains, etc.) prior to finish coat of paint.

3.3 APPLICATION

- .1 Sand and dust between each coat to remove defects visible from distance up to 1500 mm.
- .2 Finish bottoms, edges, tops and cutouts of doors after fitting as specified for door surfaces.
- .3 Finish all surfaces exposed to view, requiring finish for preservation of material, or to facilitate maintenance.
- .4 Apply number of coats of specified paints to designated surfaces as indicated in Painting Formulae and manufacturer's recommendations.
- .5 Protect and cover machinery and equipment and adjacent surfaces during painting operations.

3.3 APPLICATION
(Cont'd)

- .6 Take special care during paint application to ensure disconnects and unions remain properly operable once painting operations completed.

3.4 MECHANICAL,
ELECTRICAL AND
PROCESS EQUIPMENT

- .1 Leave factory-finished electrical and process equipment in original finish except for touch-up as required, supplied as primed only unless otherwise indicated under Divisions 26, and 40-46.
- .2 Paint exposed equipment, conduits, pipes, fittings, fasteners and hangers. Colour to match adjacent surfaces, except as noted otherwise. Paint pipe hangers to match piping.
- .3 Paint valves and miscellaneous devices to match adjacent piping. Where adjacent piping is not painted, paint valves to match adjacent machinery, as directed by the Consultant.
- .4 Paint both sides and edges of plywood backboards for electrical equipment before installation.
- .5 Do not paint over nameplates.

3.5 PAINTING
FORMULAE

- .1 Formula 1: for ductile iron piping coated with manufacturer's asphalt sealer:
1 coat BIN pigmented white shellac sealer
2 coats semi-gloss enamel CAN/CGSB-1.59
(Glidden 4308, PPG 54 line)
- .2 Formula 2: for interior copper and black iron piping and fittings, including insulated piping:
1 coat tinted enamel undercoat CGSB-1.38
(Glidden 250, PPG 6-6)
2 coats semi-gloss enamel CAN/CGSB-1.57
(Glidden 9440-0, PPG 6-90)
- .3 Formula 3: touch-up of exterior galvanized and zinc coated ferrous metals:
1 coat galvanized steel primer to CGSB-1.213 (Devoc 4120, PPG 97-687), 2 coats of Urethane Modified Industrial Enamel - gloss oil base (Pittsburg Paints).
- .4 Formula 4: for interior concrete block walls (unless noted otherwise), Dry Areas, apply:

1 coat block filler CAN/CGSB-1.188
(Glidden 36250, PPG 6-7 B/F)
2 coats semi-gloss enamel CAN/CGSB-1.57
(Glidden 94410-0, PPG 6-90)

- .5 Formula 5 for interior concrete block walls exposed to moist environments (open tank areas and open channel areas), apply:
1 coat block filler
(Devoe 4010, PPG 16-90)
2 coats semi-gloss industrial enamel, 3 mil DFT
(Devoe 4216HP, Pitt-Tech 90-474 Series)

3.6 COLOUR SCHEDULE

- .1 Colours are based on PPG Canada Inc. paint system. Other manufacturers will provide paint to match their colours as closely as possible.
- .2 Colours to match existing systems.

PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1 ANSI/NFPA 10-2013, Portable Fire Extinguishers.
	.2 CAN/ULC-S508-2013, Standard for the Rating and Fire Testing of Fire Extinguishers and Class D Extinguishing Media.
<u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u>	.1 Submit shop drawings and product data in accordance with Section 01 00 00.
<u>1.3 MAINTENANCE DATA</u>	.1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.

PART 2 - PRODUCTS

<u>2.1 MULTI-PURPOSE AMMONIUM PHOSPHATE DRY CHEMICAL EXTINGUISHERS (FE)</u>	.1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B, C class protection. Rating: 4.5kg 6-A, 80-B,C. Red paint finish, squeeze grip operation, pull pin safety lock, waterproof s.s. pressure gauge, anodized aluminum valve.
	.2 Acceptable Material: National Fire Equipment B10V-1 Flag, ABC-10F; Diamond, Amerex.
<u>2.2 MULTI-PURPOSE CARBON DIOXIDE EXTINGUISHER</u>	.1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC listed for B and C class protection. Rating 4.5 kg (10-B,C). Red paint finish, squeeze grip operation, pull pin safety lock, waterproof s.s. pressure gauge.
	.2 Acceptable material: National Fire Equipment B10V-1 Flag; Diamond.
<u>2.3 EXTINGUISHER BRACKETS</u>	.1 Type recommended by extinguisher manufacturer.

2.4 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of NFPA 10.
- .2 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install or mount extinguishers in cabinets or on brackets as indicated; top of cabinet or extinguisher must not exceed 1.5 m AFF.

PART 1 - GENERAL

1.1 GENERAL

- .1 Perform the Work included in these specifications and any accompanying drawings, by providing all supervision, labour, materials, supplies, construction tools, equipment and services, hoisting, transportation, receiving, handling, storage, and all other services and expenditures include those not specifically mentioned but which are necessary for a complete installation.

1.2 RELATED
SECTIONS

- .1 This section is to be read in conjunction with and covers items common to all sections of Division 22. It is intended to supplement the requirements of Section 01 00 00.
- .2 Concrete: Section 03 30 00
- .3 HVAC General Requirements: Section 23 05 00
- .4 Bases, Hangers and Supports: Section 23 05 29
- .5 Thermal Insulation for Piping: Section 23 07 19
- .6 Excavating, Trenching, and Backfilling: Section 31 23 10

1.3 RELATED WORK
PERFORMED BY THIS
SECTION

- .1 Caulking:
 - .1 Perform caulking in compliance with the requirements of Section 07 92 00.
- .2 Welding:
 - .1 Have welding performed by the mechanical subcontractor for all mechanical piping and structural supports and hangers.
 - .2 Have welding performed by certified welders in accordance with the Provincial Labour Requirements and By-Laws of New Brunswick.
- .3 Cutting and Patching:
 - .1 Cutting of all openings in concrete floors and walls and patching for mechanical work included in Division 22 is the responsibility of the mechanical subcontractor, unless otherwise indicated on the structural drawings.

1.4 FIXTURES AND
FITTINGS

- .1 Equipment assemblies comprised of electro-mechanical components must be CSA approved where possible and shall bear the appropriate label. If the equipment in question is not CSA approved as an assembly, have the manufacturer arrange and pay for Spot approval and labelling of the equipment prior to installation.

1.5 EQUIPMENT
INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping systems without interfering with other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated lifetime bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

1.6 PIPE INSULATION

- .1 Provide pipe insulation as per Section 23 07 19.

1.7 ANCHOR BOLTS
AND TEMPLATES

- .1 Supply anchor bolts and templates.

1.8 TRIAL USAGE

- .1 Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.9 PROTECTION OF
OPENINGS

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.10 EQUIPMENT
SUPPORTS

- .1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Division 22.

1.10 EQUIPMENT
SUPPORTS
(Cont'd)

- .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Section 05 50 00. Submit structural calculations with shop drawings.
- .3 Mount base mounted equipment on "Type B1" chamfered edge housekeeping pads, minimum of 100mm high and minimum 100mm larger than equipment dimensions all around.
- .4 Pipe hangers: as specified in Division 23.

1.11 SLEEVES

- .1 Pipe sleeves:
 - .1 Through masonry, concrete or fire rated assemblies: nominal 0.912mm (20 ga.) galvanized steel.
 - .2 Through foundation walls: Schedule 40 steel pipe with annular in continuously welded at midpoint of wall.
 - .3 Provide 25mm clearance all around service piping or ducting for building settlement/ movement.
- .2 Terminate pipe sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25mm above other floors.
- .3 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof, fire retardant, non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping to maintain fire rating integrity.
 - .3 Where sleeves pass through interior walls not fire-rated, provide acoustic caulking.
 - .4 Allow for no contact between copper tube or pipe and ferrous sleeve.
 - .5 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .6 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CAN/CGSB-1.181.

1.12 PREPARATION
FOR FIRESTOPPING

- .1 Firestopping material and installation within annular space between pipes, ducts, insulation and adjacent fire separation: specified in Section 07 80 00.

1.12 PREPARATION
FOR FIRESTOPPING
(Cont'd)

- .2 Insulated pipes and ducts: cut back insulation at fire separation to allow proper firestopping.
- .3 Firestopping material for piping and duct penetrations by Section 07 80 00.

1.13 ESCUTCHEONS

- .1 On pipes passing through walls, partitions, floors and ceilings in finished areas.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.

1.14 TESTS

- .1 Give 24 hour written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by the Consultant.
- .3 Conduct tests in presence of the Owner and the Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
 - .1 General: maintain test pressure without loss for 2 hours unless otherwise specified.
 - .2 Test drainage, waste and vent piping to the National Building Code, the Canadian Plumbing Code, and the authorities having jurisdiction.
 - .3 Test domestic hot, and cold piping at 1-1/2 times system operating pressure or minimum 862 kPa, whichever is greater.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.15 PAINTING

- .1 Finish painting as specified in Section 09 91 23 except where specified elsewhere in Division 22.

-
- 1.15 PAINTING
(Cont'd)
- .2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
 - .3 Prime and touch up marred finished paintwork to match original.
 - .4 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.
- 1.16 SPARE PARTS
- .1 Furnish spare parts in accordance with Section 01 00 00 and as follows:
 - .1 Six (6) gaskets for plumbing cleanout plugs (each size).
 - .2 One (1) set of seats, washers, and o-rings for all flush valves, faucets, hose bibs, etc.
 - .3 Two (2) vandal-proof screw tools.
 - .4 And as specified elsewhere.
- 1.17 SPECIAL TOOLS
- .1 Provide one (1) set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 00 00.
- 1.18 ACCESS DOORS
- .1 Supply access doors to concealed plumbing equipment for operating, inspecting, adjusting and servicing.
 - .2 Flush mounted 600mm x 600mm for body entry and 300mm x 300mm for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Provide fire-rated access doors where penetrating fire-rated construction. Maintain fire rating integrity of construction.
 - .3 Material:
 - .1 Special areas only such as tiled surfaces: use stainless steel with #4 satin finish.
 - .2 Remaining areas: use prime coated steel.
 - .3 Nominal 1.897mm (14 ga.) material.
 - .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.
 - .3 Installation is specified in applicable sections.
-

-
<u>1.18 ACCESS DOORS (Cont'd)</u>	.5	Acceptable Manufacturers: Acudor, Buensod, LeHage, Zurn.
<u>1.19 DIELECTRIC COUPLINGS</u>	.1	General: .1 Compatible with and to suit pressure and temperature rating of piping system. .2 Provide where pipes of dissimilar metals are joined.
	.2	Pipes NPS 2 and under: isolating unions.
	.3	Pipes NPS 2-1/2 and over: isolating flanges.
	.4	Acceptable Manufacturers: EBCO, Walter Valiet Co.
<u>1.20 DRAIN VALVES</u>	.1	Locate at low points and at section isolating valves unless otherwise specified.
	.2	Minimum NPS 3/4 unless otherwise specified: bronze, ball valve with hose end male thread, complete with cap and chain.
	.3	No water from any drain or relief valve to discharge on the floor. Pipe drains to funnel floor drains.
<u>1.21 OPERATING AND MAINTENANCE INSTRUCTIONS</u>	.1	Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
	.2	Provide demonstrations and instructions in conjunction with the appropriate equipment manufacturers representatives.
	.3	Use operation and maintenance manual, record drawings, audio visual aids, etc. as part of instruction materials.
	.4	Arrange for instructions in maintenance and operating of the following equipment by factory trained personnel and for the time period specified. The time specified does not include the time for start-up of systems and equipment:
-

Approvals:

1.22 OPERATION AND
MAINTENANCE MANUAL
(Cont'd)

- .6 (Cont'd)
 - .1 Submit three (3) copies of draft Operation and Maintenance Manual to the Consultant for approval. Submission of individual data will not be accepted unless so directed by the Consultant.
 - .2 Make changes as required and re-submit as directed by the Consultant.
- .7 Additional data: Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.23 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Shop drawings and product data to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. (eg. access door swing spaces).
- .3 Accompany shop drawings and product data with:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Points of operation on performance curves.
 - .3 Manufacturer to certify as to current model production.
 - .4 Certification of compliance to applicable codes.

1.24 CLEANING

- .1 Clean interior and exterior of all systems including strainers.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

1.25 DRAWINGS

- .1 The Drawings:
 - .1 Are not intended to show structural details or architectural features.
 - .2 Are not to be scaled.

-
- 1.25 DRAWINGS
(Cont'd)
- .1 (Cont'd)
- .3 Except where dimensioned, indicate general plumbing layouts only. Because of the small scale of the Plumbing Drawings, it is not possible to show all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories which are required to meet site conditions.
- .2 Provide field drawings to indicate relative position of various services when required by the Consultant.
- 1.26 RECORD
DRAWINGS
- .1 Refer to Section 01 00 00.
- 1.27 WARRANTIES
- .1 Make good all defects other than normal wear and tear during the life of the warranty period. Warrant all work and installed equipment to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the warranty. At any time during this period, make any necessary changes and adjustments, or replacements, to accomplish this at no additional cost to the project.
- .2 Submit written extended Warranties in Maintenance Manual as specified in Section 01 00 00.
- 1.28 PERMITS AND
REGULATIONS
- .1 Comply with all regulations and authorities having jurisdiction where applicable, including but not limited to the following:
- .1 Department of Labour.
 - .2 Fire Marshall.
 - .3 Plumbing Inspector.
 - .4 Provincial Board of Insurance Under-writers.
 - .5 National Building Code.
 - .6 Occupational Health & Safety Act.
 - .7 NFPA
- .2 Obtain and pay for any permits required by local codes and regulations and arrange for inspections applicable to the Contractor responsibilities.
-

1.28 PERMITS AND
REGULATIONS
(Cont'd)

- .3 Any additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the project.

1.29 REFERENCE
STANDARDS

- .1 Use the following latest editions and amendment of reference standards in effect on date of tender call:
- ANSI - American National Standards Institute
ASHRAE - American Society of Heating, Refrigeration & Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
AST - American Society of Testing & Materials
AWS - American Welding Society
AWWA - American Water Works Association
CEMA - Canadian Electrical Manufacturers Association
CGSB - Canadian Government Specification Board
CFUA - Canadian Fire Underwriters' Association
CHVAC - Canadian Heating, Ventilation & Air Conditioning Code (NCR)
CMB - Construction Materials Board
CSA - Canadian Standards Association
CUA - Canadian Underwriters Association
HRA - Heating, Refrigeration & Air Conditioning Institute of Canada
NBC - National Building Code of Canada
NBFU - National Board of Fire Underwriters'
NBS - National Bureau of Standards
NFPA - National Fire Protection Association
TIMA - Thermal Insulation Manufacturers Association
UL - Underwriters' Laboratories
ULC - Underwriters' Laboratories of Canada

1.30 ELECTRICAL

- .1 Electrical work to conform to Division 26 including the following:
- .1 Control wiring and conduit is specified in Division 26 and Section 40 91 00. Refer also to Division 26 and Section 40 91 00 for wiring associated with control systems.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED .1 Not applicable.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Plumbing General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 ASME B16.15-2013, Cast Bronze Threaded Fittings, Classes 125 and 250.
- .2 ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .4 ANSI/AWWA C111/A21.11-2017, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- .5 ASTM A307-14, Specification for Carbon Steel Bolts and Studs, 414 MPa Tensile Strength.
- .6 ASTM B32-08(R2014), Specification for Solder Metal.
- .7 ASTM B75-11, Specification for Seamless Copper Tube.
- .8 ASTM B88M-14, Specification for Seamless Copper Water Tube (Metric).
- .9 ASTM F492-95, Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .10 MSS SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Submit data for following: valves.

1.4 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.
-

PART 2 - PRODUCTS

2.1 PIPING

- .1 Domestic hot and cold systems within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
 - .2 Buried and embedded: copper tube, soft annealed, type L: to ASTM B88M, in long lengths and with no buried joints. "PEX", CSA approved potable water piping may be used under slab.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI B16.18. (Lead-free).
- .4 Wrought copper and copper alloy, solder type: to ANSI B16.22.
- .5 Piping NPS 2-1/2 and over: roll groove copper fittings to ASTM B75, alloy C12200. Victaulic "No-Sweat".
- .6 Mechanically formed Tee connections may be used on 25mm and above water pipe and where the branch line connection to the branch main is at least one pipe size smaller than the branch main.

2.3 JOINTS

- .1 Rubber gaskets, 3 mm thick: to ANSI/AWWA C111/A21.11.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder/brazing: tin-antimony 95-5: to ASTM B32, or tin-silver 94-6. (Lead free.)
- .4 Teflon tape: for threaded joints.
- .5 Piping NPS 2-1/2 and over: roll groove couplings with ductile or malleable iron housings, grade E EPDM flush seal gaskets and heat treated carbon steel bolts/nuts to ASTM A183. Victaulic "No-Sweat".

<u>2.3 JOINTS (Cont'd)</u>	.6	Dielectric unions between dissimilar metals to ASTM F492, complete with thermoplastic liner.
<u>2.4 GLOBE VALVES</u>	.1	NPS 2 and under, soldered: .1 To MSS SP-80, Class 125, 862 kPa, bronze body, renewable composition disc, screwed over bonnet. .2 Lockshield handles: as indicated. .3 Acceptable Product: Crane 1310; Jenkins 106 BPJ; Kitz 10; Hattersley A51M.
	.2	NPS 2 and under, screwed: .1 To MSS SP-80, Class 125, 862 kPa, bronze body, screwed over bonnet, renewable composition disc. .2 Lockshield handles: as indicated. .3 Acceptable Product: Crane 14½ P, or approved equivalent.
<u>2.5 SWING CHECK VALVES</u>	.1	NPS 2 and under, soldered: .1 To MSS SP-80, Class 125, 862 kPa, bronze body, bronze swing disc, screw in cap, regrindable .2 Acceptable Product: Crane 1342; Jenkins 4093; Hattersley A61SE.
	.2	NPS 2 and under, screwed: .1 To MSS SP-80, Class 125, 862 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat. .2 Acceptable Product: Crane 37; Jenkins 4092; Hattersley A60AT.
<u>2.6 BALL VALVES</u>	.1	NPS 2 and under, screwed: .1 To ANSI B16.18, Class 150, 1034 kPa. .2 Bronze body, stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon Buna N seat, steel lever handle. .3 Acceptable Product: Crane Capri, Jenkins 901FJ Toyo 5044A.
	.2	NPS 2 and under, soldered: .1 To ANSI B16.18, Class 150, 1034 kPa. .2 Bronze body, chrome plated brass stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon Buna N seat, steel lever handle, with NPT to copper adaptors. .3 Acceptable Product: Crane Capri, Jenkins 902FJ, Toyo 5049A.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with the 2015 Canadian Plumbing Code and the local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Assemble all piping using fittings manufactured to ANSI standards.
- .4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Connect to fixtures and equipment in accordance with manufacturers instructions unless otherwise indicated.
- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .7 Provide union nuts at all faucets. Do not directly solder faucets to supplies.
- .8 Test piping systems in accordance with Section 22 05 00.

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves and as indicated. Use ball valves for shut-off applications on piping up to and including NPS 2.

3.3 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction. After testing, provide acceptable water quality test report to the Consultant for approval.

3.4 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.

3.4 PRE-START-UP
INSPECTIONS
(Cont'd)

- .2 Verify system can be completely drained.
- .3 Confirm air chambers, expansion compensators are installed properly.

3.5 START-UP

- .1 Timing: Start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Bring HWS storage tank up to design temperature slowly.
 - .4 Monitor piping DHWS piping systems for freedom of movement, pipe expansion as designed.
 - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.6 PERFORMANCE
VERIFICATION

- .1 Timing:
 - .1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterlize DHWS systems for Legionella control.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.
 - .6 Check for proper operation of water hammer arrestors. Run one (1) outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

3.6 PERFORMANCE
VERIFICATION
(Cont'd)

- .2 (Cont'd)
 - .7 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.
- .3 Reports:
 - .1 In accordance with Section 22 05 00: Reports, using Report Forms and Schematics.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

PART 1 - GENERAL

<u>1.1 RELATED WORK</u>	.1 Plumbing General Requirements: Section 22 05 00 .2 Firestopping: Section 07 80 00
<u>1.2 REFERENCES</u>	.1 ASTM D 2564-13, Specification for Solvent Cements for Poly(Vinyl-Chloride) PVC Plastic Piping Systems. .2 CSA B1800-15, Thermoplastic Non-Pressure Piping Compendium.
<u>1.3 HANDLING AND STORAGE</u>	.1 Handle and store pipe and fittings in such a manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore. .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.
<u>1.4 APPLICATION</u>	.1 Buried sanitary and storm piping: PVC type DWV. .2 Above grade sanitary, storm and vent piping: PVC type DWV with flame spread rating less than 25 and smoke developed classification less than 50.

PART 2 - PRODUCTS

<u>2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS TYPE DWV</u>	.1 Pipe, fittings and solvent cement: Polyvinyl chloride to CAN/CSA-B181.2. .2 Joints: solvent weld to ASTM D2564.
<u>2.2 FIRESTOPPING</u>	.1 As specified in Section 07 80 00.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Carefully inspect products for defects and remove defective products from site.
- .2 Confirm pipe and fittings are clean before installation.
- .3 Firestop PVC piping penetrations as required by code and to manufacturers' recommendations and as specified in Section 07 80 00.

3.2 INSTALLATION

- .1 Lay and join pipe and fittings as specified in this section and according to manufacturer's published instructions.
 - .2 Start laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.
 - .3 Prevent entry of foreign material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
 - .4 Install gaskets in accordance with manufacturer's published instructions. During cold weather store gaskets in heated area to assure flexibility.
 - .5 Align pipe carefully before joining. Do not use excessive force to join pipe sections.
 - .6 Support pipes as required to assure concentricity until joint is properly completed.
 - .7 Keep pipe joints free from mud, silt, gravel or other foreign matter.
 - .8 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
 - .9 Where deflection at joint is permitted, deflect only after joint is completed. Do not exceed maximum joint deflection recommended by manufacturer.
 - .10 Complete each joint before laying next length of pipe.
-

3.2 INSTALLATION
(Cont'd)

- .11 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations. Minimize deflection after joint has been made to avoid damage.
- .12 Provide pipe firestop barriers and/or collars on the underside of fire-rated floors and both sides of fire-rated partitions that are penetrated.
 - .1 Acceptable Material: 3M Firestop.
- .13 Make provision for Rain Water Leader thermal expansion.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE
VERIFICATION

- .1 Cleanouts:
 - .1 Confirm they are accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to verify traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Confirm fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) complete with directional arrows every floor or 4.5 m (whichever is less).

Part 1 General

1.1 SCOPE OF WORK

- .1 This section specifies the supply and installation of a compressed air system complete with compressor package units, filters, refrigerant dryers, oil/water separator, air receivers, piping and valves. Work will be done in a phased approach.
- .2 Supply and install a new compressor package unit, complete with filters, refrigerant dryer, oil/water separator, air receivers, piping and valves in the new plant room provided. The equipment will be connected to the existing compressed air network and commissioned.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels-2015.
 - .2 ASME B1.20.1-13, Pipe Threads, General Purpose, Inch-2013
 - .3 ASME B16.5-17, Pipe Flanges and Flanged Fittings-2013.
 - .4 ASME B16.11-16, Forged Fittings, Socket Welding and Threaded-2016.
 - .5 ASME B31.3-16, Process Piping-2016.
 - .2 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.
 - .2 ASTM A181/A181M-14, Standard Specification for Carbon Steel Forgings for General Purpose Piping.
 - .3 Canadian Standards Association (CSA)
 - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .4 International Organization for Standardization (ISO)
 - .1 ISO 8573-1:2010, Compressed Air Part 1: Contaminants and purity classes
 - .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
-

- 1.3 SHOP DRAWINGS AND PRODUCT DATA
- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
 - .2 Include following: air compressor, refrigerant dryer, filters, air receivers, automatic drains and oil/water separator, valves.

Part 2 Products

- 2.1 AIR COMPRESSOR
- .1 General:
 - .1 Rotary screw, oil injected, air cooled, packaged air compressor with Variable Speed Drive (VSD). Compressor to include factory installed air and oil filters (less than 2 ppm fluid carry over), unit mounted control panel. All rotary parts are internally isolated.
 - .2 Control:
 - .1 Manual control with H-0-A starter switch.
 - .3 Accessories:
 - .1 Guards and pressure gauges.
 - .2 Automatic "zero air loss" condensate drains.
 - .4 Air intake:
 - .1 Complete with bird screen, replaceable cartridge type intake filter.
 - .5 48. Supply vibration isolation pads as per Section 23 05
 - .6 Acceptable material: Sullair Atlas Copco.

- 2.2 AIR QUALITY CONTROL
- .1 The new installation includes a combination of refrigerant dryer and filters to maintain as minimum, Air Quality Class 1:4:2 in accordance with ISO 8573.1-2010. Capacity selection of the dryer and filters are to match the capacity of the new air compressor for summer and winter conditions.

	Summer	Winter
Room Dry Bulb Temperature, °F	85	70
Relative Humidity, %	40	10

2.2 AIR QUALITY
CONTROL
(Cont'd)

- .2 Supply each filter complete with a differential pressure indicator.
- .3 Provide each in-line filter as well as the refrigerant dryer with a "zero air loss" automated condensate drain (condensate to be piped to the oil/water separator).
- .4 Supply voltage for automated drain: 120 VAC, 1 Phase, 60 Hz
- .5 Provide for remote starting and stopping the dryer by interface with the building automation and control system.
- .6 Supply voltage for dryer: 120VAC, 1 Phase, 60 Hz.

2.3 OIL/WATER
SEPARATOR

- .1 Condensate from the new dryer and filters will be piped to the oil/water separator.
- .2 Select the capacity of the separator to match the condensate produced by the new compressor, dryer and filters during summer conditions.
- .3 Maximum oil carry over: 10 ppm.

2.4 Piping

- .1 To ASTM A53, Gr. B ERW black steel, schedule 80 (3/4"-2" NPS).
- .2 Fittings: ASME B16.11, CL3000, ASTM A105N, socket welded or threaded.
- .3 Joints: NPS2 and smaller: socket welded or NPT threaded c/w Teflon tape.

2.5 TUBING

- .1 Only to be used for condensate dryer and filters.
- .2 Refer to Section 22 13 18 - Drainage Waste and Vent Piping.

2.6 BALL VALVES

- .1 Three piece design or top entry for ease of in line maintenance.

2.6 BALL VALVES (Cont'd)	.2	To ASTM A181/A181M, Class 70, carbon steel body socket welded or screwed ends, stainless steel ball and associated trim suitable for compressed air application.

	.3	Minimum pressure rating: 150 psig at 176°F.

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 datasheet.

3.2 COMPRESSOR PACKAGE	.1	Install on vibration isolators on housekeeping pad as indicated.

3.3 REFRIGERATED AIR DRYER	.1	Install the dryer on a base frame elevated to allow for condensate to freely flow from the dryer to the oil/water separator.
	.2	Supply the base frame, painted.

3.4 COMPRESSED AIR LINE FILTERS	.1	Install as per manufacturer's instructions.
	.2	Position the filters at an elevation to allow for condensate to freely flow from the automatic condensate drain to the oil/water separator.

3.5 OIL/WATER SEPARATOR	.1	Install as per manufacturer's instructions.
	.2	Pipe filtered condensate to the floor drain.

3.6 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION	.1	Install shut off valves at outlets, major branch lines and in locations as indicated.

3.6 COMPRESSED AIR
PIPING CONNECTIONS
AND INSTALLATION
(Cont'd)

- .2 Install unions to permit removal or replacement of equipment.
- .3 Grade piping at 1% slope minimum.
- .4 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.
- .5 Provide drains from refrigerated air dryers, air line filters and oil/water separator.
- .6 Weld steel piping in accordance with Section 23 05 17 - Pipe Welding and;
 - .1 To ASME B31.3 and requirements of authority having jurisdiction.
 - .2 Weld concealed and inaccessible piping regardless of size.
- .7 Thread piping in accordance with ASME B1.20.1.
- .8 Paint piping and color code compressed air pipe.

3.7 SITE
TESTS/INSPECTION

- .1 Testing: pressure test new installation in accordance with requirements of Section 21 05 01 - Mechanical General Requirements, for 4 hour minimum, to 150 psi, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 2 psi.

3.8 CLEANING

- .1 Refer to Section 23 08 02 - Cleaning and Start-Up of Mechanical Systems.
- .2 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.
- .3 Check entire installation is approved by authority having jurisdiction.
- .4 Perform cleaning operations as specified in Section 23 08 02 - Cleaning and Start-up of Mechanical Systems and in accordance with manufacturer's recommendations.
- .5 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.9 FACTORY TESTING

- .1 Inspection and Testing:
 - .1 Test air compressor system to confirm proper operation at rated power supply and for electrical and mechanical integrity prior to shipment.
 - .2 The Equipment Supplier grants the right to inspect the instrumentation and control equipment to any authorized representative of the purchaser or Owner's representative before shipment from factory. If inspection is required to give 48 hours' notice in advance of the time when the equipment will be ready for inspection at the factory. The Owner will pay the costs associated with having the Consultant observe the testing. Include all cost to conduct testing in the stipulated price.
 - .3 Have all equipment tested by the equipment supplier.

3.10 DELIVERY

- .1 Shipment: ship equipment assembled to the greatest extent possible to reduce installation and start-up costs.
- .2 Coordinate deliveries with the Owner .

3.11 RESPONSIBILITY OF TEMPORARY TRAIL USAGE

- .1 Obtain written confirmation from the installing contractor that equipment is installed and ready for testing.
- .2 The guarantee period will not be affected by temporary trail use of the equipment.
- .3 Clean and renew equipment and systems used prior to acceptance. Restore to original or new working condition.
- .4 Protect equipment and system openings from dirt, dust, and other foreign materials during temporary usage.

3.12 SITE INSPECTION, TESTING AND START-UP

- .1 Provide the services of qualified service personnel, mechanics, or other trained personnel for a minimum of one (1) trip, of one (1) eight (8) hour day on-site to check the complete installation and be present for start-up of the equipment. Provide a written report to the Consultant stating the following:
 - .1 That the system is operating in accordance with design specifications.

3.12 SITE
INSPECTION, TESTING
AND START-UP
(Cont'd)

- .1 (Cont'd)
 - .2 That the equipment has been satisfactorily installed by the Contractor and/or outline any modifications that have been made or are required to be made as a result of the commissioning or testing of the equipment.
 - .3 That the equipment is now ready for permanent operation.
 - .4 That operation, lubrication and maintenance instructions for the equipment have been presented to the Owner.
 - .5 That the equipment has been properly lubricated with the correct lubricants.
- .2 Have the Equipment Supplier's representative fully instruct permanent operator of equipment in proper operation and maintenance of equipment.
- .3 Advise the Consultant and Owner in writing at least one (1) week in advance of the proposed date for testing and start-up. Provide necessary tools, materials and equipment for carrying out tests. Provide water for testing. Conduct tests in the presence of the Consultant and Owner.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.

3.13 IDENTIFICATION

- .1 Locate manufacturer's nameplates so that they are easily read. Do not paint over plates.

3.14 COMMISSIONING

- .1 Commission in accordance with Section 01 00 00.

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1 Plumbing General Requirements: Section 22 05 00
<u>1.2 REFERENCES</u>	.1 CAN/CSA C22.2, No. 110-94(R2014), Construction and Test of Electric Storage Tank Water Heaters. .2 CAN/CSA C191-14, Performance of Electric Storage Tank Water Heaters for Household Service. .3 CAN/CSA C309-M90(R2014), Performance Requirements for Glass-Lined Storage Tanks for Household Water Service.
<u>1.3 SHOP DRAWINGS</u>	.1 Submit shop drawings in accordance with Section 01 00 00. .2 Indicate: .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
<u>1.4 MAINTENANCE AND ENGINEERING DATA</u>	.1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.

PART 2 - PRODUCTS

<u>2.1 ELECTRIC HOT WATER STORAGE TANK</u>	.1 To CAN/CSA C22.2 No. 110, CAN/CSA-C191 and CAN/CSA-C309 for glass lined storage tanks, with immersion type elements and immersion type adjustable thermostats. .2 As indicated on schedules.

PART 3 - EXECUTION

<u>3.1 INSTALLATION</u>	.1 Install in accordance with manufacturer's recommendations.
-

3.2 TOUCH-UP .1 Where exterior enamel is damaged, touch-up with original coating material.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Plumbing General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 CSA-B45 Series-02(R2013), CSA Standards on Plumbing Fixtures.
- .2 CSA B125.3-2012, Plumbing Fittings.
- .3 CAN/CSA-B651-12, Accessible Design for the Built Environment.
- .4 ANSI/ASSE 1020-2004, Performance Requirements for Pressure Vacuum Breaker Assembly.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 00 00.
- .2 Indicate: dimensions, construction details and roughing-in dimensions for all fixtures and trim.

1.4 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.
- .2 Data to include:
 - .1 Description of plumbing fixtures and trim giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.5 FIXTURES AND
TRIM

- .1 Manufacture plumbing fixtures in accordance with CAN/CSA-B45 Series.
- .2 Manufacture plumbing fittings in accordance with CAN/CSA-B125.
- .3 Architectural drawings govern in determination of number and location of fixtures.

1.5 FIXTURES AND
TRIM
(Cont'd)

- .4 Fixtures of the same type to be the product of one manufacturer. Same applies to trim. See also the Plumbing Fixture Schedule on the drawings.
- .5 Exposed plumbing brass to be triple chromium plated.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 As indicated in the plumbing fixture schedule on the Drawings.
- .2 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Chrome plated flexible supply pipes each with screw driver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with cleanout on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.

PART 3 - EXECUTION

3.1 FIXTURE
INSTALLATION

- .1 Connect fixtures complete with supplies and drains, trapped, supported level and square. Hot water faucets to be on the left. Fixtures on outside walls to have supplies from floor; other fixtures to be served from wall.
- .2 Provide union connections (soldered or screwed) to all fixture supplies. Do not directly solder faucets to supplies. Do not provide compression NPS 3/8 chrome valves.
- .3 Caulk joints between walls, floors and plumbing fixtures.

3.2 COMMISSIONING

- .1 Screens and strainers: clean out.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.

3.2 COMMISSIONING
(Cont'd)

- .3 Checks:
.1 Water closets: flushing action.
.2 Aerators: operation, cleanliness.
.3 Vacuum breakers, backflow preventers: operation
under all conditions.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Plumbing General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 CAN/CSA B64-Series-11(R2016), Backflow Preventers and Vacuum Breakers.
- .2 CSA B79-08(R2013), Floor, Area and Shower Drains and Cleanouts for Residential Construction.
- .3 PDI-WH201-2010, Water Hammer Arrestors.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 00 00.
- .2 Indicate dimensions, construction details and materials for the following: floor drains, (all types), cleanouts, non-freeze wall hydrants, water hammer arrestors, backflow preventers, hose bibbs, strainers, traps, and trap seal primers, solenoid valves for floor drain traps.

1.5 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.
- .2 Data to include:
- .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

- .1 Floor drains: to CSA-B79.

2.1 FLOOR DRAINS
(Cont'd)

- .2 FD: general duty; Dura-coated cast iron body, 100mm dia. bottom outlet. Invertible membrane clamp and adjustable collar with seepage slots, nickel bronze strainer, and trap primer connection.
 - .1 Acceptable Product: Zurn ZN-415-B-P, or approved equivalent.
- .3 FFD: combination funnel floor drain; cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral oval funnel, trap primer connection. Funnel floor drain in Lab shall be corrosion resistant, complete with acid resisting epoxy coating.
 - .1 Acceptable Product: Zurn ZN-415-BF-P, or approved equivalent.

2.2 CLEANOUTS

- .1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket, vandal proof screws.
 - .1 Acceptable Product: Regular Floor Areas: Zurn ZN-1400-2; Tiled Areas: Zurn ZN-1400-2-X; or approved equivalent.
- .2 Access covers:
 - .1 Wall access: face or wall type, stainless steel, square and or round cover with flush head vandal proof screws, bevelled edge frame complete with anchoring lugs.
 - .1 Acceptable Product: Zurn ZANB-1460-2-VP; or approved equivalent.
 - .2 See also Section 23 05 00, for additional specifications regarding types and finishes of access covers.
 - .3 Provide fire rated access covers to maintain the integrity of fire rated construction.
 - .2 Floor access: round cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for unfinished concrete floors: nickel bronze, round, gasket, vandal-proof screws; cast iron, epoxy coated for lab area.
 - .1 Acceptable Product: Zurn ZANB-1460-13; or approved equivalent.
 - .3 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, epoxy coated for lab areas complete with vandal-proof locking screws:

<u>2.2 CLEANOUTS (Cont'd)</u>	.2 (Cont'd) .2 (Cont'd) .1 Acceptable Product: Zurn ZANB-1460-14; or approved equivalent.
<u>2.3 ROOF DRAINS</u>	.1 RD-1: standard roof drains with cast iron body with aluminum or cast iron dome, underdeck clamp, extension, roof sump receiver and waterproof flange, to suit roof construction, flashing clamp ring with integral gravel stop. .1 Acceptable Product: Zurn Z-121; or approved equivalent.
<u>2.4 ENCASED NON-FREEZE WALL HYDRANTS</u>	.1 Provide frost proof wall hydrant, complete with anti-siphon feature. .2 Provide one extra key. .3 Recessed with integral vacuum breaker, NPS 3/4 outlet, polished bronze finish, brass exterior parts, nickel bronze box, adjustable wall flange. .4 Wall opening: 184 mm square. .5 Acceptable Product: Zurn Ecolotrol ZN-1300; or approved equivalent
<u>2.5 WATER HAMMER ARRESTORS</u>	.1 Type 304 stainless steel or copper construction, bellows type: to Plumbing and Drainage Institute Standard PDI-WH 201. .2 Acceptable Product: Zurn Z-1700 Shoktrol; or approved equivalent.
<u>2.6 BACKFLOW PREVENTERS</u>	.1 To CAN/CSA-B64 Series. .2 Reduced pressure principle type complete with strainer, full port, 1/4 turn shut-off ball valves, air gap fitting piped to FFD (for hot water heating system water make-up, as indicated): .1 Acceptable Manufacturers: Watts; Febco; CONBRACO.

2.7 VACUUM BREAKERS

- .1 To CAN/CSA-B64 Series.
- .2 Atmospheric vacuum breaker:
 - .1 Acceptable Product: Watts 288A.
- .3 Pressure vacuum breaker:
 - .1 Acceptable Product: Watts N36; Febco; complete with shutoff ball valves.
- .4 Hose connection vacuum breaker:
 - .1 Acceptable Product: Watts 8.

2.8 ELECTRONIC TRAP
SEAL PRIMERS

- .1 Solenoid valve complete with vacuum breakers and 120/24 volt transformers.
- .2 Provide wall access doors where required to conceal trap primer valve and/or solenoid valve. Fire rated access doors in fire rated wall construction.
- .3 Provide trap primer complete with an adjustable 24 hour timer set to discharge water at set intervals.

2.9 STRAINERS

- .1 862 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
 - .1 Acceptable Product: Armstrong F4SC; Braukmann FY32; Crane 988-1/2; Leitch BE; Spirax BT; Toyo 380; Watts 777 Series.

2.10 HOSE RACK

- .1 Wall mounted hose, industrial grade, 3/4 NPS fixed connector fabricated galvanized steel bracket with 15 m (unless rated otherwise on drawings) of 3/4 NPS pressure rated rubber hose and lever handle shut off valve complete with in-line vacuum breaker.
- .2 Provide and install wall-mounted hose racks and mounting hardware as per drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with the 2015 Canadian Plumbing Code, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.
- .3 Provide access panels where components are installed in walls partitions or inaccessible ceiling spaces.

3.2 CLEANOUTS

- .1 In addition to those required by code, and as indicated, install at base of all soil and waste stacks, and rainwater leaders and where indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.
- .4 For sinks and lavatory basins, provide cleanout in branch waste/stack or provide removable trap dip - no cleanout plug in bottom of dip.
- .5 Provide common cleanout in stack which serves two sinks or lavatory basins by using a double sanitary tee.

3.3 ENCASED NON-FREEZE WALL HYDRANTS

- .1 Install non-freeze wall hydrants 600 mm above finished grade unless otherwise indicated.

3.4 WATER HAMMER ARRESTORS

- .1 Install in the following locations, sized for the number of fixtures to be served:
 - .1 Branch supplies to individual fixtures or group of fixtures.
 - .2 Branch supplies to large washroom groups.

3.5 BACKFLOW PREVENTORS

- .1 Install in accordance with CSA B64.10, where indicated and elsewhere as required by code for proper functioning of equipment and/or systems.

-
<u>3.5 BACKFLOW PREVENTORS (Cont'd)</u>	.2	Pipe discharge from B.F.P. device over to nearest funnel floor drain or service sink.
-
<u>3.6 VACUUM BEAKERS</u>	.1	Install on each domestic hot water system and where indicated.
-
<u>3.7 ELECTRONIC TRAP SEAL PRIMERS</u>	.1	Install on cold water supply in consealed space where indicated on the Drawings.
	.2	Install NPS 1/2 Type "K" soft copper tubing to floor drains.
	.3	Install in accordance with manufacturer's recommendations.
-
<u>3.8 STRAINERS</u>	.1	Install with sufficient room to remove basket.
-
<u>3.9 COMMISSIONING</u>	.1	Refer to Section 01 00 00.
	.2	In context of this paragraph, "verify" to include "demonstrate" to the Consultant.
	.3	Timing: commission only after start-up deficiencies rectified.
	.4	Access doors: verify size and location relative to items to be services.
	.5	Adjust to suit site conditions, including, but not necessarily limited to, following: .1 Floor drains: .1 Verify proper operation of trap primer, flushing features. .2 Verify security and removability of strainers. .2 Cleanouts: .1 Verify covers are gastight, secure and easily removable. .2 Verify that cleanout rods can probe as far as next cleanout. .3 Non-freeze wall, hydrants: .1 Verify complete drainage. .2 Verify operation of vacuum breaker. .4 Water hammer arrestors:
-

3.9 COMMISSIONING
(Cont'd)

- .5 (Cont'd)
- .4 (Cont'd)
 - .1 Verify accessibility.
- .5 Backflow preventers, vacuum breakers:
 - .1 Verify installation of correct type to suit application.
 - .2 Adjust as necessary to ensure proper operation.
 - .3 Verify visibility of discharge.
- .6 Trap seal primers:
 - .1 Verify operation.
 - .2 Adjust flow rate to suit site conditions.
- .7 Pipeline strainers:
 - .1 Verify accessibility of basket.
 - .2 Clean out during commissioning until system clean.
- .6 Commissioning reports:
 - .1 Record all results on approved report forms.
 - .2 Include signature of tester and supervisor.
- .7 Verification:
 - .1 Notify the Consultant 24 hours before commencing tests.
 - .2 Have all tests and procedures witnessed by the Consultant.
- .8 Training: train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures in accordance with Section 22 05 00.
- .9 Demonstrations:
 - .1 Demonstrate full compliance with Design Criteria in accordance with Section 22 05 00.
 - .2 Demonstrations also to show completeness of O&M personnel training.
- .10 Submit typed and witnessed plumbing test certificates to the Consultant for review. Include same in O&M Manuals.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Plumbing General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
.1 CAN/CSA-B45 Series-02, CSA Standards on
Plumbing Fixtures.
.2 CSA B125.3-12, Plumbing Fittings.
.3 CAN/CSA-B651-12(R2017), Barrier-Free Design.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance
with Section 01 00 00.
.2 Indicate, for all fixtures: Dimensions, construction
details, roughing-in dimensions.

1.4 OPERATIONS AND
MAINTENANCE DATA

- .1 Provide maintenance data including monitoring
requirements for incorporation into manuals
specified in Section 01 00 00.
.2 Include:
.1 Description of fixtures and trim, giving
manufacturer's name, type, model, year, capacity.
.2 Details of operation, servicing, maintenance.
.3 List of recommended spare parts.

1.5 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Separate and recycle waste materials in accordance
with regulatory authorities.
.2 Collect and separate plastic, paper packaging and
corrugated cardboard in accordance with Waste
Management Plan.
.3 Fold up metal banding, flatten and place in
designated area for recycling.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Fixture piping.
 - .1 Cold water supplies to each fixture:
 - .1 Chrome plated rigid supply pipes each with screwdriver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with cleanout on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.
- .5 Chair carriers:
 - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: measured from finished floor.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments: Adjust water flow rate to design flow rates.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 This section is to be read in conjunction with and covers items common to all sections of Division 23. It is intended to supplement the requirements of Section 01 00 00.
- .2 Specification sections referred to within this section are as follows:
 - .1 Concrete: Section 03 30 00
 - .2 Metal Fabrications: Section 05 50 00
 - .3 Fireproofing: Section 07 80 00
 - .4 Sealants: Section 07 92 00
 - .5 Plumbing Specialties and Accessories: Section 22 42 01
 - .6 Duct Accessories: Section 23 33 00
 - .7 Building Automated Systems: Section 23 09 00

1.2 GENERAL

- .1 Perform the Work included in these specifications and any accompanying drawings, by providing all supervision, labour, materials, supplies, construction tools, equipment and services, hoisting, transportation, receiving, handling, storage, and all other services and expenditures; unless otherwise specified in the scope. Including those not specifically mentioned but which are necessary for a complete installation.

1.3 REFERENCES

- .1 NEMA MG1-2016, Motors and Generators.
- .2 CSA C390-10(R2015), Test Methods, Marking Requirements, and Energy Efficiency Levels for Three-Phase Induction Motors.
- .3 CAN/CGSB 1.181-99, Ready-Mix Organic Zinc-Rich Coatings.

1.4 EQUIPMENT

- .1 Equipment assemblies comprised of electro-mechanical components must be CSA approved where possible and shall bear the appropriate label. If the equipment in question is not CSA approved as an assembly, have the manufacturer arrange and pay for Spot approval and labelling of the equipment prior to installation.

1.5 EQUIPMENT
INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems without interfering with other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated lifetime bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

1.6 ANCHOR BOLTS
AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by others.

1.7 TRIAL USAGE

- .1 The Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.8 PROTECTION OF
OPENINGS

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.9 ELECTRICAL

- .1 Electrical work and electrical equipment:
 - .1 Refer to mechanical drawings to determine mechanical/electrical wiring responsibilities.

1.10 MOTORS

- .1 Provide motors for mechanical equipment as specified and as indicated.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install alternative motor approved by the Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motor frames to be either of rigid fabricated steel or castings.

1.10 MOTORS
(Cont'd)

- .4 All studs, nuts and bolts subject to periodic removal maintenance purposes must have Unified or American Standard Threads.
- .5 Specific requirements:
 - .1 Specific requirements for motors are given on Equipment Schedules or other sections of this specification.
 - .2 In general, fractional horsepower motors smaller than 560 w (3/4 hp) to be 115 volts, single phase, 60 Hz. Motors 560 w (3/4 hp) and larger to be 575 volts, three phase, 60 Hz or 208 volts, three phase, 60 Hz, as indicated or as specified herein.
 - .3 Motors for variable A/C frequency drives shall be Definite Purpose Invertor Fed Motors in accordance with NEMA MG1, Part 31; compatible with the VFD.
 - .4 Provide 3-phase motor starters complete with phase loss protection.
- .6 Performance requirements:
 - .1 Provide motors designed for continuous duty at rated output and for full voltage starting, unless another starting method is specified.
 - .2 Motors must be capable of operation at rated output without exceeding their breakdown torque point during voltage dips to 80 percent of rated voltage for periods of up to 15 seconds during electrical system disturbance.
 - .3 As a minimum, motors to develop torques as specified by NEMA MG1, design B for 3 phase motors and design N or O for single phase motors. The motor code letter must be between B and H unless specified otherwise.
 - .4 Operation within service factor: provide motors sized to operate within the nameplate horsepower rating for all operating conditions. Normal operation should not require operation at a service factor greater than 1.0.
 - .5 Motors must be high efficiency. Their quoted efficiency rating at either 75% or 100% of their rated load must be equal to or greater than the efficiency values in the following table when derived using CSA C390 method.

<u>HP OF MOTOR</u>	<u>ENERGY EFFICIENCY VALUE AT 1760 RPM</u>
1.0	82.5
1.5	84.0
2.0	84.0
3.0	87.5
5.0	87.5

1.10 MOTORS
(Cont'd)

7.5	89.5
10.0	89.5
15.0	91.0
20.0	91.0
25.0	92.4
30.0	92.4
40.0	93.0
50.0	93.0

.7 Winding temperature rating:

.1 Motors to be rated for continuous operation without exceeding the following values of temperature rise above an ambient of 40°C.

<u>ENCLOSURE</u>	<u>MEASUREMENT BY THERMOMETER °C</u>	<u>MEASUREMENT BY RESISTANCE °C</u>
	CLASS B	CLASS B
Drip Proof	60	70
Drip Proof Fully Guarded	70	80
Totally Enclosed Fan Cooled	75	80

.2 Drip proof motors specified for 60°C rise continuous rating with Class B insulation must have a service factor of not less than 1.15.

.8 Insulation: use Class B insulation for the motor windings. Provide additional varnish impregnation and bake treatments to the finish wound stator as further protection against severe moisture or dust laden environments.

.9 Bearings:

.1 Motor bearings to preferably be of the grease lubricated type, constructed and mounted to exclude dirt and moisture and to prevent lubricant from reaching the motor internals.

.2 Anti-friction and generally all bearings must have a minimum rating life of 100,000 hours, for the loading and speed conditions corresponding to the application.

.10 Enclosures:

1.10 MOTORS
(Cont'd)

- .10 (Cont'd)
 - .1 Provide drip proof motors for all indoor applications except in cases where environmental conditions of severe dust laden atmospheres or in extremely wet locations, require alternative arrangements, or where indicated otherwise.
 - .2 Motors to have the direction of rotation marked on the stator frame or end brackets.
 - .3 Provide 3 phase motors with lifting lugs or eyes.
 - .4 Provide totally enclosed motors with drain holes fitted with pipe plugs.
- .11 Terminal box:
 - .1 Arrange terminal boxes to permit rotation through 360° in 90° intervals and locate at a position which will allow conduit access in any of the four rotation positions.
 - .2 Provide a grounding lug inside the terminal boxes of motors rated 74.6 (100 hp) and smaller.
- .12 Base plate:
 - .1 Provide a common base plate for the driven equipment and motor.
 - .2 Provide adjustable slide bases or rails for all motors where belt drives are used.
- .13 Painting: remove all rust, scale and grease from the stator painting. Paint internals and externals to prevent corrosion after cleaning, using the Manufacturer's standard paints.
- .14 Single phase motors: provide single phase motors of the capacitor-start or two-value capacitor type.
- .15 Marking: mark all motors according to CSA C22.2.

1.11 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors up to 7.5 kw (10 hp): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 Minimum drive rating: 2.0 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

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<u>1.11 BELT DRIVES (Cont'd)</u>	.5	Motor slide rail adjustment plates to allow for 150mm minimum centre line adjustment.
-
<u>1.12 GUARDS</u>	.1	Provide guards for unprotected drives and/or drive couplings.
	.2	Guards for belt drives: .1 Expanded metal screen welded to steel frame. .2 Nominal 1.214mm (18 ga.) thick sheet metal tops and bottoms. .3 38mm dia holes on both shaft centres for insertion of tachometer. .4 Removable for servicing.
	.3	Provide means to permit lubrication and use of test instruments with guards in place.
	.4	Install belt guards to allow movement of motors for adjusting belt tension.
	.5	Guard for flexible coupling: .1 "U" shaped, nominal 1.519mm (16 ga.) thick galvanized mild steel. .2 Securely fasten in place. .3 Removable for servicing.
	.6	Unprotected fan inlets or outlets: .1 Wire or expanded metal screen, galvanized, 19mm mesh. .2 Net free area of guard: not less than 80% of fan openings. .3 Securely fasten in place. .4 Removable for servicing.
-
<u>1.13 EQUIPMENT SUPPORTS</u>	.1	Equipment supports supplied by equipment manufacturer: specified elsewhere in Division 23.
	.2	Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Section 05 50 00.
	.3	Mount base mounted equipment on "Type B1" chamfered edge housekeeping pads, minimum of 100mm high and minimum 100mm larger than equipment dimensions all around. Concrete specified in Section 03 30 00.
-
<u>1.14 SLEEVES</u>	.1	Pipe sleeves:
-

1.14 SLEEVES
(Cont'd)

- .1 (Cont'd)
 - .1 Through masonry, concrete or fire rated assemblies: nominal 0.912mm (20 ga.) galvanized steel.
 - .2 Through foundation walls: Schedule 40 steel pipe with annular in continuously welded at midpoint of wall.
 - .3 Provide 25mm clearance all around service piping or ducting for building settlement/ movement.
- .2 Duct sleeves:
 - .1 Through masonry, concrete, or fire rated assemblies: in accordance with SMACNA Fire Damper Guide, Table 2-2, and as below.
- .3 Terminate pipe sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25mm above other floors.
- .4 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof, fire retardant, non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping to maintain fire rating integrity.
 - .3 Where sleeves pass through interior walls not fire-rated, provide acoustic caulking.
 - .4 Allow for no contact between copper tube or pipe and ferrous sleeve.
 - .5 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .6 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CAN/CGSB-1.181.

1.15 PREPARATION
FOR FIRESTOPPING

- .1 Firestopping material and installation within annular space between pipes, ducts, insulation and adjacent fire separation: specified in Section 07 80 00.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe to move without damaging firestopping material.
- .4 Insulated pipes and ducts: cut back insulation at fire separation to allow proper firestopping.

1.15 PREPARATION
FOR FIRESTOPPING
(Cont'd)

- .5 Firestopping material for piping and duct penetrations in Section 07 80 00.

1.16 ESCUTCHEONS

- .1 On pipes passing through walls, partitions, floors and ceilings in finished areas.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.

1.17 TESTS

- .1 Give 24 hour written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by the Consultant.
- .3 Conduct tests in presence of the Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
.1 General: maintain test pressure without loss for 2 hours unless otherwise specified.
.2 Hydraulically test hydronic piping systems at 1-1/2 times system operating pressure or minimum 862 kPa, whichever is greater.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.18 PAINTING

- .1 Finish painting as specified in Section 09 91 23 except where specified elsewhere in the Mechanical Specifications.
- .2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original.

-
<u>1.18 PAINTING</u> <u>(Cont'd)</u>	.4	Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.
<u>1.19 SPARE PARTS</u>	.1	Furnish spare parts as follows: .1 One (1) set of belts for each piece of machinery. .2 One (1) filter cartridge or set of filter media for each filter or filter bank in addition to final operating set. See also Section 23 44 00. .3 Two (2) vandal-proof screw tools. .4 Thermostat and control components (including cabinets) keys. .5 And as specified elsewhere.
<u>1.20 SPECIAL TOOLS</u>	.1	Provide one (1) set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 00 00.
	.2	Furnish one (1) commercial quality grease gun, grease and adaptors to suit the various types of grease and grease fittings.
<u>1.21 ACCESS DOORS</u>	.1	Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.
	.2	Flush mounted 600mm x 600mm for body entry and 300mm x 300mm for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Provide fire-rated access doors where penetrating fire-rated construction. Maintain fire rating integrity of construction.
	.3	Material: .1 Special areas only such as tiled surfaces: use stainless steel with #4 satin finish. .2 Remaining areas: use prime coated steel. .3 Nominal 1.897mm (14 ga.) material.
	.4	Installation: .1 Locate so that concealed items are accessible. .2 Locate so that hand or body entry (as applicable) is achieved. .3 Installation is specified in applicable sections.
-

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<u>1.21 ACCESS DOORS (Cont'd)</u>	.5	Refer also to Section 23 33 00 for duct access doors.
	.6	Acceptable Material: Acudor, Buensod, LeHage, Zurn.
<u>1.22 DIELECTRIC COUPLINGS</u>	.1	General: .1 Compatible with and to suit pressure and temperature rating of piping system. .2 Where pipes of dissimilar metals are joined.
	.2	Pipes NPS 2 and under: isolating unions.
	.3	Pipes NPS 2-1/2 and over: isolating flanges.
	.4	Acceptable Material: EBCO, Walter Valiet Co.
<u>1.23 DRAIN VALVES</u>	.1	Locate at low points and at section isolating valves unless otherwise specified.
	.2	Minimum NPS 3/4 unless otherwise specified: bronze, ball valve with hose end male thread, complete with cap and chain.
	.3	No water from any drain or relief valve to discharge on the floor. Pipe drains to hub drains or funnel floor drains.
<u>1.24 OPERATING AND MAINTENANCE INSTRUCTIONS</u>	.1	Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
	.2	Provide demonstrations and instructions in conjunction with the appropriate equipment manufacturers representatives.
	.3	Use operation and maintenance manual, record drawings, audio visual aids, etc. as part of instruction materials.
	.4	Have instructions in maintenance and operating of the following equipment given by factory trained personnel and for the time period specified. The time specified does not include the time for start-up of systems and equipment:
-

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<u>1.24 OPERATING AND MAINTENANCE INSTRUCTIONS (Cont'd)</u>	.4	(Cont'd) .1 Give instruction on the operation and maintenance of all mechanical components including but not limited to: pumps, fans, air handling units, boilers and domestic hot water system. Instruction period to be for a period of not less than one (1) working day. Review with the instructors for an additional 1/2 working day, 90 days after the acceptance of the building by the Owner. .2 Where more detailed instructions for some equipment or systems are called for in other sections of the specifications, those sections of the specifications shall take precedence over this section.
<u>1.25 OPERATION AND MAINTENANCE MANUAL</u>	.1	Provide operation and maintenance data for incorporation into manual specified in Section 01 00 00.
	.2	Operation and maintenance manual to be approved by and final copies deposited with the Consultant before final inspection.
	.3	Operation data to include: .1 Control schematics for each system including environmental controls. .2 Description of each system and its controls. .3 Description of operation of each system at various loads together with reset schedules and seasonal variances. .4 Operation instruction for each system and each component. .5 Description of actions to be taken in event of equipment failure.
	.4	Maintenance data to include: .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment. .2 Data to include schedules of tasks, frequency, tools required and task time.
	.5	Performance data to include: .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete. .2 Equipment performance verification test results. .3 Special performance data as specified elsewhere.
-

1.25 OPERATION AND
MAINTENANCE MANUAL
(Cont'd)

- .5 (Cont'd)
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
- .6 Approvals:
 - .1 Submit draft copies of Operation and Maintenance Manual to the Consultant for approval. Submission of individual data will not be accepted unless so directed by the Consultant.
 - .2 Make changes as required and re-submit as directed by the Consultant.
- .7 Additional data: Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.26 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. (eg. access door swing spaces).
- .3 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify as to current model production.
 - .5 Certification of compliance to applicable codes.

1.27 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork, fans and air handling systems.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

1.28 DRAWINGS

- .1 The Consultant's mechanical drawings:
 - .1 Are not intended to show structural details or architectural features.

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- 1.28 DRAWINGS (Cont'd)
- .1 (Cont'd)
 - .2 Are not to be scaled.
 - .3 Except where dimensioned, indicate general mechanical layouts only. Because of the small scale of the Mechanical Drawings, it is not possible to show all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories which are required to meet site conditions.
 - .2 Provide field drawings to indicate relative position of various services when required by the Consultant.
- 1.29 RECORD DRAWINGS
- .1 Refer to Section 01 00 00.
- 1.30 WARRANTIES
- .1 Make good all defects other than normal wear and tear during the life of the warranty period. Warrant all work and installed equipment to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the warranty. At any time during this period, make any necessary changes and adjustments, or replacements, to accomplish this at no additional cost to the project.
- 1.31 PERMITS AND REGULATIONS
- .1 Comply with all regulations and authorities having jurisdiction where applicable, including but not limited to the following:
 - .1 Department of Labour.
 - .2 Fire Marshall.
 - .3 Plumbing Inspector.
 - .4 Provincial Board of Insurance Under-writers.
 - .5 National Building Code.
 - .6 Occupational Health & Safety Act.
 - .7 NFPA
 - .2 Obtain and pay for any permits required by local codes and regulations and arrange for inspections applicable to the Contractor responsibilities.
 - .3 Any additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the Owner.
-

1.32 RELATED WORK

- .1 Caulking:
 - .1 Perform caulking in compliance with the requirements of Section 07 92 00.
- .2 Welding:
 - .1 Have welding performed as specified in Division 23 for all mechanical piping and structural supports and hangers.
 - .2 Have welding performed by certified welders in accordance with the Provincial Labour Requirements and By-Laws.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Firestopping: Section 07 80 00
- .2 Cleaning and Start-up of Mechanical Piping Systems:
Section 23 08 02

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.181-99, Ready-Mixed Organic
Zinc-Rich Coating.

1.3 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Separate and recycle waste materials in accordance
with authorities having jurisdiction.
- .2 Collect and separate plastic, paper packaging and
corrugated cardboard in accordance with Waste
Management Plan.
- .3 Fold up metal banding, flatten and place in
designated area for recycling.

PART 3 - EXECUTION

3.1 CONNECTIONS TO
EQUIPMENT

- .1 In accordance with manufacturer's instructions
unless otherwise indicated.
- .2 Use valves and either unions or flanges for
isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on
vibration isolation and when piping subject to
movement.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and
components for observation of operation, inspection,
servicing, maintenance and as recommended by
manufacturer.

3.2 CLEARANCES
(Cont'd)

- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated or specified otherwise.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 bronze gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install air vents at high points in piping systems and where indicated.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC
COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: Isolating flanges.

3.6 PIPEWORK
INSTALLATION

- .1 Screwed fittings to be jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.

3.6 PIPEWORK
INSTALLATION
(Cont'd)

- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main. Hole saw (or drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework so as to minimize furring space, maximize headroom, conserve space.
- .8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.
- .9 Except where indicated, install so as to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated and specified.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above the horizontal position unless otherwise indicated.
 - .4 Valves to be accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate, ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Install plug cocks or ball valves for glycol service.
 - .9 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

3.6 PIPEWORK
INSTALLATION
(Cont'd)

- .15 Check Valves:
.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.8 PREPARATION FOR
FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 80 00.
.2 Uninsulated unheated pipes not subject to movement: No special preparation.
.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.9 FLUSHING OUT
OF PIPING SYSTEMS

- .1 In accordance with Section 23 08 02.
.2 Before start-up, clean interior of piping systems in accordance with relevant sections of Divisions 22 and 23.
.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Mechanical General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 ASME B31.1-2016, Power Piping.
- .2 ANSI/ASME Boiler and Pressure Vessel Code-2015:
.1 Section 1: Power Boilers.
.2 Section V: Nondestructive Examination.
.3 Section IX: Welding and Brazing Qualifications.
- .3 ASME B31.9-2014, Building Services Piping.
- .4 CSA W47.2-09(2014), Certification of Companies for Fusion Welding of Aluminum.
- .5 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .6 CSA B51-14, Boiler, Pressure Vessel and Pressure Piping Code.
- .7 CAN/CSA-W117.2-12, Safety in Welding, Cutting and Allied Processes.
- .8 CSA W178.1-14, Certification of Welding Inspection Organizations.
- .9 CSA W178.2-14, Certification of Welding Inspectors.
- .10 ANSI/AWSB2.1/B2.1M-2015, Welding Procedures and Performance Qualifications.
- .11 AWS C1.1/C1.1M-2012, Recommended Practices for Resistance Welding.
- .12 AWS WI:2015, Welding Inspection Handbook.
- .13 ANSI/AWWA C206-17, Field Welding of Steel Water Pipe.

1.3 WELDERS
QUALIFICATIONS

- .1 Welding qualifications to be in accordance with CSA B51.

1.3 WELDERS
QUALIFICATIONS
(Cont'd)

- .2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction.
- .3 Furnish welder's qualifications to Consultant.
- .4 Each welder to possess identification stamp issued by authority having jurisdiction.
- .5 Certification of companies for fusion welding of aluminum to be in accordance with CSA W47.2.

1.4 INSPECTORS'
QUALIFICATIONS

- .1 Inspectors to be qualified to CSA W178.2.

1.5 WELDING
PROCEDURES

- .1 Registration of welding procedures in accordance with CSA B51.
- .2 Copy of welding procedures to be available for inspection at all times.
- .3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2.

PART 2 - PRODUCTS

2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Welding to be in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B2.1/B2.1M, AWS C1.1/C1.1M, and applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION
REQUIREMENTS

- .1 Identify each weld with welder's identification stamp.
- .2 Backing rings:

3.2 INSTALLATION
REQUIREMENTS
(Cont'd)

- .2 (Cont'd)
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 2 and smaller: install welding type sockets.
 - .2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND
TESTS - GENERAL
REQUIREMENTS

- .1 Review all weld quality requirements and defect limits of applicable codes and standards with Consultant before any work is started.
- .2 Formulate "Inspection and Test Plan" in association with Consultant.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for visual inspection of all welds during early stages of welding procedures in accordance with AWS WI. Repair or replace all defects as required by codes and as specified herein.

3.4 EXAMINATIONS
AND TESTS

- .1 General:
 - .1 Perform examinations and tests by tradesmen qualified in accordance with CSA W178.1 and CSA W178.2 and approved by the Consultant.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test all welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.
- .2 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .3 Failure of visual examinations:
 - .1 Upon failure of any weld by visual and/or hydrostatic examination, perform additional testing as directed by Consultant.
- .4 Hydrostatically test all welds to requirements of ANSI/ASME B31.1.

3.5 DEFECTS CAUSING REJECTION .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

3.6 REPAIR OF WELDS WHICH FAILED TESTS .1 Re-inspect and re-test repaired or re-worked welds at the Contractor's expense.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Mechanical Identification: Section 23 05 53

1.2 REFERENCES

- .1 ASME B40.100-2013, Gauges-Pressure, Indicating Dial Type-Elastic Element.
- .2 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .3 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Submit manufacturer's product data for following items:
 - .1 Thermometers.
 - .2 Pressure gauges.
 - .3 Stop cocks.
 - .4 Wells.
 - .5 Snubbers.

1.4 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Thermometers and pressure gauges to operate at mid point of scale or range.

2.2 DIRECT READING
THERMOMETERS

- .1 Industrial, variable angle type, aluminum case, graduated in degrees Celsius and degrees Fahrenheit brass stem, liquid filled, 225 mm scale length: to CAN/CGSB 14.4.
 - .1 Acceptable Material: Trerice BX9; Weiss; Taylor; Baker; Winter's.
-

- 2.3 PRESSURE GAUGES
- .1 112 mm dia., dial type: to ANSI/ASME B40.1, Grade A, having 1% of full scale over middle half of range accuracy unless otherwise specified. Graduated in C and F.
 - .1 Acceptable Material: Trerice 620B series; Weiss; Taylor, Baker; Winter's.
 - .2 Provide mini ball valve and:
 - .1 Snubber for pulsating operation.
 - .2 Diaphragm for corrosive service.

PART 3 - EXECUTION

- 3.1 GENERAL
- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
 - .2 Provide engraved lamicaid nameplates as specified in Section 23 05 53, identifying medium.
 - .3 Locate between equipment and first fitting or valve.

- 3.2 PRESSURE GAUGES
- .1 Install in following locations:
 - .1 Domestic and fire water entrance.
 - .2 Suction and discharge of pumps over 1/2 hp.
 - .2 Use extensions on all pressure gauge connections to permit mini-ball valve complete with snubber to be clear of insulation and jacket.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Metal Fabrications: Section 05 50 00
- .2 Plumbing General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 ANSI B31.1-2016, Power Piping.
- .2 MSS SP-58-2009, Pipe Hangers and Supports -
Materials, Design and Manufacture.
- .3 ASTM A307-14, Standard Specification for Carbon
Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .4 ASTM A563-15, Standard Specification for Carbon and
Alloy Steel Nuts.
- .5 NFPA 13-2016, Installation of Sprinkler Systems.
- .6 NFPA 20-2016, Standard for Installation of
Stationary Pumps for Fire Protection.

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance
with Section 01 00 00.
- .2 Indicate on manufacturers catalogue literature the
following:
 - .1 Upper attachment.
 - .2 Middle attachment.
 - .3 Pipe attachment.
 - .4 Riser clamps.
 - .5 Shields and saddles.
 - .6 Sway braces.

1.4 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into
manual specified in Section 01 00 00.

1.5 DESIGN
REQUIREMENTS

- .1 Construct pipe hanger and support to manufacturer's
recommendations utilizing manufacturer's regular
production components, parts and assemblies.

1.5 DESIGN
REQUIREMENTS
(Cont'd)

- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
- .3 Do not allow supports, guides, anchors to transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and ANSI/MSS SP-58.
- .2 Support only from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

2.2 UPPER
ATTACHMENTS

- .1 Concrete:
 - .1 Inserts for cast-in-place concrete: galvanized steel wedge to MSS SP-58, type 18. ULC listed for pipe NPS 3/4 through NPS 8.
 - .1 Acceptable Material: Grinnell fig. 281.
 - .2 Carbon steel plate with clevis, for surface mount: malleable iron socket and expansion case and bolt. Minimum two expansion cases and bolts for each hanger.
 - .1 Acceptable Material: Grinnell, Plate fig. 49, Socket Fig. 290, Expansion Case fig. 117.
- .2 Steel beam (bottom flange):
 - .1 Cold piping NPS 2 and under: malleable iron C clamp to ANSI/MSS SP-58, type 19. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 61.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: malleable iron beam clamp to ANSI/MSS SP-58, type 28 or 29. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 229.
- .3 Steel beam (top):

2.2 UPPER
ATTACHMENTS
(Cont'd)

- .3 (Cont'd)
 - .1 Cold piping NPS 2 and under: malleable iron "top of beam" C clamp to ANSI/MSS SP-58, type 19. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 61.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to ANSI/MSS SP-58, type 25. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 227.
- .4 Steel joist:
 - .1 Cold piping NPS 2 and under: steel washer plate with double locking nuts.
 - .1 Acceptable Material: Grinnell fig. 60.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.
 - .1 Acceptable Material: Grinnell: washer plate, fig. 60, clevis, fig. 66, socket, fig. 290.
- .5 Steel channel or angle (bottom):
 - .1 Cold piping NPS 2 and under; malleable iron C clamp to ANSI/MSS SP-58, type 23. ULC listed.
 - .1 Acceptable Material: Carpenter & Patterson, fig. 196 c/w locknut; Grinnell fig. 86.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping; universal channel clamp. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 226.
- .6 Steel channel or angle (top):
 - .1 Cold piping NPS 2 and under; malleable iron "top of beam" C clamp to ANSI/MSS SP-58, type 19. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 61.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to ANSI/MSS SP-58, type 25. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 227.

2.3 MIDDLE
ATTACHMENT (ROD)

- .1 Carbon steel threaded rod, cadmium finished.
 - .1 Acceptable Material: Grinnell fig. 146.

2.4 PIPE ATTACHMENT

- .1 Cold piping, steel or cast iron: hot piping steel, with less than 25mm horizontal movement; hot piping, steel, with more than 300mm middle attachment rod length: adjustable clevis to ANSI/MSS SP-58, type 1. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 260.
- .2 Cold copper piping; hot copper piping with less than 25mm horizontal movement; hot copper piping with more than 300mm middle attachment rod length: adjustable clevis to ANSI/MSS SP-58, type 1. Copper plated.
 - .1 Acceptable Material: Grinnell fig. CT 65.

2.5 RISER CLAMPS

- .1 Steel or cast iron pipe: primed carbon steel to ANSI/MSS SP-58, type 42. ULC listed.
 - .1 Acceptable Material: Grinnell fig. 261.
- .2 Copper pipe: carbon steel copper finished to ANSI/MSS SP-58, type 42.
 - .1 Acceptable Material: Grinnell fig. CT-121.

2.6 SADDLES AND SHIELDS

- .1 Cold piping NPS 1-1/4 and over: protection shield with high density insulation under shield with uninterrupted vapor barrier.
 - .1 Acceptable Material: Grinnell fig. 167.
- .2 Hot piping NPS 1-1/4 and over: protective saddle with insulation under saddle.
 - .1 Acceptable Material: Grinnell fig. 160 to 166.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.7 SUPPLEMENTARY STRUCTURAL STEEL MEMBERS

- .1 Provide as required. Refer to Section 05 50 00.

2.8 CONCRETE EQUIPMENT PAD

- .1 Mount base mounted equipment on chamfered edge housekeeping pads, minimum 100mm high and minimum 100mm larger than equipment dimensions all around. Concrete specified in Section 03 30 00.

2.9 EQUIPMENT
SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.10 EQUIPMENT
ANCHOR BOLTS AND
TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

PART 3 - EXECUTION

3.1 HANGER SPACING

- .1 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as in table below, whichever is more stringent.
- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Copper piping: up to NPS 1/2: every 1524mm maximum.
- .3 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .4 Within 300mm of each horizontal elbow.

<u>Pipe Size: NPS</u>	<u>Rod Diameter</u>	<u>Spacing Steel</u>	<u>Spacing Copper</u>
up to 1 1/4	9.5mm	2100mm	1800mm
1-1/2	9.5mm	2700mm	2400mm
2	9.5mm	3000mm	2700mm
2-1/2	9.5mm	3600mm	3000mm
3	9.5mm	3600mm	3000mm
4	16mm	4200mm	3600mm
5	16mm	4800mm	---
6	22mm	5100mm	---
8	22mm	5700mm	---

- .2 Space hangers for parallel runs of piping such that the finished, insulated clearance between the pipes, and between a pipe and a wall, is minimum 50mm.

3.2 HANGER
INSTALLATION

- .1 Position hanger so that rod is vertical in operating (hot) condition.
- .2 Adjust hangers to equalize load of piping on structure.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Cast-in-Place Concrete: Section 03 30 00

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Provide separate shop drawings for each isolated system complete with performance and product data.
- .3 No seismic control measures are required.

PART 2 - PRODUCTS

2.1 SPRING HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1: stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
- .3 Performance: 5% maximum transmissibility and as indicated.
- .4 Acceptable Manufacturer: Korfund; Vibro-Acoustics; Vibron; Mason.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .2 Confirm piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping and ducting passing through walls and floors do not transmit vibrations.

3.1 INSTALLATION
(Cont'd)

- .3 Isolate all piping within mechanical and/or ventilation rooms or within 15m total pipe length of vibration isolated equipment from the building structure by means of vibration isolation mounts, resilient pipe guides, and resilient penetration sleeve/seals.
- .4 Where isolation is bolted to floor, use vibration isolation rubber washers.
- .5 Block and shim level all bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Confirm there is no physical contact between isolated equipment and building structure.
- .6 Install spring hangers for horizontal unit heaters, in-line fans and suspended air handling units.
- .7 Isolate all fans and air handling units not internally isolated from the building structure by means of isolators.
- .8 Electrical wiring and conduit to vibration isolated equipment to be flexible connections.
- .9 Isolate non-vibrating equipment in mechanical rooms and/or ventilation rooms such as tanks, which are connected to vibrating equipment via piping, etc., from the floors with elastomeric pads.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
 - .3 Provide ULC and CSA registration plates as required by respective agency and inspection authority.

- 1.2 SAMPLES
- .1 Submit samples in accordance with Section 01 00 00.
 - .2 Submit samples and lists of proposed wording for approval before engraving.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS NAMEPLATES
- .1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters and numbers.
 - .2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and HP of motors, year manufactured, RPM, SF, efficiency, etc.

- 2.2 SYSTEM NAMEPLATES
- .1 Colour:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background except where required otherwise by applicable codes.
 - .2 Construction: 3mm thick, laminated plastic or white anodized aluminum, matte finish, square corners, letters accurately aligned and machine engraved into core. Etched in data on aluminum sheet is unacceptable.
 - .3 Sizes:
 - .1 Conform to following table:

<u>Size #</u>	<u>Dimensions (mm. x mm.)</u>	<u>No. of Lines</u>	<u>Height (mm)</u>
1	10 x 50	1	3
2	12 x 75	1	5
3	12 x 75	2	3

2.2 SYSTEM
NAMEPLATES
(Cont'd)

.3 (Cont'd)

4	19 x 100	1	8
5	19 x 200	1	8
6	19 x 100	2	5
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	19

.2 Use average of 25 letters/numbers per nameplate.

.3 Use size #6 for terminal cabinets and control panels.

.4 Use size #9 for equipment in mechanical rooms.

.5 Use size #2 for control components and sensors.

2.3 PIPING

.1 General:

.1 To CAN/CGSB-24.3.

.2 Identify medium by lettered legend, classification by primary and secondary colours, direction of flow by arrows.

.2 Sizes:

.1 Legend: block capitals to following table:

<u>Outside Dia. of Pipe or Insulation</u>	<u>Size of Letters</u>
up to NPS 1-1/4	12mm
NPS 1-1/2 to 2	19mm
NPS 2-1/2 to 6	32mm
NPS 8 to 10	62mm
over NPS 10	87mm

.2 Primary colour bands:

.1 At valves and fittings: 200mm long.

.2 Elsewhere: 100mm long.

.3 Secondary colour bands: 50mm wide, 75mm in from one end of primary colour band.

.4 Arrows:

.1 Outside diameter of pipe/insulation 38mm and greater: 150mm long x 38mm high.

.2 Outside diameter of pipe/insulation less than 38mm: 100mm long x 50mm high.

.3 Use double headed arrows where flow is reversible.

.3 Material:

.1 Paint: to CAN/CGSB-1.60.

2.3 PIPING
(Cont'd)

- .3 (Cont'd)
- .2 Legend markers, arrow colour bands: plastic coated cloth material with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 148.8°C and intermittent temperature of 204.4°C. Apply to clean, prepared surfaces. Wrap tape around pipe or pipe covering with ends overlapping one (1) pipe diameter.
- .3 Waterproof and heat resistant plastic marker tags: for pipes and tubing NPS and smaller.
- .4 Acceptable Material: W.H. Brady Inc., Seton Name Plate Corp., Setmark Pipe Markers, S.M.S. Construction Specialties.
- .4 Colours: Where not covered by table below, submit legend, primary and secondary classification colours to Consultant for approval.
- .5 Table: Pipe and valve identification. Use existing facility identification system and provide new as required.

<u>Pipe Marker Legend</u>	<u>Valve Tag Legend</u>	<u>Primary Colour</u>	<u>Secondary Colour</u>
Domestic cold water	D.C.W.	Green	None
Domestic hot water	D.H.W.L	Green	None
Storm sewer	S.S.	Green	None
Sanitary sewer	SAN.S.	Green	None
Vent (Plumbing)	V.P.	Green	None

- .1 Legend and arrows: Black or white to contrast with primary colour.
- .6 Control wiring as specified in Section 23 09 00.

2.4 DUCTWORK

- .1 50mm high black stencilled letters indicating fan/system I.D. and directional flow arrows 150mm long x 50mm high. Mark "Odour" on odour collection duct work.

2.5 VALVES AND CONTROLLERS

- .1 Circular white plastic tags with 12mm high engraved black lettering.

2.6 CONTROLS
IDENTIFICATION

- .1 Identify all control systems, equipment, components, and sensors.
- .2 Inscription to identify function and, where applicable, fail-safe position.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do identification work in accordance with CAN/CGSB-24.3.
- .2 Provide ULC and CSA registration plates, as required by respective agency.
- .3 Provide identification only after all painting has been completed.

3.2 LOCATION OF
NAMEPLATES

- .1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system.
- .2 Provide stand-offs for nameplates on hot surfaces and insulated surfaces.
- .3 Do not insulate or paint over plates.

3.3 PIPING

- .1 Locations:
 - .1 On long straight runs in open areas, in mechanical and ventilation equipment rooms, and in areas with no ceilings so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 9m intervals.
 - .2 Adjacent to all changes in direction.
 - .3 At least once in each small room through which piping passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of any separation such as walls, floors and partitions.
 - .6 Where piping is concealed in pipe chase, ceiling space, or other confined space, at entry and leaving points and adjacent to each access opening. In ceiling space, piping systems shall be identified every 9m (maximum) and as specified herein.

3.3 PIPING
(Cont'd)

- .1 (Cont'd)
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close to valve as possible, preferably on upstream side.
 - .9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.
 - .10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

3.4 DUCTWORK

- .1 Stencil over final finish only.
- .2 Locations of ductwork identification:
 - .1 On long straight runs in open areas in mechanical and ventilation equipment rooms and in areas with no ceilings so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 9m intervals.
 - .2 Adjacent to all changes in direction.
 - .3 At least once in each small room through which ductwork passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of any separation such as walls, floors and partitions.
 - .6 Where ductwork is concealed in duct chase, ceiling space or other confined space, at entry and leaving points and adjacent to each access opening, maximum 9m apart.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled dampers. Where this is not possible, place identification as close to damper as possible, preferably on upstream side.
 - .9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.
 - .10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.
 - .11 Beside each access door.

3.5 VALVES AND
CONTROLLERS

- .1 Secure tags with non-ferrous chains or closed "S" hooks for valves and operating controllers except at plumbing fixtures and radiation.
- .2 Provide circular 12mm dia. colour coded self-adhesive valve identification tabs on the underside of suspended ceiling systems, attached to the suspension grid, located at all heating, domestic water, and bearing the same colours as scheduled in 2.3.5. Where two (2) colours are shown use a second inner 6mm dia. tab centred on the primary 12mm tab. See paragraph 2.7.

PART 1 - GENERAL

1.1 GENERAL

- .1 A balancing and certifying agent, hereinafter referred to as "the Agency", will balance and certify all air handling systems including exhaust systems.
 - .1 Acceptable Recognized Agents: Associated Air Balance Council (AABC) agents, National Environmental Balancing Bureau (NEBB) member agents.
 - .2 Relevant, demonstrated, minimum 5-year experience with similar projects may be substituted for the above standard of acceptance, provided that the proposed Agency makes such a request, enclosing appropriate references, during the Tender Period.
- .2 The Agency will be responsible to the Contractor but report jointly to the Consultant and the Contractor. Report in writing to the Consultant discrepancies or items not installed in accordance with the Contract Documents.
- .3 Balance and test all systems in accordance with the latest and most stringent measures stipulated in either Associated Air Balance Council (AABC), "National Standards for Total System Balance"; National Environment Balancing Bureau (NEBB) "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems"; and ANSI/ASHRAE 111 "Standard Practices for Measurement, Testing, Ventilation, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems". Final balancing and certifying reports to include details of actual test procedures used and subsequent results.
- .4 Submit three (3) copies of the Balancing and Certifying report upon completion of the work.

1.2 CONTRACTOR'S
RESPONSIBILITY

- Provide the Agency within three (3) weeks of tender close, with one (1) set of Contract Documents, and as issued changes orders.
- .1 Provide shop drawings within 30 days of their approval in accordance with Section 01 00 00.
 - .1 Cooperate with the Agency in the following manner:

1.2 CONTRACTOR'S
RESPONSIBILITY
(Cont'd)

- .1 (Cont'd)
 - .1 Provide immediate labour and tools to make corrections when required without undue delay. Install balancing flow and temperature sensing and regulating devices and equipment as well as balancing dampers as required by the Agency and approved by the Consultant.
 - .2 Operate air systems and equipment as and when required by the Agency or the Consultant.
- .2 Before balancing commences, the following Work must be complete:
 - .1 All equipment operable in safe and normal operation.
 - .2 Environmental control systems complete and operable.
 - .3 Proper thermal overload protection in place for electrical equipment.
 - .4 Air systems:
 - .1 Filters clean and in place.
 - .2 Duct systems clean of debris.
 - .3 Correct fan rotation verified.
 - .4 Fire and volume dampers in place and open.
 - .5 Coil fins cleaned and combed.
 - .6 Access doors closed and duct end caps in place.
 - .7 All outlets installed and connected.
 - .8 Duct system leakage test complete.

1.3 AGENCY'S
RESPONSIBILITY

- .1 Within five (5) weeks of tender award the Agency will perform a preconstruction Contract Drawing and specification review and provide:
 - .1 A written report on deficiencies in the Contract Documents.
 - .2 Recommend where additional balancing devices should be installed.
 - .3 Detail those balance and inspection procedures stipulated in the AABC National Balancing Standards, the NEBB Procedural Standards for Balancing, or ANSI/ASHRAE Standard Practices for Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems which cannot be followed and applied to this project.
- .2 The Agency will perform a complete review and inspection of the mechanical work during construction. These inspections will occur at regular intervals to provide for a minimum of three (3) inspections. After each inspection the Agency will meet the Consultant and provide a written report to recommend corrective action.

1.3 AGENCY'S
RESPONSIBILITY
(Cont'd)

- .3 Leave all system components in proper working order and with correct settings.
 - .1 Replace belt guards.
 - .2 Close access doors.
 - .3 Close doors to electrical switch boxes.
- .4 All recorded data must represent a true, actually measured, or observed condition. Report any observed abnormal conditions in the mechanical systems or conditions, which prevent Total System Balance, immediately to the Consultant.
- .5 Permanently mark settings of all valves, dampers and other adjustment devices to allow the setting to be restored. Set and lock all memory stop balancing devices.
- .6 Prior to starting testing and balancing submit to the Consultant the following:
 - .1 A list of instruments to be used for testing and balancing.
 - .2 Calibration date for instrument and the serial number for calibration.
 - .3 Report in writing the sequence in which areas and equipment will be tested and balanced.

1.4 AIR SYSTEMS

- .1 The Agency to include the following for air systems:
 - .1 Installation data, manufacturer and model, size, arrangement discharge and class of fans, motor type, horsepower, voltage, phase, cycles, and full load amps. Location and local identification data.
 - .2 Design data, total volume, flow rate, static pressure, motor horsepower, r/min and amps, outside air flow rate, air fan r/min, fan power.
 - .3 Recorded data, air flow rates, static pressure, fan r/min, motor operating amps, motor power.
 - .4 System schematics:
 - .1 Complete systems schematic with required and actual flow rates at each outlet or inlet. Show room numbers and floors.
 - .2 Duct air quantities: for mains, branches and maximum and minimum for outside air and exhaust; duct size, pressure reading, sum of velocity measurements, average velocity, duct recorded flow rates, duct design flow rates.
 - .3 Air inlets and outlets, supply or exhaust outlet identification. Location number designation.

1.4 AIR SYSTEMS
(Cont'd)

- .1 (Cont'd)
 - .5 Manufacturer's catalogue identification and type, application factors, designated area, design and recorded velocities, design and recorded air flow rates, deflector vane or diffusion cone settings.
 - .6 Permissible deviation from design air quantities will be as follows:
 - .1 Fans: +5% to +10%.
 - .2 Diffusers and supply grilles: 0% to +10%.
 - .3 Return and exhaust grilles: 0% to - 10%.
 - .7 After submission of report, perform random check of 30% of air inlets and outlets in the presence of and as directed by the Consultant.

PART 1 - GENERAL

1.1 REFERENCES

- .1 ASTM C 411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 CAN/ULC-S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 ANSI/NFPA 90A-2015, Installation of Air Conditioning and Ventilating Systems, 2002 Edition.
- .4 ANSI/NFPA 90B-2015, Installation of Warm Air Heating and Air Conditioning Systems, 2006 Edition.
- .5 ASTM C 553-13, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .6 CAN/CGSB 51-GP-52MA-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Materials to be tested in accordance with ASTM C411.

2.2 MINERAL FIBRE
BLANKET WITH
VAPOUR BARRIER

- .1 Application: on either cold or variable temperature, round, rectangular (width less than 750 mm) or oval ducting.
 - .1 Minimum 3 m from roof or exterior walls connected to exhaust fans.
 - .2 Outside air intakes, 50 mm entire length including outside air intake plenums.
- .2 Material:
 - .1 To ASTM C553, rigid mineral fiber blanket, min. density of 0.86 watt/meter.°k; CGSB 51-GP-52M for vapour barrier, flexible foil faced (in concealed areas).
 - .2 Acceptable material: Knauf Duct Wrap FSK; Owens Corning FRK faced flexible duct insulation; Manville Microlite; Manson Alley Wrap FSK.
- .3 Fresh air intakes and exhaust plenums to have 50 mm thick insulation.

2.3 MINERAL FIBRE
RIGID WITH VAPOUR
BARRIER

- .1 Application: on either cold or variable temperature rectangular duct greater than 750 mm in width.
 - .1 Minimum 3 m from roof or exterior walls connected to exhaust fans.
 - .2 Outside air intakes, 50 mm entire length including outside air intake plenums. Thickness; 50 mm.
- .2 Material: CAN/ULC-S110M, rigid mineral fiberboard; vapour barrier, jacket and facing material.
- .3 Fresh air intakes and exhaust plenums to have 50 mm thick insulation.

2.4 FASTENINGS

- .1 Tape: self adhesive, 100 mm wide, aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - .1 Acceptable material: S. Fattal Insultape; Tuck; Compac.
- .2 Contact adhesive: quick-setting.
 - .1 Acceptable material: Armstrong 520; Childers CP.82; Foster 85-20; Bakor 230-39, asbestos free.
- .3 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.
 - .1 Acceptable material: Childers CP.80; Foster 85-75; Bakor 230-06, asbestos free.

2.4 FASTENINGS
(Cont'd)

- .4 For Canvas (All exposed ducting):
 - .1 Washable adhesive for cementing canvas lagging cloth to duct insulation.
 - .2 Acceptable material: Childers CP.52; Foster 8142W; Bakor 120-18, asbestos free.
- .5 Pins:
 - .1 Weld pins 4 mm diameter, with 32 mm diameter head for installation through the insulation. Length to suit thickness of insulation.
 - .2 Acceptable material: Duro Dyne, Clip-Pin.
 - .3 Weld pins 2 mm diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 32 mm square.
 - .4 Acceptable material: Duro Dyne spotter pins with spotter clips or stop clips as required.

2.5 JACKETS

- .1 Apply canvas jackets complete with lagging adhesive on all exposed ductwork, ULC listed plain weave, cotton fabric, 227 grams, as follows:
 - .1 Ducting that has air moving at less than 16°C to be complete with vapour barrier.
 - .2 Factory applied foil-scrim-kraft facing consisting of aluminum foil reinforced with fibreglass yarn mesh and laminated to chemically treated fire resistant kraft is acceptable for duct insulation in concealed spaces.
 - .3 Acceptable materials: Alpha-Maritex 3451-RW, Clairmont Diplag 60, S. Fattal Thermocanvas.
- .2 Acceptable material: Bakor Foilskin or approved equivalent.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved. Insulation and surfaces must be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.
- .2 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for standing duct seams and without interruption at sleeves and supports.

3.1 APPLICATION
(Cont'd)

- .3 Use stand-offs for all duct mounted control accessories.
- .4 Apply 50 mm wide x 0.912mm (20 ga.) thick galvanized sheet metal corner reinforcement to all rectangular ductwork which is to have a canvas jacket.

3.2 INSTALLATION

- .1 General:
 - .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - .2 Adhere and seal vapour barrier using vapour seal adhesives.
 - .3 Stagger longitudinal and horizontal joints, on multilayered insulation.
 - .4 Fill voids or openings between insulation and duct sleeve voids.
- .2 Mechanical fastenings:
 - .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 200 mm centres, but not less than two (2) rows per side and bottom.

3.3 FIRE PROTECTION
FOR CANVAS
JACKETING

- .1 Provide two coats of fire retardant sealer over canvas finish which is not ULC classified to CAN/ULC-S102 prior to painting.
- .2 Install canvas with ULC classification stamp on the exterior surface.

PART 1 - GENERAL

1.1 REFERENCE

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM B209M-14, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335/ASTM C335M-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C449/C449M-07(R2013), Specification for Mineral FiberHydraulicSetting Thermal Insulating and Finishing Cement.
 - .4 ASTM C533-13, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .5 ASTM C534/ASTM C534M-14, Standard Specification for Preformed Flexible Cellular Thermal Insulation In Sheet And Tubular Form.
 - .6 ASTM C547-15, Specification for Mineral Fiber Pipe Insulation.
 - .7 ASTM C553-13, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .8 ASTM C612-14, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .9 ASTM C921-10(R2015), Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51GP52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC)
 - .1 National Insulation Standards.
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 PRODUCT DATA

- .1 Submit samples in accordance with Section 01 00 00.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 00 00.

<u>1.3 SAMPLES (Cont'd)</u>	.2	Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

<u>1.4 MANUFACTURER'S INSTRUCTIONS</u>	.1	Submit manufacturer's installation instructions in accordance with Section 01 00 00.
	.2	Installation instructions to include procedures to be used, installation standards to be achieved.

<u>1.5 QUALIFICATIONS</u>	.1	Installer to be specialist in performing work of this section, and have at least three (3) years successful experience in this size and type of project, qualified to standards member of TIAC.

<u>1.6 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
	.2	Protect from weather and construction traffic.
	.3	Protect against damage from any source.
	.4	Store at temperatures and conditions recommended by manufacturer.

PART 2 - PRODUCTS

<u>2.1 FIRE AND SMOKE RATING</u>	.1	In accordance with CAN/ULC-S102: .1 Maximum flame spread rating: 25. .2 Maximum smoke developed rating: 50.
	.2	Acceptable product: Manson, Knauf, Owens Corning

<u>2.2 INSULATION</u>	.1	Mineral fibre: includes glass fibre, rock wool, slag wool.
	.2	Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

2.2 INSULATION
(Cont'd)

- .3 TIAC Code A1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C547.
 - .2 Maximum "k" factor: ASTM C547.
- .4 TIAC Code A2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: ASTM C533.
 - .2 Maximum "k" factor: ASTM C533.
 - .3 Design to permit periodic removal and reinstallation.
- .5 TIAC Code A3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .4 Mineral fibre:
 - .1 Mineral fibre: ASTM C547.
 - .2 Jacket: to CGSB 51GP52Ma.
 - .3 Maximum "k" factor: ASTM C547.
- .6 TIAC Code A6: Flexible unicellular tubular elastomer.
 - .4 Mineral fibre: ASTM C 612.
 - .1 Insulation: with vapour retarder jacket to ASTM C534.
 - .2 Jacket: to CGSB 51GP52Ma.
 - .3 Maximum "k" factor: C534.
 - .4 Certified by manufacturer free of potential stress corrosion cracking corrodants.
 - .5 Flame spread index less than 25, and smoke developed index less than 50.
- .7 TIAC Code C1: Rigid mineral fibre board, unfaced.
 - .1 Mineral fibre: ASTM C612.
 - .2 Maximum "k" factor: ASTM C612.
- .8 TIAC Code C2: Mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: ASTM C553.
 - .2 Jacket: to CGSB 51GP52Ma.
 - .3 Maximum "k" factor: ASTM C553.
- .9 TIAC Code C4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C612.
 - .2 Jacket: to CGSB 51GP52Ma.
 - .3 Maximum "k" factor: ASTM C612.
- .10 Provide removeable pre-fabricated insulation pads for valves.

2.3 CEMENT

- .1 Thermal insulating and finish
 - .1 To: ASTM C449/C449M.
 - .2 Hydraulic setting or air drying on mineral wool, to ASTM C449.

2.4 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.
- .2 Aluminum:
 - .1 To ASTM B 209.
 - .2 Thickness: 0.40 mm sheet.
 - .3 Finish: Stucco embossed or corrugated.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.25 mm thick dieshaped fitting covers with factoryattached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.5 INSULATION
SECUREMENTS

- .1 Tape: Self adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation.
- .7 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER
LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR RETARDER
FINISH

- .1 Type A6 to manufacturer's recommendation.

PART 3 - EXECUTION

3.1 PRE-INSULATION
REQUIREMENTS

- .1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards
 - .1 Hot equipment: To TIAC code 1503-H.
 - .2 Cold equipment: to TIAC code 1503-C or 1503CA.
- .2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.
- .4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .5 Use two (2) layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports outside vapour retarder jacket.
- .7 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-
FABRICATED
INSULATION AND
ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT
INSULATION
SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 Hot Equipment:
 - .1 TIAC code A1 or C1 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
 - .3 Thicknesses:
 - .1 Domestic hot water storage tanks 50 mm
 - .2 Buffer tanks: 50mm.
 - .4 Finishes:
 - .1 Equipment in mechanical rooms: TIAC code CEF/1 with jacket.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Plumbing General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 CAN/CGSB-S102-11, Method of Test for Surface Burning Characteristics of Floor Covering and Miscellaneous Materials and Assemblies.
- .3 ASTM C547-15, Specification for Mineral Fibre Pipe Insulation.
- .4 CGSB 51-GP-52MA-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 ASTM C335-10E1, Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.
- .6 NFPA 90A, 2015, Installation of Air Conditioning and Ventilating Systems.
- .7 NFPA 90B, 2015, Installation of Warm Air Conditioning Systems.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.4 DEFINITIONS

- .1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
- .2 "EXPOSED" - will mean "not concealed" as defined herein.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Test materials in accordance with ASTM C411.

2.2 P-1 FORMED
MINERAL FIBER TO
204°C

- .1 Application: for the following piping, valves and fittings:
 - .1 Domestic hot water and hot water recirculating, temperature 60°C.
- .2 Materials:
 - .1 ASTM C547, jacketed rigid mineral fiber sleeving for piping.
 - .2 Acceptable Materials: Owens Corning SSL-II; Knauf ASJ; Manson Alley-K-APT; Manville Micro-Lok-AP-T; Fattal Fat-lock ASJ.
- .3 Thermal Conductivity "k" must not exceed 0.035 watt/meter °k at 24°C mean temperature when tested in accordance with ASTM C335. Thickness:

<u>System</u>	Nominal Pipe Sizes (NPS) Thickness			
	25mm & under	32mm 50mm	62mm 100mm	125mm & Over
D.H.W.	25mm	38mm	38mm	N/A

2.3 P-2 FLEXIBLE
UNICELLULAR TUBULAR
ELASTOMER

- .1 Application: for piping, valves and fittings on refrigerant piping.
- .2 Materials: acceptable material Armaflex.

<u>System</u>	Nominal Pipe Sizes (NPS) Thickness	
	25mm and under	32mm to 50mm
Refrigerant piping	38mm	38mm

2.4 P-3 FORMED
MINERAL FIBER C/W
VAPOUR BARRIER TO
85°C

- .1 Application: for piping, valves and fittings on:
 - .1 Domestic cold water (DCW).
 - .2 Rainwater/storm piping above slag: full.
 - .3 Condensate drain piping.
- .2 Material:
 - .1 To ASTM C547, rigid mineral fiber sleeving for piping and CGSB 51-GP-52Ma, vapour barrier jacket and facing material.
 - .2 Acceptable Material: Owens Corning SSL-II; Knauf ASJ; Manson Alley-K-APT; Manville Micro Lok-AP-T; Fattal Fat-lock ASJ.
- .3 Thermal Conductivity "k" must not exceed 0.035 watt/meter °k at 24°C mean temperature when tested in accordance with ASTM C335. Thickness:

System	Nominal Pipe Sizes (NPS) Thickness			
	25mm & under	32mm 50mm	62mm 100mm	125mm & over
D.C.W.	25mm	38mm	38mm	50mm
Rainwater/storm piping	25mm	38mm	38mm	50mm
Condensate drain	25mm	38mm	38mm	50mm

2.5 P-4 FLEXIBLE
MINERAL FIBER C/W
VAPOUR BARRIER TO
-16°C

- .1 Application on:
 - .1 Underside of roof drain bodies.
- .2 Materials:
 - .1 To ASTM C553, mineral fiber blanket for
 - .1 Acceptable Material: Knauf Duct Wrap FSK; Owens Corning faced flexible duct insulation; Manville Microlite; Manson Alley Wrap FSK.
- .3 Thickness: all sizes, 38mm.

2.6 FASTENINGS

- .1 For insulation systems P-1, P-2, P-3, P-4:
 - .1 Tape: self-adhesive, 100mm wide, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - .2 Acceptable Material: Compact; S. Fattal Insultape; TUCK.

2.6 FASTENINGS
(Cont'd)

- .2 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.
 - .1 Acceptable Material: Childers CP.82; Foster 85-75; Bakor 230-06, asbestos-free.
- .3 Lagging adhesive: fire retardant coating.
 - .1 Acceptable Material: Childers CP.50A-HV2; Foster 30-36; Bakor 120-09, asbestos-free.
- .4 For underside of roof drain bodies.
 - .1 Contact adhesive: quick-setting for seams and joints.
 - .1 Acceptable Material: Armstrong 520 adhesive; Childers CP.82; Foster 85-20; Bakor 230-39, asbestos-free.

2.7 INSULATION
CEMENT

- .1 To ASTM C449
- .2 For installation at piping elbows and at ends of insulation (eg. around 2-way or 3-way control valves).

2.8 JACKETS

- .1 Interior piping:
 - .1 All service jacket (ASJ) for piping except use canvas cloth jacketing for all exposed piping insulation.
 - .2 Canvas cloth jacketing shall be ULC listed, plain weave, cotton fabric, 228 grams and lagging adhesive.
 - .3 Acceptable Materials: Alpha-Maritex 3451 - RW, Clairmont Diplag 60, S. Fattal Thermocanvas.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved. Clean and dry insulation and surfaces before installation and during application of any finish. Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified herein.
- .2 Insulation on roof drain bodies held in place with 100% coverage of adhesive.

3.1 APPLICATION
(Cont'd)

- .3 On piping with insulation and vapour barrier or jacket, install high density insulation under hanger shield. Maintain integrity of vapour barrier or jacket over full length of pipe without interruption at fittings and supports.
- .4 Use piping saddles and shields. Clevis hangers must not penetrate the insulation. Use oversized clevis hangers.

3.2 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Multi-layered: staggered butt joint construction.
- .3 Vertical pipe over NPS 3: insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5m centres.
- .4 Seal and finish exposed ends and other terminations with insulating cement.
- .5 Expansion joints in piping: provide for adequate movement of expansion joint without damage to insulation or finishes.
- .6 Flanges and unions at equipment, expansion joints, valves, other components requiring regular maintenance: install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.
- .7 Insulation is not required for:
 - .1 Chrome plated piping, valves and fittings.

3.3 FASTENINGS

- .1 Secure pipe insulation by tape at each end and centre of each section, but not greater than 1m on centres.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials
.1 ASTM E202-12, Test Methods for Analysis of
Ethylene Glycols and Propylene Glycols.

PART 2 - PRODUCTS

2.1 CLEANING
SOLUTIONS

- .1 Low foaming detergent at all temperatures
- .2 No pH neutralization required
- .3 Designed for use on most metals including aluminium
- .4 Biodegradable
- .5 Phosphate Free
- .6 Nitrite Free

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Steel Piping, Valves and Fittings; Hydronic Systems:
Section 23 21 16

1.2 REFERENCES

- .1 ANSI/AWS A5.8/A5.8M-2011, Specification for Brazing
and Braze Welding.
- .2 ASME B16.4-2016, Grey-Iron Threaded Fittings.
- .3 ASME B16.15-2013, Cast Bronze Threaded Fittings.
- .4 ANSI B16.18-2012, Cast Copper Alloy, Solder Joint
Pressure Fittings.
- .5 ASME B16.22-2013, Wrought Copper and Copper Alloy
Solder Joint Pressure Fittings.
- .6 ASTM B32-08(R2014), Specification for Solder Metal.
- .7 ASTM B88-14, Specification for Seamless Copper Water
Tube.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section
01 00 00.
- .2 Indicate on manufacturers catalogue literature the
following: valves.

1.4 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into
manual specified in Section 01 00 00.

PART 2 - PRODUCTS

2.1 PIPING

- .1 Type "L" hard drawn copper tubing: to ASTM B88M.
- .2 Roll grooved copper piping may be used but products
must be of one manufacturer throughout.

2.2 FITTINGS

- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
-

2.2 FITTINGS
(Cont'd)

- .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
- .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.
- .5 Roll grooved fittings: with rigid joints.

2.3 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.
- .3 Brazing: as indicated.

2.4 VALVES - ALL
TYPES

- .1 See Section 23 21 16.

PART 3 - EXECUTION

3.1 PIPING
INSTALLATION

- .1 Refer to Section 23 21 16.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Testing, Adjusting, Balancing (TAB) of Mechanical Systems: Section 23 05 95

1.2 REFERENCES

- .1 ASME B18.2.1-2012, Square and Hex Bolts and Screws.
- .2 ASME B18.2.2-2015, Square and Hex Nuts.
- .3 ANSI/ASME B16.5-2017, Pipe Flanges and Flanged Fittings.
- .4 ANSI/AWWA C111/A21.11-17, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- .5 ASME B16.1-2015, Cast Iron Pipe Flanges and Flanged Fittings.
- .6 ASME B16.3-2016, Malleable-Iron Threaded Fittings.
- .7 ASME B16.9-2012, Factory-Made Wrought Steel Butt Welded Fittings.
- .8 ASTM A47/A47M-99(2014), Specification for Ferritic Malleable Iron Castings.
- .9 ASTM A53/A53M-12, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .10 ASTM A536-84(2014), Specification for Ductile Iron Castings.
- .11 ASTM B62-15, Specification for Composition Bronze or Ounce Metal Castings.
- .12 ASTM D2000-2012, Standard Classification System for Rubber Products in Automotive Applications.
- .13 CSA-B242-05(R2016), Grooved and Shoulder Type Mechanical Pipe Couplings.
- .14 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.
- .15 MSS SP-70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.

1.2 REFERENCES
(Cont'd)

- .16 MSS SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.
- .17 MSS SP-85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Indicate on manufacturers catalogue literature the following:
 - .1 Valves.
 - .2 Grooved fittings.

1.4 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.

PART 2 - PRODUCTS

2.1 PIPE

- .1 Steel pipe: to ASTM A53, Grade B, as follows:
 - .1 To NPS 6, Schedule 40.
 - .2 NPS 8 and over, Schedule 30.
 - .3 Chemical pot feeder piping, Schedule 80.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with teflon tape.
- .2 NPS 2-1/2 and over: welded fittings and flanges to CSA W47.1.
- .3 Roll grooved: rigid coupling to CSA B242, except for first three (3) couplings next to circulating pumps which are to be flexible pattern, minimum pressure rating 2069 kPa.
- .4 Flanges: plain, slip-on or weld neck.
- .5 Orifice flanges: slip-on raised face, 2069 kPa.
- .6 Flange gaskets: to ANSI/AWWA C111/A21.11. 3 mm, red rubber impregnated cloth to ASTM D2000.
- .7 Pipe thread: taper.

2.2 PIPE JOINTS
(Cont'd)

- .8 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
- .9 Roll grooved coupling gaskets: grade E, type EPDM. All grooved products to be of one manufacturer.
 - .1 Acceptable Material: Victaulic Style 07 Rigid Couplings; Victaulic Style 77 Flexible Couplings shall be used on expansion loops.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ANSI/ASME B16.1, Class 125.
 - .2 Steel: to ANSI/ASME B16.5.
- .3 Butt-welding fittings: steel, to ANSI/ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3.
- .5 Fittings for roll grooved piping: ductile iron to ASTM A536. All grooved products to be of one manufacturer.

2.4 GATE VALVES

- .1 NPS 2 and under: NOT applicable - use ball valves.
- .2 Rising stem: to ANSI/MSS SP-80, Class 125, bronze body, solid wedge disc.
 - .1 Acceptable Material: Crane 428; Jenkins 810; Kitz 24; Hattersley T607M; Toyo 293.
- .3 NPS 2-1/2 and over in mechanical and ventilation rooms, flanged:
 - .1 Rising stem: to MSS SP-70, Class 125, FF flanges, cast-iron body, OS & Y bronze trim.
 - .2 Acceptable Material: Crane 465½; Jenkins 454J; Hattersley T504; Toyo 421JA.
- .4 NPS 2-1/2 and over other than mechanical and ventilation rooms, flanged:
 - .1 Non-rising stem: to MSS SP-70, Class 125, FF flanges, cast-iron body, bronze trim, bolted bonnet.
 - .2 Acceptable Material: Crane 461; Jenkins 452; Kitz 75; Hattersley T501; Toyo 415JA.

2.4 GATE VALVES
(Cont'd)

- .5 Victaulic Style VIC300 butterfly valves are acceptable in lieu of gate valves, glycol/water and hot water heating systems both inside and outside the Mechanical and Ventilation Rooms.

2.5 BALL VALVES

- .1 NPS 2 and under:
.1 To ASTM B62, 4137 kPa WOG, bronze body, screwed ends, TFE seal, hard chrome solid ball, teflon seats and lever handle.
.2 Acceptable Material: Jenkins 901FJ and 902FJ, or approved equivalent.

2.6 GLOBE VALVES

- .1 NPS 2 and under, screwed:
.1 To MSS SP-80, Class 125, bronze body, screwed over bonnet, renewable composition disc suitable for service.
.2 Lockshield handles: as indicated.
.3 Acceptable Material: Crane 5; Jenkins 106BP; Hattersley A50M.
.2 NPS 2-1/2 and over, flanged:
.1 To MSS SP-85, Class 125, F.F. flanges, cast iron body, bronze trim, OS&Y, bolted bonnet, bronze disc and seat ring.
.2 Acceptable Material: Crane 351; Jenkins 2342; Kitz 76; Hattersley 731; Toyo 400JA.

2.7 SILENT CHECK
VALVES

- .1 NPS 2 and under:
.1 To ASTM B62, Class 125, cast steel, wafer style, brass seat rings, brass inner valve, stainless steel spring.
.2 Acceptable Manufacturers: Toyo; Kitz; Crane; Jenkins; Milwaukee Valve Company; Hattersley.
.2 NPS 2-1/2 and over:
.1 Class 125, cast steel, wafer style, bronze trim, stainless spring.
.2 Acceptable Manufacturers: Toyo; Kitz; Crane; Jenkins; Milwaukee Valve Company; Hattersley.
.3 NPS 4 and over, for roll grooved end pipe:
.1 To MSS SP-71, Class 125, ductile iron body, bronze discs, EPDM seat.
.2 Acceptable Material: Victaulic 711, 715, 716.

2.8 CIRCUIT
BALANCING VALVES

- .1 General:
 - .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports for connecting to differential pressure meter.
- .2 Accuracy:
 - .1 Readout to be within plus or minus 2% of actual flow at design flow rate.
- .3 NPS 2 and under:
 - .1 Pressure die-cast zinc dezincification resistant copper alloy (Ametal) construction; maximum WP: 862 kPa; max temp: 121°C, screwed ends, Teflon disc, screwed in bonnet.
 - .2 Acceptable Manufacturers: ITT Bell & Gossett; Armstrong; Tour & Anderson; TACO.
- .4 Flow control: at least four (4) full turns of handwheel with digital hand wheel and tamperproof concealed mechanical memory.
- .5 Insulation: use prefabricated shipping packaging of R-5.4 polyurethane as insulation for installation.
- .6 NPS 2-1/2 and over:
 - .1 Body: epoxy resin coated cast iron: bonnet and trim: zinc-dezincification resistant copper alloy (Ametal); bonnet bolts of stainless steel maximum WP: 862 kPa; Max. temp: 121°C; ANSI Class 125 flanged ends or grooved ends.
 - .2 Flow control: at least eight (8) full turns of handwheel with vernier type or digital type ring settings and tamperproof concealed mechanical memory.
 - .3 Acceptable Manufacturers: ITT Bell & Gossett, Armstrong, Taco, Tour & Anderson.
- .7 Drain connection:
 - .1 NPS 3/4 valved and capped drain connection suitable for hose socket to be incorporated into the valve body or provided as separate item.

2.9 GROOVED END
VALVES

- .1 Where grooved piping concept is used in place of welded or threaded systems, incorporate grooved end valves of comparable construction.

PART 3 - EXECUTION

3.1 PIPING
INSTALLATION

- .1 Connect to equipment in accordance with equipment manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers pipe size changes, installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves, fittings.
- .6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .7 Assemble piping using fittings manufactured to ANSI standards.
- .8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .9 Install circuit balancing valves complete with flow measuring fittings for all coils, air handling units, unit heaters, force flow heaters, perimeter radiation and heat exchangers.

3.2 FLUSHING,
CLEANING AND
FILLING

- .1 Flush after pressure test for minimum of 4 hrs.
- .2 Fill with solution of water and non-foaming, weight. phosphate-free detergent 3% solution by Circulate for 3 hrs. minimum.
- .3 Drain and flush for 4 hrs. Remove strainer screen/basket and clean.

<u>3.2 FLUSHING, CLEANING AND FILLING (Cont'd)</u>	.4	Refill system with clean water. Circulate for 2 hrs. minimum.
	.5	Drain and flush for 2 hrs. Remove strainer screen/basket and clean. Re-install after obtaining approval of the Consultant.
	.6	Refill with clean water, adding water treatment as specified.
<u>3.3 FILLING OF SYSTEM</u>	.1	Refill system with clean water adding water treatment as specified.
<u>3.4 VALVES</u>	.1	Install valves with stems upright or horizontal unless approved otherwise by the Consultant.
	.2	Install ball valves at all branch take-offs and to isolate each piece of equipment, and as indicated or specified herein. Use isolating gate valves for piping greater than NPS 2.
	.3	Provide silent check valves on discharge of pumps where indicated.
	.4	Provide globe valve bypass where indicated around control valves.
<u>3.5 TESTING</u>	.1	Test system in accordance with Section 23 05 95.
<u>3.6 BALANCING</u>	.1	Install flow balancing valves as indicated and as specified herein.
	.2	Balance water systems to within plus or minus 5% of design output.
	.3	Refer to Section 23 05 95 for applicable procedures.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-2016, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-2013, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-2016, Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 307-14, Specification for Carbon Steel Bolts and Studs, 414 MPa Tensile Strength.
 - .2 ASTM B 280-16, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B52-13, Mechanical Refrigeration Code.

PART 2 - PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B 280, type ACR B.
 - .2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2068 kPa and temperature 121°C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, 45% Ag-15% Cu or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .3 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A 307, heavy series.

- 2.2 FITTINGS
(Cont'd)
- .4 Flared:
.1 Bronze or brass, for refrigeration, to ASME B16.26.
- 2.3 PIPE SLEEVES
- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.
- 2.4 VALVES
- .1 22mm and under: Class 500, 3495 kPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moistureproof seal for below freezing applications, brazed connections.
- .2 Over 22mm: Class 375, 2502 kPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moistureproof seal for below freezing applications, brazed connections.

PART 3 - EXECUTION

- 3.1 GENERAL
- .1 Work to be performed by licensed (certified) refrigeration personnel.
- .2 Install in accordance with CSA B52, and ASME B31.5.
- 3.2 BRAZING PROCEDURES
- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.
- 3.3 PIPING INSTALLATION
- .1 General:
.1 Soft annealed copper tubing: bend without crimping or constriction Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Suction lines:
.1 Pitch at least 12 mm per 3 m away from the evaporator.
.2 Provide trap at base of risers.

3.3 PIPING
INSTALLATION
(Cont'd)

- .2 (Cont'd)
- .3 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified above.
 - .2 Small riser: size for 5m/s fpm at minimum load. Connect upstream of traps on large riser.

3.4 PRESSURE AND
LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 1999 kPa and 1000 kPa on high and low sides respectively.
- .3 Test Procedure: Build pressure up to 34 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.5 DEHYDRATION AND
CHARGING

- .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 96 kPa vacuum and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to the Consultant.
- .7 Charging:

3.5 DEHYDRATION AND .7
CHARGING
(Cont'd)

- (Cont'd)
- .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
- .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to the Consultant.

3.6 INSTRUCTIONS

- .1 Post instructions in frame with glass cover in accordance with CSA B52.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Firestopping and Smoke Seals: Section 07 80 00

1.2 REFERENCES

- .1 SMACNA 1966-2006, HVAC Duct Construction Standards, Metal and Flexible, 1995.
- .2 SMACNA 1958-2006, HVAC Systems Duct Design, 1990.
- .3 ASHRAE Handbook.
- .4 ASTM A653/A653M-15E1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Indicate following:
- .1 Sealants
 - .2 Tape
 - .3 Proprietary Joints

1.4 CERTIFICATION
OF RATINGS

- .1 Catalogue or published ratings must be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 SEAL
CLASSIFICATION

- .1 Classification as follows:

<u>Maximum Pressure (Pa)</u>	<u>SMACNA Seal Class</u>	<u>Location of duct</u>
250	B	Main risers and headers
125	C	Branch run-outs

2.1 SEAL
CLASSIFICATION
(Cont'd)

- .2 Seal classification:
 - .1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape, or combination thereof.
 - .2 Class C: transverse joints and connections made air tight with sealant, tape, or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sealant: oil resistant, polymer type non-toxic flame resistant duct sealant. Temperature range of -30°C to 93°C.
 - .1 Acceptable Material: Duro Dyne S-2; Foster 30-32; Bakor 530-09.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50mm.
 - .1 Acceptable Material: Duro Dyne FT-2.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows: R/D = 1.5 at fan discharge, R/D = 1.0 elsewhere.
- .3 Square mitred elbows: with single thickness vanes.
- .4 Main supply duct branches without splitter damper. Provide branch duct balancing dampers.
- .5 Sub branch duct with 45° boot connection and branch duct balancing damper.
- .6 Transitions:
 - .1 Diverging: 45° maximum included angle.
 - .2 Converging: 60° maximum included angle.
- .7 Offsets: short radiused elbows as indicated.
- .8 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles as for transitions.

2.6 FIRESTOPPING

- .1 Retaining angles all around duct sleeve, on both sides of fire separation. Refer also to Section 07 80 00.
- .2 Firestopping material and installation must not distort duct.
- .3 Breakaway duct joints at fire damper locations.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653, Z90 zinc coating.
- .2 Thickness: to SMACNA HVAC duct construction standard.
- .3 Fabrication: to SMACNA HVAC duct construction standard.
- .4 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
 - .1 Acceptable Manufacturers: Ductmate Canada Ltd.; Exanno Nexus, for proprietary joints.

2.8 STAINLESS STEEL

- .1 Ductwork to be fabricated from 316 stainless steel. For ductwork located in and/or serving the Septage Receiving Area use 316 stainless steel.
- .2 Provide ductwork fabrication, reinforcing, installation and support in accordance with SMACNA guidelines for low pressure ductwork.
- .3 Joints on stainless steel ductwork routed through the mechanical room to be continuously welded.

2.9 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm wide.
- .2 Hanger configuration: to SMACNA, galvanized steel angle with black galvanized steel rods to SMACNA HVAC Duct Construction Standard, Section 4.
- .3 Upper hanger attachments:
 - .1 For steel joist: manufactured joist clamp or steel plate washer.

2.9 HANGERS AND
SUPPORTS
(Cont'd)

- .3 (Cont'd)
 - .1 (Cont'd)
 - .1 Acceptable Material: Grinnell fig. 86 for joist clamps, Grinnell fig. 60 for plate washer.
 - .2 For steel beams: manufactured beam clamps:
 - .1 Acceptable Material: Grinnell fig. 93 and 89X clip.
 - .4 Hangers for stainless steel ducting as detailed on Drawings.

2.10 SHEET METAL
PLENUMS

- .1 Nominal 1.214 (18 ga.) galvanized steel sheet re-squared and formed into 600mm wide panels with 50mm deep standing seams in accordance with SMACNA HVAC equipment and casings standard.
- .2 Where indicated, plenum shall be constructed of 1.214 (18 ga.) 316 stainless steel sheet required and formed into 600 mm wide panels with seams continuously welded.
- .3 Formed channel sections top and bottom of vertical sections and at all wall and floor intersections.
- .4 Galvanized 50mm x 50mm x 3mm thick angle frames around all duct and access door openings.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standards.
- .2 Support risers in accordance with SMACNA.
- .3 Install breakaway joints in ductwork on each side of fire separation.
- .4 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .5 Provide access doors every 7.5m for future maintenance, inspection and cleaning. Not applicable to individual branch ducts serving grilles, registers and diffusers.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA HVAC duct construction standards.

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intakes.
 - .2 Plenums.
- .2 Form bottom of horizontal duct without longitudinal seams. Seal joints of bottom and side sheets. Seal all with duct sealer.

3.4 SHEET METAL
PLENUMS

- .1 Add sealant during closure of standing seams and channel sections and fasten with bolts or blind rivets at 30mm on centre.
- .2 Secure angle frames to wall or floor at 600mm on centre and caulk air-tight. Provide 6mm thick neoprene pads to avoid dissimilar metal contact.
- .3 Provide light metal channel at wall and floor into which insulation can be finished.

3.5 LEAKAGE TESTS

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Make trial leakage tests as instructed to demonstrate workmanship.
- .3 Install no additional ductwork until trial test has been approved by the Consultant.
- .4 Test section minimum of 22.5m long with not less than three (3) branch takeoffs and two 90° elbows.
- .5 Complete test before insulation or concealment.

3.6 SEALING AND
TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

3.6 SEALING AND
TAPING
(Cont'd)

.2 Bed tape in sealant and recoat with minimum of one
(1) coat of sealant to manufacturer's
recommendations.

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Ductwork - Low Pressure Metallic to 500 Pa: Section 23 31 14
<u>1.2 REFERENCES</u>	.1	Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): .1 SMACNA 1966-2006 HVAC Duct Construction Standards - Metal and Flexible.
<u>1.3 PRODUCT DATA</u>	.1	Submit product data in accordance with Section 01 00 00.
	.2	Indicate the following: .1 Flexible connections. .2 Duct access doors. .3 Turning vanes. .4 Instrument test ports. .5 Access doors.
<u>1.4 CERTIFICATION OF RATINGS</u>	.1	Catalogue or published ratings must be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

<u>2.1 FLEXIBLE CONNECTIONS</u>	.1	Frame: 75mm wide galvanized sheet metal, nominal 0.607mm (24 ga.), with fabric clenched by means of double locked seams.
	.2	Flexible material: fire resistant, woven fiberglass, extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, self-extinguishing.
	.3	Acceptable Manufacturers: Duro Dyne; Metal-Fab; Durolon.
-

2.2 ACCESS DOORS IN
DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, nominal 0.607mm (24 ga.) complete with sheet metal angle frame, gasketted.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.607mm (24 ga.) thick complete with sheet metal angle frame and 25mm thick rigid glass fibre insulation, gasketted.
- .3 Size: 300mm x 350mm covering a 250mm x 300mm opening in duct.
- .4 See also Section 23 31 14.
- .5 Hardware:
 - .1 Forged bolts, stop nuts and non-corrosive star shaped handle.
 - .2 Neoprene or foam rubber gasket.
 - .3 Reinforce duct adjacent to access door as required to prevent distortion and smooth cut edges to prevent injury to service personnel.
 - .4 Acceptable Manufacturers: NR Murphy Ltd. Fabricated cleanout door; Nexus PDQ; Nailor.

2.3 TURNING VANES

- .1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.4 INSTRUMENT TEST
PORTS

- .1 Nominal 1.519mm (16 ga.) steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 32mm minimum inside diameter. Length to suit 38mm insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable Material: Duro Dyne IP1 or IP2.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Flexible connections:

3.1 INSTALLATION
(Cont'd)

- .1 (Cont'd)
 - .1 Install in following locations:
 - .1 Inlets to Air Handling Units.
 - .2 Inlets and outlets of supply and exhaust fans.
 - .3 As indicated.
 - .2 Distance between metal parts when system in operation: 38mm to 62mm.
 - .3 Install in accordance with recommendations of SMACNA.
 - .4 When fan is running:
 - .1 Ducting on each side of flexible connection to be in alignment.
 - .2 Provide slack material in flexible connection.
- .2 Access doors:
 - .1 Location:
 - .1 At fire dampers, to allow link replacement.
 - .2 At control dampers, to allow inspection.
 - .3 At devices requiring maintenance.
 - .4 At locations required by code.
 - .5 Ducting systems must be accessible every 7.5 m maximum (see also Section 23 31 14).
 - .6 Elsewhere as indicated.
- .3 Instrument test ports.
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locations.
 - .1 For traverse readings:
 - .1 At inlets and outlets of fan systems.
 - .2 At main and sub-main ducts.
- .4 Turning vanes:
 - .1 Install in all mitre bends, in accordance with recommendations of SMACNA and as indicated.

PART 1 - GENERAL

1.1 REFERENCES .1 SMACNA 1966-2006 HVAC Duct Construction Standards,
Metal and Flexible.

1.2 PRODUCT DATA .1 Submit product data in accordance with Section
01 00 00.

.2 Indicate construction, size and location.

PART 2 - PRODUCTS

2.1 GENERAL .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE
DAMPERS .1 Of same material as duct, but one sheet metal
thickness heavier. V-groove stiffened.
.2 Size and configuration to recommendations of SMACNA.
.3 Locking quadrant with shaft extension to accommodate
insulation thickness.
.4 Inside and outside nylon end bearings.
.5 Channel frame of same material as adjacent duct,
complete with angle stop.

2.3 MULTI-BLADED
DAMPERS .1 Factory manufactured of material compatible with
duct.
.2 Opposed blade: configuration, metal thickness and
construction to recommendations of SMACNA.
.3 Maximum blade height: 100mm.
.4 Bearings: self-lubricating nylon.
.5 Linkage: shaft extension with locking quadrant.
.6 Channel frame of same material as adjacent duct,
complete with angle stop.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply and exhaust systems, balancing dampers are to be located in each branch duct.
- .4 Each grille, register and diffuser connection to have balancing damper located as close as possible to the main ducts.
- .5 Install splitter damper blade, pivot and control rod in rigid manner to prevent vibration.
- .6 Caulk air-tight between duct and damper frame.
- .7 Installation of dampers to be vibration free.

PART 1 - GENERAL

<u>1.1 GENERAL</u>	.1	This section applies to operating dampers not specified in under the Controls scope of work.
<u>1.2 PRODUCT DATA</u>	.1	Submit product data in accordance with Section 01 00 00.
	.2	Indicate the following: .1 Performance data. .2 Construction, size and location.
<u>1.3 MAINTENANCE DATA</u>	.1	Provide maintenance data for incorporation into manual specified in Section 01 00 00.
<u>1.4 CERTIFICATION OF RATINGS</u>	.1	Catalogue or published ratings must be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

PART 2 - PRODUCTS

<u>2.1 MULTI-LEAF DAMPERS</u>	.1	Opposed blade or parallel blade to suit application, for throttling or open/closed action; parallel blade type for mixing application.
	.2	Extruded aluminum, interlocking blades, complete with internal polyurethane blade insulation, extruded EPDM elastomer seals, extruded TPE thermoplastic frame seals, extruded aluminum frame complete with polystyrene insulation. (Low leakage construction).
	.3	Bearings comprised of a celcon inner bearing fixed to a 11mm aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in the frame; no metal-to-metal or metal-to-plastic contact.
-

2.1 MULTI-LEAF
DAMPERS
(Cont'd)

- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod. Linkage hardware is installed in frame side and constructed of aluminum and corrosion resistant zinc and nickel-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
- .5 Operator:
 - .1 120/1/60 or 24VAC electric actuators as on the plans.
 - .2 Two-position spring return motors:
 - .1 For normally closed position, complete with accessories for direct drive coupling to the control damper shift.
 - .2 Provide integral end switch where indicated.
 - .3 Acceptable Manufacturers: Belimo; Honeywell; Johnson.
- .6 Performance: leakage in closed position to be less than 82 L/S/m² at 1 kPa differential across damper. Pressure drop at full open position for a 1200mm x 1200mm damper to be less than 7.5 Pa differential across damper at 5 m/s air flow.
- .7 Acceptable Material: Tamco Series 9000, or approved equivalent.

2.2 BACK DRAFT
DAMPERS

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted or counterweighted, as required for positive closure.
- .2 Acceptable Material: Tamco Series 7000, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.

3.1 INSTALLATION
(Cont'd)

- .4 Upon system start-up, ensure that dampers operate through full angular range and seal tightly in their closed position. See also Controls related specification sections.
- .5 Caulk airtight between duct and damper frame for tight close-off.
- .6 Extend damper control rod or jackshaft through damper casing to the outside of the duct or equipment casing to allow proper connection of direct-coupled damper actuator.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Firestopping and Smoke Seals: Section 07 80 00
- .2 Duct Accessories: Section 23 33 00

1.2 REFERENCES

- .1 NFPA 90A-2015, Installation of Air Conditioning and Ventilating Systems.
- .2 CAN/ULC-S112-2010, Standard Method of Fire Test of Fire-Damper Assemblies.
- .3 CAN4-S112.2-2007, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .4 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 00 00.
- .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Fire stop flaps.

1.4 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.

1.5 MAINTENANCE
MATERIALS

- .1 Provide maintenance materials as listed below.
 - .1 Six (6) fusible links of each type of fire dampers.

1.6 CERTIFICATION
OF RATINGS

- .1 Catalogue or published ratings must be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.
-

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: listed and bear label of ULC, meet requirements of provincial fire authority and NFPA 90A.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged, round or square; interlocking type; roll door type; guillotine type; sized to maintain full duct cross section where possible.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 38mm x 38mm x 1.519mm (16 ga.) retaining angle frame, on full perimeter of fire damper mounting sleeve, on both sides of fire separation being pierced and as shown.
- .6 Acceptable Manufacturers: Controlled Air Type B; Ruskin, Nailor, Penn.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with SMACNA Fire damper Guide and in accordance with conditions of ULC listing.
- .2 Fire test fire damper assemblies in accordance with CAN/ULC-S112.
- .3 Maintain integrity of fire separation.
- .4 After completion and prior to concealment obtain inspection and approvals of complete installation from the authorities having jurisdiction.
- .5 Install access door adjacent to each damper. See Section 23 33 00.
- .6 Coordinate with installer of firestopping. Refer also to Section 07 80 00.

PART 1 - GENERAL

- 1.1 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 00 00.
 - .2 Indicate for each item as applicable:
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Movement handled; axial, lateral, angular and the amounts of each.
 - .3 Nominal size and dimensions including details of construction and assembly.
- 1.2 MAINTENANCE DATA
- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.
 - .2 Data to include:
 - .1 Servicing requirements, including any special requirements, stuffing box packing, lubrication and recommended procedures.

PART 2 - PRODUCTS

- 2.1 ANCHORS AND GUIDES
- .1 Anchors:
 - .1 Provide as indicated.
 - .2 Structural steel members secured to building structure.
 - .2 Alignment guides:
 - .1 Provide as indicated to accomodate specified thickness of insulation.
 - .2 Carbon steel bolted spider and outer housing.
 - .3 Copper plated spider for copper piping.
- 2.2 FLEXIBLE CONNECTIONS
- .1 Application: to suit motion.
 - .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
 - .3 Inner hose: bronze, corrugated.
 - .4 Braided wire mesh, bronze outer jacket.

- 2.2 FLEXIBLE CONNECTIONS (Cont'd)
- .5 Diameter and type of end connection: as indicated.
 - .6 Operating conditions:
 - .1 Working pressure: 1034 kPa.
 - .2 Working temperature: 93°C.
 - .3 To match system requirements.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install pipe anchors, guides and flexible pipe connections as indicated and in accordance with manufacturers instructions. Anchors to withstand 150% of axial thrust.
 - .2 Confirm a minimum of one-half of the pipe alignment spider is within the guide under all conditions.
 - .3 All horizontally installed flexible loops must have 180° return bend supported.

PART 1 - GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-2015, Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B-2015, Installation of Warm Air Heating and Air Conditioning Systems.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA 1966-2006, HVAC Duct Construction Standards Metal and Flexible.
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC S110-07, Fire Tests for Air Ducts.
 - .2 UL 181-2005, Factory Made Air Ducts and Connectors.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 00 00.
- .2 Indicate the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.

1.3 CERTIFICATION
OF RATINGS

- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 SAMPLES

- .1 Submit samples with product data of different types of flexible duct being used in accordance with Section 01 00 00.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC S110.

2.1 GENERAL
(Cont'd)

- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC -
ACOUSTIC INSULATED

- .1 Non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible glass fibre acoustic insulation and encased in aluminum foil and mylar laminate vapour barrier.
- .2 Performance:
 - .1 Factory tested to 1000 Pa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

Duct Dia.	Frequency (Hz)				
	125	250	500	1000	2000
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

PART 3 - EXECUTION

3.1 DUCT
INSTALLATION

- .1 Install in accordance with: NFPA 90A and NFPA 90B SMACNA.
- .2 Do trial test to demonstrate workmanship.
- .3 Use for minimum 0.9m and maximum 1.5m between ceiling mounted diffusers and branch ducts on supply duct systems only. Do not use for exhaust air duct systems.
- .4 Flexible duct to have no more than a 15° offset and must have a minimum of two (2) hangers.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Mechanical General Requirements: Section 23 05 00
- .2 Vibration Isolation: Section 23 05 48
- .3 Duct Accessories: Section 23 33 00
- .4 Building Automation System: Section 23 09 00

1.2 REFERENCES

- .1 AMCA 99-16, Standards Handbook.
- .2 ANSI/AMCA 210-16, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 AMCA 300-2014, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51-2007, Laboratory Methods of Testing Fans for Rating.

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Product data to include fan curves and sound rating data, showing point of operation.
- .3 Indicate the following: motors, wheels, bearings, shafts, drives for all return and exhaust fans, dimensions, weight, sound power levels and service clearances.

1.4 OPERATION AND
MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 00 00.

1.5 MAINTENANCE
MATERIALS

- .1 Provide maintenance materials as follows:
 - .1 Spare parts to include:
 - .1 Matched sets of belts.

1.6 MANUFACTURED
ITEMS

- .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

PART 2 - PRODUCTS

2.1 FANS GENERAL

- .1 Capacity, static pressure, revolutions per minute, power, model and size as indicated in fan schedule on Drawings.
- .2 Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301, tested to AMCA 300. Unit must bear AMCA certified sound rating seal where appropriate.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit must bear AMCA certified rating seal, except for propeller fans smaller than 300mm diameter.
- .5 Motors: high efficiency; sizes as indicated. Refer also to Section 23 05 00 for additional motor requirements.
- .6 Factory primed before assembly in colour standard to manufacturer.
- .7 Scroll casing drains: as indicated, complete with plug.
- .8 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

PART 3 - EXECUTION

3.1 FAN
INSTALLATION

- .1 Install fans as indicated
- .2 Install fan restraining snubbers.

3.1 FAN
INSTALLATION
(Cont'd)

.3 Provide replacement sheaves and belts if required
for final air balance.

PART 1 - GENERAL

1.1 REFERENCES

- .1 AMCA 99-16, Standards Handbook.
- .2 ANSI/AMCA 210-16, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 AMCA 300-14, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301-14, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51-2016, Laboratory Methods of Testing Fans for Rating.
- .6 ABMA 9:2015, Load Rating and Fatigue Life for Ball Bearings.
- .7 ABMA 11:2014, Load Rating and Fatigue Life for Roller Bearings.

1.2 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Product data to include fan curves and sound rating data.
- .3 Indicate following: motors, wheels, bearings, dimensions, weight, sound power levels and drives for all roof and wall exhausters.

1.3 OPERATION AND
MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 00 00.

1.4 CERTIFICATION
OF RATINGS

- .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide confirmation of testing.

PART 2 - PRODUCTS

2.1 FANS GENERAL

- .1 Capacity, static pressure, fan and motor RPM, hp, model and size as indicated in the schedule.
- .2 Sound ratings: comply with AMCA 301, tested to AMCA 300.
- .3 Statically and dynamically balanced. Constructed in conformity with AMCA 99.
- .4 Ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51.
- .5 Bearings: ball bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 h. Bearings to be rated and selected in accordance with ABMA 9 and ABMA 11.
- .6 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, fan inlet and outlet safety screens, as indicated.

2.2 TYPICAL
EXHAUSTERS

- .1 Centrifugal belt driven:
 - .1 Housings: spun aluminum complete with resilient mounted motor and fan.
 - .2 Impeller: aluminum non-overloading.
 - .3 Adjustable motor sheave or direct drive, see schedule on Drawings.
 - .4 Aluminum birdscreen.
 - .5 Motorized low leakage gasketed aluminum backdraft dampers.
 - .6 Electrical weatherproof disconnect switch within fan housing.
 - .7 Continuous curb gaskets, stainless steel securing bolts and screws.
- .2 See also schedule on Drawings.
- .3 Acceptable Manufacturers: Greenheck; Penn; Loren Cook.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install curbs in accordance with roofing manufacturers recommendations to ensure a weather-tight fit.

PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1 NFPA 90A-2015, Installation of Air Conditioning and Ventilation Systems.
<u>1.2 PRODUCT DATA</u>	.1 Submit product data in accordance with Section 01 00 00. .2 Indicate the following: .1 Capacity. .2 Throw and terminal velocity. .3 Noise criteria. .4 Pressure drop. .5 Neck velocity. .6 Finish.
<u>1.3 MAINTENANCE MATERIALS</u>	.1 Provide maintenance materials as listed below in accordance with Section 01 00 00. .2 Include: .1 Keys for volume control adjustment. .2 Keys for air flow pattern adjustment.
<u>1.4 MANUFACTURED ITEMS</u>	.1 Grilles, registers and diffusers shall be product of one manufacturer.
<u>1.5 CERTIFICATION OF RATINGS</u>	.1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by them from independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

<u>2.1 GENERAL</u>	.1 Standard product to meet capacity and size indicated with a maximum RC 25 to 35 as required/indicated on the Drawings.
-

2.1 GENERAL
(Cont'd)

- .2 Where grilles, and registers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accordance with NFPA 90A and NBC.
- .3 Where diffusers penetrate fire rated ceilings, provide fire stop flaps and radiation blankets/barriers in accordance with NFPA 90A and NBC.
- .4 Frames:
 - .1 Steel: standard prime and off-white baked-on enamel coated cold rolled steel with exposed welded joints ground flush and completely closed mitered corners.
 - .2 Aluminum: extruded clear lacquer with mechanical fasteners and completely closed mitered corners.
 - .3 Provide full perimeter gaskets.
 - .4 Provide concealed fasteners and operators.
- .5 See also schedule on the mechanical drawings.
- .6 Acceptable Manufacturers: E.H. Price; Titus; Nailor.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with oval head cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers in place. Provide safety chains where needed.
- .4 Install side wall grilles so that line-of-sight to inside of duct is prevented.

PART 1 - GENERAL

1.1 REFERENCES

- .1 ASTM E90-09(R2016), Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 ANSI/ASHRAE 51-2016, Laboratory Method of Testing Fans for Rating.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Indicate fabrication and erection details, including anchorage, accessories, and finishes.

1.3 MAINTENANCE DATA

- .1 Provide operation and maintenance data for maintenance of manually operated louvres for incorporation into manual specified in Section 01 00 00.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by them from independent testing agency signifying adherence to codes and standards.

1.5 TEST REPORTS

- .1 Submit certified data from index laboratory substantiating acoustic aerodynamic performance to ASTM E 90.

PART 2 - PRODUCTS

2.1 GOOSENECK HOODS

- .1 Thickness, joints and construction to SMACNA and ASHRAE.
- .2 Provide birdscreening.
- .3 Prefabricated insulated roof curbs, minimum 450mm high.

2.2 STATIONARY
LOUVRES

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1.5m between supports.
- .4 Frame, head, sill and jamb: 150mm deep one piece extruded aluminum, minimum 2.657mm (12 ga.) thick with approved caulking slot, integral to unit and sill extension as indicated. Sill drain piped to outside.
- .5 Mullions: at 1500mm maximum centres.
- .6 Fastenings: stainless steel SAW-194-8F with SAW-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12mm x 12mm openings, 2mm dia. wire aluminum birdscreen on inside face of louvres in formed U-frame. (Removable.)
- .8 Finish: factory applied prime coat finish. G.C. shall apply finish coat of paint (color by the Consultant).
- .9 Acceptable Material: Ruskin; E.H. Price; Construction Specialties; Airolite Type K6776; TA Morrison; Alumavent; Penn Canada; M.W. McGill.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install to the sizes and where indicated in accordance with manufacturer's recommendations and in accordance with recommendations of SMACNA.
- .2 Reinforce and brace air vents, intakes and gooseneck hoods for wind speed in accordance with NBC for location.
- .3 Locate louvers minimum 750mm above adjacent roof or grade level.
- .4 Caulk around entire perimeter using a waterproof, non-hardening mastic sealant.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Mechanical General Requirements: Section 23 05 00

1.2 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Indicate the following: construction, ASHRAE test efficiency, clean and maximum recommended pressure drop, gauges and accessories.

1.3 MAINTENANCE
DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.

1.4 CERTIFICATION
OF RATINGS

- .1 Catalogued or published ratings to be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Filters: suitable for non- condensing air at 100% RH and air temperatures between -40°C and +40°C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

2.2 ACCESSORIES

- .1 Holding frames: "T" section or channel section construction of stainless steel.
- .2 Seals: to ensure leak-proof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors on each side of air handling unit cabinet.
.1 Prefilters: through doors on each side of AHU.

2.2 ACCESSORIES .4 (Cont'd)
(Cont'd) .2 Final Filters: face loading from within AHU.

2.3 AIR FILTER .1 Dial type: diaphragm actuated, direct reading.
GAUGES .2 Range: 0 to 750 Pa.
.3 One (1) for each bank of filters as indicated on the drawings.
.4 Permanent pointer set for manufacturer's recommended final pressure drop.
.5 Acceptable Material: Magnehelic 2000 series diaphragm actuated direct reading, dial type.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install in accordance with manufacturers
GENERAL recommendations.

3.2 REPLACEMENT .1 Provide three (3) complete sets of filters for each
MEDIA HRV.
.2 Replace all temporary media with new prior to air balance testing.
.3 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.3 SPARE FILTER .1 See Section 01 00 00.
MEDIA

PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1	ANSI/ASHRAE 84-2013, Method of Testing Air-to-Air Heat Exchangers.
<u>1.2 SHOP DRAWINGS</u>	.1	Submit shop drawings and product data in accordance with Section 01 00 00.
<u>1.3 MANUFACTURED ITEMS</u>	.1	Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
	.2	Provide confirmation of testing.

PART 2 - PRODUCTS

<u>2.1 HEAT RECOVERY VENTILATOR</u>	.1	Packaged, indoor, heat recovery ventilator consisting of flat plate heat exchanger, ventilation air fan, exhaust air fan, filters, necessary dampers, temperature sensors and microprocessor controls.
	.2	Units must be capable of transferring sensible energy as shown on schedule.
	.3	Cabinets to be constructed of 20 gauge galvanized steel with 16 gauge galvanized frame.
	.4	Provide access to all components that require servicing through sealed and easily removable access panels.
	.5	Heat recovery core to be of rugged polypropylene construction and be factory installed in units.
	.6	Fans to operate on a stable efficient part of the fan curve when delivering the air qualities scheduled against the static of the system. Statically and dynamically balance fans to shipment and provide with internal vibration isolation mounts.
-

2.1 HEAT RECOVERY
VENTILATOR
(Cont'd)

- .7 Motors to be continuous duty, permanently lubricated and matched to the fan loads.
- .8 Units to have single point power connection only.
- .9 Units to have 24 VAC for field installed sensing devices.
- .10 Equip units with medium efficiency filtration (30% DSE).
- .11 Service connectors to be quick disconnect type.
- .12 Equip units with exhaust only defrost cycle to prevent frost from forming on the heat recovery core and maintain exhaust ventilation at all times.
- .13 Units must be ULC listed under standard UL 1812 for Ducted Air-to-Air Heat Exchangers.
- .14 Provide units complete with non-fused disconnect switch.
- .15 Acceptable products: Venmar, Lossnay, Renew Aire, or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Allow for adequate clearance for servicing and maintenance.

3.2 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1	ANSI/ASHRAE 84-2013, Method of Testing Air-to-Air Heat Exchangers.
<u>1.2 SHOP DRAWINGS</u>	.1	Submit shop drawings and product data in accordance with Section 01 00 00.
<u>1.3 MANUFACTURED ITEMS</u>	.1	Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
	.2	Provide confirmation of testing.

PART 2 - PRODUCTS

<u>2.1 HEAT RECOVERY VENTILATOR</u>	.1	Packaged, indoor, heat recovery ventilator consisting of flat plate heat exchanger, ventilation air fan, exhaust air fan, filters, necessary dampers, temperature sensors and microprocessor controls.
	.2	Units must be capable of transferring sensible energy as shown on schedule.
	.3	Cabinets: constructed of 20 gauge galvanized steel with 16 gauge galvanized frame.
	.4	Access to all components that require servicing shall be provided through sealed and easily removable access panels.
	.5	Heat recovery core to be of rugged polypropylene construction and will be factory installed in units.
	.6	Fans to operate on a stable efficient part of the fan curve when delivering the air qualities scheduled against the static of the system. Statically and dynamically balance fans prior to shipment and provide complete with internal vibration isolation mounts.

2.1 HEAT RECOVERY
VENTILATOR
(Cont'd)

- .7 Motors to be continuous duty, permanently lubricated and matched to the fan loads.
- .8 Units to have single point power connection only.
- .9 Units to have 24 VAC for field installed sensing devices.
- .10 Equip units with medium efficiency filtration (30% DSE).
- .11 All service connectors must be quick disconnect type.
- .12 Equip units with exhaust only defrost cycle to prevent frost from forming on the heat recovery core and maintain exhaust ventilation at all times.
- .13 Units to be ULC listed under standard UL 1812 for Ducted Air-to-Air Heat Exchangers.
- .14 Provide units complete with non-fused disconnect switch.
- .15 Acceptable products: Nu-Air or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Provide adequate clearance for servicing and maintenance.

3.2 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies the requirements for the supply, installation, testing and commissioning of split system air conditioning units AC-1 and AC-2 where indicated.
- 1.2 REFERENCES .1 Air-Conditioning and Refrigeration Institute (ARI)
.1 ANSI/ARI 210/240-2008, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- 1.3 SHOP DRAWINGS AND PRODUCT DATA .1 Submit shop drawings in accordance with Sections 01 00 00.
.2 Indicate:
.1 Capacities.
.2 ARI Ratings.
.3 Sound Power levels.
.4 Installation instructions.
.5 Start-up Instructions.
.6 O&M, Instructions.

PART 2 - PRODUCTS

- 2.1 AC-1U & AC-OU .1 General
.1 Ductless split system air conditioner, DX coil, outdoor air cooled condenser indoor evaporators.
.2 Unit must bear ARI label, CSA and CETL.
.3 Charge condensing unit with R410a refrigerant.
.4 Acceptable Manufacturers: Mitsubishi, LG, Daikin, Samson, Fujitsu.
.2 Indoor Unit (Evaporator):
.1 General: factory assembled, wired and run tested complete with factory wiring, piping, control circuit board and motor.
.2 Cabinet: refer to schedule on Drawings.
.3 Fan: statically and dynamically balanced, permanently lubricated motor bearing, 2-speeds high and low, adjustable air outlet for 2, 3 and 4 way air flow, auto air swing vanes.

- 2.1 AC-1U & AC-0U
(Cont'd)
- .2 (Cont'd)
- .4 Coil: non ferrous construction with plate fins on copper tubing, silver alloy brazing. Coil to be factory pressure tested. Coil to be complete with condensate pan, drain and pump.
- .5 Electrical and controls: 208/1/60 power supply. Direct digital wall controller, 12 volts.
- .3 Outdoor Unit (Condenser):
- .1 General: factory assembled wired, pipe and run tested air cooled condenser. Horizontal air discharge. Performance to suit evaporator unit. Unit complete with wind baffles.
- .4 Controller: wall mounted, wired controller.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install where indicated and in accordance with manufacturer's instruction.
- .2 Install outdoor unit on wall brackets.
- .3 Make all piping connections.
- .4 Confirm ready access is available to all components to allow servicing in-situ or removal of components for servicing.
- 3.2 DRAIN PANS
- .1 Install so no water can accumulate and arrange so as to be easily accessible for cleaning.
- 3.3 START-UP AND COMMISSIONING
- .1 Refer to Section 01 00 00.
- .2 Manufacturer to certify installation.
- .3 Manufacturer to test and start up units and certify performance.
- .4 Manufacturer to provide verbal, and written instructions to operating personnel.
- .5 Submit written report to Consultant.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Refrigerant Piping: Section 23 23 00
- .2 HVAC Controls: Field Control Devices: Section 25 30 02

1.2 REFERENCES

- .1 Air-Conditioning and Refrigeration Institute (ARI)
 - .1 ARI 210/240-2008, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2015, Installation of Air Conditioning and Ventilating Systems.
- .3 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 15-2016, Safety Standard for Refrigeration Systems.
- .4 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C13256-2-01 (R2015), Performance of Ground and Water Source Heat Pumps.
 - .2 CAN/CSA-C656-14, Performance Standard for Single Package Central Air Conditioners and Heat Pumps.
- .5 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Sections 01 00 00.
- .2 Indicate:
 - .1 Capacities.
 - .2 ARI Ratings.
 - .3 Sound Power levels.
 - .4 Installation instructions.
 - .5 Start-up Instructions.
 - .6 O&M, Instructions.

1.4 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 00 00.
- .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 appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by the Consultant.

1.5 WARRANTY

- .1 Provide a warranty that expressly states the heat pumps are comprehensively covered for a period of six (6) years.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Heat pumps/AC units: CSA approved and carry ARI or CSA certification seal.
- .2 Provide any additional accessories and controls required for a complete working system as indicated on drawings.

2.2 REFRIGERANTS

- .1 Type of Refrigerant: R410A.

2.3 DRAIN PANS

- .1 Design and construct condensate drain pans under indoor coils so that no water can accumulate and install to allow for easy cleaning.
- .2 Include condensate pumps as required.

2.4 AIR-SOURCE HEAT
PUMP/AC

- .1 As per schedules.

2.5 ZONE
CONTROLLERS

- .1 Wired wall mount controller complete with 7-day schedule, heating/cooling/auto modes.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated and in accordance with the manufacturer's instructions.
- .2 Install outdoor units in accordance with manufacturer's instructions.
- .3 Secure with hold-down bolts.
- .4 Make duct connections through flexible connections.
- .5 Level unit with fans running. Align ductwork. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.
- .6 Make piping connections.
- .7 Allow for nothing to obstruct ready access to components or to prevent removal of components for servicing.
- .8 Provide complete controls for this system as specified in this Section and Division 25.
- .9 Pipe condensate drain line to funnel floor drain near water entrance.

3.2 DRAIN PANS

- .1 Install so that no water can accumulate and arrange for easy access for cleaning.

3.3 CONTROLS

- .1 Provide wiring and programming as required for a complete working system.

3.4 START-UP AND
COMMISSIONING

- .1 Manufacturer to certify installation and performance. Submit written report to the Consultant and Owner.
- .2 Demonstrate to the Consultant and Owner operation of system, including sequences of operation, startup, shutdown, schedules, etc.

3.5 MAINTENANCE
SERVICE DURING
WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain HVAC controls system for warranty period of one (1) year after date of substantial completion. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when controls system is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish the Owner with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service system after receiving request for service.
 - .5 Perform work continuously until system restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of system based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of the Consultant.

PART 1 - GENERAL

- 1.1 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Indicate:
- .1 Equipment, capacity, piping, and connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Special enclosures.
- 1.2 MAINTENANCE DATA .1 Provide maintenance data for incorporation into manual specified in Section 01 00 00.

PART 2 - PRODUCTS

- 2.1 CAPACITY .1 As indicated on drawings, based on 88°C entering water temperature, 11.1°C temperature drop and 18°C E.A.T.
- 2.2 COMMERCIAL FINNED TUBE RADIATION .1 Heating elements: NPS 1-1/4 seamless copper tubing, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100mm x 100mm nominal, 1 or 2 row as indicated on the drawings.
- .2 Element hangers: ball bearings or plastic lined cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.
-

2.2 COMMERCIAL
FINNED TUBE
RADIATION
(Cont'd)

- .3 Standard enclosures: 1.214mm (18 ga.) steel complete with components for wall-to-wall or complete with die formed end caps having no knock-outs, with inside corners, outside corners, as indicated. Provide full length channel and sealer strip at top of wall edge. Height as indicated. Joints and filler pieces to be flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces to be clear of grilles and located to provide easy access to valves and vents. Provide access doors for valves and vents. Finish cabinet with factory applied baked on paint (color by Consultant).
- .4 Dimensions for enclosures: measure site conditions. Do not scale from Drawing.
- .5 Provide for noiseless expansion of all components.
- .6 Acceptable Manufacturers: Trane; Engineered Air; Modine; Rosemex, Sigma Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout and reviewed shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with the Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .6 Valves
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating ball valve on inlet and circuit balancing valve on outlet of each unit.
- .7 Venting:
 - .1 Install standard automatic air vent with mini ball valve on continuous finned tube radiation.

3.1 INSTALLATION
(Cont'd)

- .8 Clean finned tubes and comb straight.
- .9 Flush, clean and drain interconnecting piping before connecting radiation to system. Provide temporary by-pass loops to ensure thorough cleaning of run-outs.

PART 1 - GENERAL

1.1 GENERAL

- .1 This Section covers items common to sections of Division 26. This section supplements requirements of Section 01 00 00.
- .2 Refer to the electrical drawings and scope of work herein.

1.2 REFERENCES

- .1 CSA-C22.1-15, Canadian Electrical Code, Part 1.
- .2 CAN/CSA C22.2 No. 0.1-M1985(R2013), General Requirements for Double-Insulated Equipment.
- .3 CSA-C22.3 No. 7-2015, Underground Systems.
- .4 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50 000 V.
- .5 EEMAC Y1-2-1979, Standard for Performance Specification for Finishing Systems for Outdoor Electrical Equipment.

1.3 SCOPE OF WORK

- .1 The Work under this contract consists of furnishing all materials, tools, equipment, and labour, and performing the electrical services as indicated and as specified herein and on the Electrical Drawings.
- .2 Supply and install new underground ductbanks as noted on the drawings.
- .3 Supply and install conduits, including all necessary fittings, couplings, glands, seals, and mounting hardware as indicated on the Drawings and as required by codes and authority having jurisdiction.
- .4 Supply and install new termination junction boxes, including all necessary fittings and mounting hardware as indicated on the Drawings.
- .5 Supply and install outdoor lighting fixtures and associated switches and photo control cells as indicated on the Drawings.
- .6 Supply and install new circuit breaker panels as indicated, 120/208V panelboard "P1".

1.3 SCOPE OF WORK
(Cont'd)

- .7 Supply and install local disconnect switches as indicated on the drawings.
- .8 Supply and install new service entrance breaker, metering cabinet for utility, manual transfer switch and portable generator connection box.
- .9 Supply and installation of motor control center including TVSS, motor starters, VFD, breakers and disconnect switches.
- .10 Supply and installation of manual transfer switch and exterior portable generator connection enclosure.
- .11 Supply and install power distribution, general services, and control and instrumentation wiring and cabling.
- .12 Supply and grounding as necessary to satisfy the CEC-Part 1 and the local provincial inspection department.
- .13 Install and interwire electrical/instrumentation for mechanical and process systems specified in other divisions including the supply and installation of power, control, and instrumentation cabling, conduit, and mounting hardware in accordance with these specifications and manufacturers recommendations and shop drawings.
- .14 Document, test, and calibrate to the satisfaction of the Consultant electrical equipment as specified herein and on the Drawings.
- .15 Safely store electrical equipment awaiting installation.
- .16 Protect installed electrical equipment during construction.
- .17 Repair/replace equipment damaged during construction or otherwise deemed defective or non-compliant with these specifications at no expense to the Contract. These expenses include all materials, labour, and other fees.
- .18 Supply and install instrumentation.
- .19 Install pre-selected equipment. Supply and install all required ancillary equipment to complete the installation of pre-selected equipment.

1.3 SCOPE OF WORK
(Cont'd)

- .20 Obtain "scope of work" clarification prior to issuing of Tender. Any cost extras due to any misunderstanding/misinterpretation of the scope of work will not be entertained during the construction phase of the work.
- .21 Coordinate/schedule with other trades to ensure that the construction proceeds in a timely and efficient manner. Minimize disturbance to existing systems and provide access for plant operators for routine maintenance and inspection.
- .22 Some areas within the facility are Zone 1 and Zone 2 hazardous locations as defined by Section 18 of the Canadian Electrical Code. All electrical installations in these areas must be completed in accordance with the Canadian Electrical Code for the specified classification. These areas may contain hydrogen sulphide (North American Gas Group C) and methane (North American Gas Group D) gases. These areas are also a Category 2 location in accordance with Section 22 of the Canadian Electrical Code and the electrical installation shall be completed as per the requirements of a Category 2 location. Refer to the Electrical Drawings for hazardous locations.

1.4 CODES AND
STANDARDS

- .1 Do complete installation in accordance with CSA C22.1 and local regulations except where specified otherwise.
- .2 Comply with all CSA electrical bulletins in force at the time of tender submission. While not identified or specified by reference number in this division, the bulletins shall be considered to form part of the related CSA part II standard.
- .3 Abbreviations for electrical terms: to CSA Z85.

1.5 CARE, OPERATION
AND START-UP

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components, including but not limited to overload relays, motor circuit protectors, circuit breakers, electronic motor soft starters.

1.5 CARE, OPERATION
AND START-UP
(Cont'd)

- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.6 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.7 PERMITS, FEES
AND INSPECTION

- .1 Submit to the Electrical Inspection Department, Municipal Authority and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Submit this information within twenty (20) working days of the award of Tender and provide the Consultant with written notice at the time this has been submitted.
- .2 Provide the Consultant with a copy of the Electrical Inspection Department and Supply Authority Plans Review Report immediately upon receipt. No shop drawings will be reviewed prior to receipt of the Plans Review Report from the Contractor.
- .3 Obtain all necessary permits including an Electrical Wiring Permit for electrical work and Communications Cabling Permit for communications cabling work from the authority having jurisdiction prior to commencement of work. Provide a copy of each permit to the Consultant upon receipt. Properly display the permits on the work site.
- .4 Upon specific request, the Consultant will provide to the Contractor, up to a maximum of three (3) copies of the drawings and specifications required for submittal to the Electrical Inspection Department and Supply Authority. These drawings and specifications will be provided to the Contractor at no cost, unless specified otherwise.

1.7 PERMITS, FEES
AND INSPECTION
(Cont'd)

- .5 Arrange for all required inspections to be conducted by the authority having jurisdiction. Provide a copy of all inspection reports to the Consultant immediately upon receipt. Notify the Consultant immediately of changes required by the authority having jurisdiction prior to making changes. All changes must be approved by the Consultant.
- .6 Furnish Certificates of Acceptance from authorities having jurisdiction upon completion of Work. Include a copy in the Operations and Maintenance Manual.
- .7 Pay all associated fees.

1.8 MATERIALS AND
EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 00 00.
- .2 Equipment and material to be certified by an agency (preferably CSA) approved by the applicable Provincial Electrical Inspection Department. Where there is no alternative to supplying equipment which is not appropriately certified. Special approval from applicable Provincial Electrical Inspection Department will be required. Pay all costs associated with obtaining such approval.
- .3 Factory assemble control panels and component assemblies.

1.9 ELECTRIC
MOTOR, EQUIPMENT
AND CONTROLS

- .1 Coordinate supplier and installer responsibility for mechanical and process equipment specified in other specification divisions to provide a complete and functioning systems.
- .2 Confirm location of mechanical and process equipment and associated control devices specified in other divisions. All device locations may not be necessarily shown on the electrical drawings.

1.10 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
 - .2 Paint outdoor electrical equipment green finish to EEMAC Y1-1.

1.10 FINISHES
(Cont'd)

- .2 Clean and touch up surfaces of existing and new shop-painted equipment scratched or marred during shipment or installation, to match original paint to the satisfaction of the Consultant. If not acceptable, replace equipment at no additional cost to the contract.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.11 FASTENERS AND
EQUIPMENT MOUNTING

- .1 Fastening devices for all equipment and components, including bolts, nuts, washers, and screws shall be stainless steel throughout except as follows:
 - .1 Use zinc plated steel fastening devices in the electrical rooms, and other dry areas.
 - .2 Use 316L stainless steel fastening devices in non-hazardous, damp areas.
- .2 In the Control Building, wall mount electrical equipment on 21mm thick fire retardant plywood backboards that are fastened directly to the wall. Paint plywood with two (2) coats of fire retardant paint to match wall colour.

1.12 EQUIPMENT
IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as specified herein.
- .2 Identification:
 - .1 Provide all switchboards, panels, disconnect switches, MCC's, receptacles, transformers, control panels, fire alarm devices, magnetic starters, TOL's, etc. with "lamicoid" nameplates as further described herein. Take care to affix all plates true and level, and plumb in all instances.
 - .2 Affix nameplates to all "NEMA 1" surfaces with stainless steel type "fasteners".
 - .3 Affix nameplates to other types of surfaces with contact type cement.
 - .4 Affix nameplates to building "exterior" surfaces with nylon inserts and stainless steel self tapping screws unless specifically indicated otherwise.
 - .5 Apply contact type cement (buttered) to complete rear side of plate, as opposed to several locations or areas on same.
 - .6 Lamicoid nameplates installed on distribution panelboards, motor control centres, transformers, and splitters must indicate the following:
 - .1 Designated name of equipment.

1.12 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.6 (Cont'd)

- .2 Amerage of overcurrent protection device.
- .3 Voltages, number of phases and wires.
- .4 Designation of power source.
PANEL C - 100 AMPS
120/208V - 3PH - 4W
FED FROM PANEL B

.7 Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, etc., must contain the following information:

- .1 Designated name of equipment or equipment being fed, whichever is applicable.
- .2 Designated name of power source.
- .3 Branch circuit breaker number(s) where possible.
- .4 Voltage(s) and phase.

FAN NO. 5
PANEL H - CKT. 17
120V - 1 PH

SUPPLY FAN NO. 3
M.C.C. NO. 1
600V - 3 PH

.8 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate the maximum designated/designed fuse size.

.9 Install lamicoid nameplates on all junction and pull boxes sized 150 mm x 150 mm and larger indicating name of system, designated panel name and electrical characteristics where applicable.

.10 Install lamicoid nameplates above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source complete with associated circuit breaker number(s). Lamicoid plate to be 1.5 mm thick x 13 mm high complete with 6 mm black letters on white core, directly above all flush receptacles. Plate to be identical width as finish device plate and the top left and right corners to be rounded off.

.11 Lamicoid nameplates above 120V receptacles protected by GFCI circuit breakers, or GFCI type receptacles are to be identified as per the following:

- .1 1.5mm thick x 19mm wide complete with 6 mm black letters on white core above all receptacles. Identical width as finish device plate (EXAMPLE: GFCI Protected Panel H-26).

1.12 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .2 (Cont'd)
- .12 Lamicoid nameplate(s) for voice/data/CATV/CCTV/multimedia outlets shall be applied directly to face of finish plate.
- .1 1.5mm thick x 19mm wide complete with 6mm black letters on white core above all receptacles. Identical width as finish device plate.
- .13 Allow for an "average" of 40 letters for each lamicoid nameplate.
- .14 Lamicoid 3 mm thick plastic engraving sheet, white face, black core, for all electrical systems except fire alarm systems which shall have red face with white core.
- .15 Lettering on lamicoid nameplates shall not "start", nor "end" nearer than 9 mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates must be as indicated in the following chart:

NOMINAL NAMEPLATE SIZES

Size 1	10mm x	50mm	1 line	5mm high letters
Size 2	13mm x	75mm	1 line	6mm high letters
Size 3	16mm x	75mm	2 lines	5mm high letters
Size 4	19mm x	90mm	1 line	10mm high letters
Size 5	50mm x	90mm	2 lines	13mm high letters
Size 6	25mm x	100mm	1 line	13mm high letters
Size 7	25mm x	100mm	2 lines	6mm high letters
Size 8	50mm x	150mm	2 lines	13mm high letters
Size 9	50mm x	100mm	3 lines	10mm high letters

- .3 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
- .4 Identification to be English.
- .5 Provide lamicoid nameplates and install on, or adjacent to, all various systems' control panels and/or cabinets complete with information as indicated. Nameplates are to reflect individual system's assigned name, and where applicable, also indicate both designated panel name and associated branch circuit breaker number(s).
- .6 Co-ordinate names of equipment and systems with other trades to ensure that equipment identification is consistent.

1.12 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .7 In addition to required nameplates and colour coding, junction boxes to have the panel and circuit numbers of all wiring contained within listed on the coverplate. Write list using black indelible marker.
- .8 Colour code electrical junction boxes and pull boxes to match existing systems.
- .9 Provide clearly visible marking on electrical equipment to warn persons of potential electrical shock and arc flash hazards as specified in Section 2 of the Canadian Electrical Code.
- .10 Provide terminal boxes, panels and miscellaneous equipment fed from two or more sources with a warning nameplate prominently displayed: "CAUTION - MORE THAN ONE SOURCE VOLTAGE".
- .11 Provide terminal boxes, panels and miscellaneous wire ways containing intrinsically safe circuits with a warning nameplate prominently displayed: "INTRINSICALLY SAFE CIRCUIT".
- .12 Provide typewritten panel schedules for all panelboards impacted during the Work.

1.13 WIRING
IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Panduit PLD-1 and PLD-2 or approved equivalent.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Indicate panel and circuit number on all phase conductors (i.e., Panel A, ckt 3) at the device and at any intermediate junction/pull boxes.
- .6 Identify all neutral conductors to indicate the phase conductor with which they are associated and at any intermediate junction/pull boxes.

1.14 CONDUIT AND
CABLE
IDENTIFICATION

- .1 Colour code conduits, boxes and cables to match existing systems.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 For power cables to electrical equipment, indicate designated name of equipment and designated name of power source (i.e., WAS Pump #1 - fed from Panel (P1 circuit X)).
- .4 Where more than one (1) cable terminates at a device, add cable number (i.e., -1, -2) to end of cable identification.
- .5 Use Electrovert PVC K-marking sleeves (black on yellow), complete with PVC carrier strip and self-locking nylon cable ties (black) or approved equivalent.

1.15 WIRING
TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.16 MANUFACTURERS
AND CSA LABELS

- .1 Visible and legible after equipment is installed.

1.17 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department.
- .2 Decal or Porcelain enamel signs, minimum size 180 mm x 250 mm.

1.18 LOCATION OF
EQUIPMENT

- .1 Locate outlets in accordance with the Drawings and these Specifications.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of equipment at no extra cost or credit, providing distance does not exceed 3 m and information is given before installation.

1.18 LOCATION OF
EQUIPMENT
(Cont'd)

- .4 Locate light switches on latch side of doors.

1.19 MOUNTING
HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
- .1 Local switches: 1350 mm (54").
 - .2 Wall receptacles:
 - .1 Elevated mounting in process areas: 1200 mm (48").
 - .2 Outdoors: 1200 mm (48") above finished grade.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Control Panels: HMI Centreline 1500 mm (60") above finished floor or finish grade.

1.20 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Submit, at completion of Work, a report listing phase and neutral currents on panelboards, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.21 CONDUIT AND
CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
- .2 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50mm.
- .3 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .4 Arrange and pay for holes through exterior walls; provide flashings and make weatherproof.

1.21 CONDUIT AND
CABLE INSTALLATION
(Cont'd)

- .5 Install conduits to be embedded or plastered over, neatly and close to the building structure so furring can be kept to a minimum.
- .6 Use rigid aluminum conduit in all hazardous areas.

1.22 FIRESTOPPING

- .1 Provide firestopping and smoke sealing of all cable, cabletrough or conduit penetrations through fire resistant separations in accordance with Section 07 80 00.

1.23 FIELD QUALITY
CONTROL

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phase rotation, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing:
 - .1 Megger circuits, feeders and distribution equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and distribution equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
 - .4 Provide a type written tabular report indicating test results.
- .4 Provide a type written tabular report indicating the normal field measured load current for all motors, indicating the motor circuit protector trip setting or fuse type/rating, the overload heater element sizes and/or settings. Indicate the motor nameplate current.
- .5 Advise Consultant of dates when testing will take place. Provide five (5) days notice of such tests.
- .6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

1.23 FIELD QUALITY
CONTROL
(Cont'd)

- .7 Submit test results for Consultant's review and approval.

1.24 QUALITY
ASSURANCE

- .1 Instructions:
.1 Interferences: electrical drawings are generally of a diagrammatic nature. Plan and coordinate the work to eliminate interferences with other trades. Provide all necessary raceway offsets, fittings, and boxes, adjust all fixture and equipment boxes, adjust all fixture and equipment locations and provide all supporting materials required for a planned, coordinated and neat installation. Where interferences occur, the Consultant's authorized representative will decide which item must be relocated regardless of which was installed first.
.2 Electrical workmanship: provide workmanship of the highest quality. Sub-standard work will not be accepted. Use only persons skilled in the trades involved.
.3 Electrical materials: provide all materials used in this work, unless particularly specified otherwise, that are new, free from flaws, or imperfections.
.4 Sleeves and inserts: furnish and locate all sleeves and inserts required for this work in accordance with drawings.
- .2 Applicable standards:
.1 All electrical Work must conform with the requirements and recommendations of the latest edition of the Canadian Electrical Code and all local codes and ordinances. In conflicts between codes, the more stringent requirements shall govern.
.2 In no instance will the standard established by this specification be reduced by any of the codes or standards referred to in this specification.
.3 Standards: the specifications and standards of the following organizations are by reference made as part of these specifications and all electrical work, unless otherwise indicated, shall comply with their requirements and recommendations wherever applicable.
.4 Canadian Standard Association (CSA).
.5 Illuminating Consultants Society (I.E.S.).
.6 Institute of Electrical and Electronics Engineers (I.E.E.E.).
.7 Instrument Society of America (I.S.A.).
.8 American Society for Testing Materials (A.S.T.M.).

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1.24 QUALITY ASSURANCE <u>(Cont'd)</u>	.2 (Cont'd) .9 Certified Ballast Manufacturers (C.B.M.). .10 Insulated Power Cable Consultants Association (I.P.C.E.A.). .11 Electrical Equipment Manufacturer's Association of Canada (E.E.M.A.C.). .12 National Fire Protection Association (N.F.P.A.). .13 Underwriter's Laboratories of Canada (U.L.C.). .14 Joint Industrial Council (J.I.C.). .15 All local and provincial codes and ordinances.
1.25 PROCESS EQUIPMENT PACKAGES <u></u>	.1 Coordinate electrical work with the process system vendors. .2 Verify connection details and requirements for interwiring between vendor supplied process equipment packages specified in other divisions. .3 Refer to manufacturer's shop drawings for connection details and recommended installation details. .4 Provide all cable, conduit, supports and miscellaneous hardware as per the requirements of this specification.
1.26 RECORD DRAWINGS <u></u>	.1 Record Drawings: .1 After award of Contract, Consultant will provide a set of full-sized drawings for purpose of maintaining record drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by Consultant. .2 Identify drawings as "Project Record Copy". Maintain in new condition and make available for inspection on site by Consultant. .3 On completion of Work and prior to final inspection, submit record documents to Consultant.
1.27 WASTE MANAGEMENT AND DISPOSAL <u></u>	.1 Remove from site and dispose of all debris and waste materials at appropriate disposal/recycling facilities. .2 Separate and recycle waste materials in accordance with applicable Construction/Demolition Waste Management And Disposal Regulations.
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PART 2 - PRODUCTS

2.1 NOT USED .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED .1 Not applicable.

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA C22.2, No. 65-13, Standard for Wire Connectors.

PART 2 - PRODUCTS

- 2.1 WIRE AND BOX CONNECTORS
- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
 - .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
 - .3 Tin-plated copper, colour keyed, crimp type compression connectors, (long barrel, two hole) with a straight, 45° or 90° lug tongue configuration as required.
 - .1 Acceptable products: Thomas & Betts "Color-keyed" compression connectors or approved equivalent.
 - .4 Clamps or connectors for armoured cable, liquid tight, flexible conduit, as required.
 - .5 All wire connectors must be rated for operating voltage indicated.

PART 3 - EXECUTION

- 3.1 WIRE AND BOX CONNECTORS INSTALLATION
- .1 Make all connections and terminations electrically and mechanically secure. Sizes of connectors to be as per manufacturer's recommendations for various sizes and combinations of wire sizes.
 - .2 Make all joints required in branch wiring #8 and smaller utilizing "twist-on" pressure type connectors as manufactured by "Ideal" (colour coded wirenut) or "Marrettes" #31, #33 or #35, or approved equivalents.

3.1 WIRE AND BOX
CONNECTORS
INSTALLATION
(Cont'd)

- .3 Make branch wiring joints larger than #8 AWG utilizing colour keyed crimp type compression connectors (two hole, long barrel, tin-plated copper) complete with manufacturer approved compression tools. Apply a first layer of rubber insulating tape followed by additional layers of vinyl electrical tape. Bolt compression connectors together and torqued in accordance with manufacturer's recommendation. Heat shrink can also be used.
- .4 Plier tighten marrette type connectors.
- .5 Make wire connectors for connections to equipment not provided with lugs utilizing colour keyed, crimp type compression connectors (long barrel, two hole, tin-plated copper, straight lug tongue) complete with manufacturer approved compression tools. Alternate lug tongue configurations (45° and 90°) will be accepted where required by application.

PART 1 - GENERAL

<u>1.1 SUBMITTALS</u>	.1 Submit shop drawings, and product data in accordance with Section 01 00 00.
<u>1.2 RELATED SECTIONS</u>	.1 Conduits, Conduit Fastenings and Conduit Fittings: Section 26 05 34 .2 Wire and Box Connectors (0 - 1000V): Section 26 05 20 .3 Primary Process Instrumentation Devices and Cabling: Section 40 90 00. .3 Process Control System Equipment and Cabling: Section 40 91 00.
<u>1.3 REFERENCES</u>	.1 CSA C22.1-15, Canadian Electrical Code.

PART 2 - PRODUCTS

<u>2.1 BUILDING WIRES</u>	.1 Conductors: soft drawn, stranded, copper(of 98% conductivity). Minimum size #12 AWG. .2 Copper conductors: size as indicated, with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90-XLPE. .3 Copper conductors: size as indicated, with 1000V insulation of chemically cross-linked thermosetting polyethylene material rated RWU90-XLPE. .4 Colour code wiring in accordance with the Canadian electrical Code.
<u>2.2 PROCESS CONTROL AND INSTRUMENTATION CABLING</u>	.1 Refer to Section 40 90 00 and electrical drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF
BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.
 - .2 Use RWU90 for all underground runs.

3.2 INSTALLATION OF
CABLES: GENERAL

- .1 Support cables independently of supports used for equipment of other trades; do not support from or secure cables to ductwork and piping.
- .2 Install cables in a neat and professional manner, so as to conserve headroom.
- .3 Install cables parallel and perpendicular to building lines.
- .4 In wet/damp areas and outdoors, cables to enter into the bottom of the equipment.
- .5 Twist together stranded conductors at each termination.
- .6 Ty-rap branch circuit phase conductors and neutral (where applicable) at the closest point of entry within all panelboards, pullboxes, junction boxes, motor control centres and switchboards.

PART 1 - GENERAL

1.1 RELATED WORK .1 Electrical General Requirements: Section 26 05 00

PART 2 - PRODUCTS

2.1 EQUIPMENT .1 Clamps for grounding of conductor, size as required and suitable for application.

.2 Direct buried grounding conductors: bare stranded copper of 98% conductivity, soft annealed, size as indicated.

.3 Insulated grounding and bonding conductors: soft drawn, stranded copper of 98% conductivity, type RW90 (green coloured insulation) in all conduits. Minimum size: #14 AWG or as indicated in Table No. 16 of C.E.C., whichever is larger.

.4 Provide ground connections taking place on the ground bus as follows:

.1 For wire sizes 6 AWG and smaller: copper, one-hole, short barrel (single crimp) lugs.

.2 Wire larger than 6 AWG to be two-hole, long barrel (dual crimp) lugs.

.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.7 Copper, crimp type compression connectors (long barrel, two hole).

.8 Copper crimp type compression connectors (cable to cable, cable to ground rod, etc.)

2.2 MANUFACTURERS .1 Acceptable manufacturers: FCI - Burndy Corporation, Erico Inc., Thomas & Betts, Ilsco.

PART 3 - EXECUTION

3.1 INSTALLATION
GENERAL

- .1 Install complete permanent, continuous, grounding systems including conductors, connectors, accessories, as indicated to conform to requirements of Consultant, and local authority having jurisdiction over installation.
- .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 using exothermic welding process or inspectable copper crimp type compression connectors.
- .5 Use mechanical connectors for grounding connections to equipment provided with grounding lugs except grounding terminations in 600V switchboards, 600V type CDP panel boards, and 600V motor control centres are to be copper, long barrel, two hole crimp type compression connectors.
- .6 Use copper, crimp type compression connectors for grounding connections to equipment not provided with connectors.
- .7 Soldered joints not permitted.
- .8 Make grounding connections in radial configurations only, with connections terminating at single grounding point. Avoid loop connections.
- .9 Install insulated copper bonding conductor in all conduit runs.
- .10 The 'feed' bonding conductor shall be secured (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or providing a "pig-tail" lead for device terminations.
- .11 Twist together all ground/bond wires with a screw-on type wire connector, and then place in the rear of the outlet box.

3.2 SYSTEM AND
CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary systems.

3.3 EQUIPMENT
GROUNDING & BONDING

- .1 Install grounding and bonding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, frames of motors, motor starters, control panels, distribution panels, outdoor lighting, process equipment, instrumentation, and process piping.

3.4 FIELD QUALITY
CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform tests before energizing electrical system.

PART 1 - GENERAL

1.1 NOT APPLICABLE .1 Not applicable.

PART 2 - PRODUCT

2.1 SUPPORT CHANNELS .1 U shape, size 41 mm x 41 mm, 2.7 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.

.2 Standard rolled structural steel shapes and plates or prefabricated structural systems.

.3 Use 316 stainless steel throughout the Project.

2.2 CABLE TIES .1 Nylon flame retardent, low smoke cable tie, size as required.

.2 Nylon flame retardant, low smoke cable tie mounting bracket. Mechanical fastening type only; adhesive mounts not acceptable.

.3 The use of cable ties for supporting purposes is not permitted. Cable ties can only be used to hold various system cables in place.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Secure equipment to solid masonry, tile and plaster surfaces with mechanical anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls with stainless steel toggle bolts.

.4 Support equipment, conduit or cables using stainless steel clips, stainless steel spring loaded bolts, stainless steel cable clamps designed as accessories to basic channel members.

3.1 INSTALLATION
(Cont'd)

- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 Stainless steel one-hole straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Stainless steel two-hole straps for conduits and cables larger than 50 mm.
- .6 Suspended support systems for horizontal runs:
 - .1 Support individual cable and conduit runs with minimum 12 mm dia. continuously stainless steel threaded rods and stainless steel spring clips.
 - .2 Support two (2) or more cables and conduits on stainless steel channels supported by minimum 12 mm dia stainless steel threaded rod hangers where direct fastening to building construction is impractical.
 - .3 Continuously threaded rods shall be stainless steel to match supporting hardware.
- .7 For surface mounting of two or more conduits and cable, use support channels spaced in accordance with the Canadian Electrical Code (maximum 1.5m spacing).
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Provide adequate support for conduits and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure conduits or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .12 Provide fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Provide hot dipped galvanized or stainless steel beam clamps to secure conduits to exposed steel work.

3.1 INSTALLATION
(Cont'd)

- .14 Various suspended types of junction, pull and/or outlet boxes as well as conduits, are to be supported with minimum size 12 mm threaded rod, nuts and flat washers. Secure threaded rods to boxes with one flat washer and nut installed on both sides of box.
 - .1 One (1) rod required for all type boxes sized 150 mm x 150 mm and smaller.
 - .2 Two (2) rods required for boxes sized 200 mm x 200 mm and larger, up to and including those sized 300 mm x 300 mm.
 - .3 Minimum of four (4) rods required for all boxes sized larger than 300 mm x 300 mm.
 - .4 Cut-off all excess rod within 12 mm of channel bottom.
- .15 In addition to C.E.C. minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300 mm and mid point of "all" 90° bends. Maximum spacings between conduit support channels will be as dictated by smallest size conduit(s) being supported and/or secured to same.
- .16 Where galvanized steel supports are exposed to moisture, touch-up all field cut surfaces with galvanizing paint.
- .17 Provide isolation pads between dis-similar metals where required.
- .18 Coordinate the location of electrical support systems with other trades before installation.

PART 1 - GENERAL

<u>1.1 SUBMITTALS</u>	.1	Submit shop drawings, and product data in accordance with Section 01 00 00.
<u>1.2 RELATED SECTIONS</u>	.1	Primary Process Instrumentation Devices and Cabling: Section 40 90 00.
	.2	Process Control System Equipment and Cabling: Section 40 91 00.

PART 2 - PRODUCTS

<u>2.1 JUNCTION AND PULL BOXES</u>	.1	General: Provide outlet, tap, junction, pull and floor boxes with screw-fastened covers. Provide junction and pull boxes longer than 500mm (20") in any dimension complete with continuously hinged cover.
	.2	Tap, Junction and Pull Boxes: Provide boxes constructed of welded and galvanized sheet steel, of sizes required by Canadian Electrical Code. Use 14 USS gauge metal on boxes with no dimension of 600 mm or more, except use 10-gauge boxes with any dimension of 900 mm or more.
	.3	Dusttight boxes: In electrical room and lab provide NEMA type 12 boxes (painted steel) with clamped, threaded or screw fastened covers.
	.4	Watertight Boxes: In process, wet and outdoor locations, provide NEMA Type 4X water-tight boxes with clamped, threaded or bolted covers. Boxes to be fibre reinforced for all areas except Class 1 Zone 2 locations. Use 316SS for hazardous areas.
	.5	Hazardous Rated Boxes: .1 Boxes must be suitable for the hazardous classification as noted on the drawings. .2 Boxes to be 316SS increased safety enclosures with certification for installation in Class 1 Zone 2 areas.

PART 3 - EXECUTION

3.1 CABINETS,
JUNCTION AND PULL
BOXES

- .1 Only main junction and pull boxes are indicated on the drawings. Provide boxes to suit field conditions and where required by the Canadian Electrical Code.
- .2 Install junction and pull boxes in inconspicuous but accessible locations.
- .3 Mount cabinets with top not higher than 2m above finished floor.
- .4 Provide all required mounting hardware.
- .5 Junction or outlet boxes feeding a maximum of two (2) fixture drops must not be sized smaller than 100mm square.
- .6 Concealed boxes located in the ceiling spaces above suspended type ceilings are not to be installed greater than 762mm above the finished ceiling elevation.
- .7 Provide junction boxes larger than 150mm x 150mm used in branch circuit wiring complete with bonding terminal stripes.
- .8 Bond all pull boxes with bonding conductor.

3.2 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.

PART 1 - GENERAL

1.1 NOT APPLICABLE .1 Not applicable

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES .1 General:
.1 Size boxes in accordance with CSA C22.1.
.2 100 mm square or larger outlet boxes as required for special devices.
.3 Gang boxes where wiring devices are grouped.
.4 Blank cover plates for boxes without wiring devices.
.5 Combination boxes with barriers where outlets for more than one system are grouped.

.2 Sheet steel outlet boxes:
.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 75 x 50 x 38 mm or as indicated. 100 mm square outlet boxes when more than one conduit enters one side.
.2 100 mm square or octagonal outlet boxes for lighting fixture outlets.
.3 Electro-galvanized steel utility boxes for outlets connected to surface mounted EMT, minimum size 100mm x 54mm x 47mm.

.3 Masonry boxes: electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

.4 Concrete boxes: electro-galvanized steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

.5 Surface mounted outlet boxes:
.1 Cast FS or FD copper free aluminum or feralloy boxes (to match conduit material) with factory threaded hubs and mounting feet for surface wiring of switches, receptacles, thermostats, etc.
.2 NEMA 4X PVC outlet boxes in areas where PVC conduit is to be used.

.6 Explosion proof outlet boxes:

2.1 OUTLET AND
CONDUIT BOXES
(Cont'd)

- .6 (Cont'd)
 - .1 Surface mounted, single gang, cast copper free aluminum or galvanized iron alloy (to match conduit material) outlet box with factory threaded hubs, rated for installation in the hazardous area classification as noted on the drawings.
 - .2 Confirm the outlet box and device are compatible and that the required hazardous rating is maintained.

2.2 FITTINGS -
GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes. Use watertight bushings and cable connectors for all cable/conduit terminations in process control cabinets and NEMA 3R/4/4X pull/junction boxes.

PART 3 - EXECUTION

3.1 OUTLET BOX, AND
CONDUIT BOX
INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
- .3 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers not allowed.
- .4 Recess outlet boxes in finished areas.

PART 1 - GENERAL

<u>1.1 LOCATION OF CONDUIT</u>	.1	Drawings do not show all conduits. Those shown are in diagrammatic form only.
<u>1.2 RELATED WORK</u>	.1	Section 26 05 29 - Fastenings and Supports.
	.2	Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
<u>1.3 REFERENCES</u>	.1	CAN/CSA-C22.2 No. 18.1-13, Outlet Boxes, Conduit Boxes and Fittings and Associated Hardware.
	.2	CSA-C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
	.3	CSA C22.2 No. 45.1-2007 (R2012), Electrical Rigid Metal Conduit - Steel.
	.4	CSA C22.2 No. 45.2-2008 (R2013), Electrical Rigid Metal Conduit - Aluminum.
	.5	CSA C22.2 No. 56-2013, Flexible Metal Conduit and and Liquid Tight Flexible Metal Conduit.
	.6	CSA C22.2 No. 83-M1985 (R2013), Electrical Metal Tubing.

PART 2 - PRODUCTS

<u>2.1 CONDUITS</u>	.1	Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1.
	.2	Rigid aluminum threaded conduit, fittings and connectors: to CSA C22.2 No. 45.2.
	.3	Rigid PVC conduit, fittings and connectors: to CSA C22.2 No. 211.2.
	.4	Flexible aluminum conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.
	.5	Minimum power and control/instrumentation conduit size for all areas: 21mm.

<u>2.1 CONDUITS (Cont'd)</u>	.6	Rigid PVC conduit to be FT4 rated.
	.7	Flexible hazardous area rated conduit.
<u>2.2 CONDUIT FASTENINGS</u>	.1	One hole conduit straps to secure surface conduits 50 mm and smaller. Two hole conduit straps for conduits larger than 50 mm.
	.2	Heavy duty pipe clamps (with adjustable saddle) to secure conduits to support channels.
	.3	Refer to Section 26 05 29 for suspended and surface support systems for conduits.
	.4	Finish and material for conduit fastenings to match conduit.
	.5	Provide isolators between dis-similar metals as required.
<u>2.3 CONDUIT FITTINGS</u>	.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	Connectors and couplings for EMT: steel set-screws.
	.4	Cast type EYS and EYD type sealing fittings with factory threaded hubs and rated for installation in the hazardous areas as noted on the drawings. .1 Acceptable Manufacturers: Appleton, Crouse-Hinds or Killark.
<u>2.4 EXPANSION FITTINGS FOR RIGID CONDUIT</u>	.1	Weatherproof expansion fittings with internal bonding assembly suitable for linear expansion as required.
	.2	Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
	.3	Weatherproof expansion fittings for linear expansion at entry to building as required.

2.4 EXPANSION
FITTINGS FOR RIGID
CONDUIT
(Cont'd)

- .4 Provide expansion fittings at exit point (above-ground) of all underground services, and where indicated on the drawings.
- .5 Use liquid tight flexible hazardous area rated conduit for expansion in hazardous areas.

2.5 FISH CORD

- .1 Polypropylene.

PART 3 - EXECUTION

3.1 CONDUIT
INSTALLATION

- .1 General:
 - .1 Use rigid aluminum threaded conduit unless otherwise indicated.
 - .2 Use rigid PVC conduit for all direct buried underground services. Convert to rigid aluminum prior to exiting to above grade in all hazardous areas.
 - .3 In the Process Building (non-hazardous area), use rigid PVC or rigid aluminum conduit. Rigid PVC conduit to be strapped/secured every 450mm.
 - .4 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .5 In finished areas, conceal conduits in attic space and in wall voids where possible.
 - .6 In non-hazardous areas, use liquid tight flexible metal conduit for connection to vibrating equipment and instruments. In Zone 1/Zone 2 hazardous areas, use explosion-proof flexible couplings for connections to vibrating equipment and all instruments.
 - .7 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .8 Mechanically bend metallic conduit over 21 mm dia.
 - .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .10 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
 - .11 Dry conduits out before installing wire.
 - .12 Provide minimum 300 mm spacing between instrumentation/control conduits and 208V power conduits. Where possible, instrumentation control conduits to cross at right angles to 208V power conduits.

3.1 CONDUIT
INSTALLATION
(Cont'd)

- .1 (Cont'd)
 - .13 Install conduit sealing fittings in hazardous areas in accordance with Canadian Electrical Code requirements. Fill with compound. Seal all conduit leaving a hazardous area using an approved sealing fitting when conduit is continuous.
 - .14 Drawings do not show all required unions. Unions shall be installed to facilitate removal of equipment. Where seals are installed, install the unions between the equipment and the seal.
 - .15 Install conduits to prevent low pockets where moisture can accumulate. Install a combination breather and drain fitting at the lowest point of each above-grade conduit system, which is unbroken by sealing fittings or other obstructions.
 - .2 Surface conduits:
 - .1 Run parallel or perpendicular to building lines.
 - .2 Group conduits wherever possible on suspended or surface channels.
 - .3 Do not pass conduits through structural members except as indicated.
 - .4 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum 25 mm at crossovers.
 - .5 Fasten to flutes of metal roof deck when practical.
 - .6 Do not run conduits where they obstruct lifting devices such as monorails, cranes and hoists.
 - .3 Concealed conduits:
 - .1 Do not install horizontal runs in masonry walls.
 - .2 Do not install conduits in concrete toppings.
 - .3 Run parallel or perpendicular to building lines.
 - .4 Conduits underground: slope conduits to provide drainage.
 - .5 Supply and install pull string in each spare conduit. Cap and seal conduit at each end.
-

3.1 CONDUIT
INSTALLATION
(Cont'd)

- .6 Dewatering Room 106 and Bin Room 107 are Class 1 Zone 2 hazardous areas that will be ventilated to remove the hazardous area classification. In the event that the ventilation fails the rooms will again be classified as hazardous spaces. Install all wiring, conduit and equipment installations are to meet Class 1 Zone 2 requirements. Some process equipment will not have a hazardous area classification and hence will be shut down when the ventilation system fails or is shut down. In this case, install wiring and conduits to meet Class 1 Zone 2 hazardous area to gas egression into other non-hazardous spaces.

PART 1 - GENERAL

1.1 NOT USED .1 Not Applicable

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Applicable

PART 3 - EXECUTION

3.1 CABLE
INSTALLATION IN
DUCTS .1 Install cables as indicated in ducts.
.2 Do not install spliced cables.
.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
multiconductor control cables reel off in same
direction during installation.
.6 After installation of cables, seal duct ends with
duct sealing compound.
.7 After installation of cables in hazardous areas seal
duct ends with appropriate sealing devices and
compound.

3.2 FIELD QUALITY
CONTROL .1 Perform tests in accordance with Section 26 05 00.
.2 Perform tests using qualified personnel. Provide
necessary instruments and equipment.
.3 Check phase rotation and identify each phase
conductor of each feeder.

3.2 FIELD QUALITY
CONTROL
(Cont'd)

- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor for 600V circuits and 500V megger on each phase conductor for 120/208V circuits.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for energization.
- .6 Provide the Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

PART 1 - GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA .1 Submit shop drawings in accordance with Section 01 00 00.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.2 OPERATIONS AND MAINTENANCE DATA .1 Provide operations and maintenance data for panelboards for incorporation in to manual.

.2 Include panel schedules.

PART 2 - PRODUCTS

2.1 PANELBOARDS .1 Panelboard:
.1 Install 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.

.2 Bus and breakers rated for the interrupting capacity (momentary rms symmetrical) as indicated on the drawings. Minimum 18 kA.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboard: mains, number of circuits, and number and size of branch circuit breakers as indicated on the drawings.

.5 Provide two (2) keys for each panelboard and key panelboards alike.

.6 Tin-plated, copper busbars with neutral of same ampere rating as mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

2.1 PANELBOARDS
(Cont'd)

- .9 Trim and door finish: baked grey enamel.
- .10 Provide panelboard complete with driphood.
- .11 Surface mount panelboards unless noted otherwise.
- .12 Hinged panel cover to access connection to breakers.

2.2 BREAKERS

- .1 Breakers: as specified in Section 26 28 21.
- .2 Bolt-on breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Lock-on devices for 10 % of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.
- .4 Ground fault circuit interrupter breakers as noted on drawings.

2.3 EQUIPMENT
IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 9 engraved.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 ACCEPTABLE
MANUFACTURERS

- .1 Cutler-Hammer, Square D, Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate panelboard as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Connect panelboard to source transformer or circuit breaker as indicated.
- .3 Connect loads to circuits.

3.1 INSTALLATION
(Cont'd)

.4 Connect neutral conductors to common neutral bus
with respective neutral identified.

.5 Install type-written panel schedule in panelboards.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements for the supply and installation of the motor control centres.
- 1.2 RELATED WORK .1 Electrical General Requirements: Section 26 05 00
.2 Circuit Breakers: Section 26 28 21
.3 Motor Starters to 600V: Section 26 29 10
.4 Motor Soft Starters: Section 26 29 13
.5 Variable Frequency Drivers: Section 26 29 23
.6 Service Entrance TVSS Protection: Section 26 43 13
- 1.3 REFERENCES .1 CAN/CSA-C22.2, No. 5-2013, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-National standard, with UL 489 and NMX-J-266-ANCE).
.2 CSA-C22.2, No. 14-2013, Industrial Control Equipment.
.3 CSA-C22.2 No. 66-1988(R2011), Specialty Transformers.
- 1.4 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 00 00.
.2 Indicate:
.1 Outline dimensions
.2 Configuration of equipment on elevation drawing complete with motor starter identification on the same elevation.
.3 Dimensioned foundation template.
.4 Cable duct entry and exit locations.
.5 Dimensioned position and size of busbars.
.6 Schematic and wiring diagrams for motor starters.
.7 Magnetic circuit breaker type.
.8 Overload relay type.
.9 Starter size and type.
.10 Enclosure type.

<u>1.4 SHOP DRAWINGS (Cont'd)</u>	.2 (Cont'd) .11 MCC elevation to provide starter labels to identify each load.

<u>1.5 OPERATION AND MAINTENANCE DATA</u>	.1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 00 00. .2 Include data for each type and style of starter.

PART 2 - PRODUCTS

<u>2.1 MOTOR CONTROL CENTRE</u>	.1 Motor control centre manufactured to NEMA Standards. .2 Control equipment to CSA-C22.2, No. 14. .3 Control transformers to CSA-C22.2 No. 66. .4 Circuit breakers to CSA-C22.2 No.5. .5 Rating 600 volts, 60 Hz, 3-phase, 3-wire, continuous ampere rating and short circuit interrupting rating (momentary RMS symmetrical) as indicated on the drawings. .6 Compartmentalized vertical sections with common power busbars, front only arrangement, minimum 300mm depth. .7 Floor mounting, free standing, enclosed dead front. .8 Indoor NEMA Type 2 enclosure with gasketed doors and driphood. .9 Front mounting. .10 Class 1 type B wiring. .11 Horizontal wireways, equipped with cable supports across top and bottom, extending full width of motor control center insulated from busbars by steel barriers.

2.1 MOTOR CONTROL
CENTRE
(Cont'd)

- .12 Vertical wireways for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.
- .13 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.
- .14 Incoming cables to enter at top or bottom, as indicated on the drawings.
- .15 Provision for outgoing cables to exit via top or bottom.
- .16 Removable lifting means.
- .17 Continuous 100 mm channel iron floor sills with 19 mm diameter holes for bolts.
- .18 Main horizontal and branch vertical, three phase, high conductivity, tin-plated copper busbars (aluminum not acceptable) in separate compartment extending entire width and height of motor control centre, supported on insulators and rated:
 - .1 Main horizontal busbars ampere rating as noted on the drawings.
 - .2 Branch vertical busbars ampere rating as recommended by manufacturer for loads indicated.
- .19 Branch vertical busbars for distribution of power to units in vertical sections.
- .20 Automatic shutters to cover plug-in stab openings when units are removed.
- .21 No other cables, wires, equipment in main and branch busbar compartments.
- .22 Brace buswork to withstand effects of short-circuit current of minimum 32 KA (momentary rms symmetrical) at rated voltage.
- .23 Bus Supports: high dielectric strength, low moisture absorption, high impact material, with long creepage surface designed to discourage collection of dust.
- .24 Copper ground bus, minimum size 25 mm x 6 mm extending entire width of motor control centre, located at bottom.

2.1 MOTOR CONTROL
CENTRE
(Cont'd)

- .25 Motor starter units NEMA size 4 and smaller, circuit breaker units 200A and smaller plug-in type shall connect to the vertical bus by means of self-aligning silver plated copper stab-on connectors provided with stainless steel back-up springs. Provision for units to be installed or removed, off load, while buses are energized.
- .26 Isolate units withdrawn from vertical bus but support by structure. Unit must be capable of complete withdrawal.
- .27 Do not mount unit terminal blocks mounted in vertical wireway.
- .28 Where applicable, overload relays shall be manually reset from front with door closed.
- .29 Hinge doors on left side.
- .30 Provide MCC units (starter, breaker, etc.) complete with external operating handle of circuit switch (with defeater mechanism) to prevent door opening with switch in the 'on' position. Provide for three (3) padlocks to lock operating handle in 'off' position and lock door closed.
- .31 Provide devices and components by one (1) manufacturer except where noted otherwise to facilitate ease of maintenance.
- .32 Provide equipment in accordance with Section 26 05 00. Individual compartment name-plates engraved as indicated.
- .33 All painted parts must undergo a phosphetizing prepaint treatment for rust resistance. Final coat of paint to be ANSI 61 Light Grey.
- .34 General arrangement and individual unit features to be as indicated on the Drawings.
- .35 Provide all current and potential instrument transformers.
- .36 Provide spare parts as follows:
 - .1 One (1) spare set contactor contacts for each size used.
 - .2 One (1) spare contactor coil of each size used.
 - .3 Six (6) control fuses of each size used.
 - .4 One (1) control transformer of each size used.
 - .5 One (1) spare electronic overload relay.

2.1 MOTOR CONTROL
CENTRE
(Cont'd)

- .37 Control fuses to be HRC, fast acting high interrupting capacity.

2.2 MOTOR STARTERS

- .1 Provide motor starters and devices in accordance with Section 26 29 10.

2.3 CIRCUIT
BREAKERS

- .1 Provide circuit breakers in accordance with Section 26 28 21.

2.4 VARIABLE
FREQUENCY DRIVES

- .1 Provide variable frequency drives in accordance with Section 26 29 23

2.5 EQUIPMENT
IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Starter and breaker designation label, white plate, black letters, size 4, engraved as indicated.
- .3 Motor control centre designation label, white plate, black letters, size 9, engraved as indicated.

2.6 ACCEPTABLE
MANUFACTURER'S

- .1 New MCC No. 2:
 - .1 Allen Bradley.
 - .2 Cutler-Hammer.
 - .3 Square D (Schneider Canada).
 - .4 Furnas (Siemens).

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Fully wrap the motor control centre and protect from dust and moisture during construction.
- .2 Set and secure (bolt) motor control centre in place on channel bases, rigid, plumb and square to the building floor and wall.
- .3 Install starters, connect power and control as indicated.

3.1 INSTALLATION
(Cont'd)

- .4 Confirm correct breaker trip settings and overload device elements are installed and set to match the respective motor full load current and service factor.

3.2 TESTS

- .1 Perform tests in accordance with Sections 01 00 00 and 26 05 00 and the manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Confirm sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Confirm monitoring equipment is connected and properly working upon completion of installation. Simulate I/O from each unit and verify status and alarms at the plant PLC and EMCS control system.

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1 Electrical General Requirements: Section 26 05 00
<u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u>	.1 Submit shop drawings and product data in accordance with Section 01 00 00.
<u>1.3 REFERENCES</u>	.1 CSA C22.2 No. 111-10(R2015), General-use Snap Switches. .2 CSA C22.2 No.55-15, Special Use Switches. .3 CSA C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices.

PART 2 - PRODUCTS

<u>2.1 SWITCHES</u>	.1 Design S1: .1 Heavy duty 20A, 120V, single pole, toggle switch with the following features: .1 Rated for the hazardous classification as noted on the drawings. .2 Factory sealed switching mechanism. .3 Aluminum operator mechanism and nylon cam. .4 Copper free, cast aluminum body with threaded hubs, 316 stainless steel hardware and aluminum alloy cover. .5 Weatherproof coverplate. .6 Acceptable manufacturers: .1 Crouse-Hinds .2 Appleton .3 Killark .2 Hazardous rated switches of one manufacturer throughout project.

PART 3 - EXECUTION

<u>3.1 INSTALLATION</u>	.1 Switches:

3.1 INSTALLATION
(Cont'd)

- .1 (Cont'd)
- .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Mount toggle switches at height specified in Section 26 05 00 or as indicated.

PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1 CAN/CSA C22.2 No. 248.8-11, Low Voltage Fuses - Part 8 Class J fuses.
	.2 CAN/CSA C22.2 No. 248.4-00(R2015), Low Voltage Fuses - Part 4: Class CC fuses.
<u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u>	.1 Submit shop drawings and product data in accordance with Section 01 00 00.
<u>1.3 MAINTENANCE MATERIALS</u>	.1 Three (3) spare fuses of each type and size.
<u>1.4 DELIVERY AND STORAGE</u>	.1 Ship fuses in original containers.
	.2 Do not ship fuses installed.
	.3 Store fuses in original containers in moisture free location.

PART 2 - PRODUCTS

<u>2.1 FUSES GENERAL</u>	.1 Fuses: use the product of one (1) manufacturer throughout.
	.2 Low voltage fuses, types as specified, shall be CSA certified in accordance with CSA Standard C22.2 No. 248.
<u>2.2 FUSE TYPES</u>	.1 Fuses: high rupturing capacity (HRC) type, minimum 200kA interrupting rating (momentary RMS symmetrical).
	.2 Class J: .1 Fuses rated 1 to 600 amperes, 600 Vac, shall be CSA certified Class J in accordance with Standard C22.2 No. 248.8.

2.2 FUSE TYPES
(Cont'd)

- .2 (Cont'd)
 - .2 Where a time delay characteristic is required, fuses must carry 500% of their ampere rating for not less than 10 seconds and shall be clearly labelled "time delay".
- .3 Class CC:
 - .1 Fuses rated 1 to 30 amperes, 600 Vac, shall be CSA certified Class CC in accordance with Standard C22.2 No. 248.4.
 - .2 Where a time delay characteristic is required, fuses must carry 200% of their ampere rating for not less than 12 seconds.
- .4 Standard of acceptance:
 - .1 Class J: Mersen type A4J (non-time delay) and AJT (time delay).
 - .2 Class CC: Mersen type ATMR (non-time delay) and ATDR (time delay) and ATQR (time delay).
 - .3 Class J (VFD's): Mersen type HSJ (semi-conductor, time delay).
- .5 Acceptable manufacturers:
 - .1 Mersen.
 - .2 Bussmann.
 - .3 Littlefuse.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Confirm correct fuses are fitted to physically matched mounting devices.
- .3 Confirm correct fuses fitted to assigned electrical circuit.
- .4 Confirm fuse size is correctly identified on equipment.
- .5 For feeder circuit fuses, use fast acting Class J fuses unless otherwise noted.
- .6 For full voltage non-reversing motor starters, full voltage reversing motor starters, full voltage multi-speed motor starters and transformers, use time delay Class J fuses.
- .7 For variable frequency drives use Class VFD type.

3.1 INSTALLATION
(Cont'd)

- .8 For 600Vac control circuits, use Class CC type fuses. Use time delay Class CC fuses upstream of control transformers and solenoids.

PART 1 - GENERAL

<u>1.1 SHOP DRAWINGS AND PRODUCT DATA</u>	.1 Submit shop drawings and product data in accordance with Section 01 00 00.

PART 2 - PRODUCTS

<u>2.1 BREAKERS GENERAL</u>	.1 Bolt-on moulded case circuit breaker, quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient. .2 Common trip breakers: with single handle for multiple applications. .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 5 to 10 x current rating. .4 Circuit breakers with interchangeable trips as indicated. .5 Circuit breakers to have interrupting rating (momentary RMS symmetrical) as indicated. .6 Terminals must be suitable for 75°C conductors.
<u>2.2 THERMAL MAGNETIC BREAKERS</u>	.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping. .2 Provide ground fault interrupter type for circuits so marked.
<u>2.3 MANUFACTURERS</u>	.1 Acceptable manufacturers: Cutler-Hammer, Square D, Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 Provide typewritten panel schedules for all impacted panelboards.

PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Electrical General Requirements: Section 26 05 00

1.2 PRODUCT DATA .1 Submit shop drawings and product data in accordance with Section 01 00 00.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Heavy duty, fusible and non-fusible, horsepower rated, single throw disconnect switch in CSA enclosure type as indicated (minimum CSA Enclosure Type 1).
- .2 Electrical rating as indicated on the drawings.
- .3 Provision for padlocking in off switch position by three (3) padlocks.
- .4 Mechanically interlocked door to prevent opening when handle in ON position.
- .5 Fuses: size as indicated.
- .6 Fuseholders: suitable without adapters, for type and size of fuse indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Viewing window to view open/close status of disconnect switch blades.
- .10 Switches to be NEMA enclosure type 12 unless noted otherwise. Switches located outdoors and in wet/damp process areas to be NEMA 4X (stainless steel) construction.
- .11 Double throw manual transfer switch as noted on the drawings.
- .12 Acceptable material:
 - .1 Siemens.

2.1 DISCONNECT
SWITCHES
(Cont'd)

- .12 (Cont'd)
- .2 Cutler Hammer.
- .3 Square D.

2.2 MANUAL TOGGLE
TYPE SWITCHES

- .1 Single phase manual "on-off" switch, horsepower rated.
- .2 Voltage rating: 208V, single or three phase, 60Hz.
- .3 Current rating: minimum 30A at rated voltage.
- .4 Toggle type switch with quick-make, quick-break switching mechanism.
- .5 Terminals: screw type, suitable for #10AWG (or smaller) copper conductors.
- .6 Enclosure: NEMA type 12 unless noted otherwise.
- .7 Unit complete with locking tab to permit padlocking in the off position.
- .8 Acceptable materials: Square D Type K (Class 2510) or approved equivalent.
- .9 Acceptable manufacturers: Square D, Cutler Hammer, Siemens, Hubbell.

2.3 EQUIPMENT
IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses as indicated.
- .2 Install true, plumb and square to building lines.
- .3 Install disconnect switch with proper clearance for operation of handle.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements for the supply and installation of motor starters.
- 1.2 RELATED WORK .1 Electrical General Requirements: Section 26 05 00
- 1.3 SHOP DRAWINGS AND PRODUCT DATA .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Indicate:
- .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Schematic and wiring diagrams for each type of starter.
 - .6 Circuit breaker type.
 - .7 Overload relay type.
- 1.4 OPERATION AND MAINTENANCE DATA .1 Provide operation and maintenance data for motor control centre for incorporation into manual.
- .2 Include data for each type and style of starter.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Starters: EEMAC E14-1.
- .1 Half size starters not acceptable.
 - .2 IEC equipment not acceptable.
 - .3 Minimum starter size 1. Overloads shall be sized for actual motor horsepower ratings.
- 2.2 MANUAL MOTOR STARTERS .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
- .1 Switching mechanism, toggle type quick make and break.
-

2.2 MANUAL MOTOR
STARTERS
(Cont'd)

- .1 (Cont'd)
 - .2 Overload heater(s), manual reset, trip indicating handle.
 - .3 Terminals: screw type, suitable for #10AWG (or smaller) copper conductors.
 - .4 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.
 - .3 NEMA Type 4X (stainless steel) in wet/damp process areas, in chemical rooms and in chlorine rooms.
- .2 Accessories:
 - .1 Toggle switch labelled as indicated.
 - .2 Indicating light: standard, heavy duty, oil tight LED type and colour as follows: Green = Run/On.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
- .3 Acceptable manufacturers: Square D, Cutler-Hammer, Siemens.

2.3 FULL VOLTAGE
MAGNETIC STARTERS

- .1 Single phase and 3-phase magnetic or combination magnetic starters of size, type (non-reversing, reversing or multi-speed type), rating as indicated on the Drawings with components as follows:
 - .1 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.
 - .3 NEMA Type 4X (stainless steel) in wet/damp process areas, in chemical rooms and in chlorine rooms.
 - .2 120 V operating coil with primary and secondary fused control transformer where indicated. Provide control fuses for 120 V power supply circuit from panelboards.
 - .3 For three-phase magnetic starters, provide solid state motor overload protective device in each phase, with single phasing and ground fault protection, manually reset from outside enclosure.
 - .4 For single-phase magnetic starters, provide standard overload relay (ambient compensated, bimetallic type) with interchangeable heaters. Overload protective device shall be manually reset from outside of the enclosure.
 - .5 Power and control terminals.

2.3 FULL VOLTAGE
MAGNETIC STARTERS
(Cont'd)

- .1 (Cont'd)
 - .6 Wiring and schematic diagram inside starter enclosure in visible location.
 - .7 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter or fused disconnect switch as noted on the Drawings and with operating lever on outside of enclosure to control disconnecting device and provision for:
 - .1 Locking in "OFF" position with up to three (3) padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door is open.
- .3 Accessories:
 - .1 Selector switches: industrial heavy duty, Nema style, 30mm, watertight, corrosion resistant (NEMA 4X enclosure only), oil and dust tight, labelled as indicated.
 - .2 Indicating lights: industrial, heavy duty, NEMA style, 30 mm, watertight, corrosion resistant (NEMA 4X enclosure only), oil and dust tight, LED type, colour as indicated.
 - .3 Auxiliary contacts as indicated.
 - .4 Provide motor current transducers for starter units indicated on the drawings.
 - .5 Provide door mounted devices, terminal blocks, and auxiliary contacts as detailed on the Drawings.

2.4 EQUIPMENT
IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Magnetic starter designation label, white plate, black letters, size 9, engraved as indicated.
- .3 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

2.5 ACCEPTABLE
MANUFACTURERS

- .1 Allen Bradley.
- .2 Cutler-Hammer.
- .3 Square D (Schneider Canada).

2.5 ACCEPTABLE MANUFACTURERS (Cont'd) .4 Furnas (Siemens).

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install starters, connect power and control as indicated.
.2 Confirm correct breakers, fuses and overload devices elements are installed and set per manufacturer's recommendation for motor size and coordination study.

3.2 TESTS .1 Perform tests in accordance with Sections 01 00 00 and 26 05 00 and manufacturer's instructions.
.2 Operate switches, contactors to verify correct functioning.
.3 Perform starting and stopping sequences of contactors and relays.
.4 Confirm sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
.5 Confirm monitoring equipment is connected and properly working upon completion of installation. Simulate I/O from each unit and verify status and alarms.

PART 1 - GENERAL

1.1 DESCRIPTION OF
SYSTEM

- .1 This specification describes the requirements for design, supply and delivery of electronic soft starters. Contractor shall refer to related specification sections for mechanical and process motor specifications.
- .2 Where noted, motor soft starters shall be factory installed in a Motor Control Centre. Refer to specification Section 26 24 19.

1.2 RELATED
SECTIONS

- .1 Sludge blowers: Section 46 53 53
- .2 Electrical general requirements: Section 26 05 00
- .3 Motor control centre: Section 26 24 19

1.3 REFERENCES

- .1 Provide starter that is designed to meet or exceed applicable CSA, UL, NEMA, and IEEE standards.
- .2 Complete installation according to CSA Standards unless specified otherwise.
- .3 Comply with CSA Electrical Bulletins in force at time of tender submission. While not identified and specified by number in this Division, these bulletins are to be considered as forming part of related CSA Part II standard.

1.4 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure type
 - .5 Wiring diagram
 - .6 Interconnection diagram

1.5 WARRANTY .1 Provide a warranty all material for a period of two (2) years minimum from the Substantial Completion date that expressly states the Contractor will replace, at no cost to the Owner, faulty materials. Warranty to include the cost of all labour, travel and expenses for repairs within the warranty period.

1.6 OPERATIONS AND MAINTENANCE DATA .1 Provide operations and maintenance information in accordance with Section 01 00 00. This includes information on the drives and any required relays and other components that make up the complete package.

1.7 SPARE PARTS .1 Submit list and price of recommended spare parts to have on site to limit downtime.
.2 Submit manufacturer's policy of providing spare parts for older equipment (e.g., spare parts are to be available for 10 years minimum after original equipment has been manufactured).

PART 2 - PRODUCTS

2.1 GENERAL .1 Provide soft starters for the following motors:
.1 Blower building: Air Blower motors.
.2 Refer to drawings for motor hp ratings and quantities.

2.2 POWER SUPPLY .1 The normal power source for the equipment is a padmount utility transformer as noted on the drawings with a 600/347V secondary. The emergency power source is an emergency generator, rated as noted on the drawings.
.2 The minimum required three-phase momentary short circuit current (rms symmetrical) rating at rated voltage shall be as noted on the drawings.

2.3 MOTOR STARTER

- .1 Microprocessor-based, reduced-voltage, solid- state motor controller designed for soft- starting NEMA design A through F induction motors. Starter to have an integral closed loop current control.
- .2 Starter designed for the following environmental conditions:
 - .1 Nominal operating ambient temperature from 0 to 40 degrees Celsius enclosed.
 - .2 Relative humidity of 5% to 95%, non-condensing.
 - .3 Storage requirements:
 - .1 -20 to 70 degrees Celsius.
 - .2 Rate of temperature change of less than 6 degrees Celsius in 30 minutes.
 - .3 Relative humidity from 20% to 95%, non-condensing.
 - .4 Rate of humidity change of less than 10% in 30 minutes.
 - .4 Operating altitude shall not exceed 1000 metres above sea level without de-rating.
- .3 The starter input voltage ratings shall be 600 V, 3-phase, 60 Hz. Voltage tolerance shall be -15%, +10%. Frequency tolerance shall be $\pm 10\%$.
- .4 Control input:
 - .1 Single-phase control voltage of 120 Vac, 60 Hz, regulation of $\pm 10\%$.
 - .2 Two (2) wire dry contact control (start/stop signal from PLC).
- .5 Output to motor:
 - .1 Motor control interface to be accomplished using silicon controlled rectifier (SCR) power section.
 - .2 500% full load current for 30 seconds, 125% continuous.
 - .3 Peak inverse voltage rating of 2.5 x line voltage.
 - .4 99.7% overall efficiency (minimum).
- .6 User interface:
 - .1 Isolated fault and run status contacts for connection to plant PLC.
 - .2 Door mounted LCD display complete with programming buttons and local start/stop and reset buttons.
 - .3 RS-232/485 communications port. Port shall allow access to starter status and set-up information.

2.3 MOTOR STARTER
(Cont'd)

- .7 Starter sizes available for standard motor horsepower ratings.
- .8 Starters to incorporate means whereby the actual motor current is measured to ensure proper overcurrent protection of the motor.
- .9 Provide the following protection and control features:
 - .1 Standard user-programmable logic control, enabling the following protection features through the SCR power section:
 - .1 Adjustable electronic motor overload (Class 10, 20, 30).
 - .2 Adjustable up-to-speed motor protection.
 - .3 Adjustable over-/under-voltage protection.
 - .4 Adjustable line to average current imbalance.
 - .5 Single phase protection.
 - .6 Adjustable number of starts per hour.
 - .7 Adjustable time between starts.
 - .8 Programmable over-current detection level and delay time.
 - .9 Programmable under-current detection level and delay time.
 - .10 Programmable residual ground fault detection level and delay time.
 - .11 Adjustable initial torque.
 - .12 Adjustable motor torque control on starting.
 - .13 Instantaneous electronic over- current trip.
 - .14 Shorted SCR detection.
 - .15 Selectable phase rotation.
 - .16 Line current imbalance detection.
 - .17 Adjustable start-up ramp time from 0 to 60 seconds (minimum).
 - .18 Adjustable initial current.
 - .19 Adjustable maximum current.
 - .20 Line phase loss detection.
 - .21 'Up-to-speed' indication.
 - .22 External fault reset capability.
 - .23 External trip input.
 - .24 Time stamped event and fault recorder.
 - .2 Minimum two (2) form "C" relay outputs, rated at least 5 Amps continuous at 120Vac (two contacts for run and fault status indication to PLC)
- .10 Starter to provide monitoring, via the front mounted LCD display, of the following parameters:
 - .1 Phase-to-phase supply voltage.
 - .2 Three-phase line current.
 - .3 Supplied power in kilo-Watts.

2.3 MOTOR STARTER
(Cont'd)

- .10 (Cont'd)
 - .4 Supplied energy in kilo-Watt*hours.
 - .5 Elapsed run time.
 - .6 Power factor of supplied load.
 - .7 Motor thermal capacity usage.

2.4 ACCESSORIES

- .1 Bypass contactor:
 - .1 To reduce heat build-up during normal operation, supply and install a bypass contactor. The bypass contactor will bypass the SCR's of the solid state starter once the motor is up to speed.
 - .2 Bypass contactor to bypass the solid state SCR's only. The bypass contactor must not be required to start the motor.
 - .3 Bypass contactor to be a stand-alone type or an integral type as supplied by the solid state starter manufacturer.
 - .4 Maintain all protective and monitoring functions of the solid state starter when the bypass contactor is in operation.
- .2 Provide all necessary CTs and CPTs for specified monitoring and protection.
- .3 Provide a three pole fused disconnect switch in each solid state starter enclosure to remove all power to the starter. Disconnect switch to be operable from the front or side without opening the enclosure door. Make provision for locking the switch in the "off" position and preventing switching to the "on" position while the enclosure door is open.
- .4 Provide each disconnect switch complete with three (3) HRC high speed, class J fuses (refer to Section 26 28 14 for fuse specifications). Size fuses in accordance with manufacturer's recommendations for motor horsepower rating.
- .5 Provide DIN rail mounted terminal blocks, complete with labels for all field wiring. Blocks to be section type, medium duty, 600 V, 15A rated. Provide spare terminals (15% of used terminals) in any strip. Terminate external wiring on terminal strips. Provide separate terminal strips for ac and dc circuits.
- .6 Control fuses to be HRC type, complete with din rail mounted, finger safe fuse holders (Ferraz Shawmut Ultrasafe type or approved equivalent, complete with blown fuse indicator).

-
<u>2.4 ACCESSORIES (Cont'd)</u>	.7 Control transformer: .1 Single-phase, dry-type, control transformer with 600 Volt primary and 120 Volt secondary complete with two (2) primary fuses and one (1) secondary fuse installed with starter as indicated. .2 Size control transformer for control circuit load plus 20% spare capacity. .8 Starter to include integrated fan to automatically operate in accordance with manufacturer's cooling requirements.
<u>2.5 ENCLOSURE</u>	.1 The specified combination starter and breaker must be factory integrated into the specified Motor Control Centre by the MCC manufacturer.
<u>2.6 USER DOCUMENTATION</u>	.1 Supply each starter with one (1) complete set of documentation including: .1 Complete schematics and wiring diagrams. .2 Instruction Manual. .3 Contactor and disconnect system data. .4 Component layout drawings. .2 Provide documentation in electronic format if requested.
<u>2.7 STANDARD OF ACCEPTANCE</u>	.1 Allen-Bradley SMC-Flex.
<u>2.8 ACCEPTABLE MANUFACTURERS</u>	.1 Telemechanique (Schneider Electric). .2 Toshiba. .3 Benshaw. .4 Cutler-Hammer. .5 Siemens.
-

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect motor soft starters in Motor Control Centre for equipment as specified.
- .2 Check starter and adjust in accordance with manufacturer's recommendations.
- .3 Mount control switches, lights and LCD display in door of MCC section for each soft starter.
- .4 Connect power and control wiring (digital and analog inputs and outputs) as noted on the drawings.

3.2 COMMISSIONING

- .1 Arrange and pay for a factory certified representative to set-up and commission soft starters at site for proper operation to the satisfaction of the Consultant. Document all testing and set-up and submit to Consultant. Assume that a minimum of three (3) days (not including travel) for commissioning equipment will be required. Assume that a minimum of two (2) trips to site will be required.
- .2 Provide commissioning test reports and setup/configuration parameters (hard copy and files on CD).
- .3 Coordinate with controls system integrator during testing and commissioning of the soft starters to establish proper operation to the satisfaction of the Consultant.

3.3 TRAINING

- .1 Provide a factory certified representative as required to train personnel at site. Assume that a one (1) day training period will be required.

PART 1 - GENERAL

<u>1.1 DESCRIPTION OF SYSTEM</u>	.1	This specification describes the requirements for design, supply and delivery of variable speed drives. Refer to related specification sections for mechanical and process motor specifications.
<u>1.2 RELATED SECTIONS</u>	.1	Electrical General Requirements: Section 26 05 00
<u>1.3 CODES AND STANDARDS</u>	.1	Starter must be designed to meet or exceed applicable CSA, UL, NEMA, and IEEE standards.
	.2	Complete installation according to CSA Standards unless specified otherwise.
	.3	Comply with CSA Electrical Bulletins in force at time of tender submission.
<u>1.4 SHOP DRAWINGS</u>	.1	Provide shop drawings in accordance with specification Section 01 00 00.
	.2	Indicate: .1 Outline dimensions of cabinet and mounting instructions. .2 Drive, size, type and configuration. .3 Layout of identified internal and front panel mounted components. .4 Schematic and wiring diagrams. .5 Component data sheets. .6 Enclosure type.
<u>1.5 WARRANTY</u>	.1	Provide warranty for all material for a period of one (1) year minimum from the Substantial Completion Date and that expressly states the Contractor will replace at no cost to the Owner, faulty materials. The warranty must include the cost of all labour, travel and expenses for repairs within the warranty period.

1.6 OPERATION AND
MAINTENANCE MANUAL

- .1 Provide operation and maintenance data including information on the drives and any required relays and other components that make up the complete package.

1.7 SPARE PARTS

- .1 Submit list of recommended spare parts to have on site to limit downtime.
- .2 Submit manufacturer's policy of providing spare parts for older equipment (e.g.: spare parts are to be available for ten (10) years minimum after original equipment has been manufactured).

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Provide a variable speed drive for motors indicated.

2.2 POWER SUPPLY

- .1 The source voltage to each VFD is 600V, 3-phase via utility power or a 600V, 3-phase diesel engine generator. Refer to the single line diagram on the drawings.
- .2 The minimum required three phase momentary short circuit current (rms symmetrical) rating at rated voltage is 25KAIC at 600V.

2.3 DESIGN CRITERIA

- .1 Digital, pulse width modulated, modular construction, CSA approved.
- .2 Drive to convert incoming fixed frequency three phase ac power into variable voltage and variable frequency utilizing pulse width modulation.
- .3 Drive to include a full wave diode bridge rectifier to convert ac to dc. SCR and other switching power devices are not acceptable.
- .4 Drive to utilize dc capacitors to filter out bus ripple and provide smooth dc power to the transistor section.
- .5 Drive to utilize IGBT transistors to produce a pulse width modulated output. SCR's are not acceptable. The IGBT minimum Vce rating will be 1200V.

2.3 DESIGN CRITERIA
(Cont'd)

- .6 Drive main input power will be 600V, 3-phase, 60hz. Voltage tolerance shall be -15%/+10%. Frequency tolerance shall be 48hz to 63hz.
- .7 Drive to be rated to provide current to support motors at 1.15 service factor continuously.
- .8 The efficiency of the drive must be a minimum of 95% at full load and full speed.
- .9 Displacement power factor must be greater than 0.95 lagging over the entire speed range.
- .10 Provide minimum 3% input line reactors or equivalent. Input line reactors or equivalent can be integral to the VFD.
- .11 Provide output dv/dt filter complete with NEMA 1 enclosure downstream from each VFD. Locate dv/dt filter next to, within or above the MCC or drive enclosure.
- .12 Drive must be able to provide full rated output current continuously. For variable torque loads, VFD must be able to provide 110% overload for up to one (1) minute and 150% overload for up to three (3) seconds. For constant torque loads, VFD must be able to provide 150% overload for up to one (1) minute and 200% overload for up to three (3) seconds.
- .13 Provide drive complete with power line loss ride through feature for a minimum of 0.5 seconds.
- .14 The drive will be controlled by an integral local/remote (or hand/auto) selector switch on the drive operator keypad. In the local (or hand) position, the drive shall stop/stop via the drive operator keypad and the drive speed will be changed from the drive operator keypad. In the remote (or auto) position, the drive start/stop will be initiated from a remote dry contact in the PLC (or as indicated) and speed will be controlled by a remote 4-20mA analog signal or to a preset speed setpoint. The drive will ramp up and down between a preset minimum base speed and the maximum motor speed (maximum 100%) over an adjustable time period.
- .15 Provide most recent version of programming software and appropriate interface hardware to enable drive configuration from a laptop computer.
- .16 Provide digital input points as indicated on the Drawings.

2.3 DESIGN CRITERIA
(Cont'd)

- .17 Provide 4-20mA output signal to indicate motor current or speed.
- .18 Provide analog input point to accept a 4-20mA analog signal from the PLC or EMCS (Speed adjust in auto).
- .19 Provide relay contacts (dry, rated 120V) for monitoring the following: run, VFD fault and VFD in remote (or auto).
- .20 Protective functions:
 - .1 Drive to have built in CSA approved adjustable electronic motor overload (class 10, 20, 30) protection to protect the connected motor.
 - .2 Drive to have input metal oxide varistors (MOV's) for surge protection.
 - .3 Provide drive complete with the following protective functions:
 - .1 Over and under voltage.
 - .2 Overcurrent.
 - .3 Ground fault.
 - .4 Drive over temperature.
 - .5 Blown dc bus fuse.
 - .6 Overload.
 - .7 Input and output phase loss.
 - .8 Unbalance current fault
 - .9 Motor stall protection.
 - .4 Provide for three (3) auto restart attempts for selected fault conditions.
 - .5 Drive to permit the operator to lock out the reverse operation for applications where reverse would damage equipment.
- .21 Provide each drive complete with an operator keypad for local programming, monitoring, speed control and start/stop control. Each keypad must be visible and accessible from the front of the enclosure with the door closed. Provide keypad complete with the following minimum features:
 - .1 LCD high resolution display.
 - .2 Keypad shall indicate the following minimum operating conditions: drive run, drive stopped, drive fault.
 - .3 As a minimum, output speed, power, frequency and current must be displayed continuously as selected by the user.
 - .4 Fault reset button.
 - .5 Local/remote (or hand/auto) selection.
 - .6 Start/stop buttons (for local control).
 - .7 Present fault condition shall be displayed.
 - .8 Keypad entries must be password protected.
- .22 Programming features:

2.3 DESIGN CRITERIA
(Cont'd)

- .22 (Cont'd)
- .1 Drive to have a minimum of three (3) independently adjustable acceleration and deceleration ramps. Times are to be adjustable from 0.1 to 3200 seconds (nominal).
 - .2 Drive to have an adjustable output frequency from 25-320hz (nominal).
 - .3 Control methods available to be selectable sensorless vector, selectable Volts/hz patterns, and direct torque control.
 - .4 Drive to have adjustable minimum and maximum speed settings.
 - .5 Drive to have an adjustable carrier frequency (nominal 1-15khz).
 - .6 Drive must have a minimum of three (3) adjustable frequency reject points to prevent system operation at resonant speed.
- .23 Drive to be sized for variable torque or constant torque load to match the application load characteristics.
- .24 Provide drive electronics complete with conformal coatings for protection against dust and chemicals.
- .25 Provide drive complete with enclosure, enclosure rating as indicated on the drawings.

2.4 ACCESSORIES

- .1 Provide terminal blocks, complete with labels for power and control field wiring. Terminate external wiring on terminal strips. Provide separate terminal strips for ac and dc circuits.
- .2 If required by manufacturer, starter to include integrated fan to automatically operate in accordance with manufacturer's cooling requirements.

2.5 ACCEPTABLE
MATERIALS

- .1 Cutler-Hammer SVX 9000 Series.
- .2 Allen Bradley Powerflex 525 series.
- .3 ABB ACS-550 series.
- .4 Schneider Altivar 61.
- .5 Inclusion in this list does not exempt the requirement that any specified model must be compliant with the equipment specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect VFD and input line reactor and dv/dt filter where indicated on the drawings and in accordance with the manufacturer's instructions.
- .2 Check starter and adjust in accordance with project requirements and manufacturers recommendations.
- .3 Connect power and control wiring (digital and analog inputs and outputs) as noted on the drawings.

3.2 COMMISSIONING

- .1 Arrange and pay for a factory certified representative to set up and commission each drive at site for proper operation to the satisfaction of the Consultant. Document all testing and set-up and submit to Consultant.
- .2 Provide commissioning test reports and setup/configuration parameters (hard copy and files on CD).

3.3 TRAINING

- .1 Provide a factory certified representative as required to train personnel at site.

PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1	UL 1778-14, Uninterruptible Power Systems.
<u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u>	.1	Submit shop drawings and product data for review and approval in accordance with Section 01 00 00.
<u>1.3 OPERATION AND MAINTENANCE DATA</u>	.1	Provide maintenance data for UPS for incorporation into manual as specified in Section 01 00 00.
<u>1.4 WARRANTY</u>	.1	Have the manufacturer provide a product warranty for a period of not less than two (2) years from the date of Substantial Completion. Warranty to include full parts and labour.
<u>1.5 SCOPE OF SUPPLY</u>	.1	One (1) UPS unit to operate electronic systems.
<u>1.6 SYSTEM DESCRIPTION</u>	.1	Uninterruptible Power Supply (UPS) System to be a solid state system providing single-phase uninterruptible AC power for sensitive electronic equipment loads. It shall comply with the requirements of the Underwriters Laboratories standard 1778, FCC Part 15, Subpart B, Class A (RFI/EMI), IEEE 587 Categories A and B, and must be listed under the Underwriters Laboratories of Canada.

PART 2 - PRODUCTS

<u>2.1 MATERIALS</u>	.1	Provide a UPS designed to operate as a true on-line double conversion system in normal, emergency, recharge and bypass modes.
	.2	UPS unit to be comprised of the following components housed in a NEMA type 1 enclosure: .1 Input converter. .2 Battery charger. .3 Inverter.

2.1 MATERIALS
(Cont'd)

- .2 (Cont'd)
 - .4 Battery (nominal 5 year life, hot swappable, consisting of the appropriate number of sealed battery cells).
 - .5 Cooling fan.
- .3 UPS system to include a front panel LCD screen or LED type status indicating the following:
 - .1 UPS on.
 - .2 Overload.
 - .3 Load percentage.
 - .4 Battery charge level.
 - .5 UPS inverter is operating and supplying power.
 - .6 UPS is in bypass.
 - .7 UPS is operating from battery power.
 - .8 UPS fault condition.
- .4 Provide UPS complete with an On/Off pushbutton and an audible alarm reset pushbutton.
- .5 UPS to have built-in protection against under voltage, overcurrent and over voltage conditions, including low-energy lightning surges on primary AC sources.
- .6 UPS to have an input and output hardwired to local panel.
- .7 UPS to have automatic transfer bypass protection to transfer output load from the inverter to the bypass source in the event of overload, over temperature, DC bus over voltage and inverter failure conditions.
- .8 Design requirements:
 - .1 Input voltage: 208 Vac nominal, 60 Hz, single phase, 2 wire plus ground.
 - .2 Output voltage: 120 Vac/208 Vac $\pm$ 3%, 60 Hz, single phase, 3 wire plus ground.
 - .3 Output load capacity:
 - .1 UPS unit: 3500VA/2450W at 0.7b lagging power factor.
 - .4 Battery Runtime shall be a minimum six (6) minute runtime at the UPS full load rating.
 - .5 If required, provide external battery or upside the UPS VA rating to achieve minimum battery run times.
- .9 Performance requirements:
 - .1 AC input to UPS:
 - .1 Voltage: 208V Vac nominal, 121-240 V range.
 - .2 Input frequency: 60 Hz, range 40-70 Hz.

2.1 MATERIALS
(Cont'd)

- .9 (Cont'd)
 - .1 (Cont'd)
 - .3 Input power factor: greater than 0.95 lagging at rated load.
 - .4 Input line transient immunity: conforming to IEEE 587, Category A and B tests.
 - .2 AC output, UPS inverter:
 - .1 Voltage: 120/208 Vac.
 - .2 Voltage regulation: $\pm 3\%$ steady state.
 - .3 Frequency: 60 Hz, $\pm 5\%$ synchronized to utility, ± 0.1 Hz free running or on battery operation.
 - .4 Frequency slew rate: 1.0 Hz per second (maximum).
 - .5 Load power factor range: 0.65 lagging to unity.
 - .6 Overload capability:
 - .1 130% rated load for 2 seconds.
 - .2 150% rated load for .5 seconds.
 - .3 200% sub-cycle.
 - .7 Voltage transient response:
 - .1 $\pm 7\%$ for 0-100% loading (normal).
 - .2 $\pm 9\%$ for 0-100% loading (battery mode).
 - .8 Transient recovery time: to nominal voltage within 90 milliseconds.
 - .9 Efficiency: minimum 83%.
- .10 Acceptable materials:
 - .1 Liebert.
 - .2 MGE Pulsar.
 - .3 PowerWare.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate UPS units on floor in electrical room.
- .2 Assemble and interconnect components to provide complete UPS as specified.
- .3 Connect AC mains to UPS.
- .4 Connect UPS output to load.
- .5 Assemble UPS and wire complete assembly.
- .6 Start up UPS and make preliminary tests to ensure satisfactory performance.

PART 1 - GENERAL

1.1 DESCRIPTION OF
WORK

- .1 This section specifies requirements for the supply and installation of Transient Voltage Surge Suppression (TVSS) internal to the Main service entrance switchboard (specified in Section 26 24 02) for the protection of the building electrical system.

1.2 REFERENCES

- .1 IEEE C62.41.2-2002, Recommended Practice on Characteristics of Surges in Low-Voltage AC Power Circuits.
- .2 IEEE C62.45-2002, Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
- .3 IEEE 1100-2005, Powering and Grounding Electronic Equipment.
- .4 UL 1283-2017, Standard for Safety for Electromagnetic Interference Filters.
- .5 UL 1449-2014, Transient Voltage Surge Suppressors.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Provide Shop Drawings with wiring diagrams, installation information, testing and maintenance procedures, and operational information for the transient protection system.
- .3 Indicate:
 - .1 Dimensional Drawing of each TVSS type, Indicating proposed mounting arrangements.
 - .2 Submit written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability.
 - .3 Submit the means of connection of the TVSS to the electrical distribution system.
 - .4 Manufacturer will provide UL-1449, Second Edition data card showing the Suppressed Voltage Rating (SVR) for the specific catalogue number

1.3 SHOP DRAWINGS
(Cont'd)

- .3 (Cont'd)
- .6 Submit test report data clearly demonstrating the maximum surge current rating has been tested on a COMPLETE TVSS unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems. Manufacturers who cannot provide this data will not be considered.
- .7 Submit data demonstrating the complete TVSS unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 12,000 ANSI/IEEE C62.41.2, Category C3 (10kA) impulses without failure or a change in performance characteristics of more than 10%.
- .8 Written detailed response to each paragraph of the specification indicating that the proposed product meets or exceeds this specification. If specific paragraphs are not met, provide written explanation as to why not.

1.4 EXTENDED
WARRANTY

- .1 Have the manufacturer provide an extended product warranty for a period of not less than ten (10) years from the Date of Substantial Completion. Warranty to expressly cover unlimited replacement of system protection modules during warranty period. The first five (5) years of this warranty must include any field labour required to perform repair or replacement work.

1.5 OPERATION AND
MAINTENANCE DATA

- .1 Provide maintenance data for TVSS for incorporation into manual specified in Section 01 00 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Acceptable manufacturers:
- .1 Liebert: Interceptor II
 - .2 Current Technology: SEL
 - .3 Cutler-Hammer Clipper Supervisor Series.

2.2 ENVIRONMENTAL

- .1 General requirements:
- .1 No audible noise generated.
 - .2 Operating Conditions:
 - .1 30 - 130 Degrees F
 - .2 15 - 85 Percent Humidity Non-Condensing

2.2 ENVIRONMENTAL
(Cont'd)

- .1 (Cont'd)
- .2 (Cont'd)
- .2 Enclosure: mount the unit in motor control center.

2.3 SURGE
SUPPRESSORS

- .1 General requirements:
 - .1 Rated for a 120/208 volt, 60 Hertz, 3-phase, 4-wire main switchboard.
 - .2 Provide surge suppressors in accordance with the following requirements:
 - .1 Unit to be parallel in design and connect in parallel to main switchboard. Each surge suppression element (MOV) must be individually fused so that a failure of one element and/or fuse will not affect other surge suppression elements.
 - .2 Unit to be UL 1449, 2nd Edition Listed.
 - .3 Unit to provide maximum UL 1449 2nd Edition Suppressed Voltage Rating (SVR) for 600Y/347 Volt systems as follows:
 - .1 L-G = 2000V
 - .2 L-L = 2000V
 - .4 Unit to provide maximum surge current rating of 200,000 amperes per mode (L-L, L-G) and 400,000 amperes per phase based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform.
 - .5 Unit to have a short circuit current rating of 50,000 amperes at rated voltage or greater.
 - .6 Unit to be UL 1283 listed as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 40 dB at 100 kHz, 30 dB at 1 MHz, 35 dB at 10 MHz, and 50 dB at 100 MHz.
 - .7 Unit to include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.
 - .8 Unit to have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of TVSS status.
 - .9 Unit to include a built-in, push-to-test feature that tests the integrity of all modules, MOVs and fuses in the system. Manufacturers that require an external test device to perform this feature will include the test set in this quotation.
 - .10 Unit to have an audible alarm with an alarm on/off switch to silence the alarm and a push to test switch to test the alarm function.

2.3 SURGE
SUPPRESSORS
(Cont'd)

- .1 (Cont'd)
- .2 (Cont'd)
 - .11 Provide an adjustable (resetable) counter to totalize transient voltage surges in both the normal and common mode. Provide the counter with a 10-year battery back-up to maintain counts in the event of power loss.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 General requirements:
 - .1 Install unit in MCC with all illuminated indicators exposed for viewing without need to open covers and door on MCC.
 - .2 Conductors between suppressor and point of attachment to service equipment must be as short as possible, preferably not exceeding 600 mm.
 - .3 Grounding: bond suppressor ground to the equipment grounding conductor and service entrance ground.
- .2 Arrange and pay for a factory certified representative to set up and commission the TVSS at site for proper operation to the satisfaction of the Consultant. Document all testing and set up and submit to Consultant. Assume that a minimum of one (1) day (not including travel) will be required.
- .3 Provide training of Owner operation and maintenance of the device.

PART 1 - GENERAL

1.1 REFERENCES

- .1 SCTE 81-2012, Surge Withstand Test Procedure.
- .2 FCC CFR47, USA Federal Communications Commission Frequency Allocations and Radio Treaty Matters; General Rules and Regulations.
- .3 IEEE C62.45-02, IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage (1000V or less) AC Power circuits.
- .4 IESNA-RP7-2004, American National Standard - Practice for Industrial Lighting.

1.2 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Submit shop drawings for the following:
 - .1 Luminaires.
- .3 Shop Drawings:
 - .1 Shop drawings to clearly indicate the following:
 - .1 Luminaire ID number as identified in contract documents.
 - .2 Fixture specification as identified in Part 2.
 - .3 Photometric data for each luminaire type.
- .4 Catalogue cuts lacking sufficient detail to indicate compliance with Contract documents will not be acceptable.
- .5 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant. Photometric data to include:
 - .1 VCP Table, spacing criterion;
 - .2 Total input watts;
 - .3 Candlepower summary, candela distribution, zonal lumen summary;
 - .4 Luminaire efficiency, C.I.E. type, coefficient of utilization;
 - .5 Lumen ratings;and
 - .6 Summary in accordance with IES procedures.

PART 2 - PRODUCTS

2.1 LUMINAIRES .1 As indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Do not scale electrical drawings for exact location of luminaires. Coordinate installation with all other services.

.2 Connect luminaires to lighting circuits as indicated.

.3 Install each luminaire properly and safely.

.4 For luminaires applied to a surface mounting outlet box, a finishing ring shall be utilized.

.5 Install a separate "fixture drop" to each lighting fixture from a junction box. Do not install luminaires in a "daisy chain" manner.

.6 Support luminaires independently from the building structure.

.7 Align luminaires mounted individually parallel or perpendicular to building grid lines, or as indicated.

3.2 LUMINAIRE CLEANING .1 Clean all luminaires one (1) week prior to Substantial Completion.

.2 Replace blemished, damaged, or unsatisfactory luminaires as directed.

3.3 MAINTENANCE .1 Obtain from the supplying lighting manufacturers, for each type of luminaire, a recommended maintenance manual including:

.1 Tools required.

.2 Types of cleaners to be used.

.3 Replacement parts identification lists.

.4 Final, as-built shop drawings.

3.3 MAINTENANCE <u>(Cont'd)</u>	.2	Provide material in accordance with Section 01 00 00.

PART 1 - GENERAL

1.1 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.

1.2 REFERENCES

- .1 CAN/CSA C860-2011, Performance of Internally Lighted Exit Lights.
- .2 CAN/ULC S572-10, Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems.

PART 2 - PRODUCTS

2.1 STANDARD UNITS
TYPE EXL1

- .1 Face and back plates: polyvinyl chloride box with polycarbonate cover, complete with gasket.
- .2 Lamps: One (1) 3 to 5 Watt LED panel, 120 V ac, 219,000 hr.
- .3 Operation: designed for 219,000 h, LED panel only, 120V ac.
- .4 Signage: Green exit pictogram conforming to CAN/ULC S572.
- .5 Mounting: Unit to have universal mounting position and single or double face as indicated on drawings.
- .6 Uniform light.
- .7 Rating: NEMA type 4X rated. Except in Rooms 106 and 107 which are to be rated for Class 1 Zone 2.
- .8 Options: unit complete with integral 90-minute battery back-up.
- .9 Acceptable materials:
 - .1 AimLite.
 - .2 Lumacell.
 - .3 Ready-Lite.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install exit lights where indicated.
- .2 Confirm exit light circuit breaker is locked in on position.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Splitters, Junction, Pull Boxes and Cabinets:
Section 26 05 31
- .2 Conduits, Conduit Fastenings and Conduit Fittings:
Section 26 05 34
- .3 Cable Trays for Electrical Systems: Section 26 05 36
- .4 Concrete Encased Duct Banks: Section 33 65 73
- .5 Direct Buried Underground Cable Ducts: Section
33 65 76

PART 2 - PRODUCTS

2.1 MATERIAL

- .1 Where concrete encasement is specified for
underground ductbanks, provide underground ducts in
accordance with Section 33 65 73.
- .2 Where direct buried ducts are specified, provide
ducts in accordance with Section 33 65 76.
- .3 Conduits: type in accordance with Section 26 05 34.
- .4 Junction and pull boxes: in accordance with Section
26 05 31.
- .5 Outlet boxes type, conduit boxes and fittings: in
accordance with Section 26 05 31.
- .6 Fish wire: polypropylene.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Provide 53 mm diameter service entrance conduit +
53m spare in accordance with the telephone utility
standards.
- .2 Provide underground ducts from the telephone utility
pole, complete with pull string and per the
requirements of the telephone utility. Refer to the
Drawings for the routing and installation details of
the underground ducts into the building.

3.1 INSTALLATION
(Cont'd)

- .3 Provide 610 mm x 610 mm x 19 mm plywood backboards for telecommunications equipment at locations shown on the Drawings. Paint plywood backboard with two (2) coats of fire retardant paint.
- .4 Provide empty raceway system, including distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute complete system.
- .5 Arrange and pay for the telephone utility to provide all required telephone wiring, patch panels, telephone outlets and other telephone equipment indicated on the drawings. Coordinate the installation of all telephone wiring in common underground conduits.

PART 1 - GENERAL

- 1.1 DESCRIPTION OF SYSTEM
- .1 Intrusion alarm: system to consist of one (1) main alarm control panel, three (3) zone expander modules, keypads, motion detectors and intrusion switches located at doors to be supervised, power supplies and all associated wiring, conduit and hardware as required to be a complete functioning system.
 - .2 Video surveillance system to consist of cameras, power supplies, monitors, digital video recorder (DVR) and all associated wiring, conduit, splitters, outlets and hardware as required to be a complete functioning system. Provide necessary network hardware and software to view surveillance system from remote location via cellular phone application or remote PC. Turn over software.
- 1.2 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 00 00.

PART 2 - PRODUCTS

- 2.1 INTRUSION ALARM SYSTEM
- .1 Control panel:
 - .1 Panel to have six (6) fully programmable, supervised zones, expandable to 12 zone capacity.
 - .2 Enclose panel in a surface mounted NEMA 1 cabinet.
 - .3 Panel to have "power on" light, "reset" key switch, "acknowledge button", common "trouble light, buzzer and silencing switch". Separate alarm lamp, trouble lamp and deactivating key switch for each zone and necessary modules and relays as required for operation as indicated.
 - .4 Power supply from 120V ac circuit with rectifier to supply 24V dc to operate complete system.
 - .5 Panel to have a complete battery back-up in the event of a normal power failure. Batteries to be nickel cadmium type and be sized to provide supervisory and trouble signal current for four hours minimum.
 - .6 Panel to have nine (9) low current programmable output relay contacts and five (5) high current programmable output relay contacts.

2.1 INTRUSION ALARM .1
SYSTEM
(Cont'd)

(Cont'd)

- .7 Provide panel complete with EEPROM memory to retain all programming information in the case of a complete power loss.
- .8 Panel to be capable of differentiating between open line condition and alarm.
- .9 Panel to display "trouble" conditions when fault occurs in wiring.
- .10 Provide all necessary software and programming for PC interface to security system.
- .11 Provide built-in dialer/modem for connection to ULC monitoring agency.
- .12 Provide output contact to plant PLC/Scada system to indicate alarm.
- .13 Provide input signal from plant PLC/Scada system to indicate fire.
- .14 Acceptable materials:
 - .1 DSC Power 832.
 - .2 Silent Knight Approved equivalent.

.2 Motion detectors:

- .1 Low noise, dual element sensor designed for commercial applications. RF, static, transient and white light immunity. Ceiling and wall mount construction, c/w mounting bracket.
- .2 Acceptable materials: same manufacturer as control panel.

.3 Door contacts:

- .1 Door contacts: suitable for flush mounting on door as indicated.
- .2 Door contracts to be suitable for installation in hazardous classification as noted on the drawings.
- .3 Door contacts to be suitable for installation in an overhead door as noted on the drawings.
- .4 Acceptable material: same manufacturer as control panel.
- .5 Fabricate custom brackets for roll up/overhead door.
- .6 Provide Class 1 Zone 2 contact switches in Rooms 106 and 107.

.4 Key pad:

- .1 Alpha-numeric LCD touchpad, built-in buzzer for key beeps. Liquid crystal display, backlit, to allow identification of each security system device, by room number.
- .2 Acceptable material: same manufacturer as control panel.

.5 Zone expansion modules:

2.1 INTRUSION ALARM .5
SYSTEM

(Cont'd)

(Cont'd)

.1 Module to have either eight (8) or sixteen (16) fully programmable, supervised zones as indicated on the Drawings.

.2 Panel to be enclosed in a surface mounted cabinet.

.3 Panel must be capable of providing 100 mA at 12VDC auxiliary current, PTC protected.

.4 Acceptable material: same manufacturer as control panel.

.6 End-of-line resistors: mount end-of-line resistors to control supervisory current in each circuit, in control panel.

.7 System operation:

.1 System operation: when supervised door is opened or motion detector is tripped, zone indicating lamp flashes and operates audible alarm at control panel. When "acknowledge" button is operated, audible signal is silenced and flashing light changes to steady glow.

.2 System restored to normal when door is closed and "reset" key switch on control panel operated.

.3 When deactivating switch is operated, supervised door on that zone opened without causing alarm. Zone trouble lamp illuminated when zone is deactivated but audible trouble signal not to sound.

.4 Fault in wiring of one zone to cause audible signal to sound even if zone in deactivated position.

.5 Upon activation of alarm, system shall identify room number.

.6 Exit/entry delay.

.7 Access codes.

2.2 CCTV SYSTEM

.1 Camera:

.1 colour.

.2 Sensitivity: day/night type camera (minimum 0.1 lux).

.3 Lines of horizontal resolution: high resolution 480 lines (colour).

.4 Format: 1/3".

.5 Environment: outdoor.

.6 Mounting: vandal-proof dome in a weather-proof (IP67 rated) housing, complete with built-in electric heater and 3-axis mounting gimble.

.7 Lens: 3.8 mm - 9.5 mm auto iris varifocal lens.

.8 Zoom: 3 x digital.

.9 Video output: 1V p.p. 75 ohm, BNC connector.

2.2 CCTV SYSTEM
(Cont'd)

- .1 (Cont'd)
 - .10 Additional features: backlight compensation and automatic gain control.
 - .11 Operational voltage: standard 24 AC.
 - .12 Current consumption: 10 watts (including heater).
 - .13 Operation temperature: -40°C to 60°C.
 - .14 Power over ethernet (POE).
- .2 Digital video recorder:
 - .1 DVR must be capable of viewing eight (8) cameras. The DVR shall have the option to view live video with or without on screen controls visible. The DVR will have the option to automatically hide on-screen controls after a user defined period of user inactivity.
 - .2 DVR must be capable of allowing the user to customize the order in which cameras appear on the monitor regardless of physical order.
 - .3 DVR to include a remote client remote report on the main screen that shall indicate when a remote connection has been established. The report will also include the originating IP address of the connected user, how long they have been connected and how much video has been transferred. This report must also keep a log of past remote connections.
 - .4 Access to the recorder will be determined by a user account basis. The system must have the ability to provide a unique account to each user. The system administrator can restrict or grant access to main screen, search screen, setup, remote access, exit and hidden camera functions.
 - .5 The recorder must not display any on-screen video until an authorized user has logged into the system. DVR to keep a log of all the user activity within the system. This log must have the ability to be exported to a text file. DVR to allow the option to automatically log out users after a user specified period of user inactivity.
 - .6 DVR to allow each camera to be setup independently. Each camera shall be capable of recording at resolutions of 352 x 240 (interlace), 704 x 480 (interlace) or 704 x 480 (progressive scan).
 - .7 DVR to provide the ability to label and number individual cameras. The text for said labelling must have the option to select colours during the setup.

2.2 CCTV SYSTEM
(Cont'd)

.2 (Cont'd)

.8 DVR to be able to record video based on motion detection, sensor, constant recording or motion and sensor. The DVR must have ability, for each individual camera, to adjust hue, brightness and contrast. Furthermore, the DVR must have day/night colour settings that allow the user to specify two sets of contrast, brightness and hue settings for each individual camera. The DVR must have the ability to automatically switch between these settings based on user defined times or sensor input.

.9 DVR to allow for up to 15 motion detection zones for each camera. The DVR must have the ability to adjust the sensitivity of the motion detection for each individual camera. Furthermore, the DVR must have day/night motion settings that allow the user to specify two (2) sensitivity settings. The DVR must have the ability to automatically switch between these two (2) settings based on user defined times or a sensor input.

.10 DVR to have a removable drive function that allows users to prevent further recording to a disk drive once it is full. Furthermore, the DVR must notify a user once the drive is full or near full.

.11 The DVR must be capable of searching data using a simple calendar interface. This calendar interface shall indicate if video has been recorded on a particular day.

.12 Recorder to provide a graphical overview of recorded video on a per camera basis in 15-minute intervals.

.13 Recorder to provide high-speed search operations including time and date searching, index searching, skip searching and event manager.

.14 The DVR must be capable of all of the following forms of video/image archiving:

.1 Print: print single images directly to a printer from the search interface. The DVR will prompt the user for the option to automatically print up to 10 subsequent frames.

.2 Save Single/Multiple Frames: save single JPEG images to removable media (to include but not limited to 1.44 MB floppy drive and USB memory drive) directly from the search interface. The DVR will prompt the user for the option to automatically save up to 10 subsequent frames. All JPEG images must be watermarked for authenticity purposes. The DVR will include utilities to verify image authenticity.

2.2 CCTV SYSTEM
(Cont'd)

.2 (Cont'd)

.14 (Cont'd)

.3 Export to MPEG Movie: ability to create an MPEG-1 video from a single camera directly from the search screen. The DVR will save this video directly on to removable media (to include 1.44 MB floppy disk drive and USB memory drive). The user must have the option to create this video at user selectable low, medium or high video quality settings.

.4 Archive to CD/DVD/Removable Media: the DVR will be able to archive video to DVD or CD, removable media or network shared drives, directly from within the DVR application. The DVR shall archive video based on a user selectable beginning and end time, the option to select a single camera, multiple cameras or all cameras. The DVR will provide the option to include a custom description field of each archive. DVR must not require that any CD or DVD media have to be formatted before use. DVR to archive video in an unaltered format such that the archived video is an exact reproduction of the originally recorded video. When archiving to DVD or CD media, the DVR must automatically include a copy of the viewing software on the CD. The viewing software should duplicate the search features of the main DVR.

.15 DVR to have the ability to support dynamic and static IP for use with Ethernet networks. DVR to include network testing functionality to confirm all network connections are working. DVR to support at least three (3) dynamic IP services and request updates to these services at user selectable intervals. DVR to provide remote connections requiring no more than one user selectable port.

.16 DVR to provide remote software that allows connections to the DVR via LAN, PSTN or ISDN. The remote software will provide an individual or multi-channel live view. The remote software must allow users to assign update priority for each individual camera.

.17 The remote viewing software must be capable of searching data using the same interface as the DVR featuring:

.1 A simple calendar interface. This calendar interface shall indicate if video has been recorded on a particular day.

.2 A graphical overview of recorded video on a per camera basis in 15-minute intervals.

.3 High-speed search operations including time and date searching, index searching, skip searching and event manager.

2.2 CCTV SYSTEM
(Cont'd)

- .2 (Cont'd)
 - .18 Provide DVR complete with the following peripherals: keyboard, mouse, UPS and isolation transformer.
 - .19 Acceptable materials: PST Caveo, or approved equivalent.
- .3 Monitor:
 - .1 24" HDMI monitor wall mounted in Lab.
 - .2 Acceptable material: View Sonic E771 or approved equivalent.
- .4 Video transceivers:
 - .1 Active power type transceivers, 12VDC input voltage.
 - .2 BNC male to terminal block connectors.
 - .3 Transmits video signal up to 2.4 km over category 5 ethernet cable.
 - .4 Acceptable material: PST VT-AllVR (receiver) and PST VT-A11VT (transmitter), or approved equivalent.
- .5 Ethernet switch:
 - .1 Power over ethernet switch.
 - .2 See drawings for additional detail.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install complete intrusion supervision and video surveillance system as indicated and in accordance with manufacturer's instructions.
- .2 Install all wiring in conduit.
- .3 Connect telephone line for ULC monitoring agency.
- .4 Install all software and provide all programming required for the operation of the PC interface to the security control panel.
- .5 Provide all connections between camera, recorder and monitor as per engineering drawings. Calibrate camera as necessary. Provide all programming necessary for the operation of the digital video recording system.
- .6 Provide certified manufacturer's representative to conduct one (1) day operator training for each system.

3.1 INSTALLATION
(Cont'd)

- .7 Aim all cameras to the satisfaction of the Owner.
- .8 Provide camera power supply for each camera. Locate power supply where noted on the Drawings.
- .9 Provide transceiver power supply for each transceiver unit. Locate power supply where indicated on the Drawings.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Test system components in presence of Consultant and Owner to confirm correct operation of system. On completion of tests, submit to Consultant certificate listing components tested.
- .3 Demonstrate camera control through the DVR.
- .4 Test and certify the intrusion alarm system.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements for clearing, grubbing and disposal.
- 1.2 RELATED .1 Excavation, Trenching and Backfilling: Section 31 23 10.
- 1.3 DEFINITIONS .1 Clearing: cutting, burning, chipping and disposal of all designated trees and brush within rights-of-way and other areas as indicated including felled trees, previously up-rooted trees, and surface debris.
- .2 Grubbing: excavation and disposal, removal of all stumps, roots, embedded timber, rock fragment, humus, rootmat and topsoil.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 No applicable.

PART 3 - EXECUTION

- 3.1 GENERAL .1 Obtain permitting as required by the authorities having jurisdiction.
- .2 Comply with conditions of permits.
- .3 Do not remove trees or brush from outside limits indicated except for any tree or branch considered unsafe.
- .4 Cut trees and brush close to ground leaving no stump higher than 300mm.
- .5 Grub out stumps and roots to not less than 200mm below ground surface.
- .6 Grub out visible rock fragments and boulders, greater than 300mm in greater dimension, but less than 0.25 m³.

3.2 REMOVAL AND
DISPOSAL

- .1 Remove cleared and grubbed material off-site unless permitted otherwise in writing.
- .2 If permitted, bury in designated areas only. Consolidate and cover with minimum 500mm thick soil and finish surface.
- .3 If permitted, burn in area designated under constant care of fire watch. Avoid surrounding vegetation, adjacent property or anything to remain.
- .4 If permitted, chip or mulch and stockpile or spread vegetation matter on-site as directed. Dispose of surplus chips off-site.

3.3 FURNISHED
SURFACES

- .1 Leave ground surface in condition suitable for immediate grading operation.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for furnishing all materials, labour, tools and equipment and performing all operations necessary to excavate all types of material encountered, placing of excavated material as backfill, disposal of unsuitable and surplus material and furnishing backfill material as specified below, all as shown on the Drawings and as specified in this Section.
- .2 The Work generally includes, but is not necessarily limited to the following items:
 - .1 Trench excavation and backfilling for pipelines, manholes, duct banks, conduits and appurtenances.
 - .2 Structure excavation and backfilling for structures.
 - .3 Supplying and placing pipe foundation material where required.
 - .4 Control of water by dewatering.
 - .5 Providing borrow material when required.
 - .6 Removal and disposal of surplus and/or unsuitable material.
 - .7 Sheet piling, shoring and bracing to support trench walls, sides of excavations, existing structures or utilities.
 - .8 Excavation of unsuitable material and placement of structural fill.

1.2 RELATED
SECTIONS

- .1 Cast-in-place Concrete: Section 03 30 00
- .2 Drilled Well Subgrade Pump: Section 33 21 00
- .3 Yard Pipework: Section 33 31 15
- .4 Hydraulic Seeding: Section 32 92 21
- .5 Granular Materials and Rip Rap: Section 31 37 10

1.3 REFERENCES

- .1 CAN/ULC-S701-11, Thermal Insulation, Poly-styrene, Boards and Pipe Covering.
- .2 ASTM D 698-12e2, Standard Test Methods for Laboratory Compaction Characteristics Of Soil Using Standard Effort (12,400 FT-LBF/FT³(600 KN-M/M³)).

1.4 DEFINITIONS

- .1 Unsuitable Material: all organic or other excavated material which is not suitable for use in work must be disposed of as defined by the Consultant.
- .2 Rock: solid rock which requires drilling and blasting, wedging, sledging or barring or breaking up with power operated tools for its removal and boulders and pieces of concrete masonry exceeding one cubic metre (1.0 m³) in volume. Frozen material is not considered rock.
- .3 Common: materials of whatever nature, which are not included under the definition of solid rock including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.
- .4 Surplus material: excavated material not required for re-use.

1.5 SAMPLES

- .1 Submit samples, sieve analysis, mix design for any imported materials as specified when requested by the Consultant, all in accordance with Section 01 00 00.

1.6 PROTECTION OF EXISTING FEATURES

- .1 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. 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. Advise Consultant of existing lines in area of excavation that require removal or relocation and cost for such work.
 - .6 Record location of maintained, re-routed and abandoned underground lines.
- .2 Existing surface features:

1.6 PROTECTION OF
EXISTING FEATURES
(Cont'd)

- .2 (Cont'd)
- .1 Conduct, with Consultant, a condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, pavement, survey bench marks and monuments which may be affected by work.
- .2 Protect existing buildings and surface features from damage while work is in progress. In event of damage, immediately make repair to approval of Consultant.

1.7 EXISTING
CONDITIONS

- .1 A geotechnical investigation has been carried out for the Site. Geotechnical Report titled "Geotechnical Investigation, Proposed Wastewater Treatment Plant - North Site" dated March 10 by Conquest Engineering is available for viewing at the office of the Consultant upon request. Any interpretation or extrapolation of its contents are at sole discretion of the Contractor and the Consultant will be held liable from such interpretations and extrapolations.
- .2 Underground pipelines are located within site boundaries. Prior to starting any excavation work review any available as-built information to identify these pipelines clearly in the field. Investigate and determine the presence of any underground utilities and repair any damage and/or pay all costs associated with damage to these existing utilities.

1.8 SUPPORT OF
EXCAVATION

- .1 Suitably slope or properly shore sides of excavations according to site conditions, all in accordance with Provincial Safety Act. Provide use of support as necessary.
- .2 The choice of any method of support will be the responsibility of the Contractor. However, drawings and calculations for the method of support selected, designed by a qualified professional engineer in accordance with the Provincial safety requirements, are to be submitted to the Consultant for review before its use.
- .3 If it is desirable that any support, other than that which may be shown on the Drawings, be left in the excavations, then the Consultant will issue instructions accordingly.

1.8 SUPPORT OF
EXCAVATION
(Cont'd)

- .4 Take every precaution against slips or falls, but if any should occur, at once make good the same. If any such slip or fall affects or may affect the stability of the permanent work, execute such remedial work as necessary, including filling up of any space left by the slip or fall with approved granular material. Submit proposed remedial work to Consultant for review.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Select Backfill Material: approved material from site excavation or borrow pits. Such material must be free from stumps, trees, roots, sod, muck or other deleterious material, and must not contain rock, boulders or masonry larger than 200 mm. The material shall be free from frost, and shall not be placed on frozen ground or in water. It must have a moisture content that will allow compaction to the specified densities.
- .2 Granular Materials: as specified in Section 31 37 10.
- .3 Sand bedding: hard granular, sharp freshwater material, well-graded from coarse to fine, free of impurities, chemicals and organic matter, and graded as follows:

<u>Sieve Size</u>	<u>Cum. % Passing</u>
4.75 mm	100
0.150 mm	0-5

- .4 Granular bedding materials: as specified in Section 31 57 10.
- .5 Foundation Material: crushed quarry-run material, nominal size 150mm or as determined by the Consultant as conditions dictate.
- .6 Structural Fill: well graded, sound, durable, granular material, free from clay, frozen lumps, organic, or deleterious matter, graded as follows:
- | <u>Sieve Size, mm</u> | <u>% Passing</u> |
|-----------------------|------------------|
|-----------------------|------------------|

112	100
80	95-100
20	20-100

2.1 MATERIALS
(Cont'd)

5	0-70
0.080	0-10

- .7 Rip Rap: as specified in Section 31 37 10.
- .8 Rigid Insulation: to CAN/ULC-S701, Type 4, expanded polystyrene, minimum compressive strength 400 kPa (60 psi).
 - .1 Acceptable products: Styrofoam Highload 60, as manufactured by Dow Chemical, Foamular 600 as manufactured by Owens Corning, or approved equivalent.
- .9 Underground warning tape:
 - .1 Detectable metallic tape, 50 mm wide clearly marked as follows:
 - .1 "CAUTION - BURIED WATER LINE", colour BLUE.
 - .2 Polyethylene, 3.5 mils thick, 75 mm wide, clearly marked as follows:
 - .1 "CAUTION - BURIED ELECTRICAL CONDUIT", colour RED.
 - .3 Acceptable product: Brady Identoline or approved equivalent.

PART 3 - EXECUTION

3.1 STOCKPILING

- .1 Stockpile excavated materials for re-use in areas designated by the Consultant. Stockpile imported materials in manner to prevent segregation. Cover all materials to seal against rain.

3.2 SHORING AND BRACING

- .1 Construct temporary works to depths, heights and locations as approved by Consultant.
- .2 During backfill operation:
 - .1 Unless otherwise indicated or as directed by Consultant, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
- .3 Upon completion of substructure construction:
 - .1 Remove shoring and bracing.

3.2 SHORING AND
BRACING
(Cont'd)

- .3 (Cont'd)
.2 Remove excess materials from site as directed by the Consultant.

3.3 EXCAVATION -
GENERAL

- .1 Advise Consultant forty-eight (48) hours before starting earthworks.
- .2 Excavate in all kinds of materials including rock encountered on Site to lines and elevations indicated and as necessary for construction. Make own computations of amounts and nature of excavation required.
- .3 Select method of excavation, support and dewatering suitable for the works. Submit proposed method to Consultant for review.
- .4 Protect property or structures above or below ground in accordance with the Contract.
- .5 Where excavation is through pavement, cut pavement along neat, straight lines.
- .6 Bear foundations or underside of all structures including pipe surrounds on the material as shown on the Drawings and neatly finish all bearing surfaces to the required levels and grades.
- .7 Earth bottoms of excavations to be undisturbed soil, free from loose, soft, or organic matter. Remove any soil softened due to frost or standing water prior to placing structures.
- .8 Where foundations of structures or buildings are founded on undisturbed subgrade, the subgrade surface shall be proof rolled in the presence of an experienced geotechnical inspector. Overexcavate any soft spots and backfill with structural fill.
- .9 If the excavated surface is unsuitable, the Consultant will determine what work is required to secure a proper foundation. If such work is due solely to the nature of the ground, then the Consultant will measure the work, but if such work is due to any act or default of the Contractor in carrying out of the Works, resulting in disturbance of natural ground conditions, then execute such work at no additional cost to the Contract.

3.3 EXCAVATION -
GENERAL
(Cont'd)

- .10 Excavation to greater depth than is shown on the Drawings will be at no additional cost to the Contract, unless ordered by the Consultant. Make good trench bottom with approved granular material adequately compacted as approved by the Consultant or with concrete as may be necessary for the safety or stability of the Works.
- .11 Pile excavated material a safe distance away from sides of trench so it will not endanger personnel and the work, reduce sight distances, and obstruct roadways.
- .12 Leave existing utility controls unobstructed and accessible at all times.
- .13 Do not obstruct drainage ditches and natural watercourses.
- .14 The Consultant reserves the right to require surplus material to be placed for embanking, general grading or other improvement or use on site, for the general benefit of the Owner.
- .15 Control grading so that the surface of the ground will be properly sloped to prevent water from running into excavated areas. Promptly remove any water which accumulates in excavations.

3.4 BLASTING

- .1 No blasting is permitted.

3.5 DRAINING,
PUMPING AND THAWING

- .1 Keep excavations and trenches free of water. Control excavations to prevent surface water running into excavated areas.
- .2 Do work in connection with dewatering and supply and maintain on the work, pumps, in number and capacity sufficient to keep bottom of excavations dry and free from water so placing of pipe, manholes, and concrete will be done in the dry. Operate equipment for as long as necessary.
- .3 Dispose of water removed from excavations in a manner that will prevent injuries to public health or private property or to any operation of the work completed or under construction. Do not pump water containing silt or other material in suspension into streams or drainage courses.

3.5 DRAINING,
PUMPING AND THAWING
(Cont'd)

- .4 Confirm sub-drains, sump holes, wells or the like required for dewatering do not endanger the stability of the Works. On completion of the work completely backfill and consolidate excavations.
- .5 Excavate, remove or thaw out frozen ground as necessary.

3.6 STRUCTURE
EXCAVATION

- .1 Excavate to lines, grades, dimensions and elevations shown on Drawings or as directed by the Owner's geotechnical engineer until soils meeting the design condition are identified.
- .2 Extend excavations sufficient distance from footings and walls to allow placing and removal of forms and for placing backfill materials indicated.

3.7 TRENCH
EXCAVATION

- .1 Trenches for piping, conduit, and related excavations must be of sufficient width and depth at all points to allow pipes to be laid, joints to be formed, and appurtenance structures to be built in a workmanlike manner, and when needed, to allow for sheeting and shoring, pumping, draining, and for removing and replacing all materials unsuitable for foundations.
- .2 Excavate trenches so pipe can be laid to the alignment and depth required. Excavation length to be not more than pipe length that can be laid and backfilled in one day. Brace and drain trench so workers may work safely and efficiently.
- .3 Remove organic material and soft deposits to a depth where medium dense to dense materials are encountered as designated by the Consultant.
- .4 Do not stockpile excavated materials alongside trench if the bearing soil will cause trench side failure or bottom uplift and affect pipe alignment.

3.8 UNSUITABLE
MATERIAL
EXCAVATION AND
BACKFILLING

- .1 Notify Consultant when materials unsuitable for use in the work are encountered and remove to depth and extent as directed by Consultant.

3.8 UNSUITABLE
MATERIAL
EXCAVATION AND
BACKFILLING
(Cont'd)

- .2 Backfill excavations with foundation material or selected backfill material as directed by the Consultant.
- .3 Dispose of unsuitable material off-site, at no additional cost to the Contract.

3.9 GRANULAR
BEDDING & SURROUND

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .2 Shape bed true to grade to provide continuous uniform bearing surface for pipe. Do not use blocks when bedding pipe.
- .3 Shape transverse depressions in bedding as required to suit joints.
- .4 Carry bedding material across actual trench width. Mounding bedding will not be permitted.
- .5 Compact each layer full width of bed to at least 95% of standard Proctor dry density.
- .6 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material or foundation material as directed by the Consultant.
- .7 After pipe installation, place and compact bedding to haunch line of pipe. Place and compact bedding material from haunch line of pipe to top of pipe in maximum 200 mm layers. Place remaining bedding material to 300 mm above top of pipe before further compaction. Compact to a density of 95% of standard Proctor density as determined by ASTM D698.

3.10 BACKFILLING-
GENERAL

- .1 Do not proceed with backfilling operation until Consultant has inspected and approved installations.
- .2 After pipelines, and structures have been built, backfill trenches and other excavated areas with materials shown on Drawings or as specified. Remove timber and debris from excavation before backfilling is commenced. Do not cover up or put out of view any work until it has been examined, measured and approved by the Consultant. If any work is covered without approval of the Consultant, it must, if required, be uncovered for examination.

3.10 BACKFILLING-
GENERAL
(Cont'd)

- .3 Do not backfill around or over cast-in-place concrete within 24 hours after placing.
- .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures, permit concrete to cure minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure.

3.11 BACKFILLING
STRUCTURES

- .1 After installation of foundations, clean excavations of trash and debris. Backfill to consist of material shown on Drawings. Place material to meet following requirements and approval of the Consultant:
 - .1 Place backfill in horizontal layers not more than 200 mm deep.
 - .2 Compact each layer by rollers, mechanical tampers, or other suitable equipment to obtain a density of not less than 100% Standard Proctor density, unless noted otherwise.
 - .3 Compact the fill placed below the footings and floor slab as well as within the zone of influence of the building to not less than 100% standard Proctor maximum dry density.

3.12 BACKFILLING
TRENCHES

- .1 Backfill trench from top of bedding to top of subgrade using materials shown on Drawings.
- .2 Place backfill in 300 mm layers and compact to 95% Standard Proctor density. Thoroughly compact each layer before placing next layer. Carry out compaction tests to demonstrate the effectiveness of backfill thickness per lift versus the number of passes with the selected equipment to achieve the specified compaction.
- .3 During backfilling, keep trenches free of water at all times and controlled so as to prevent surface water running into excavated areas. Remove silty materials, which become wetted and subsequently liquid or extremely plastic.
- .4 Leave surface of backfill initially high and repair settlement of trench backfilling.

3.13 MARKER TAPE

- .1 Place marker tape and plank in trenches above electrical conduits and pipes, where indicated.

3.14 INSULATION

- .1 Place rigid insulation in trench as indicated on Drawings. Do not disturb or break boards during backfilling.

3.15 REINSTATEMENT

- .1 Upon completion of work, remove surplus materials and debris, trim slopes, and correct defects as directed by Consultant.
- .2 Reinstall disturbed areas to condition, elevation and thickness equal to or better than that, which existed before excavation.
- .3 Clean and reinstall areas affected by work as directed by the Consultant.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This Section specifies requirements for performing all operations necessary to complete site excavation and filling, to bring the site to subgrade elevations indicated on the Drawings.
<u>1.2 RELATED WORK</u>	.1	Excavating, Trenching and Backfilling: Section 31 23 10.
	.2	Granular Materials and Rip Rap: Section 31 37 10.
<u>1.3 PROTECTION</u>	.1	Prevent damage to trees, structures, natural features, bench marks, or surface or underground utility lines which are to remain. Repair damage to original or better condition at no additional cost to the Contract.
<u>1.4 SITE CONDITIONS</u>	.1	Approximate locations of known underground and surface utility lines and buried objects are indicated on the plans.
	.2	Locate and delineate all underground and surface utilities prior to conducting any site works. Immediately report any discrepancies to the Consultant.

PART 2 - PRODUCTS

<u>2.1 MATERIALS</u>	.1	Embankment material: Select Backfill Material as specified in Section 31 23 10. Maintain material within 1% of optimum moisture content as directed. Protect approved material free from contamination.
	.2	Structural fill: As specified in Section 31 23 10.
-

PART 3 - EXECUTION

3.1 EXCAVATING

- .1 Prior to commencing cut and fill operations, agree with Consultant as to ground surface elevations to be cut and filled.
- .2 Notify Consultant whenever unsuitable materials are encountered and remove unsuitable materials to depth and extent directed.
- .3 Construct ditches to profiles indicated. Confirm there is positive drainage.
- .4 Excavate in all kinds of material including rock encountered on Site and make own computations of amount and nature of excavation required.
- .5 Perform all excavation within ± 75 mm of the lines, grades and dimensions shown on the Drawings or as established by the Consultant. During the progress of the Work, the Consultant may vary the lines, grades and dimensions of the excavations from those specified in this Section.
- .6 Proof roll subgrade in completed excavations in presence of geotechnical inspector. Over-excavate any unsuitable and backfill with approved granular fill or approved structural fill as directed by the Consultant.
- .7 Take necessary precautions to preserve the material below and beyond the lines of all excavation in the soundest possible condition.
- .8 Do not stockpile excavated site tills except as directed by the Consultant. If material is stockpiled do not endanger personnel and the work, reduce sight lines, obstruct roadways, or allow it to become saturated.
- .9 Do not obstruct existing drainage ditches and natural watercourses unless indicated on the Drawings.
- .10 Reduce steepness of slopes wherever possible, and expose smallest practical area of land for shortest possible time.

3.2 BUILDING
SUBGRADE

- .1 Place Structural Fill under filter #3, caustic containment areas of the building and any other area shown on the drawings.
- .2 Place Structural Fill in maximum 200 mm layers and compact to a minimum of 98% of the Standard Proctor maximum dry density.
- .3 Remove glacial till as shown on the drawings and replace any area identified as being soft with structural fill.

3.3 SWALES

- .1 Establish swales to provide drainage as required or indicated on the Drawings.

3.4 FINISHING

- .1 Remove soft or other unstable material that will not compact properly and fill resulting depressions with approved material.
- .2 Shape and compact entire subgrade to within 25 mm of design elevations but not uniformly high or low.
- .3 Do scarifying, blading, compacting or other methods of work as necessary to provide a thoroughly compacted site shaped to grades indicated or directed.
- .4 Finish side slopes to a neat condition, true to lines and grades indicated.
 - .1 Remove boulders encountered and fill resulting cavities.
 - .2 Hand finish slopes that cannot be finished satisfactorily by use of machine.

3.5 TESTING

- .1 Inspection and testing of compaction will be carried out by testing laboratory designated and paid for by the Owner. Arrange and coordinate testing with designated testing laboratory. Refer to Section 01 00 00.

3.6 SURPLUS
MATERIAL

- .1 Surplus excavated material is to be removed from site and disposed of properly, unless directed otherwise. Bear the cost of all removals and disposals at no additional cost to the Contract.

- 3.7 MAINTENANCE .1 Maintain finished surfaces in a condition conforming
to this section until acceptance.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This Section specifies requirements for supplying, transporting and placing gravel to lines, grades and typical cross-sections indicated on the Drawings or as directed by the Consultant.
- 1.2 RELATED WORK .1 Cast-in-Place Concrete: Section 03 30 00
- .2 Excavating, Trenching and Backfilling: Section 31 23 10
- .3 Site Grading: Section 31 23 13
- 1.3 REFERENCE STANDARDS .1 Nova Scotia Transportation and Infrastructure Renewal (NSTIR), Standards Specifications.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Granular material: crushed and screened rock or gravel, consisting of approved hard and durable stone particles, free from flat, elongated or other objectionable pieces. Gradation shall be dense, uniform and as follows:

.1 Type 1:

<u>Sieve Size (micrometre)</u>	<u>Percent Passing</u>
20,000	100
14,000	50-85
5,000	20-50
160	5-12
080	3-8*

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.2 Type 2:

<u>Sieve Size (micrometre)</u>	<u>Percent Passing</u>
80,000	100
56,000	70-100
28,000	50-80
14,000	35-65
5,000	20-50

2.1 MATERIALS
(Cont'd)

- .1 (Cont'd)
- | | |
|-----|------|
| 160 | 5-12 |
| 080 | 0-7* |
- * For gravel sources not classified as quarries the allowable percentage passing the 080 sieve shall be 3 to 5%.
- .3 Physical properties: gravel materials shall conform to the physical properties listed in Table 3.2.3, Nova Scotia Transportation and Infrastructure Renewal, Standard Specification.
- .2 Rip-rap: durable field or quarry stone with rough surfaces and angular shape, minimum thickness not less than one third of length or width and having a minimum of two parallel sides and one plane face at right angles to parallel sides. Rounded stone or boulders will not be permitted. Supply rock spalls to fill open voids. Nominal size of rip-rap 100 mm, with gradation as follows:
- | |
|--------------|
| 100% < 150mm |
| 30% > 100mm |
| 80% > 75mm |
- .3 Sand: as specified in Section 31 23 10.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements for constructing chain link fence. Work includes excavation, supply and installation of concrete footings, chain link fence, gates and accessories, and reinstatement.
- 1.2 RELATED SECTIONS .1 Concrete: Section 03 30 00
.2 Earthwork: Section 31 20 00
- 1.3 REFERENCES .1 CAN/CGSB-138.1M-97, Fabric for Chain Link Fence.
.2 CAN/CGSB-138.2M-96, Steel Framework for Chain Link Fence.
.3 CAN/CGSB-138.3M-96, Installation of Chain Link Fence.
.4 CAN/CGSB-138.4M-96, Gates for Chain Link Fence.
.5 CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- 1.4 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 00 00 showing:
.1 Installation details.
.2 Sizes and coatings of materials.
- 1.5 HANDLING AND STORAGE .1 Handle and store fence materials in such a manner as to avoid damage to materials or coatings.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Concrete: to Section 03 30 00, type GU cement minimum compressive strength 32 MPa at 28 days, slump 80mm $\pm$ 20mm.
.2 Fabric and coating: to CAN/CGSB 2-138.1-M.

2.1 MATERIALS
(Cont'd)

- .3 Posts, rails, and Fittings: to CAN/CGSB 2-138.2-M, galvanized steel. Dimensions in accordance with Table 2 and Table 3.
- .4 Gates and accessories: to CAN/CGSB 2-138.4-M, type as indicated. Framing dimensions in accordance with the following table:

GATE TYPE	OPENING (metres)	FRAMING O.D. (mm)	FRAMING Wall (mm)
Single swing	3.0	42.9	100
Double swing	6.0	42.9	100
Single swing	4.5	42.9	100
Double swing	9.0	42.9	100

PART 3 - EXECUTION

3.1 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface of 30mm to 50mm.

3.2 ERECTION OF
FENCE

- .1 Erect fence along lines as indicated and in accordance with CAN/CGSB-138.3.
- .2 Auger post holes to dimensions indicated by methods approved by the Consultant.
- .3 Space line posts 3 m apart, as measured parallel to ground surface.
- .4 Space straining posts at equal intervals not exceeding 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 150 m.
- .5 Install additional straining posts at sharp changes in grade and where directed by the Consultant.
- .6 Install corner post where change in alignment exceeds 10°.
- .7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

3.2 ERECTION OF
FENCE
(Cont'd)

- .8 Place concrete in post holes then embed posts into concrete to depths indicated. Extend concrete 50mm above ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .9 When driving posts directly into the ground or setting posts in bedrock as an approved method, driving depths, diameter of drill hole and grouting compound as specified in Section 03 30 00.
- .10 Do not install fence fabric until concrete has cured sufficiently. Submit concrete mix to the Consultant for review.
- .11 Install brace between end and gate posts and nearest line post, at inclination as indicated. Install braces on both sides of corner and straining posts in similar manner.
- .12 Install overhang tops and caps.
- .13 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .14 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .15 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300mm intervals. Knuckled selvedge at bottom. Twisted selvedge at top.
- .16 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450mm intervals. Give tie wires minimum two twists.
- .17 Install barbed wire strands and clip securely to lugs of each projection where indicated.
- .18 Install grounding rods as indicated.

3.3 INSTALLATION OF
GATES

- .1 Install gates in locations as indicated.

-
- 3.3 INSTALLATION OF GATES
(Cont'd)
- .2 Level ground between gate posts and set gate bottom approximately 40mm above ground surface.
- .3 Install gate stops where indicated.
- 3.4 TOUCH UP
- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two (2) coats of organic zinc-rich paint, to CGSB 1.181, to damaged areas. Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.
- 3.5 CLEANING
- .1 Clean and trim areas disturbed by operations. Dispose of surplus material and reinstate disturbed surfaces.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for fine grading and for the supply, placement and compaction of topsoil prior to seeding operations.
- .2 All topsoil to be obtained from an off-site source as approved by the Consultant.

1.2 RELATED WORK

- .1 Site Grading: Section 31 23 13
- .2 Hydraulic Seeding: Section 32 92 21
- .3 Sodding: Section 32 92 23

1.3 SOURCE QUALITY CONTROL

- .1 Obtain approval from Consultant of topsoil at source.
- .2 When proposed source of topsoil is approved, use no other source without written authorization.
- .3 Advise Consultant of source of topsoil to be used 7 days in advance of starting work.
- .4 Conduct soil analysis for amendments to topsoil as specified.

1.4 SCHEDULING

- .1 Schedule topsoil placement so finish grading operations coincide with seeding operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Topsoil:
 - .1 Friable loam, neither heavy clay nor of very light sandy nature, containing minimum 4% organic matter for clay loam, and 2% for sandy loam, to maximum 20% by volume.
 - .2 Containing no toxic elements or growth inhibiting materials.
 - .3 Free from debris, subsoil, vegetation, and stones and roots over 25 mm diameter.

2.1 MATERIALS
(Cont'd)

- .2 Soil amendments:
 - .1 Peatmoss:
 - .1 Derived from partially decomposed 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.
 - .2 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.
 - .3 Fertilizer:
 - .1 Complete, commercial, with 35% soluble nitrogen.
- .3 Water: potable, free of impurities.

PART 3 - EXECUTION

3.1 PREPARATION OF
EXISTING GRADE

- .1 Verify grades are correct. If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .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 Course cultivate entire area which is to receive topsoil to depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.2 PLACING AND
SPREADING OF
TOPSOIL

- .1 Place topsoil after the Consultant has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 100 mm, over unfrozen subgrade free of standing water.

3.2 PLACING AND
SPREADING OF
TOPSOIL
(Cont'd)

- .3 For sodded areas keep topsoil 25 mm below adjacent finished grade.

3.3 SOIL AMENDMENTS

- .1 Apply and thoroughly mix soil amendments and fertilizer into full specified depth of topsoil as determined by soil analysis.

3.4 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
- .2 Prepare loose friable bed by means of cultivation and subsequent raking.
- .3 Consolidate topsoil to required bulk density using equipment approved by the Consultant. Leave surfaces smooth, uniform and firm against deep footprinting.

3.5 ACCEPTANCE OF
TOPSOIL

- .1 Consultant will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading. Approval of topsoil material subject to soil testing and analysis.
- .2 All costs for soil testing and analysis will be borne by the Owner.

3.6 PROTECTION

- .1 Protect topsoiled areas until seeding operations have proceeded. Repair and fine grade any rough or disturbed areas affected by the construction and before seeding operations.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This Section specifies requirements for supplying and applying seed by the hydraulic method to all finished areas, including ditches, and areas not located on the site, but disturbed during construction that are not to be gravelled, paved or sodded.
- 1.2 RELATED WORK .1 General Requirements: Section 01 00 00
.2 Site Grading: Section 31 23 13
.3 Topsoil Placement and Fine Grading: Section 32 91 21
- 1.3 PRODUCT DATA .1 Submit product data in accordance with Section 01 00 00.
.2 Provide product data for:
.1 Seed.
.2 Mulch.
.3 Tackifier.
.3 Submit in writing to the Consultant four (4) days prior to commencing work:
.1 Size of truck slurry tank in litres.
.2 Quantity of material to be used per tank based on size of slurry tank.
.3 Number of tank loads required per hectare to achieve specified slurry mixture per hectare.
- 1.4 SCHEDULING .1 Schedule hydraulic seeding to coincide with preparation of soil surface.
- 1.5 DELIVERY AND STORAGE .1 Deliver seed in original containers showing:
.1 Analysis of seed mixture
.2 Percentage of pure seed
.3 Year of production
.4 Net mass
.5 Date when tagged and location
.6 Percentage germination
-

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Seed: Canada "Common No. 1" grade in accordance with Government of Canada "Seeds Act and Regulations".
 - .1 Grass seed mixture (by mass):
 - .1 30% Perennial Ryegrass
 - .2 40% Kentucky Bluegrass
 - .3 15% Red Fescue
 - .4 15% Chewing Fescue
 - .2 Mulch:
 - .1 Fibre: wood or wood cellulose fibre free of germination or growth-inhibiting ingredients, capable of dispersing in water to form homogenous slurry, and forming blotter-like green ground cover allowing absorption and percolation of water.
 - .3 Fertilizer: complete synthetic, slow release, with maximum 35% water soluble nitrogen. Ratio 1:4:4.
 - .4 Tackifier: water dilutable liquid dispersion containing polyvinyl acetate terpolymer emulsion.
 - .5 Water: potable, free of impurities that would inhibit germination.

2.2 EQUIPMENT

- .1 Truck:
 - .1 Slurry tank: approved commercial hydraulic equipment.
 - .2 Pumps capable of maintaining continuous non-fluctuating flow of solution.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- .1 To Section 32 91 21 - Topsoil Placement and Fine Grading.

3.2 WORKMANSHIP

- .1 Take care to prevent contamination by seeding slurry of structures, signs, fences and utilities.

3.2 WORKMANSHIP
(Cont'd)

- .2 Where contamination occurs, remove seeding slurry to satisfaction of, and by means approved by Consultant.
- .3 Do not perform work under adverse field conditions such as wind speeds over 20 km/h, or on frozen ground or ground covered with snow, ice or standing water.
- .4 Perform hydraulic seeding in the spring after snow has melted.

3.3 PLACING TOPSOIL

- .1 Refer to Section 32 91 21.

3.4 SLURRY
APPLICATION

- .1 Slurry mixture applied per hectare (ha):
 - .1 Seed: 125 kg/ha.
 - .2 Mulch: 1350 kg/ha.
 - .3 Tackifier: as per manufacturer's recommendation
 - .4 Fertilizer: 375 kg/ha, 15-25-15 for seeding done between May and September and 10-20-20 thereafter.
 - .5 Water: quantity as required to form slurry in accordance with manufacturer's recommendations.
- .2 Apply seed slurry uniformly.
- .3 Blend applications into adjacent grass, sodded areas and previous applications to form uniform surface.
- .4 Re-shoot areas where application is not uniform.

3.5 ESTABLISHMENT

- .1 Perform following operations from time of seed application until final acceptance by Consultant.
 - .1 Water seeded area as required to maintain optimum soil moisture level and to ensure germination and continued growth of grass. Control watering to prevent washouts.
 - .2 Fertilize seeded area after first cutting in accordance with fertilizing program. Spread half the required fertilizer in one direction and the remainder at right angle.
 - .3 Fertilize seeded areas one month after seeding. Spread evenly and water in well. Fertilizer at rate determined by soil test. Postpone fertilizing until following spring if application falls within four week period prior to expected end local growing season.

3.5 ESTABLISHMENT
(Cont'd)

- .1 (Cont'd)
 - .4 Repair dead or bare spots to allow establishment of seed prior to acceptance. Where continued maintenance is required after final acceptance, commence maintenance immediately following installation of Work. Continue it for one (1) year following final acceptance at Project Completion.

3.6 ACCEPTANCE

- .1 Areas will be accepted by the Consultant at the end of the maintenance period provided that:
 - .1 Seeded areas are properly established.
 - .2 Area is free of bare and dead spots.
- .2 Areas seeded in the fall will be accepted the following spring one month after the start of the growing season provided acceptance.

3.7 MAINTENANCE
DURING WARRANTY
PERIOD

- .1 Perform following operations from time of acceptance until end of maintenance period:
 - .1 Water areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.
- .2 Repair and reshoot bare spots to satisfaction of Consultant.
- .3 Cut grass and remove clippings that will smother grass to height as follows:
 - .1 Turfgrass Nursery Sod:
 - .1 40 mm during normal growing conditions.
 - .2 65 mm at end of growing season and during periods of high temperatures and low precipitation.
 - .2 Cut grass at 2 week intervals or as directed by Consultant, but at intervals so that approximately one third of growth is removed in single cut.
 - .3 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.
 - .4 Eliminate weeds by mechanical means to extent acceptable to Consultant.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 The work to be done under this Section includes the supply, installation and commissioning of well pump system.
- 1.2 RELATED WORK .1 Yard Pipework: Section 33 05 01
.2 Cast-in-Place Concrete: Section 03 30 00
.3 Metal Fabrications: Section 05 50 00
.4 Electrical: Division 26
- 1.3 REFERENCES .1 The Work under this Section must conform to the applicable requirements and referenced standards of the American Society for Testing and Materials (ASTM), Canadian Standards Association (CSA), Hydraulic Institute Standards, National Electrical Manufacturer's Association (NEMA), Canadian Electrical Manufacturers Association (CEMA), Institute of Electrical and Electronic Consultants (IEEE), Electrical Equipment Manufacturer's Association of Canada (EEMAC), NS Well Construction Regulations.
- 1.4 INTENT .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.
- 1.5 CONTRACT DRAWINGS .1 The Project Drawings are not to be considered as detail or shop drawings but as a guide to the general intent based on the equipment specified.

1.6 QUALIFICATIONS
OF EQUIPMENT
MANUFACTURERS

- .1 All items of equipment supplied must be produced by companies regularly engaged in manufacturing this type of equipment and who maintain service and parts departments from which service, repairs and replacements may be obtained quickly at all times. Mechanical details of the equipment offered must have been tried and tested by the actual construction and operation of mechanisms of the exact type and of comparable size and operating in similar service.

1.7 IDENTIFICATION
OF EQUIPMENT

- .1 Fit process equipment with the manufacturer's identification nameplates indicating size, equipment model, manufacturer's name, operating points, serial number, voltage, cycle, phase and power of motors, all factory supplied.

1.8 ELECTRICAL
EQUIPMENT

- .1 Confirm process equipment manufacturers are fully aware of all electrical accessories that are required with the equipment. Observe any special recommendations for such accessories that the manufacturers may make.

1.9 SHOP DRAWINGS

- .1 Submit shop drawings for all process equipment to the Consultant for review prior to shipment, in accordance with Section 01 00 00. Provide detailed dimensional data and operating curves in accordance with Hydraulic Institute Standards.

1.10 MAINTENANCE
MANUALS

- .1 Provide Maintenance data for inclusion in the Operations and Maintenance manuals, in accordance with Section 01 00 00.

PART 2 - PRODUCTS

2.1 WELL PUMPS

- .1 Provide one (1) submersible well pump with a 0.75 hp to 5.0 hp, 230 V, single phase. Motor: pump to have 304 stainless steel parts flow and TDH as indicated below.

.1	Well No.	Flow	TDH
	1	226 Lpm	75m

<u>2.1 WELL PUMPS</u> <u>(Cont'd)</u>	.1	(Cont'd)
	.2	Acceptable product: Grundfos SI62s or approved equal.
 <u>2.2 CONTROLLER</u>	.1	Pump controller to operate pump from pressure switch.
	.2	Pump controller to be supplied by pump manufacturer.
	.3	Built in pump overload protection.
	.4	Supply with pressure.
	.5	Acceptable product: Grundfos SA-SPM6 or approved equal.
 <u>2.3 PRESSURE TANK</u>	.1	Pressure tank: minimum 120L at 60/80 operating range drawdown.
	.2	Provide precharged with NSF 61 approved bladder.
	.3	All metal components to have corrosion resisant or provided with corrosion resistant counting.
	.4	A single tank or multiple tanks can be provided to fit into allocated space.
 <u>2.4 PRESSURE SWITCH</u>	.1	Provide full voltage pressure adjustable switch.
	.2	Factory set to turn pump on at 60 psi and off at 80 psi.

PART 3 - EXECUTION

<u>3.1 DELIVERY DATES</u>	.1	Confirm delivery dates of equipment to permit installation and operation such that there is no delay completing the Works.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with the manufacturer's instructions. Confirm such instructions are issued at the time of the shop drawings issue, and are available on site when required.
- .2 Take necessary field measurements to provide accurate and proper fitting of the work and equipment supplied into the building and around all obstructions and projections.
- .3 Provide concrete equipment bases as required by the equipment and as shown on the Drawings.
- .4 Provide connecting pipework, fittings and valves whether shown on the Drawings or not but required for the proper functioning and servicing of the equipment. Do all such work in accordance with the manufacturer's instructions at no additional cost to the Contract. Where pipe is connected to equipment, install the fitting of the piping in such a manner such that neither pipe nor equipment is strained during the joining procedure.

3.3 INSPECTION,
TESTING AND
START-UP

- .1 Provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation;
 - .3 Test installed equipment with actual plant operation to verify hydraulic balancing, head loss and effluent quality. Make adjustments required to place equipment into operation and to optimize the treated water quality.
- .2 Have the equipment manufacturer's representative fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.

3.3 INSPECTION,
TESTING AND
START-UP
(Cont'd)

- .3 Advise in writing at least one (1) week in advance of the proposed date for testing and start-up. Conduct all tests in the presence of the Consultant.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .5 Assume a minimum period of two (2) days on site for skilled supervision and instruction and a minimum of two (2) trips to the site by the equipment manufacturer. Provide as many trips and days on site to complete the installation and put the equipment into satisfactory operation.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1 This section specifies requirements for constructing a submersible pumping station. Work generally includes supply and installation of pumping equipment, valves, level regulators, metal fabrications, and related pipe.
<u>1.2 RELATED SECTIONS</u>	.1 Cast-in-place Concrete: Section 03 30 00 .2 Sanitary Sewers: Section 33 31 00 .3 Yard Piping: Section 33 34 00 .4 Electrical: Division 26 .5 Process: Division 40
<u>1.3 REFERENCE STANDARDS</u>	.1 ANSI/ASME B-16.1-2010, Class 125, Cast Iron Pipe Flanges and Flanged Fittings. .2 ANSI/AWWA C104/A21.4-2013, Cement Mortar Lining for Ductile-Iron Pipe and Fittings. .3 ANSI/AWWA C110/A21.10-2012, Ductile-Iron and Gray Iron Fittings for Water. .4 ANSI/AWWA C151/A21.51-2009, Ductile-Iron Pipe, Centrifugally Cast, for Water. .5 ASTM A36M-2014, Carbon Structural Steel. .6 ASTM A181M-2014, Carbon Steel Forgings for General-Purpose Piping. .7 CAN/CSA-C22.1-2015, Canadian Electrical Code. .8 CAN/CSA-C22.2 No. 108-2014, Liquid Pumps. .9 CSA Bulletin S2619-1998, Information and Documentation.

1.3 REFERENCE
STANDARDS
(Cont'd)

- .10 Equipment assemblies comprised of electro-mechanical components shall be CSA approved where possible and shall bear the appropriate label. If the equipment in question is not CSA approved as an assembly, the manufacturer shall arrange and pay for Spot approval and labelling of the equipment prior to installation.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00.
- .2 Indicate details of piping, valves, supports, pumps, metal fabrications, electrical connections and appurtenances.

1.5 OPERATING AND
MAINTENANCE DATA

- .1 Provide operating and maintenance data in accordance with Section 01 00 00 and as follows:
 - .1 System description.
 - .2 Design parameters, system hydraulics, design calculations, and system curves.
 - .3 Performance curves for the pumps, layout, and wiring diagrams, control system schematic, level control system schematic.
 - .4 Related civil, mechanical, and electrical drawings.
 - .5 Manufacturer's operation instructions.
 - .6 Name, address, and telephone number of equipment suppliers.
 - .1 Information on guarantees and warranties.

1.6 HANDLING AND
STORAGE

- .1 Handle and store pumps, pipe, valves, and fittings in such a manner as to avoid shock and damage. Do not use chains or cables passed through pipe or equipment. Do not damage coatings or linings.

1.7 MAINTENANCE
MATERIAL

- .1 Provide manufacturer's recommended spare parts list.
- .2 Parts to be available for use on site within 24 hours' notice.

PART 2 - PRODUCTS

2.1 PUMPS

- .1 Submersible, non-clog pumps:
 - .1 Equip each pump with submersible, electric motor, power supply and monitoring cable(s), length to suit installation
 - .2 Design criteria:
 - .1 Quantity: one (1).
 - .2 Fluid: raw sewage centrate.
 - .3 Capacity: 3.15 L/s (50 USgpm).
 - .4 Total dynamic head: 7.15m (23.5 ft).
- .2 Pump unit to be capable of delivering flow and TDH, as indicated per level B of Hydraulic Institute Standard for Centrifugal Pumps unless impellers are trimmed.
- .3 Supply each unit complete with a mating, cast iron discharge connection and hot-dip galvanized lifting chain or cable, approved for overhead lifting and of adequate strength to permit raising and lowering of the pump. Lifting system shall be compatible with existing municipal lifting equipment, Flygt.
- .4 Pump and motor close-coupled, integral design capable of handling raw, unscreened sewage. Discharge connection elbow to be permanently installed in wet well, together with the discharge piping.
- .5 Pump to be automatically connected to discharge connection elbow when lowered into place, and easily removed for inspection and service.
- .6 Major pump components: grey cast iron, with smooth surfaces, devoid of blowholes and other irregularities.
- .7 All exposed nuts and bolts to be 316 series stainless steel construction.
- .8 Protect all surfaces coming into contact with sewage, other than stainless steel or brass, by an approved, sewage-resistant coating.
- .9 Machine all mating surfaces where watertight sealing is required and fitted with nitrile or neoprene rubber O-rings. Accomplish sealing by metal-to-metal contact between machined surfaces.

2.1 PUMPS
(Cont'd)

- .10 Control compression of nitrile rubber or neoprene O-rings without the requirement of a specific torque limit. Do not use secondary sealing components, rectangular gaskets, elliptical O-rings, grease or other devices or materials.
 - .11 Volute: single port, non-concentric design with smooth fluid passages, large enough at all points of the volute to pass any size solids which pass through the impeller.
 - .12 Impeller ductile or grey cast iron, Class 30 or better, dynamically balanced, non-clog or recessed design having a long through let without acute turns.
 - .1 Impeller: capable of handling solids, fibrous material, heavy sludge, and other matter found in sewage applications.
 - .2 Pump out vanes in the back of impeller shroud to be large enough to sufficiently expel solids away from seal area.
 - .13 Pumps to be rated for operation in Class 1, Zone 2 electrically classified area.
 - .14 Cable:
 - .1 Power and/or control (monitoring) cable(s): neoprene-jacketed type SOW composite cable sized to meet or exceed electrical code requirements. Cable to be suitable for submerged use and CSA approved.
 - .15 Cable and Entry:
 - .1 Confirm cable entry design has an impermeable seal.
 - .2 Combine power, temperature sensing and moisture sensor conductors into a single cord. Entry into the pump is accomplished in two (2) ways:
 - .1 On the smaller motors (up to 30 HP), furnish a plug-in power cable to allow easy changes of both voltage and cable length without motor entry.
 - .2 On the larger motors (30 HP and above) with much larger cable sizes, the cable enters through a double grommet and internal strain relief to a terminal strip for conductor attachment.
 - .3 Cable entry design must be capable of continuous submergence underwater without loss of watertight integrity to a depth of 20 m.
 - .16 Guide Bars and Cables:
-

2.1 PUMPS
(Cont'd)

- .16 (Cont'd)
 - .1 Provide corrosion resistant vertical guide bar(s) or cables (316SS) with each pump to ensure correct alignment of pump with automatic discharge connection.
 - .2 For each pump, provide guide bar(s) or cables securely fixed at lower end to the discharge connection by means of corrosion proof bosses.
 - .3 Extend guide bar(s) or cables from discharge connection toward ground level to be securely fixed by a corrosion proof bracket (upper guide bar holder), anchored to suit installation.
 - .4 Provide intermediate bracket with special inserts to position the guide bars rigidly, where applicable.
- .17 Discharge Connections:
 - .1 Provide cast iron, automatic discharge connection for each pump to connect pump to discharge piping.
 - .2 Permanently fix the discharge connection in position with anchor bolts attached to the bottom of the pump chamber.
 - .3 Discharge connections to permit rapid and precise installation or removal of the pumps without entering pump chamber.
 - .4 Connection to ensure zero leakage between the pump and its discharge connection.
 - .5 Allow no part of the pump to bear directly on the floor of the wet well.
- .18 Electric Motor:
 - .1 The pump motor: squirrel-cage induction, inverter duty rated type design, housed in a watertight chamber of maximum efficiency and durability. Design motor for continuous duty capable of sustaining a minimum of fifteen (15) starts per hour. Motor speed and electrical characteristics as indicated.
 - .2 Motor stator: directly shrink-fitted into the stator housing. Insulate stator winding and leads with moisture-resistant varnish capable of withstanding a temperature of 155°C or the motors maximum temperature rise, whichever is greater. Insulation rating to Class F or higher.

2.1 PUMPS
(Cont'd)

- .18 (Cont'd)
- .3 Rotor bars and short-circuit rings to be made of aluminum. Use thermal sensors to monitor stator temperatures on all pumps. Equip stator with not less than two (2) thermal switches embedded in the end coils of the stator windings (one switch per phase to protect the motor against surcharges and high temperature). Use these in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.
- .4 Seal junction box chamber containing the terminal board from the motor by an elastomer compression grommet for pumps of 3 kW (4 hp) or more. Alternately, use of triple-sealed cable entry system does not require a seal junction box chamber.
- .5 Equip motor housing with a moisture detector to detect any leakage of water or pumpage, into the stator housing. The signals from the thermal switches and the moisture detector to be wired to the control panel.
- .6 Accomplish control of the moisture detector and the winding thermal switches by using a control/indicator relay(s) which will be installed and wired inside the control panel to stop the pump unit upon a fault signal. Provide relays to panel fabricator for installation in control panel.
- .7 Motor to be able to operate dry without damage while pumping under load.
- .19 Shaft and Seals:
- .1 Pump shaft: AISI 400 series stainless steel. Provide each pump with a tandem mechanical shaft seal system.
- .2 Tandem mechanical shaft seal to be of single spring design operating in an intermediate oil-filled seal cavity.
- .3 The upper of the tandem set of seals operates in cooling medium. This set contains one (1) stationary ring and one positively driven rotating ring.
- .4 Seals to be Tungsten carbide, silicone carbide and/or carbon ceramic.
- .20 Acceptable manufacturer: Xylem (Flygt).

2.2 PUMP CONTROL
PANEL

- .1 Pump to be controlled by others (WWTF PLC).

2.3 LEVEL SWITCH

- .1 Provide mechanical switches for level control.

<u>2.3 LEVEL SWITCH (Cont'd)</u>	.2	One (1) SPDT Contact rated at 5 amps @120 VAC (continuous) minimum.
	.3	Complete with integral cable, length to suit installation.
	.4	Suitable for installation in a Zone 2 hazardous location. Provide intrinsically safe relays.
	.5	Acceptable product: Flygt ENM-10, Conery 2900 Series B6 or approved equivalent.
<u>2.4 FLOAT HANGER</u>	.1	Galvanizer float hanger c/w squeeze connectors and supports to hang excess cable and cable grips.
	.2	Acceptable manufacturer: Flygt or approved equivalent.
<u>2.5 LABELS</u>	.1	Permanently affix suitable nameplates onto the pumps, motors, and other operating components to indicate the purpose of the component or operating routine and parameters applying to the component. Confirm the lift station pumps are CSA approved and the CSA logo appears on the nameplates of these components.

PART 3 - EXECUTION

<u>3.1 MANUFACTURER'S INSPECTION, TESTING AND SHIPMENT</u>	.1	Inspection and Testing: .1 Test pump proper operation at rated power supply values and for electrical and mechanical integrity prior to shipment. Pump supplier to have adequate test facilities to at least provide a single-point performance test or a complete performance curve at an accuracy of $\pm 1\%$. .2 Pump/motor assembly to be CSA approved as one, integral unit, as per CSA standard CAN/CSA-C22.2. No. 108. Proof of this approval to be submitted by the pump manufacturer together with the approval drawings. An approval of the motor unit only will not be acceptable. Cable to be CSA approved, SOW type, neoprene-jacketed, with a 90°C rating.

3.1 MANUFACTURER'S
INSPECTION, TESTING
AND SHIPMENT
(Cont'd)

- .1 (Cont'd)
- .3 The supplier grants the right of inspection of the pumping equipment to any authorized representative of the purchaser or Owner's representative before shipment from factory. If inspection is requested give 48 hours notice in advance of the time when the equipment will be ready for inspection at the factory. The Owner will pay the costs associated with having the Consultant observe the testing.
- .4 Have any equipment in the pumping station that may have been provided by another supplier tested by the original Supplier.
- .5 Pump manufacturer to perform the following inspections and tests on each pump before shipment:
- .1 Check impeller, motor rating, and electrical connections for compliance to the customer's purchase order.
- .2 A motor and cable insulation test for moisture content and/or insulation defects.
- .3 Prior to submergence, run the pump dry to establish mechanical integrity and free rotation.
- .4 Run pump for 30 minutes, submerged 2 m minimum depth.
- .5 Repeat after operational test number 4, the insulation test, number 2.
- .6 Check oil housing for any leakage of water by the lower seal.
- .7 Inspect motor housing and junction box for any water leakage.
- .8 Supply upon request, a written report stating that the above tests have been performed with each pump at the time of shipment.
- .9 Seal pump cable end with a high quality protective covering to make it impervious to moisture and/or water seepage, prior to shipping to job site and electrical installation.
- .6 Provide successful test results prior to shipment.
- .2 Shipment: ship equipment assembled to the greatest extent possible to reduce installation and start-up costs.

3.2 PRE-
INSTALLATION

- .1 Verify all layouts, dimensions, elevations and other pertinent data prior to proceeding with the work.

3.2 PRE-
INSTALLATION
(Cont'd)

- .2 Back-prime all metal surfaces being mounted directly against concrete surfaces with bitumastic paint with the exception of surfaces that will be grouted in.
- .3 Examine all components to be incorporated into the Work for cracks, pits, blow holes, finishes, and any other defects. Do not incorporate any defective materials into the Work. Remove any defective materials from the site immediately and replace defective materials with new materials. Inspect all materials and remove all dirt and other debris.
- .4 Install all components in strict accordance with each manufacturer's instructions, recommendations and the reviewed shop drawings for the various materials to be incorporated in the Work.
- .5 Install pumps, pipe, fittings, valves, accessories and appurtenances using skilled workers experienced in the tasks required.
- .6 Handle all components carefully taking care not to damage the surface finish on these components. Make good any damage or supply new components as appropriate.
- .7 Install isolation bushings between stainless steel anchors and other dissimilar materials.
- .8 Install stainless steel washers when installing anchors for pump discharge base elbows. Washers to have a stick-on plastic film on the side contacting the base elbows. Use stainless steel shims similarly protected when shimming base elbows.
- .9 Arrange for start-up, testing and commissioning by the equipment manufacturers' representatives in presence of the Owner's representatives after the installation has been completed and is ready for start-up and commissioning.
- .10 Complete all electrical installations in accordance with Division 26 and to meet or exceed applicable codes.

3.3 PIPING

- .1 Cut piping to length using equipment designed for the cutting of pipe within the maximum allowable tolerance from square cut ends in accordance with type.

3.3 PIPING
(Cont'd)

- .2 Lubricate pipe and gaskets with lubricant before installing gaskets on pipe and completing joint.
- .3 Install piping straight, parallel to walls and in such a manner so as to prevent straining during jointing procedures. Install pipe supports where shown or required.
- .4 Prior to assembling flanged joints, thoroughly clean flanges. Use a gasket lubricant to ease gasket installation. Tighten diametrically opposed bolts simultaneously.
- .5 Do not correct misalignment using fasteners or other means to pull flanges into alignment. Correct so that no eccentric loads are placed on flanges.

3.4 VALVES

- .1 Install valves in the proper orientation with respect to flow direction and in accordance with manufacturer's recommendations. Install isolation valves with the seat side towards the pump.

3.5 PUMPS AND
APPURTENANCES

- .1 Locate, align, level, adjust and install pump discharge base elbows. Locate pumps and discharge base elbows so that the pumps can be easily removed through the openings in the lift station without requiring the removal of any station equipment. Confirm sufficient clearance is present to permit easy pump removal when a flush valve is installed on the designated pump.
- .2 Install upper guide bar or cable holders and guide bar(s) or cables in accordance with the pump and anchor manufacturer's instructions, so that the guide bars are true, plumb and in the proper location and alignment so that the pumps can be easily removed through the openings in the lift station cover.
- .3 Take care to protect the finish on the pumps, pipe, fittings, valves and appurtenances from scratches and other damage. Repair any damage to the surface finishes.

3.6 ACCESSORIES

- .1 Install level regulator hanger in the position indicated or as directed by the Consultant. The level regulator hanger(s) will otherwise be mounted in a location where it will not be affected by flow from the inlet piping or prevent removal of the pumps, including a pump if fitted with flush valve, all in accordance with the pump and anchor manufacturer's instructions.
- .2 Back-prime and mount each galvanized chain hook or cable hook in the area shown and located so that the chain can be reached conveniently and such that the hook does not interfere with pump removal from the lift station. Install isolation bushings between galvanized steel and 316 stainless steel anchors. Install hooks in accordance with pump and anchor manufacturer's instructions.
- .3 Supply and install back-primed pipe supports and install with medium duty, 316 stainless steel, wedge anchors using isolation bushings all in accordance with the anchor manufacturer's instructions.
- .4 Following installation of the stainless steel anchors that use studs instead of bolts, cut the studs off level with the top of the nut.

3.7 TESTING AND COMMISSIONING

- .1 Test interior pipework: water inside pipework to be gradually increased until it reaches a minimum of 690 kPa and maintain test pressure for one hour. No leakage will be allowed.
- .2 Prior to starting the pumps, remove the plug or cap from the forcemain.
- .3 After pumps and piping have been installed, test pumps with the material they are to pump, or with water, operate and pump for a duration of time sufficient to satisfy that the complete installation has been properly installed and aligned and that the pumps run free from heating, rubbing or vibration and meet the requirements of these Specifications, and that the pumps and piping are free and clear of debris and obstructions.
- .4 Demonstrate that each pump can be easily removed from the lift station without obstruction or removal of any station equipment. Make any adjustments necessary to carry out pump removal in this manner.

3.7 TESTING AND
COMMISSIONING
(Cont'd)

- .5 Demonstrate the operation of all valves and make any adjustments necessary to permit the valves to be operated smoothly without obstruction and allow the pumps to be removed with the valves in an open or closed position.
- .6 Demonstrate integrity of pump discharge connection seal to pump by pumping down wet well sufficiently to detect leakage.
- .7 Observe wet well piping during pump operation for leaks and/or loose connections. Repair any leaks identified.
- .8 Test station piping in accordance with Section 33 34 00, Clause 3.6.
- .9 Test pump flow in accordance with specified pump curves stated for pump characteristics. Test pump flow by draw down test, flow meter or SCADA as directed by the Consultant.

PART 1 - GENERAL

1.1 SECTION
INCLUDES

- .1 Materials and installation for yard pipe that runs between process tankage and equipment.
- .2 Yard piping is defined as all piping 1.5m outside the building footprint to 1.5m outside of the property line (unless noted otherwise).

1.2 RELATED
SECTIONS

- .1 Excavating Trenching and Backfilling: Section 31 23 10.

1.3 REFERENCES

- .1 ANSI/ASME B16.1-2015, Fittings, Flanges and Valves.
- .2 ANSI/AWWA C104/A21.4-2016, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- .3 ANSI/AWWA C105/A21.5-2010, Polyethylene Encasement for Ductile Iron Pipe System.
- .4 ANSI/AWWA C110/A21.10-2012, Ductile Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm) for Water and Other Liquids.
- .5 ANSI/AWWA C111/A21.11-2017, Rubber- Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- .6 ANSI/AWWA C151/A21.51-17, Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
- .7 ANSI/AWWA C153/A21.53-2011, Ductile Iron Compact Fittings 3 in. through 24 in. (76mm through 610mm) and 54 in through 64 in. (1,400mm through 1,600mm), for Water Service.
- .8 ANSI/AWWA C509-15, Resilient Seated Gate Valves, for Water and Sewerage Systems.
- .9 ANSI/AWWA C600-2010, Installation of Ductile Iron Water Mains and Their Appurtenances.
- .10 ANSI/AWWA C606-15, Grooved and Shoulder Joints.
- .11 ASTM A183-14, Carbon Steel Track Bolts and Nuts.

1.3 REFERENCES
(Cont'd)

- .12 ASTM A240-16A, Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- .13 ASTM A276-17, Stainless and Heat- Resisting Steel Bars and Shapes.
- .14 ASTM B418-2012, Cast and Wrought Galvanic Zinc Anodes.
- .15 AWWA C115-11, Flanged Ductile Iron Pipe and Ductile Iron or Gray Iron Threaded Flanges.
- .16 AWWA C500-09, Gate Valves for Water and Sewage Systems.
- .17 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .18 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA)
- .19 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

1.4 SUBMITTALS

- .1 Submit samples in accordance with Section 01 00 00.
- .2 Submit to the Consultant for testing at least two (2) weeks prior to beginning Work the following samples of materials proposed for use:
 - .1 450mm long cut sample section of pipe, complete with material and coating certifications.
- .3 Submit manufacturer's test data and certification at least two (2) weeks prior to beginning Work in accordance with Section 01 00 00.
- .4 Certification to be marked on pipe.
- .5 Submit shop drawings in accordance with Section 01 00 00 for all pipe, fittings, valves and all other items necessary for a complete installation.

1.5 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling.
- .3 Separate for reuse and recycling and place in appropriate containers.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by the Consultant.
- .5 Divert unused concrete materials from landfill to local facility as approved by the Consultant.
- .6 Divert unused aggregate materials from landfill to facility for reuse as approved by the Consultant.
- .7 Place materials defined as hazardous or toxic in designated containers.
- .8 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .9 Fold up metal banding, flatten and place in designated area for recycling.

1.6 HANDLING AND
STORAGE

- .1 Handle and store pipe, valves and fittings, in such manner as to avoid shock and damage. Do not use chains or cables passing through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

1.7 SCHEDULING OF
WORK

- .1 Coordinate schedule with other plans required in specifications.
- .2 Where applicable, coordinate and organize work to minimize interruptions to existing services.
- .3 Notify the Owner and the Consultant a minimum of 48 hours in advance of planned interruptions in service.

-
1.7 SCHEDULING OF WORK <u>(Cont'd)</u>	.4	Do not interrupt service between 0800 hours and 1800 hours, unless otherwise authorized.
-

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS	.1	Pipe: Special Class 52, to AWWA C151, diameter as indicated.
	.2	Fittings: to AWWA C110 or C153, cement mortar lined to thickness per manufacturer's recommendation, minimum pressure rating 1035 kPa for cast-iron, 1720 kPa for ductile-iron.
	.3	Pipe Coatings: .1 Interior: cement mortar lined, thickness per manufacturer's recommendation. .2 Exterior: manufacturer's standard coating.
	.4	Joints: mechanical or push-on to AWWA C111.
	.5	Cement mortar lining for liquid service: formulated with 100% pure fused calcium aluminate aggregate and cement suitable for use in hydrogen sulfide environments. .1 Acceptable product: SewperCoat.
	.6	Unlined pipe for air service complete with high temperature gaskets.
	.7	Gaskets: to suit alternating submersion and exposure to sewage and hydrogen sulfide gaseous environments.
2.2 BOLTS FOR BURIED SERVICE	.1	T-head bolts and nuts: .1 Low alloy Corten steel.
2.3 COUPLINGS	.1	Restrained coupling type: ductile iron with minimum pressure rating of 1035 kPa, appropriate to the type and size of pipe being joined, epoxy coated with corrosion resistant, low alloy, high strength steel nuts and bolts per ANSI/AWWA C111/A21.11. .1 Acceptable products: Series 3800 Mega-Coupling Restrained Coupling.
-

2.4 THRUST
RESTRAINT

- .1 Thrust blocks and anchors: Mix design to Section 03 30 00 - Cast-in-Place Concrete. Use 15 M Grade 400 reinforcing steel where indicated.
- .2 Joint restraint device: 100 mm to 600 mm joint restraint device to AWWA C111 and C153 for mechanical or push-on joints with multiple wedge or gripper ring restraining mechanism, minimum working pressure rating 2410 KPa and minimum safety factor of 2:1. No special tools shall be required for installation.
 - .1 Acceptable products:
 - .1 Ebba Iron Megalug
 - .2 Ford
 - .3 Star
 - .3 Mechanical joint restraint devices are to be used in combination with concrete thrust blocks. Mechanical joint restraint devices alone are permitted on 11 degree horizontal bends. No pipe joints are permitted within the minimum pipe length. Identify all restrained joints/pipe in the field prior to backfilling by wrapping the pipe with a red colored adhesive tape. Wrap the joint/pipe with two bands of adhesive tape.

2.5 INSULATION

- .1 To Section 31 23 10.

2.6 GEOSYNTHETIC

- .1 Synthetic fibre, rot proof, unaffected by action of oil or salt water and not subject to attack by insects or rodents. Non-woven construction, with minimum thickness of 2 mm and minimum density of 200 g/m².

2.7 WARNING TAPE

- .1 As indicated in Section 31 23 10.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Carefully inspect products for defects and remove defective products from site.
- .2 Clean pipe, fittings and valves before installation.

3.2 TRENCHING,
BEDDING AND
BACKFILLING

- .1 Provide trenching, bedding and backfilling to Section 31 23 10.
- .2 Use Type 1 for pipe bedding and protection unless otherwise specified. Clearstone is acceptable for wet applications.
- .3 Break rock 3m beyond end of pipe where indicated for full trench width.

3.3 BURIED PIPE
INSTALLATION

- .1 Lay and join pipe, fittings, and valves, as specified herein and according to manufacturer's published instructions.
 - .2 Do not lay pipe and fittings when trench bottom is frozen, under water or when trench conditions or weather are unsuitable.
 - .3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within the following tolerances:
 - .1 Horizontal Alignment: 150 mm
 - .2 Vertical Alignment: 75 mm
 - .4 Face bell ends in direction of laying. On grades of 5% or greater, lay pipe up grade. For grades exceeding 16%, install appropriately designed gradient thrust restraint.
 - .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
 - .6 Do not use excessive force to join pipe sections.
 - .7 Install gaskets and lubricate in accordance with manufacturer's published instructions. During cold weather, store gaskets in heated area to assure that gaskets remain flexible.
 - .8 Align pipes carefully before joining.
 - .9 Support pipes as required to assure concentricity until joint is properly completed.
 - .10 Keep pipe joints free from mud, silt, gravel or other foreign materials.
-

3.3 BURIED PIPE
INSTALLATION
(Cont'd)

- .11 Avoid displacing gasket or contaminating with dirt, or other foreign material. Remove, clean, re-install and lubricate gaskets so disturbed. Do not reuse a gasket that has been contaminated with petroleum products.
- .12 Complete each joint before laying next length of pipe.
- .13 Where deflection at joints is permitted by the Consultant, deflect only after spigot is fully inserted in bell. Do not exceed joint deflection recommended by manufacturer.
- .14 At structures, provide flexible joint not more than 300 mm from outside face of structure. Support pipe between structure wall and first joint with 20 MPa concrete
- .15 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating. Leave smooth bevelled edge.
- .16 Give sufficient notice so that appropriate inspection and approval of pipe installation can be undertaken by the Consultant or the authorities having jurisdiction.
- .17 When stoppage of Work occurs, block pipe as directed by the Consultant to prevent creep during downtime.

3.4 VALVES AND
VALVE BOXES

- .1 Install valves at locations indicated. Joints and bedding as specified for pipe and fittings.
- .2 On direct buried valves, install valve boxes plumb and centered over operating nut, and true to line and grade.
- .3 Place select backfill material, maximum size 50 mm around valve box to subgrade.
- .4 When valves are installed with cover in excess of 2.0 m, provide a valve stem extension in accordance with Project Drawings.

3.5 THRUST
RESTRAINT

- .1 Provide formed thrust blocks to undisturbed ground on all bends greater than 22 degrees. Keep joints and couplings free of concrete and construct, so as to avoid conflict with manholes in dual pipe trenches.
- .2 Backfill over thrust blocks when concrete has sufficient strength and can withstand earth pressure.
- .3 Provide mechanical joint restraint devices where specified.
- .4 Mechanical joint restraint alone is permitted on 11 and 22 degree horizontal bends.
- .5 Where mechanical joint restraint is used alone, provide a single length of pipe within the minimum pipe length.
- .6 Place double polyethylene on bend before pouring concrete thrust block.

3.6 HYDROSTATIC
TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic test.
- .2 Include all appurtenances in the system test.
- .3 Do not carry out testing until the surface is at finished grade.
- .4 Perform tests in presence of the Consultant or his representative. Provide the Consultant with at least 24 hours notice prior to conducting any tests. Provide a ¼ inch NPT connection at an appropriate location for the Consultant's pressure gauge.
- .5 Provide isolated source potable water for performing tests. Direct cross-connection to potable water distribution system to provide water for tests is forbidden.
- .6 Pressure test all valves.
- .7 Open all valves in test section.
- .8 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air-vacuum release valves are installed.

- .9 Conduct the test at a minimum pressure of the greater of 1035 kPa or one and one-half (1.5) times the operating pressure at the lowest point of elevation of the system being tested. In any case, the test pressure must not exceed 1205 kPa. Do pressure testing in sections where necessary to meet testing requirements. Conduct testing in accordance to AWWA C600.
- .10 Conduct the test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted during the test period.
- .11 Locate and repair defects if test fails. Retest until results show remedial measures have been successful.
- .12 All water used for pipe testing including pressure testing and flushing will be the responsibility of the Contractor and will be chlorinated potable water.
- .13 Following acceptance of field tests, the Consultant may order a second test. Cost of retesting will be paid by the Owner providing the test is satisfactory. If it is not satisfactory the Contractor will pay for the re-test.
- .1 Connect new mains to existing mains as indicated.
- .2 Do not make a connection to an existing main within 1.0 m of a fitting, pipe joint or miscellaneous appurtenances.
- .3 Owner does not guarantee leak tight operation of existing valves.
- .4 No work will be performed on existing main until all items required to complete the connection are on site and the outside diameter and type of pipe have been confirmed.
- .5 When a connection is made to an exiting main, an inspection of the joints for leakage must be made by the Consultant, while the main is under operating pressure, prior to backfilling.

- 3.8 WARNING TAPE .1 Place warning tape on top of first backfill layer above pipe, along entire length of new pipe and similarly over existing pipe exposed during construction.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies the requirements for the supply and installation of precast concrete storm sewer catch basins and precast concrete septic holding tanks, both complete with metal castings and appurtenances.
- 1.2 RELATED WORK .1 Cast-in-Place Concrete: Section 03 30 00
.2 Exterior Waterproofing: Section 07 11 00
.3 Excavating, Trenching and Backfilling: Section 31 23 10
- 1.3 REFERENCES .1 ASTM A48/A48M-03(R2012), Specification for Gray Iron Castings.
.2 ASTM A123-15, Standard Specification for Zinc-Dipped (Hot-Dipped Galvanized) coatings on Iron and Steel Products.
.3 ASTM C478M-15A, Specification for Precast Reinforced Concrete Manhole Sections.
.4 CSA B66-10(R2015), Design, Material and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks.
.5 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for use in Building construction.
.6 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
.7 CSA A23.1/A23.2-14, Concrete Materials and Methods for Concrete Construction.
.8 CSA A257 Series-14, Standards for Concrete Pipe.
.9 CSA A3000-2013, Cementitious Materials.
.10 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
-

1.3 REFERENCES
(Cont'd)

- .11 Nova Scotia Environment - Onsite Sewage Disposal
System Technical Guidelines - June 2013.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section
01 00 00.
- .2 Submit manufacturer's test data and certification
that materials meet requirements of this section.
Include manufacturer's drawings, information, size
of components, dimensions and details where
pertinent.

PART 2 - PRODUCTS

2.1 PRECAST CATCH
BASIN

- .1 Precast catch basin sections: to ASTM C478M,
circular. Top sections flat slab top type with
opening offset for vertical ladder installation.
Precast concrete bases to be approved by the
Consultant.
- .2 Joints: make watertight using rubber O-rings.
- .3 Mortar:
.1 Cement: to CAN/CSA-A3000.
- .4 Adjusting rings: precast concrete, to ASTM C478.
- .5 Frames and covers: to dimensions as indicated and
following requirements:
.1 Metal gratings and covers to bear evenly on
frames. A frame with grating or cover to constitute
one unit. Assemble and mark unit components before
shipment.
.2 Gray iron castings: to ASTM A48.
.3 Bearing surfaces to be ground to eliminate
surface imperfections.
.4 Frames and covers: heavy duty municipal type
for road service and as indicated on the drawings.
Cover cast with perforations for storm sewer
application.
.1 Acceptable product: IMP Group Ltd. S-441.
- .6 Granular bedding material: as specified in Section
31 37 10.
- .7 Concrete: for adjustment, cast-in-place bases and
benching, as specified in Section 03 30 00.

PART 3 - EXECUTION

3.1 EXCAVATION AND
BACKFILLING

- .1 Provide excavating and backfilling in accordance with Section 31 23 10.
- .2 Obtain approval of the Consultant before installing, catch basin or holding tank.

3.2 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00.
- .2 Position metal inserts in accordance with dimensions and details as indicated.

3.3 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Dewater excavation as directed by the Consultant and remove soft and foreign material before placing concrete base.
- .3 Set precast concrete base on 150 mm minimum of granular bedding compacted in accordance with Section 31 23 10 when units are placed on soils.
- .4 Set riser sections on precast base and make joint watertight with O-ring gaskets. Grout joints inside and out with non-shrink grout.
- .5 Plug lifting holes with non-shrink grout.
- .6 Place stub outlets at elevations and in position indicated. Provide type of gasket connection as indicated.
- .7 Install benching where shown on the Drawings using concrete suitable for exposure classification C-2 as specified in CSA-A23.1.
- .8 Install frames and covers on applicable top sections to elevation shown on Drawings or as directed. Use cast-in-place concrete (min. 150 mm thickness) or cast-in-place concrete with 15 M reinforcing bar in centre (for adjustments between 75 mm and 150 mm) or "Rapid-Set" or "Set-45" epoxy mortar (between 20 mm and 75 mm). Cast-in-place concrete shall not exceed the outside edge of the capping ring.

3.3 INSTALLATION
(Cont'd)

- .9 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

3.4 SYSTEM
CLEANLINESS

- .1 Upon adjustment, removal of catchment device and all works associated with restoration around the manhole, provide all testing equipment, labour, incidentals, traffic control, etc., required to undertake an inspection of the system to verify its cleanliness. Do inspection in the presence of the Consultant.

3.5 LEAKAGE TEST

- .1 Install watertight plugs or seals on inlets and outlets of each unit and fill with water. Allow 24 hours for absorption of water into concrete and top up before testing. Leakage not to exceed 0.3% per hour of volume of unit.
- .2 If permissible leakage is exceeded, correct defects. Repeat until acceptable to the Consultant.

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section specifies requirements for constructing storm sewers and culverts. Work includes supply and installation of pipe, fittings and service connections.
<u>1.2 RELATED SECTIONS</u>	.1	Concrete: Section 03 30 00
	.2	Metal Fabrications: Section 05 50 00
	.3	Earthwork: Section 31 20 00
	.4	Reinstatement: Section 32 98 00
	.5	Precast Manholes, Catch Basins and Structures: Section 33 39 00
	.6	Standard Details Section 39 00 00
<u>1.3 REFERENCE STANDARDS</u>	.1	ASTM C14M-15A, Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).
	.2	ASTM C76M-16, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).
	.3	ASTM D1056-14, Flexible Cellular Materials - Sponge or Expanded Rubber.
	.4	CAN/CSA A257 Series-14, Standards for Concrete Pipe and Manhole Sections.
	.5	National Association of Sewer Service Companies (NASSCO) Specification Guidelines.
<u>1.4 CERTIFICATES</u>	.1	Upon request, submit manufacturers' test data and certification that products and materials meet requirements of this Section in accordance with Section 01 00 00 for items listed in Supplementary Specifications.

1.5 HANDLING AND
STORAGE

- .1 Handle and store pipe and fittings in such a manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore.
- .2 Store gaskets in accordance with the manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 CONCRETE PIPE
AND FITTINGS

- .1 Pipe and Fittings:
 - .1 Non-reinforced: to ASTM C 14M or CAN/CSA A257.1.
 - .2 Reinforced: to ASTM C 76M or CAN/CSA A257.2.
- .2 Joints: bell and spigot with flexible rubber gaskets to CAN/CSA A257.3-M.

2.2 MARKER STAKES

- .1 Timber, 40mm x 90mm.

2.3 GROUT

- .1 Non-shrink: to Section 03 30 00.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Inspect products for defects and remove defective products from site.
- .2 Confirm pipe and fittings are clean before installation.

3.2 EXCAVATING
BEDDING AND
BACKFILLING

- .1 Perform excavation, bedding and backfilling in accordance with Section 31 23 10.

3.3 PIPE
INSTALLATION

- .1 Lay and join pipe and fittings as specified herein and according to manufacturer's published instructions.
- .2 Lay pipe and fittings on prepared bed, true to line and grade indicated within following tolerances:

3.3 PIPE
INSTALLATION
(Cont'd)

- .2 (Cont'd)
 - .1 Horizontal Alignment: 50mm.
 - .2 Vertical Alignment: the lesser of 13mm or one half the rise per pipe length.
- .3 Commence laying at outlet and proceed in upstream direction with bell ends facing upgrade.
- .4 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary water-tight bulkheads when pipelaying is not in progress.
- .5 Install gaskets in accordance with manufacturers published instructions.
- .6 Align pipe before joining.
- .7 Support pipes as required to achieve concentricity until joint is properly completed.
- .8 Keep pipe joints free from mud, silt, gravel or other foreign material.
- .9 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
- .10 Complete each joint before laying next length of pipe.
- .11 Where deflection at joints is permitted, deflect only after the joint is completed. Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .12 Where a flexible joint is not integral to the structure, provide flexible joint not more than 1 metre from outside face of structure.
- .13 Cut pipe as required for fittings or closure pieces, square to centreline, and as recommended by manufacturer.
- .14 Make watertight connections to manholes and catchbasins. Do not use non-shrink grout unless approved by the Consultant.

3.4 SERVICE
CONNECTIONS

- .1 Lay and join pipe and fittings to manufacturers published instructions.

3.4 SERVICE
CONNECTIONS
(Cont'd)

- .2 Maintain minimum 2 percent grade.
- .3 Use tee, wye fittings, saddles or core-in type sewer connectors for connections to sewer. For all connections cut hole using appropriate equipment and approved methods.
- .4 Use long sweep bends where possible. Make up required horizontal and vertical bends from standard bends of 45 degrees or less, separated by straight section of pipe having minimum length of four pipe diameters.
- .5 Plug service laterals with watertight caps or plugs at termination points. Paint cap and stub end of pipe GREEN.
- .6 Place temporary marker stake at end of each plugged or capped service lateral, extending from pipe end at pipe level to 600mm above grade. Paint exposed portion of stake GREEN with designation STORM in black.

3.5 INSPECTION

- .1 The Consultant may require inspection of installed sewers by television camera, photographic camera or by other visual method.
- .2 Provide television camera inspection.

3.6 CLOSED CIRCUIT
TELEVISION
INSPECTION

- .1 Conduct closed circuit television inspection procedures to meet National Association of Sewer Service Companies (NASSCO) CCTV Inspection guidelines.
- .2 Equipment:
 - .1 Provide equipment meeting following requirements:
 - .1 Self-contained, self-leveling monitoring unit and pan-tilt camera with remotely controlled lighting system capable of varying the illumination.
 - .2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.
 - .3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .3 Inspection:

3.6 CLOSED CIRCUIT
TELEVISION
INSPECTION
(Cont'd)

- .3 (Cont'd)
 - .1 Perform inspection of pipe from manhole to manhole by passing TV camera through sewer in direction of flow.
 - .2 Classify results in accordance with NASSCO Guidelines.
- .4 Records:
 - .1 Maintain inspection record in log form, during television inspection.
 - .2 Log to include location of each fault and service lateral distance measured from centreline of reference manhole and position referenced to axis of pipe.
 - .3 Photograph fault from the television screen. All photographs to be clear and precise with distinct definition of fault.
 - .4 Include detailed technical description with photographs as supporting data for each fault.
 - .5 Provide minimum of two (2) photographs for each sewer main section televised, detailing typical joint, and typical building service lateral.
 - .6 All photos and videos to be in colour.
- .5 Reports:
 - .1 Provide a composite report of TV inspection. Enclose report in binder on letter size paper. Include following pages and information.
 - .1 Title page identifying project, camera operator and dates of inspection.
 - .2 Index page identifying street name, section from manhole to manhole, page number or numbers where information for section is contained.
 - .2 Organize inspection records in sequence from upstream manhole to downstream manhole.
 - .3 Report on each sewer main section to contain:
 - .1 Heading:
 - .1 Street name.
 - .2 Manhole numbers applicable to section.
 - .3 Reference drawing number, if applicable.
 - .4 Weather on the day of inspection.
 - .5 Statement of soil condition in area of inspection, i.e., dry, damp, wet, frozen.
 - .6 Date of inspection.
 - .2 Key Plan, showing corresponding manhole numbers, magnetic north, horizontal distance, pipe and material between manholes, and direction of flow.

- 3.6 CLOSED CIRCUIT .5 (Cont'd)
TELEVISION .3 (Cont'd)
INSPECTION .3 Inspection findings for each sewer main
(Cont'd) section to include:
- .1 Location of all faults.
 - .2 Photographs of all faults.
 - .3 Location of all service laterals.
 - .4 One (1) photograph each of typical joint and typical when service laterals faults are not found.
 - .4 Mount photographs on left-hand page and place corresponding description on right-hand page. Number all photographs in order. Number beside photograph to correspond with description number.
 - .5 Enclose all pages of report in transparent sheet protector.
- .6 Accuracy:
- .1 Maximum permissible error in accuracy to be within following limits of fault location:
 - .1 Up to 375mm pipe: $\pm 75\text{mm}$ per 100 m of length.
 - .2 450mm - 600mm pipe: $\pm 150\text{mm}$ per 100 m of length.
 - .3 750mm - 900mm pipe: $\pm 225\text{mm}$ per 100 m of length.
- .7 Video Record:
- .1 Supply a complete record of all inspections in digital format.
 - .2 Index all files, listing sections of inspections.
 - .3 Submit electronically on a thumb drive or CD/DVDs with written reports to the Consultant.
- .8 Repeat Inspection:
- .1 Repair faults detected during television inspection. Repeat television inspection at no cost to Owner.

PART 1 - GENERAL

1.1 GENERAL

- .1 This section covers items common to all sections of Divisions 40 through 46 and is intended to supplement the requirements of Division 1.
- .2 All materials and equipment must be new, of first quality and readily available locally.
- .3 The Owner has pre-selected various pieces of process equipment. Refer to Section 01 00 00 for the complete list of pre-selected equipment and Appendix A for pre-selected equipment specifications. Supply and install all equipment that is not identified as pre-selected and necessary for a complete and functional system.

1.2 DRAWINGS

- .1 The Drawings indicate the extent and general arrangement of the various systems and must be read in conjunction with these specifications.
 - .2 Where field conditions necessitate departures from the Drawings, submit working drawings for the proposed departures to the Consultant for review prior to installation.
 - .3 Because of the small scale of the Drawings, it is not possible to indicate all offsets and accessories that may be required for the installation.
 - .4 Investigate carefully the, architectural, electrical, mechanical, structural and finish conditions affecting this work and arrange details accordingly. Furnish and install items required to meet such conditions.
-

1.3 REFERENCE
STANDARDS

- .1 The Work under this Section must conform to the applicable requirements of the National Building Code and National Plumbing Code of Canada, National Fire Protection Association, Underwriters Laboratories of Canada, and referenced standards throughout these Specifications of the American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society of Testing and Materials (ASTM), Canadian Standards Association (CSA), the Canadian General Standards Board (CGSB), and the Sheet Metal and Air Conditioning Contractors' National Association Inc. (SMACNA).
- .2 Equipment assemblies comprised of electro-mechanical components must be CSA approved where possible and shall bear the appropriate label. If the equipment in question is not CSA approved as an assembly, have the manufacturer arrange and pay for "spot approval" and labelling of the equipment prior to installation.

1.4 DELIVERY,
STORAGE AND
HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperature and conditions required by manufacturer at no additional cost to the Contract.

1.5 INSPECTION

- .1 All manufacturing operations and finished pipes, fittings and appurtenances will be subject to inspection by the Consultant. Furnish all labour necessary to assist the Owner or his inspectors in inspecting the materials.

1.6 EQUIPMENT
INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems without interfering with other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated lifetime bearings.

<u>1.6 EQUIPMENT INSTALLATION (Cont'd)</u>	.3	Pipe equipment drains to floor drains and/or as indicated.
	.4	Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.
<u>1.7 CUTTING AND PATCHING</u>	.1	Provide equipment and inserts in time to prevent cutting of new work.
	.2	Coordinate and provide sizes of openings and locations (prior to work).
<u>1.8 ANCHOR BOLTS AND TEMPLATES</u>	.1	Supply anchor bolts and templates for installation by other divisions.
<u>1.9 TRIAL USAGE</u>	.1	The Consultant, Owner or Owner's representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
	.2	Trial usage to apply to following equipment and systems: .1 Blowers. .2 Pumps. .3 Decanters. .4 Process Controls. .5 Grinder. .6 Screen. .7 Centrifuge/Polymer. .8 Valves.
<u>1.10 PROTECTION OF OPENINGS</u>	.1	Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
<u>1.11 ELECTRICAL</u>	.1	Electrical Work to conform to Division 26 including the following: .1 Supplier and installer responsibility is indicated on electrical drawings and related mechanical responsibility is indicated on mechanical drawings.

1.11 ELECTRICAL
(Cont'd)

- .1 (Cont'd)
- .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 40. Refer to Division 26 for quality of materials and workmanship.
- .3 Run all control wiring in conduit. Refer to Division 26 for materials and installation.

1.12 MOTORS

- .1 Provide motors for mechanical equipment as specified and/or as indicated.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install alternative motor approved by the Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motor frames to be either of rigid fabricated steel or castings.
- .4 All studs, nuts and bolts subject to periodic removal maintenance purposes must have Unified or American Standard Threads.
- .5 Specific requirements:
 - .1 In general, fractional horsepower motors smaller than 3/4 hp to be 115 volts, single phase, 60 Hz. Motors 1 hp and larger, to be 208 volts, three phase, 60 Hz.
 - .2 Enclosures to be open drip-proof, unless otherwise specified. TEFC enclosure in corrosive or wet environments.
- .6 Performance requirements:
 - .1 Motors will be given factory routine tests in accordance with CSA C22.2 and marked in accordance with this test.
 - .2 As a minimum, the motors must develop torques as specified by NEMA MG1, design B for 3 phase motors and design N or O for single phase motors. The motor code letter must be between B and H unless specified otherwise.
 - .3 Operation within service factor: motors shall be sized to operate within the nameplate horsepower rating for all operating conditions. Normal operation should not require operation at a service factor greater than 1.0.
 - .4 Motors 1 hp and greater shall be high efficiency.

1.13 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 Use standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 Minimum drive rating: 2.0 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .5 Motor adjustment plates to allow for 50mm minimum centre line adjustment.

1.14 GUARDS

- .1 Provide guards for all unprotected drives.
- .2 Guard for flexible pump coupling:
 - .1 "U" shaped, minimum 1.5mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.

1.15 EQUIPMENT
SUPPORTS

- .1 Equipment supports specified elsewhere in Division 40 or shown on drawings.
- .2 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100mm high and 100mm larger than equipment dimensions all around.

1.16 SLEEVES

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
- .4 Sizes: minimum 6mm clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.

-
- 1.16 SLEEVES
(Cont'd)
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25mm above other floors.
 - .6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated or gas-tight walls, floors and partitions, maintain fire rating integrity.
 - .3 Allow for no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CAN/CGSB-1.182.
- 1.17 PREPARATION FOR FIRESTOPPING
- .1 Uninsulated unheated pipes not subject to movement: no special preparation.
 - .2 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe to move without damaging firestopping material.
 - .3 Insulated pipes and ducts: cut back insulation and vapour barrier at fire separation and prepare as above.
- 1.18 ESCUTCHEONS
- .1 On pipes passing through walls, partitions, floors and ceilings in finished areas.
 - .2 Chrome or nickel plated brass or Type 302 stainless steel, split type with set screws.
 - .3 Outside diameter to cover opening or sleeve.
 - .4 Inside diameter to fit around finished pipe.
 - .5 Secure only to bare pipe or flat surface.
- 1.19 TESTS
- .1 Give 24 h written notice of date for tests.
 - .2 Insulate or conceal work only after testing and approval by the Consultant.
-

1.19 TESTS
(Cont'd)

- .3 Conduct tests in presence of the Consultant or local Authority having jurisdiction.
- .4 Bear costs including retesting and making good.
- .5 Piping:
 - .1 General: maintain test pressure without loss for four (4) h unless otherwise specified. Record all data and provide a written report.
 - .2 Test drainage, waste and vent piping to the National Plumbing Code and/or the local authorities having jurisdiction.
 - .3 Test domestic hot, cold, process piping and service water piping to the National Plumbing Code at 1½ times system operating pressure or minimum 860 kPa, whichever is greater.
 - .4 Low pressure air pipes will be subject to a pressure test. Fill the pipe under test with air to a pressure of 200 kPa. Examine pipe for leaks, use a soap solution applied at any joints. Repair leaks. The pipe work will be accepted when the applied test pressure of 200 kPa is maintained for two (2) hours without loss.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, remove or isolate all equipment or other parts which are not designed to withstand test pressures or test medium. Re-install after test is completed.

1.20 PAINTING

- .1 To Section 09 91 23 and as follows:
 - .1 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work, including pipe hangers. Use zinc rich primer on galvanized materials.
 - .2 Prime and touch up marred finished paintwork to match original.
 - .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.21 SPARE PARTS

- .1 Provide spare parts where specified or as indicated on the drawings.

1.22 SPECIAL TOOLS

- .1 Provide one (1) set of special tools required to service equipment as recommended by manufacturers.

1.23 DIELECTRIC
COUPLINGS

- .1 General:
 - .1 Compatible with and to suit pressure rating of piping system.
 - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 2 and under: isolating unions.
- .3 Pipes NPS 2-1/2 and over: isolating flanges.
- .4 Acceptable material: EBCO, Walter Valiet Co.

1.24 DRAIN VALVES

- .1 Locate at low points and at section isolating valves unless otherwise specified.

1.25 CO-OPERATION
WITH OTHER TRADES

- .1 In areas where ducts, piping, and electrical fixtures are in close proximity to each other, cooperate fully with the other trade in laying out the location of same.
- .2 Report immediately to the Consultant for his comments areas of conflict. Do not install work until corrective measures are approved.
- .3 Take special care with structural coordination.
- .4 If required, prepare interference layout drawings prior to construction and submit these to the Consultant for his review. These drawings must clearly indicate all necessary associated trade work such as light fixtures, etc.
- .5 Coordinate location and furnish all embedded items for installation in poured-in-place concrete and masonry.

1.26 OPERATION AND
MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into Maintenance Manuals in accordance with Section 01 00 00.
- .2 Instructions to include step-by-step directions for starting up and shutting down heating, ventilation, fire protection, water and drainage systems, valves, turning on and off of motor switches, etc., step-by-step directions for minor troubleshooting, and periodic maintenance instructions such as cleaning, oiling, etc., for all equipment provided under this Contract, including type of lubricant.

1.26 OPERATION AND
MAINTENANCE MANUAL
(Cont'd)

- .3 All bulletins must pertain to equipment installed on this job only. General bulleting describing any items of equipment not installed on this job will be rejected.
- .4 Preface all instructions by a simple description of the entire system, explaining its purpose and operation so that a person completely unfamiliar with the building can operate all systems by following the instructions.
- .5 Include preparation of such instructions and schematic diagrams as part of the work under this Section.
- .6 Each manufacturer to submit recommended list of spare parts with maintenance manuals.
- .7 Approvals:
 - .1 Submit two (2) copies of draft Operating and Maintenance Manual to the Consultant for approval. Submission of individual data will not be accepted unless so directed by the Consultant.
 - .2 Make changes as required and re-submit as directed by the Consultant before requesting final site inspection of project.
- .8 Additional data:
 - .1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during commissioning.

1.27 ACCEPTABLE
MATERIAL

- .1 This term means that the item named and specified by catalogue number meets specification in all respects regarding performance, quality of material and workmanship, and is acceptable to the Consultant.
- .2 Alternate materials may be approved by the Consultant prior to tender closing and/or during the shop drawing phase at the discretion of the Consultant.

1.28 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit product data in accordance with Section 01 00 00.
- .2 Shop drawings and product data to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. eg. access door swing spaces.

1.28 SHOP DRAWINGS
AND PRODUCT DATA
(Cont'd)

- .2 (Cont'd)
- .3 Roughing-in dimensions and all other physical characteristics pertinent to installation.
- .3 Accompany shop drawings and product data with:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Certification as to current model production.
 - .5 Certification of compliance to applicable codes.

1.29 CLEANING

- .1 Clean interior and exterior of all systems including strainers, fans, ducting and piping distribution systems, HRVs, pumps, process equipment, etc.
- .2 Upon completion of testing, remove all test equipment and cap holes to satisfaction of the Consultant.
- .3 In preparation for final acceptance, clean and refurbish all equipment, fixtures and trim and leave in operating condition including replacement of all filters in all air and piping systems in preparation for final acceptance.
- .4 Leave all areas cleaned of debris and unused materials.

1.30 RECORD
DRAWINGS

- .1 Maintain record drawings (red line) on site for work in accordance with Section 01 00 00.

1.31 GUARANTEE

- .1 Guarantee all work in accordance with General Conditions.
- .2 Submit manufacturers' written extended guarantees to the Owner in a binder.
- .3 During the guarantee period, make all required changes, adjustments and replacements at no additional cost to the Contract.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED .1 Not applicable.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 The Work of this Section consists of furnishing all materials, labour, tools and equipment and performing all operations necessary to complete all process piping, valves, actuators, insulation and connection to equipment inside the treatment plant buildings, within tanks and within chambers.
- .2 The division of responsibility between interior plant piping (as specified herein), and yard piping (as specified under Section 33 31 00 and 33 34 00) to be 1.5m outside the building footprint, chambers, and tanks or as indicated on drawings. The transition fitting would be specified under yard piping. Piping located beneath foundation and tank slabs will be included under the responsibility of Section 33 34 00, up to the location indicated on the drawings. The fitting at said location would be considered yard piping.
- .3 The Work includes but is not limited to: the supply and installation of pipes, hangers and supports, fittings, valves, couplings, actuators, connections to equipment, pressure gauges, all other appurtenances, and carrying out of all hydrostatic and leakage tests.
- .4 Provide pipes and appurtenances in accordance with details shown on the Drawings; suitable for the purpose for which they are intended. Do not install any pipe until the manufacturer's name and test certificate have been submitted to the Consultant for approval.
- .5 Work also includes filling process tankage and associated infrastructure with water to test for leakage, as well as commissioning process equipment systems individually and as a whole. Coordinate with pre-selected equipment suppliers as required to facilitate this process.

1.2 RELATED WORK

- .1 Yard Piping: Section 33 34 00
- .2 Cast-in-place Concrete: Section 03 30 00
- .3 Miscellaneous Metals: Section 05 50 00
- .4 Painting: Section 09 91 23

1.2 RELATED WORK
(Cont'd)

- .5 Pumping Equipment: Section 43 20 00
- .6 Process General Requirements: Section 40 05 00
- .7 Electrical: Division 26

1.3 REFERENCES

- .1 ANSI B18.2.1-2012, Square, Hex, Heavy Hex, and Askew Head Bolts.
- .2 ASME B16.1-2015, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
- .3 AWWA C115-11, Flanged Ductile Iron or Gray-Iron Threaded Flanges.
- .4 AWWA C104-16, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- .5 AWWA C606-15, Grooved and Shouldered Joints.
- .6 ANSI/AWWA C151/A21.51-09, American National Standard for Ductile Iron Pipe, Centrifugally Cast for Water.
- .7 ASTM A536-84(R2014), Standard Specification for Ductile Iron Castings.
- .8 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod, 60000 PSI Tensile Strengths.
- .9 ASTM F3125-15A, Standard Specification for Structural Bolts, Steel and Alloy Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .10 ASTM A53-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .11 ASTM A126-04(R2014), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .12 AWWA C111-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

- 1.4 INTENT .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.
- 1.5 SHOP DRAWINGS .1 Provide shop drawings in accordance with Section 01 00 00 for:
.1 Pipe and fittings.
.2 All valves, gates and actuators.
.3 Pressure gauges and accessories.
.4 Solenoid valves.
.5 Piping layouts (piping 75 mm and larger).
.2 Provide piping arrangements so as to relate specifically to the type of equipment and fittings to be installed. Submit any changes in the layout of piping or equipment due to the acceptance of alternates with dimensioned scale drawings for approval by the Consultant.
- 1.6 IDENTIFICATION OF EQUIPMENT .1 Fit all equipment with manufacturer's identification nameplates indicating size, equipment model, manufacturer's name and serial number.

PART 2 - PRODUCTS

- 2.1 PIPE SYSTEMS .1 Stainless Steel (SS):
.1 Pipe materials: 304L stainless steel.
.2 All pipe and fittings must be manufactured to ASTM A778 or A774 from sheet and plate of domestic origin conforming to ASTM A403 or ASTM A240, A304L. Sheet finish to be plate finish No. 1.
.3 Supply pipe and fittings for service up to 1350kPa operating pressure and maximum 95°C and in the following nominal wall thicknesses:
.1 Less than 150mm (Schedule 10).
.2 150mm to 750mm (Schedule 10).
.4 Fittings: elbows to 600mm to be smooth flow Schedule 10 design.
.5 Stub-ends Type A: 304L stainless steel conforming to ASTM A240 and pressed type Schedule 10S, supplied with bevelled ends to ASME B16.9.

2.1 PIPE SYSTEMS
(Cont'd)

- .1 (Cont'd)
 - .6 Flanges: ANSI/ASME 250 pound stainless steel, slip-on, lap joint or welding-neck type. Bolts for flanged joints to be of finished, hexagon type, complete with suitable nuts, made of 304 stainless steel confirming to the standard ANSI B18.2.1.
 - .7 Backing Flanges: shall be carbon steel, hot dipped galvanized to ASME B16.1, Class 150 suitable for rated pressure.
 - .8 Gaskets: 3.2mm thick Buna N composition or Neoprene suitably reinforced.
 - .9 Minimize field welding of pipe.
 - .10 Bolt assemblies shall be stainless steel.
 - .11 Welding in fabricator's shop and in the field to be performed by qualified welders to approved procedures. Welding rod or wire must be of the same composition or superior to the pipe and fitting material. The weld deposit at the seam must have a slight crown on both sides of the weld and no cracks or crevices will be allowed. Remove excessive weld deposits, slag, weld splatter and projections into interior of the pipe by grinding.
- .2 Ductile Iron (DI):
 - .1 Pipe material: ductile iron to AWWA C151, special class 54, cement mortar lined (liquid) or unlined (air) to AWWA C104, maximum working pressure 2400 kPa.
 - .2 Pipe joints: flanged to AWWA C115 with 125 lb. flange dimensions to ANSI/ASME B16.1.
 - .3 Fittings: ductile iron or grey iron to AWWA C110 with 125 lbs. flange connections to ANSI/ASME B16.1 and cement mortar lined (liquid) or unlined (air) to AWWA C104.
 - .4 Gaskets: neoprene rubber (liquid); EPDM (air) suitable for high temp service.
 - .5 Couplings: Victaulic style 31 and Dresser style where shown on the Drawings.
 - .6 Coatings: all pipe and fittings to be coated with manufacturer's standard coating.
 - .7 Bolt assemblies to conform to ASTM A307 for Grade B steel machine bolts and nuts.
 - .8 Grooved end couplings are acceptable alternates to flanged coupling as described in clause 2.1.2.3.
 - .1 Groove end couplings shall be ductile iron to ASTM A536, Victaulic Style 31, complete with flush seal "M" gasket.
 - .2 Groove end fittings to have rigid radius in accordance with ANSI/AWWA C606. Fittings to conform to ANSI A21.10/AWWA C110. Standard of acceptance; Victaulic.
 - .9 Provide additional grounding rings as required for magnetic type flow meters.

2.1 PIPE SYSTEMS
(Cont'd)

- .3 Ductile iron fittings:
 - .1 Joints to AWWA C111 and as follows:
 - .1 Mechanical, high strength heat treated cast-iron or alloy steel tee head bolts with hex nuts. Restrained joints where required.
 - .2 Push-on joint with continuous rubber-moulded ring gasket (liquid) or high temperature EPDM gasket (air).
 - .2 Fittings: ductile iron to AWWA C110, cement mortar-lined (liquid) or unlined (air) to AWWA C104.
 - .3 Coatings: all pipe and fittings to be coated with manufacturers standard coating.
 - .4 Provide flange joints and fittings above ground. Provide mechanical joints where buried.
 - .5 Grooved end couplings are acceptable alternates to flanged coupling as described in clause 2.1.2.3.
 - .1 Groove end couplings shall be ductile iron to ASTM A536, Victaulic Style 31, complete with flush seal "M" gasket.
 - .2 Groove end fittings to have rigid radius in accordance with ANSI/AWWA C606. Fittings to conform to ANSI A21.10/AWWA C110. Standard of acceptance; Victaulic.
- .4 Flexible coupling:
 - .1 Ductile steel, solid sleeve flexible coupling complete with high strength low alloy steel corrosion resistant bolts and nuts to AWWA C111 standard grade SBR gaskets.
 - .1 Acceptable product: Romac Style 501 or approved equivalent.
- .5 PVC (Rigid) Pipe:
 - .1 Pipe material: polyvinyl chloride (PVC) pressure pipe to ANSI/AWWA C900 and certified to CSA B137.
 - .2 Size: as indicated.
 - .3 Class: IPS Schedule 80.
 - .4 Pipe joints: solvent cemented, cement to ANSI/ASTM D2564 except clauses 5.5 and 6.3.3.
 - .5 Fittings: PVC Class 150, solvent weld moulded fittings.
 - .6 Flanges: PVC in accordance with ASTM A181, Grade 1-150 lbs., with neoprene gaskets.
 - .7 Provide flanges and flange to socket transitions where applicable and as shown on the drawings, suitable to connect to valves and equipment. Fittings 50mm and below are not necessarily shown on the drawings and may be threaded or solvent cemented.
 - .8 Use long-radius bends on rigid PVC chemical/polymer dosing lines.

2.2 VALVES AND
MISCELLANEOUS ITEMS

- .1 Check valves:
 - .1 Wafer check valves: for use in cold water or low pressure air service. Wafer style, 125 lbs, swing check valve. One piece ASTM A126 Class B cast iron body. Ductile iron disk with 316 stainless steel trim. Valve to have resilient O-ring seats installed in a metal seat pressed into the body and accommodate field replacement. Suitable for temperatures in excess of 65°C.
 - .1 Acceptable product: Val-matic Series 8820, Check Rite, Proquip or approved equivalent.
 - .2 Size 25 mm and smaller (stainless steel): swing check with threaded end connections. Standard of Acceptance: Watts Series 806.1, Grinnell, or approved equivalent.
 - .3 Size 38-50 mm: bronze, lift check type, vertically mounted, class 125 with threaded end connections.
 - .1 Acceptable product: Jenkins Figure 119J, Crane or approved equivalent.
 - .4 Ball Check Valve:
 - .1 Flanged ends, cast-iron body non-clog, unobstructed free flow type suitable for mounting in vertical position for raw sewage service and with flanged end connections.
 - .1 Acceptable product: HDL Type 5087 or approved equivalent.
 - .2 Swing-Flex check valves with visual disk indicator, Val-matic Series 500 are an acceptable equivalent.
 - .5 Grooved end couplings are acceptable alternates to flanged coupling as described in clause 2.1.2.3.
 - .1 Groove end couplings shall be ductile iron to ASTM A536, Victaulic Style 31, complete with flush seal "M" gasket.
 - .2 Groove end fittings to have rigid radius in accordance with ANSI/AWWA C606. Fittings to conform to ANSI A21.10/AWWA C110. Standard of acceptance; Victaulic.
- .2 Ball valves:
 - .1 Size 50 mm and smaller (PVC): fabricated from polyvinyl chloride with Teflon seats and EPDM seals. True union (Safe-Blocking Valve) connections.
 - .1 Acceptable product: Chemline Series 21, Chemtrol or approved equivalent.
 - .2 Size 100 mm and smaller (stainless steel): three (3) piece body, 6900 kPa rated, full port ball valve with threaded end connections. Standard of acceptance: Crane Series 9500, PMP Model A302, Flow-Tek Series 5000 or approved equivalent.

2.2 VALVES AND
MISCELLANEOUS ITEMS
(Cont'd)

- .2 (Cont'd)
 - .3 Size 50 mm and smaller (bronze): 2 piece body, 4150 kPa rated, full port ball valve with stainless steel balls and with threaded end connections. Standard of Acceptance: Watts Series B-6800, Crane Series 9200, PMP model Q104, Flow-Tek or approved equivalent.
 - .4 Grooved end couplings are acceptable alternates to flanged coupling as described in clause 2.1.2.3.
 - .1 Groove end couplings shall be ductile iron to ASTM A536, Victaulic Style 31, complete with flush seal "M" gasket.
 - .2 Groove end fittings to have rigid radius in accordance with ANSI/AWWA C606. Fittings to conform to ANSI A21.10/AWWA C110. Standard of acceptance; Victaulic.
- .3 Plug valves:
 - .1 Rugged, eccentric type plug valves suitable for raw sewage service and minimum of 90% full port area.
 - .2 Rating: 1050 kPa at 37°C.
 - .3 Body: ASTM A126 Class B cast iron with nickel-welded raised seats, Class 125 flanged ANSI B16.1 end connections above 50 mm size. Grooved end connections to ANSI/AWWA C606 are an acceptable alternative.
 - .4 Plug: Buna N or Neoprene coated for resilient plug face and bubble tight shut off.
 - .5 Bearings: stainless steel and teflon permanently lubricated.
 - .6 Packing: Buna N or Teflon combination.
 - .7 Bolted bonnet design repackable without removing bonnet.
 - .8 Actuator: lever actuator for 100 mm and smaller valves; geared actuator for valves greater than 100 mm; have the actuator supplied by valve manufacturer. Geared actuators to indicate valve position and have permanently lubricated bearings, semi-steel housing and seals against dirt and water. Actuators for gear operated valves will be by handwheel if centerline elevations are within 2135 mm of the finished floor. Valves with centerlines greater than 2135 mm from the finished floor will be operated by chain operator and chain wheel provided by the valve manufacturer to operate that particular valve.
 - .9 Acceptable products: Dezurik Series 100, Milliken Figure 601, Valmatic Cam Centric, Keystone Ballcentric, Victaulic-Series 365 (up to 450 mm size) or approved equivalent. Above model numbers refer to 1050 kPa rated valve models.

2.2 VALVES AND
MISCELLANEOUS ITEMS
(Cont'd)

- .4 Solenoid valves:
 - .1 Brass body, normally closed, two-way, direct acting type with general purpose enclosures and manual overrides. Solenoids to operate on 120 volt (AC), single phase, 60 hz power supply.
 - .2 Refer to service conditions for individual solenoid valves as shown on the drawings.
 - .3 Acceptable product: ASCO - Red Hat 8210 Series or approved equivalent.
- .5 Butterfly valves:
 - .1 Wafer type butterfly valves, flangeless, resilient seated, cast iron, wafer style body suitable for installation between ANSI B16.1 flanges. Seats of EPDM, suitable for use with air or water. Shafts to be one piece of 316 stainless steel, finish ground and polished with EPDM shaft seals. Provide shaft bushings above and below disk and below mounting flange for actuator. Discs to be bronze. The disc to shaft connections to be type 316 stainless steel. Pins, shaft and disc of all valves must be individually machined and completely interchangeable.
 - .1 Equip manually operated valves 200 mm and smaller with manual lever actuators.
 - .2 Manually operated valves 250 mm and larger shall have gear actuators.
 - .3 Acceptable products: Keystone - Figure AR1, DeZurik BRS, Newman Hattersley or approved equivalent.
- .6 Air/Vacuum Release Valves:
 - .1 Heavy-duty cast iron type body, with a combination small and large orifice. Small orifice to be stainless steel with a minimum opening of 25 mm, valve shall be suitable for working at 1.0 MPa working pressure. The overall height must not exceed 450 mm.
 - .2 Operation to be independent floats located in both orifices.
 - .3 Orifices must be capable of expelling air at a high rate during filling and at low rate during operation and will admit air while draining the pipeline. Seats must be replaceable.
 - .4 Valves to have no moving parts except for the floats, which will remain in the throat area discharging air without blowing shut.
 - .5 Valves must not leak in the closed position when pipeline is filled.
 - .6 Acceptable product: Valmatic Model 300 Short Style or approved equivalent.

2.2 VALVES AND
MISCELLANEOUS ITEMS
(Cont'd)

- .6 (Cont'd)
.7 Corporation stop: Install 50 mm corporation stop at inlet of valve. Brass complete with IPS inside and outside thread, size as indicated.
.8 Acceptable product: Mueller A-218 or approved equivalent.

2.3 PRESSURE GAUGES

- .1 General: supply all pressure gauges and isolation cocks from a single manufacturer. All pressure gauges to contain diaphragm seal.
.2 Pressure gauge: 115 mm size, black fibreglass reinforced case, filled with glycerine. Stainless steel bourdon tubes and sockets. Show the full operating range with nominal operation at mid-span on the dial. Accuracy to within $\pm 0.5\%$ of span. Connections 12 mm NPT brass.
.3 Provide brass isolation cock between gauge seal and pipe connections.
.4 Provide one (1) additional gauge (0-100 psi). Turn over as spare.
.5 Diaphragm seals: clean-out design with removable viton diaphragm. Housing material and all wetted parts to be type 316 stainless steel. Assembly to have standard fill/bleed connection and have 12 mm NPT threaded ends complete with flushing connection.
.1 Acceptable product: ASHCROFT TYPE 200 or approved equal.
.6 Acceptable product: Trerice Model No. 450 LFSS, Wika Type 233.34, Ashcroft Model 1279, Winters P5000.

2.4 MODULAR WATER-
STOP SEALS
(ACCEPTABLE
ALTERNATIVE)

- .1 For pipes passing through or into concrete or at a location or elevation which may be below finished grade or a liquid level, a modular water stop seal (sleeve) may be installed.
.2 Furnish sleeves by the manufacturer of the material supplied for the annular space. Coordinate sleeve sizes with the carrier pipe size and material for complete compatibility. Sleeves to be galvanized steel with an intermediate waterstop collar with a continuous double fillet weld.
.3 Sleeve Size:

2.4 MODULAR WATER-
STOP SEALS
(ACCEPTABLE
ALTERNATIVE)
(Cont'd)

- .3 (Cont'd)
 - .1 For walls, the ends of the sleeve to be flush with the wall faces.
 - .2 Sleeves to have an inside diameter at least 25mm larger than the pipe outside diameter and of the correct size to provide for the material specified for the annular space.
- .4 Annular Space:
 - .1 For sleeves installed submerged or below grade, seal the annular space watertight with mechanically expanded interlocking synthetic rubber links. Nuts and bolts to be zinc coated steel.
- .5 Acceptable manufacturer: Link-Seal, Pen-Seal Proco, or approved equivalent.

2.5 PIPE INSULATION

- .1 Application: for pipe sizes 25 mm and under: 25 mm insulation thickness, for pipe sizes 75 mm and under: 38 mm thick insulation, for pipe sizes 100 and over: 50 mm thick insulation.
- .2 Fibrous glass, with vapour barrier, rigid, preformed to CAN/CGSB 51-GP-51M.
 - .1 Acceptable material: Schueller; Owens Corning; Manson Insulation; Johns Manville, Knauf.
- .3 Enclose the exterior surface with preformed 0.38 mm thick PVC (white) jacket complete with pre-formed elbows, sealant tape.
 - .1 Acceptable material: Plasticor- Insulguard; Manville-Zeston.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Install piping in the locations indicated, and to the elevations and lines as shown on the Drawings.
- .2 Pipes entering concrete tanks, or structures to be done by one of the methods shown on the Drawings.
- .3 Co-ordinate location and furnish embedded items for installation in poured-in-place concrete.
- .4 Cut pipes where necessary to obtain the exact location of fittings or valves.

3.1 GENERAL
(Cont'd)

- .5 Run piping as directly as practical and make provisions for expansion, jarring, vibrations and settling.
- .6 In the installation of piping, do not cut girders, beams or other members of building in such a manner as to reduce strength of the girder, beam, or other member of the building below that required for the purpose for which it was intended.
- .7 Run pipes to avoid conflicts between pipes of different functions. Where conflicts between pipe locations occur, process pipe to have precedence over plumbing and heating pressure pipes, gravity pipes will have precedence over pressure pipes and large diameter pressure pipes will have precedence over smaller diameter pipes. Notify the Consultant of conflicts. The Consultant will provide the resolution.
- .8 Accomplish the loading, hauling, unloading of pipes and appurtenances without damage to the same. Dropping of pipe and appurtenances on the ground will not be permitted. The Contractor will be liable for any damage to the pipe or appurtenances until they are accepted in the completed Work.

3.2 JOINTING OF
PIPE AND FITTINGS

- .1 Where pipe is to be connected to equipment, fit pipe so that neither pipe nor equipment is strained during the joining procedure.
- .2 Where flanged pipe and fittings are used, make joints with 3 mm Buna N or neoprene gaskets and bolts and nuts conforming to ASTM A307 for stainless steel machine bolts and nuts. Tighten nuts alternately to a uniform torque to achieve even distribution of pressure on joint gasket and to avoid unequal stresses in flanges. Provide sleeve coupling, flanged adaptor, victaulic coupling or vic-flange couple where shown on the Drawings or where required to install pipe or to permit future equipment or pipe removal for maintenance purposes.
 - .1 Provide 304 stainless steel machine nuts and bolts for joints involving stainless steel pipe or in areas where nuts and bolts will not be painted.
 - .2 Provide EDPM gaskets on low pressure air piping subject to temperatures in excess of 65°C. This includes but is not limited to piping on the discharge side of blowers.

3.2 JOINTING OF
PIPE AND FITTINGS
(Cont'd)

- .3 Where victaulic grooved pipe and fittings are used, do jointing procedures in strict compliance with the manufacturer's instructions.
- .4 Install PVC pipe and fittings and join with solvent welding method in accordance with the manufacturer's instructions, using the correct solvent cement for the type of pipe used. Threaded joints will only be permitted at screwed end valves.
- .5 Screwed pipes to be NPT. Make joints with graphite and oil filler and adequate unions provided for ease of future uncoupling. Ream cut ends of pipe to remove burrs.
- .6 Orient valves for ease of operation. Obtain the Consultant's approval of a particular orientation before completing joints.
- .7 Install specialities and other like items in accordance with the manufacturer's instructions. Provide small piping, or tubing, with fittings where required for their proper operation and servicing whether shown on the Drawings or not.
- .8 Where PVC pipe joints or fitting joints have failed under test or during operation, the entire joint must be replaced and repaired with new material. Re-cementing failed joints will not be accepted.

3.3 PIPE SUPPORT

- .1 Provide permanent support in the form of concrete saddles, hangers, wall brackets, adjustable stands or small pipe column supports where shown on the Drawings, or where evidently required for support and/or thrust restraint. Place permanent supports properly take the weight of the pipework before any temporary support is removed. Design pipe support system and provide a reputable supplier of pipe support equipment.
- .2 Restrain valves and fittings so that all thrusts are supported independent of the piping system. All restraints must conform to the pipe manufacturer's recommendation.
- .3 Install pipe supports such as hangers or support legs with maximum support spacing as follows:

3.3 PIPE SUPPORT (Cont'd)

Pipe Size	SS Stainless Steel	PVC	Ductile Iron
Up to			
19 mm	1980 mm	1000 mm	
25 mm	2100 mm	1200 mm	
50 mm	3000 mm	1500 mm	1800 mm
75 mm	3400 mm	2000 mm	1980 mm
100 mm	4000 mm	2500 mm	2585 mm
150 mm	4300 mm	3000 mm	2743 mm
200 mm	4900 mm		3200 mm
250 mm	4900 mm		4000 mm
300 mm	5200 mm		4000 mm
350 mm	5500 mm		4000 mm
450 mm	5500 mm		4000 mm
900 mm	5500 mm		4000 mm

- .4 The above spacing does not apply where there are concentrated loads between supports, such as flanges, valves, specialities. These will be supported separately. Provide additional pipe supports where pipes connect to equipment or machinery, so that no load is exerted from piping to such equipment or machinery.
- .5 Supports or hangers to be of the type which allow expansion of pipe for ambient temperature changes. All metal supports must be galvanized before installation.

3.4 VALVES AND APPURTENANCES

- .1 Install valves and appurtenances in strict accordance with the manufacturer's instructions and as directed by the Consultant.

3.5 PIPE CLEANING AND TESTING

- .1 Flush and clean pipes upon completion and prior to testing.
- .2 Pressure test piping as specified in Section 40 05 00.

3.6 GAUGES AND INSTRUMENT INSTALLATION

- .1 Fabricate and install piping, accessories and valve assemblies for pressure sensing gauges and transducers as indicated on the drawings.

3.6 GAUGES AND
INSTRUMENT
INSTALLATION
(Cont'd)

- .2 Provide isolation valves for all devices and run piping to prevent air pockets or sediment from accumulating in sensing lines.
- .3 Unless otherwise indicated piping shall be stainless steel schedule 10.
- .4 Supply and install pressure gauges as shown on the drawings and as specified herein.

3.7 IDENTIFICATION

- .1 Complete valve and equipment identification in accordance with the existing system in place.
- .2 Equipment to be identified includes all equipment specified herein.
- .3 Coordinate identification work with the Owner.

3.8 PAINTING

- .1 Paint piping, valves, fittings, fasteners and supports, etc., as specified in Section 09 91 23.
- .2 Follow painting schedule as described in Section 09 91 23.
- .3 Coordinate painting and pipe identification work to avoid conflicts.

3.9 CLEANUP

- .1 Upon completion of testing, remove all test equipment and cap holes to satisfaction of the Consultant.
- .2 Clean and refurbish all equipment and fixtures and leave in operating condition in preparation for final acceptance.

3.10 INSULATION

- .1 Provide pipe insulation where indicated on the drawings.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section and its associated drawings specifies the requirements for the supply, calibration, installation, cabling, termination, testing and commissioning of the instrumentation and controls equipment.
 - .2 The Instrumentation and Controls scope of Work as described in this section and as shown on the drawings consists of, but is not limited to, the following:
 - .1 Supply, calibrate, store, install, cable, terminate, test and commission instrumentation and controls equipment as identified on the drawings, and as specified herein.
 - .2 Receive, store, mount, cable, terminate, test and commission instrumentation and controls associated with equipment as supplied under other Divisions.
 - .3 Relocate existing instrumentation and controls equipment as identified on the drawings and specified herein.
 - .4 Connect new PLC I/O identified on the drawings to the plant PLC control system.
 - .5 Remove existing PLC I/O, instrumentation and controls equipment identified on the drawings.
 - .6 Assist system integrator as required to provide a complete and operational plant control system as indicated or implied in the Contract Documents.
 - .3 The drawings supplement this specification section in defining the Instrumentation & Controls scope of work required.
 - .4 Determine the final instrumentation/ controls cabling requirements after equipment shop drawings have been approved, to meet the control requirements as indicated or implied by the Contract Documents. There was an effort to include for "spare" conductors on the drawings to help accommodate for any required cabling changes during construction. The Contractor is free to use these "spare" conductors as required.
-

1.1 WORK INCLUDED
(Cont'd)

- .5 Determine the instrumentation and controls equipment/cabling termination details (for all plant instrumentation and controls cabling) to reflect the equipment and panels actually supplied (after shop drawing approval) and match the intent as indicated or implied in the Contract Documents, to supply a complete and functioning plant. Document the above instrumentation and controls cabling termination details in the form of either "As-built" termination detail drawings/loop drawings.
- .6 PLC and HMI programming, testing and commissioning associated with this project will be completed by the system integrator and has been pre-selected by the Town and will be carried in this Contract. The system integrator will work with the Contractor to verify and test wiring termination and confirm operation of instrumentation and equipment. The system integrator will work with the Contractor to plan and execute the commissioning of the plant modification work.

1.2 RELATED WORK

- .1 Demolitions, Removals and Modifications: Section 02 41 10
- .2 Electrical: Division 26.
- .3 Process Mechanical Piping and Appurtenances: Section 40 05 10
- .4 Process Control System Equipment and Cabling: Section 40 91 00.

1.3 REFERENCES

- .1 Carry out the Work of this section in accordance with all applicable Federal, Provincial, Municipal and other laws/ordinances, and with the latest edition of the following standards which shall be deemed to be and form part of this specification:
 - .1 American Society of Mechanical Engineers.
 - .2 Institute of Electrical and Electronic Engineers.
 - .3 American Society for Testing Materials.
 - .4 Manufacturers Standardization Society.
 - .5 Canadian Standards Association.
 - .6 Instrument Society of America.
 - .7 Canadian Electrical Code.
- .2 ASME/ANSI B16.5-2013, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

1.3 REFERENCES
(Cont'd)

- .3 In the event of a conflict between the above mentioned standards, this specification, or the attached drawings, notify the Consultant, who will then advise on which standard is to be followed.
- .4 Carry out all Instrumentation and controls works (Instrumentation mounting, tubing, cabling, terminating, calibration, testing and commissioning) by certified inter-provincial ticketed Instrument Tradesmen.

1.4 SUBMITTALS

- .1 Submit instrumentation and controls equipment shop drawings in accordance with 01 00 00. Have shop drawings reviewed and approved by the Consultant prior to instrumentation and controls equipment purchase or use.
- .2 Instrumentation and controls equipment shop drawings to include, but not be limited to, the following:
 - .1 Complete model number of each instrument being proposed, with model number breakdown codes.
 - .2 Identify applicable instrument/equipment tag numbers on every shop drawing.
 - .3 Equipment operational specifications.
 - .4 Equipment dimensions, weight, mounting details, and materials of construction.
 - .5 Equipment power requirements, air supply requirements, process signal type, etc.
 - .6 Electrical termination information specific to the device being purchased in this contract.
 - .7 Complete parts list with recommended inventory of spare parts.
 - .8 Frequency and method of calibration (if applicable).
 - .9 Manufacturer's installation recommendations/requirements.
 - .10 Any sizing calculations (if applicable).
 - .11 For relay control panels and field junction boxes, provide layout and wiring diagram, complete with detailed materials list.
- .3 Submit operations and maintenance manuals for all instrumentation and controls equipment in accordance with Section 01 00 00. Include information based on the following requirements:
 - .1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, calibration, maintenance and repair of the supplied equipment.

1.4 SUBMITTALS
(Cont'd)

- .3 (Cont'd)
 - .2 Include names and addresses of local suppliers for all items included in maintenance manuals.
 - .3 Include all instrumentation calibration sheets.

PART 2 - PRODUCT

2.1 GENERAL
INSTRUMENTATION

- .1 Instrumentation and controls equipment must be of a proven design for each application and designed, manufactured, inspected, and tested to comply with the applicable regulations, codes, and standards.
- .2 Select instrumentation and controls equipment selected to suit the process and environmental requirements for each application as described or implied in this specification and the drawings.
- .3 Construct all instrumentation and controls equipment to operate safely and reliably under all operating conditions without undue wear, vibration, heat, noise, or other operating problems. Parts subject to wear, corrosion, or other deterioration, or requiring adjustment, inspection or repair, must be accessible and capable of convenient field maintenance.
- .4 Provide proposed instrumentation and controls equipment that is certified by an agency (preferably CSA) recognized by the applicable provincial Electrical Inspection Department. Where there is no alternative to supplying equipment that is not appropriately certified, special approval from the applicable provincial Electrical Inspection Department will be required. Bear all costs associated with obtaining such approval at no additional cost to the Contract.
- .5 Instrumentation and controls equipment located in process areas must have a minimum enclosure rating of NEMA 4X (IP66). Those located in electrical rooms shall have a minimum enclosure rating of NEMA 12 (IP65).
- .6 The minimum instrumentation and controls equipment electrical connection size will be 13 mm NPT.
- .7 Instrumentation and controls equipment requiring a power supply will be 120 VAC, 60 Hz.

2.1 GENERAL
INSTRUMENTATION
(Cont'd)

- .8 All "wired" instrumentation and controls equipment must have provision for externally grounding the instrument housing/enclosure.
- .9 Provide instrumentation and controls equipment complete with a securely fastened manufacturer's nameplate indicating instrument model, serial number, calibrated range, etc., as required for ordering a replacement item.
- .10 Mount instruments not directly coupled to a process connection on manufactured instrument stands (2 NPS pipe construction with sealed ends, galvanized) or on a nearby wall. All mounting hardware for mounting instrument stands and instruments must be 316 SS. Mount instruments as per manufacturer's recommendations.
- .11 Process impulse line tubing from a process connection to an instrument to be a minimum 13mm x 1.2 mm, 316 SS seamless and annealed to ASTM A269.
- .12 Use 316 SS twin-ferrule design tube fitting on all instrument impulse and air supply tubing. All threaded fittings to be tapered NPT. Accomplish sealing of threaded connections by using high quality PTFE tape. Acceptable tube fitting manufacturer's: Swagelok, Parker, or approved alternate.
- .13 Supply instrument tags for all plant instruments indicated on the drawings. Affix a stainless steel tag indicating the instrument tag number to the instrument using stainless steel wire. The tag must be approximately 50 mm x 25 mm and stamped in a legible manner, with a minimum 10 mm character size, and in the same format as shown on the drawings.
- .14 Equipment requiring intrinsically safe wiring to meet a hazardous area classification shall come complete with all recommended intrinsically safe barriers, etc., as required to meet the applicable hazardous classification.

2.2 PRESSURE
INSTRUMENTS

- .1 Select the range of pressure measuring instruments so that full scale reading will equal 200% of maximum operating pressure, or 120% of system design pressure, whichever is greater.

2.2 PRESSURE
INSTRUMENTS
(Cont'd)

- .2 Mount pressure gauges (complete with block valves) to the process connections and oriented for easy viewing by an operator. In areas of excessive vibration or inaccessibility, remote mount the gauges on an instrument stand (keeping process impulse line lengths to a minimum). General pressure gauge design and performance requirements will be as follows:
 - .1 115 mm dial, glycerine filled, black thermoplastic or 304SS case construction, safety glass, with rear blow-out disc.
 - .2 316SS wetted parts and movement (unless specified otherwise).
 - .3 White dial with block scale and balanced pointer, dual scale (kPag and psig).
 - .4 13 mm NPT bottom process connection.
 - .5 Minimum accuracy of $\pm 1.0\%$ of full scale (ASME B40.1, Grade 1A) or better.
 - .6 Capable of 150% overpressure for short durations without incurring damage.
 - .7 Acceptable manufacturers: WIKA, Ametek, Ashcroft, US Gauge, Winters.
- .3 Mount pressure and differential pressure transmitters (complete with isolation manifolds) directly to the process connections where practical. In areas of excessive vibration or inaccessibility, Mount transmitters on 2 NPS instrument stands and orient for easy viewing and adjustment by an operator. General pressure transmitter design and performance requirements shall be as follows:
 - .1 Pressure Range: as indicated on the drawings.
 - .2 2-wire, "smart" microprocessor based electronics with HART, loop powered (24 VDC), with a 4-20mA output signal.
 - .3 Minimum accuracy of 0.5% full range.
 - .4 Capable of local and remote calibration, with continuous self-diagnostics.
 - .5 Output signal to be immune from EM and RF interference.
 - .6 All wetted parts and gaskets to be of a material suited for the specified process conditions (316SS as a minimum).
 - .7 Complete with programmable indicator to provide a digital readout in engineering units.
 - .8 Complete with all mounting hardware (316SS) for 2 NPS instrument stand mounting if remote mounted.
 - .9 Capable of 150% overpressure without incurring damage or requiring recalibration.
 - .10 Differential pressure transmitters must be capable of withstanding the full pressure rating on either side of the pressure element with the other side vented to atmosphere without damage.

2.2 PRESSURE
INSTRUMENTS
(Cont'd)

.3 (Cont'd)

.11 Differential pressure transmitters shall have a selectable linear or square root output.

.12 Acceptable manufacturers: ABB, Foxboro, Honeywell, Rosemount, Siemens, Endress and Hauser.

.13 Provide all pressure measuring instruments with isolation manifolds. Provide pressure gauges with block valves. Provide pressure switches and transmitters complete with two-valve block and bleed manifolds (either mounted directly on the process connection or on an instrument stand, depending on instrument mounting), and provide differential pressure switches and transmitters (except where diaphragm seals are fitted) with 3-valve isolation manifolds. Isolation manifolds to be of 316SS construction, with seat type, seals, packing materials, etc., selected to meet the specified process conditions for each application. Manifolds must have at least a five-year warranty on stem seal leakage with no maintenance requirements. Process connections on manifolds shall be 13mm NPT. Instrument connections on manifolds can be either 13mm FNPT or flanged, depending on the application. Provide isolation manifolds mounted directly to insulated piping/equipment complete with the required lagging extensions.

.1 Acceptable manufacturers: any that meet the above specifications. Suggested manufacturers: PGI International, Parker Hannifin Corporation, Century Valve, Anderson Greenwood, etc. Inclusion in this list does not exempt the requirement that any proposed model must be compliant with the equipment specifications.

.14 Diaphragm seals, where specified, must be of 316SS construction, complete with fill and flushing connections, glycerine filled, 13mm NPT instrument and process connections.

.1 Acceptable manufacturers: any that meet the above specifications. Suggested manufacturers: WIKA, Ashcroft, Winters, etc. Inclusion in this list does not exempt the requirement that any proposed model must be compliant with the equipment specifications.

2.2 PRESSURE
INSTRUMENTS
(Cont'd)

- .3 (Cont'd)
- .15 Use insert pressure gauge/sensor assemblies (in-line type seals), where specified, for hostile abrasive and sludge applications to provide isolation of the pressure sensing devices from the product stream. Assemblies to be wafer style with integral flange gaskets and suitable for mounting between all 12 S/S ANSI flanges. The integral sleeve must be made of flexible rubber and shall allow full port flow with 360° self cleaning sensing surface (one wetted part). Rigid outer housing to be cast or ductile iron with 13mm NPT fitting for pressure sensor.

2.3 LEVEL
INSTRUMENTS

- .1 Sanitary water pump station and centrate pump station level switch design and performance requirements to be as follows:
- .1 Top mounted float type switch.
 - .2 One (1) SPDT contact, rated for at least 5 amps @ 120 VAC (continuous use).
 - .3 Suitable for immersion in sewage, Class 1 Zone 1 hazardous area.
 - .4 Acceptable manufacturers: Magnetrol, Flygt.
- .2 Ultrasonic type level transmitters to generally have the sensor mounted local to the basin/tank, and the transmitter located remotely. General level transmitter design and performance requirements to be as follows:
- .1 Range (min/max): as indicated on the drawings.
 - .2 An isolated 4-20 mA output signal.
 - .3 Minimum accuracy of 0.25% of calibrated range.
 - .4 Capable of local calibration/setup, with self diagnostics.
 - .5 120 VAC power supply.
 - .6 Local display of level with engineering units.
 - .7 At least two (2) programmable relay outputs. SPDT contacts rated for a minimum of 5A at 120 VAC (continuous use).
 - .8 Automatic level to volume conversion for standard or custom tank shapes.
 - .9 With temperature compensation.
 - .10 Able to program the level transmitter locally using keypad with simple menu driven software.
 - .11 Level transducer to have six degree (or less) beam angle, complete with integral sensor cable. Confirm sensor cable length on site.
 - .12 Remote mount the transmitter where indicated on drawings. Transmitter to have a NEMA 4X enclosure rating.

2.3 LEVEL
INSTRUMENTS
(Cont'd)

- .2 (Cont'd)
 - .13 Acceptable manufacturers: Siemens (Milltronics), Rosemount, Greyline, Endress and Hauser and Solid AT.
- .3 Submersible depth level transducers shall have the following design and performance requirements:
 - .1 2-wire, loop powered, with a 4-20mA output signal.
 - .2 316SS or titanium construction.
 - .3 Minimum accuracy of 0.25% of full scale.
 - .4 Complete with attached cabling (length to suit each application), with vent tube and kevlar tension members. Sensor to be suspended by cable.
 - .5 Flush teflon coated diaphragm pressure port to reduce grease or biosolids build-up (self-cleaning).
 - .6 NEMA 6 (IP68) and Class 1 Zone 1 rating.
 - .7 Proof pressure shall be a 100% full scale.
 - .8 Acceptable manufacturers: any that meet the above specifications. Suggested manufacturers: Druck, Winters, ABB, Honeywell, Rosemount, etc. Inclusion in this list does not exempt the requirement that any proposed model must be compliant with the equipment specifications.

2.4 FLOW
INSTRUMENTS

- .1 Magnetic flow meters must meet the following design and performance requirements:
 - .1 Line size: as indicated on the drawings.
 - .2 Connection: 125# ANSI flanged.
 - .3 Plant inlet flow:
 - .1 Min. flow: XXX USgpm.
 - .2 Max. flow: XXXX USgpm.
 - .3 Pipe material: XXXX.
 - .4 Pipe diameter: XXXXmm.
 - .4 Fine screen flow:
 - .1 Min. flow: XXX USgpm.
 - .2 Max. flow: XXX USgpm.
 - .3 Pipe material: XXX.
 - .4 Pipe diameter: XXXmm.
 - .5 Flow tube: NSF 61 certified and of the "formed" type, complete with SS grid backing.
 - .6 Minimum 316 SS, self cleaning electrodes.
 - .7 Supply grounding hardware in accordance to manufacturer's recommendations.
 - .8 Generally, mount flow transmitters remotely from the flow tubes. Integrally mounted flow transmitters will be permitted if meter is readily accessible to the operator.
 - .9 Flow tubes located in areas that could be submerged must be rated accordingly.

2.4 FLOW
INSTRUMENTS
(Cont'd)

- .1 (Cont'd)
 - .10 Flow transmitters to have a minimum enclosure rating of NEMA 4X.
 - .11 Able to program flow transmitter locally using keypad via simple menu-driven software, with integral display showing flow rate with engineering units, and totalized flow.
 - .12 Online diagnostics of flow sensor and electronics, including process checks, linearity and calibration checks. Operator alarm notification via transmitter display, relay outputs, and output signal (4-20 mA upscale/downscale manipulation).
 - .13 4-20 mA output of flow rate, self powered, isolated. Frequency pulse output for flow totalization (dry contact rated 30 VDC).
 - .14 Minimum system flow accuracy of +/- 0.5% of reading.
 - .15 Have adjustable damping ability.
 - .16 An adjustable low flow cutoff.
 - .17 Rated for Class 1 Zone 2 hazardous area.
 - .18 Acceptable manufacturers: ABB, Foxboro, Krohne, Siemens, Rosemount, Endress and Hauser.

2.5 ANALYTICAL
INSTRUMENTS

- .1 Analytical instrument controllers/ transmitters shall meet the following design and performance requirements:
 - .1 Microprocessor-based analyzer, with menu-driven self-contained LCD/keypad entry for equipment setup, calibration and troubleshooting.
 - .2 Able to accept up to two (2) analytical sensors, with simple "plug and play" set-up for the different sensor types. Sensor types to include, but not be limited to: pH, dissolved oxygen and turbidity.
 - .3 120 VAC, 60 Hz power supply.
 - .4 Graphic dot matrix LCD display and keypad with easy menu-driven software for instrument set-up, calibration and troubleshooting.
 - .5 Complete with two (2) fully configurable 4-20 mA analog outputs and two (2) dry form 'C' alarm contacts.
 - .6 All user settings to be retained indefinitely in non-volatile memory (EPROM).
 - .7 Minimum two (2) year warranty.
 - .8 Rated for Class 1 Zone 2 hazardous area.
 - .9 Acceptable manufacturer: HACH Model SC200 or approved alternate.
- .2 Turbidimeters must meet the following design and performance requirements:

2.5 ANALYTICAL
INSTRUMENTS
(Cont'd)

- .2 (Cont'd)
 - .1 Compatible with the analytical controller/transmitter selected (plug and play connection).
 - .2 Of the continuous reading on-line nephelometric measurement principle type.
 - .3 With built-in bubble removal system that is immune to changes in sample flow.
 - .4 One-point calibration with no interruption in sample flow.
 - .5 Measurement range of 0.001 to 100 NTU.
 - .6 Accuracy of $\pm 2\%$ of reading from 0 to 40 NTU and $\pm 5\%$ of reading from 40 to 100 NTU.
 - .7 Repeatability of $\pm 1\%$ of reading.
 - .8 NEMA 4X enclosure, wall-mounted, complete with integral sensor cable for connection to the analytical controller/transmitter.
 - .9 With 6mm FNPT sample inlet connection and a 13mm FNPT drain connection.
 - .10 Minimum two (2) year warranty.
 - .11 Rated for Class 1 Zone 2 hazardous area.
 - .12 Acceptable manufacturers: HACH Model 1720E.
- .3 pH sensors must meet the following design and performance requirements:
 - .1 Compatible with the analytical controller/transmitter selected (plug and play connection).
 - .2 Differential electrode measurement technique with three electrodes for increased accuracy and elimination of sensor ground loops.
 - .3 Totally encapsulated sensor electronics with built-in preamplifier.
 - .4 Measuring range of -2 to 14 pH.
 - .5 Sensitivity of ± 0.01 pH.
 - .6 Built-in temperature element for automatic temperature compensation.
 - .7 One inch MNPT process connection (convertible style), or self plumbed (panel-mounted) with external feedwater connection.
 - .8 Sensor body shall be constructed complete with salt bridge of matching material, glass process electrodes, titanium ground electrodes and viton O-ring seals.
 - .9 Complete with integral sensor cable for connection to the analytical controller/transmitter.
 - .10 Probe signal cable shall be capable of separation from probe without calibration loss.
 - .11 Probe shall be suitable for low conductivity/alkalinity water below $50 \mu\text{S}/\text{cm}^2$.
 - .12 Acceptable manufacturers: ABB, Hach or approved alternate.

2.6 MISCELLANEOUS

- .1 Field-mounted pushbuttons to be 30.5 mm heavy duty, corrosion resistant/watertight/oiltight, booted, flush, momentary contact (unless indicated otherwise on Drawings), minimum NEMA 4X, complete with one (1) normally closed and one (1) normally open contact (start, stop, etc.), (refer to control schematic drawings for the required number of switch contacts).
 - .1 Rated for Class 1 Zone 2 hazardous area where indicated on the drawings.
 - .2 Acceptable manufacturers: Allen Bradley, Crouse-Hinds, Telemecanique, Cutler Hammer, and Killark.
- .2 Field-mounted selector switches to be heavy duty, corrosion resistant/watertight/oiltight, front-mounted, two (2) or three (3) position (refer to control schematic drawings), either maintained or spring return contact (refer to control schematic drawings), minimum NEMA 4X, and complete with one normally open and one normally closed contact per position.
 - .1 Rated for Class 1 Zone 2 hazardous area where indicated on the drawings.
 - .2 Acceptable manufacturers: Allen Bradley, Crouse-Hinds, Telemecanique, Cutler Hammer, and Killark.
- .3 Field mounted indicating lights to be heavy duty, corrosion resistant/watertight/oiltight, NEMA 4X, 120 VAC, LED and coloured as per the Drawings.
 - .1 Rated for Class 1 Zone 2 hazardous area where indicated on the drawings.
 - .2 Acceptable manufacturers: Allen Bradley, Crouse-Hinds, Telemecanique, Cutler Hammer, and Killark.
- .4 Local control station enclosures (pushbutton, selector switch, etc.) must be the heavy industrial type, corrosion resistant, minimum NEMA 4X, and sized to house the required number of pushbuttons, switches, etc., as indicated on the drawings.
 - .1 Assembly to be rated for Class 1 Zone 2 using increase safety enclosures and rated devices where indicated on the drawings.
 - .2 Acceptable manufacturers: Allen Bradley, Crouse-Hinds, Telemecanique, Cutler Hammer, and Killark.
- .5 Smoke Detectors:
 - .1 Smoke detectors to be ceiling mount ionization type.

2.6 MISCELLANEOUS
(Cont'd)

- .5 (Cont'd)
- .2 Heat detectors to be ceiling mount, combination rate-of-rise and fixed temperature type (58°C).
 - .3 In hazardous areas, smoke/heat detectors must also be rated for Class 1, Zone 1 or Zone 2 hazardous areas as noted on the drawings.
 - .4 Detectors to be 120 Vac type with isolated normally closed contact (rated 5A, 120V) for alarm to PLC.
 - .5 Wire detectors to PLC as indicated on the drawings.
 - .6 Acceptable products:
 - .1 Smoke detectors (non-hazardous): Edwards #ESA5011KA, or approved equivalent.
 - .2 Heat detectors (non-hazardous, dry areas): Edwards CF135-2 Series, or approved equivalent.
 - .3 Heat detectors (non-hazardous, damp or wet areas): Edwards CF135 MP, or approved equivalent.
 - .4 Heat detectors (hazardous, Class 1, Groups C and D): GE #CR135EWT, or approved equivalent.
 - .6 Indoor and outdoor indicating/alarm lights: 120 VAC, CSA certified, LED lamp type, minimum NEMA 4X, corrosion resistant, with guard over tempered glass globe, have two 19 mm NPT cable entries, available in multiple colours, steady or flashing or strobe, easy lamp replacement, suitable for wall or pendant mounting, etc., as indicated on the drawings.
 - .1 Rated for Class 1 Zone 2 hazardous area where indicated on drawings.
 - .2 Acceptable manufacturers: Federal signal, Edwards, Crouse-Hinds, or approved alternate.

2.7 INSTRUMENTATION
CABLING/WIRING

- .1 24 VDC instrumentation signal cables in conduit, use single or multi-paired (or triad), individually and overall shielded, #16 gauge copper conductors, 600V, XLPE insulation, with overall PVC jacket.
- .2 120VAC instrumentation digital control wiring in conduits, use multiconductor industrial control cable, #14 gauge copper conductors, 600V, TEW or RW90 with overall PVC jacket.
- .3 Supply RS232, RS485 and Cat 6 ethernet cables, CAT 6 patch cords, connectors and adaptors, etc., as required to make a complete functional communications networks as indicated or implied on the Drawings. Patch cord lengths will be confirmed on site.

2.7 INSTRUMENTATION
CABLING/WIRING
(Cont'd)

- .4 Ground shields for 24 VDC twisted pair and triad Instrumentation signal cables on the end supplying the loop power, and tape on the opposite end. All shield grounds to be continuous through any intermediate field junction boxes (individually terminated and isolated).
- .5 Ground 120 VAC multiconductor Instrumentation signal cable grounds on both ends. When run through intermediate junction boxes, bring 120 VAC cable grounds to a common junction box ground bar, and connect to earth ground via a junction box ground.
- .6 Ground all Field Control Panels and Junction Boxes to local structural steel (clamp) using a #6 green copper grounding cable.
- .7 All cables and conduits to enter field instruments, control panels and junction boxes from the bottom only. Top entry cables/conduits will only be permitted for PLC I/O cabinets and control panels located in Electrical Rooms. Use grounding bushings when terminating in non-conductive boxes or plates.
- .8 Install unarmoured 24 VDC instrumentation signal wiring and 120VAC instrumentation digital control wiring in conduits.
- .9 Inside all Instruments, Control Panels, and Termination Junction Boxes, identify all cable conductors using wire markers (Weidmuller PT transparent sleeves with TM-I labels, or approved alternate). Mark conductors with their corresponding instrument tag number and Instrument terminal block number (ex: HS3004/C, where HS3004 is the Instrument tag number, and "C" is the Instrument terminal block number the conductor is terminated on). This "conductor identifier" must remain the same through any intermediate junction boxes, etc., all the way back to its corresponding PLC/control cabinet.
- .10 Identify all cables at both ends with its cable number using flexible PVC slip-on wire markers on a carrier strip and fastened to the cable using chemical resistant ty-raps (Electrovert K-Markers, or approved equivalent). Labelling must be done at all cable terminal points and must be on the armour at the point of junction box/instrument entry.
- .11 Leave conductors being terminated within a junction box/control panel long enough to be removed from its assigned terminal block and reassigned to anywhere within the junction box/control panel.

2.7 INSTRUMENTATION
CABLING/WIRING
(Cont'd)

- .12 Terminate spare conductors of a cable inside its associated junction box/control panel on spare terminals and clearly identify with the cable number (ex: Spare-JB3000). Leave adequate length to run the spare conductors anywhere within the junction box/control panel. Terminate spare conductors where identified.
- .13 Fit stranded conductors with vinyl insulated wire end ferrules when terminating to terminal blocks, and vinyl insulated locking fork terminal connectors when terminating to screw terminals.
- .14 For instruments with wire leads that are unarmoured (for example: ultrasonic transducers), install an intermediate field junction box (rated for its specified area classification) close to the instrument as practical, complete with required terminal blocks. Protect any exposed "non-armoured" wire leads using liquid-tight flexible metallic conduit. Where sensor leads are long enough to reach the transmitter, provide conduit for routing "non-armoured" sensor wiring between sensor and transmitter.

2.8 PLANT SCADA
SYSTEM

- .1 Provide and terminate PLC I/O cabinets and plant interconnecting communications cabling as indicated on the drawings. The Primary and Secondary PC Workstations (HMI-01 and HMI-02) are part of a pre-selected equipment package to be installed under this Contract.
- .2 Control system integration will be provided by the control system integrator pre-selected by the Owner. Coordinate activities with the Owner and the control system integrator.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Execute Work in a professional manner so that it presents a neat appearance when completed.
- .2 Install all instrumentation and control equipment being supplied by, or issued to, where and as indicated on the drawings, and in accordance with the manufacturer's instructions. Strictly adhere to the manufacturer's installation instructions.

3.1 INSTALLATION
(Cont'd)

- .3 The Drawings indicate the extent and general arrangement of the instrumentation and controls equipment. Exact installation locations, distances and levels will be governed by actual field conditions and is subject to approval by the Consultant.
- .4 If any departures from the original intent of the Drawings and/or the Specifications are deemed necessary by the Contractor, submit details of such departures with Drawings if necessary, together with reasons for the departure to the Consultant as soon as practical for approval. No such departure will be made without prior written consent of the Consultant.
- .5 Unless otherwise specified, fabricate and erect all support brackets or mounting brackets required. Purchase with all necessary mounting brackets from the instrument vendor.
- .6 Locate instruments to minimize the possibility of damage from high temperature, vibration or humidity, and not to interfere with, or be damaged by, maintenance of other equipment. Instrument installation must also provide for easy accessibility for operation, inspection, and maintenance purposes.
- .7 Only use qualified riggers and handlers of the appropriate trades with suitable lifting gear to move field junction boxes, instruments, etc., and take all necessary precautions to avoid distortion or other damage.
- .8 Store materials in a manner as to maintain the preservation of their quality and fitness for the work, and to facilitate inspection by the Consultant/Owner at any time. Keep instruments and equipment clean and protect against damage, dirt, and moisture.
- .9 Protect installed equipment against water or dirt until it is commissioned. Use clear plastic sheeting of not less than 8-mil thickness for this purpose.
- .10 Keep all enclosures, rooms, trenches, etc., free from construction debris, materials, dirt and water at all times during construction.
- .11 Coordinate equipment delivery, storage and installation requirements with all of the vendors.

3.1 INSTALLATION
(Cont'd)

- .12 Repair/replace equipment damaged during construction, or otherwise deemed defective or non-compliant with this specification, at no additional expense to the Contract. These expenses includes all material, labour and other fees.
- .13 Areas identified around project tankage (SBR's), screen room and centrifuge room are considered Class 1 Zone 2 hazardous areas. Equipment and wiring practices in these areas are to meet the requirements layout in the Canadian electrical code as it pertains to classified hazardous areas. Although ventilation will be used to de-rate rooms the wiring practices must follow that of a classified hazardous area.

3.2 TESTING AND
CALIBRATION
EQUIPMENT

- .1 Calibrate test and calibration equipment to an industry recognized standard and affix proof of calibration along with date of next calibration on the equipment.
- .2 Provide calibration certificate for each instrument.

3.3 TESTING AND
CHECK-OUT

- .1 Conduct all tests necessary to confirm the material and workmanship are of the required degree of excellence, and that the supplied equipment will perform as specified and guaranteed (verify wiring, wire continuity checks, tubing leak tests, etc.).
- .2 Calibrate instruments before installation. Secure the services of qualified personnel (manufacturer's representative) and equipment to conduct field instrument calibration.
- .3 Document the results of all tests/calibrations make available to the Consultant and included in the project Operations and Maintenance manual specified.
- .4 Coordinate with suppliers of other Divisions for their required testing and commissioning procedures.

3.4 COMMISSIONING
AND START-UP

- .1 Arrange and pay for the services of a manufacturer's factory service representative to supervise the installation, start-up, check, adjust, balance and calibrate all supplied instruments to the satisfaction of the Consultant. Provide these services for such period, and for as many visits as necessary to put the installation in working order, and to ensure that the operating personnel are conversant with all aspects of equipment and operation.
- .2 Submit a written report signed by the manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of the equipment has been performed outlining modifications that have been made as a result of testing/commissioning the equipment; and
 - .2 That the maintenance instructions for the equipment have been presented to the Consultant and Owner.
- .3 After the instrumentation and controls equipment and vendor packages have been installed, calibrated, checked out and tested by the Contractor, the plant PLC programming and HMI SCADA system testing/commissioning can begin. Coordinate this Work with the Owner's control system integrator. This will involve a point-by-point check for all PLC and HMI system monitored field I/O points, logic checks, communication checks, complete plant controls integration, and equipment start-ups.
- .4 Provide technical personnel during this phase of the work for instrument recalibration, re-wiring, reprogramming, etc., as required until the integrated plant control system is deemed ready for plant operation.
- .5 The existing controls and instrumentation must remain in operation until the plant expansion is inspected/tested at which point a staged relocation will occupy. Refer to Section 02 41 10 for additional requirements.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section and its associated drawings specify the requirements for the design, fabrication, supply, installation and testing, of the process control system equipment, including but not limited to relay control panels, termination junction boxes, and remote I/O panels.
- .2 The electrical drawings supplement this specification section in defining the scope of Work required.
- .3 The following drawings supplement this specification section in defining the control panel and termination junction box scope of work required:
 - .1 Control System Block Diagram: identifies the new components of the plant control system architecture, number of PLC panels, control system hardware and the control system interconnecting cabling required.
 - .2 Instrumentation Cabling Diagrams: shows the number of cables entering each control panel or termination junction box. Confirm each panel/junction box is large enough to accommodate the required number of glanded cables/conduits.
 - .3 PLC I/O Lists: lists all of the hardwired I/O required for the PLC control panels.
 - .4 Electrical Control Schematic Drawings: use to assist in the design of relay control panels, indicating the number of relays, pushbuttons, switches, field I/O, etc., required for each panel.
 - .5 Control Panel and Field Junction Box Layout details: provide basic control panel and field box layouts, required equipment, terminal block arrangements, termination details etc.

1.2 REFERENCES

- .1 Carry out the Work under this section in accordance with all applicable Federal, Provincial, Municipal and other laws, ordinances and with the latest edition of the following standards which shall be deemed to be and form part of this specification.
 - .1 American Society of Mechanical Engineers.
 - .2 Institute of Electrical and Electronic Engineers.
 - .3 American Society for Testing Materials.
 - .4 Manufacturers Standardization Society.
 - .5 Canadian Standards Association.
 - .6 Instrument Society of America.
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1.2 REFERENCES
(Cont'd)

- .1 (Cont'd)
- .7 Canadian Electrical Code.
- .2 In the event of a conflict between the above mentioned standards, this specification, or the attached drawings, notify the Consultant, who will then advise on which standard is to be followed.

1.3 SUBMITTALS

- .1 Supply shop drawings for all control panels and termination junction boxes being supplied. Shop drawings will be reviewed and approved by the Consultant before equipment can be ordered. Submit shop drawings in accordance with 01 00 00.
- .2 Control panel and termination junction box shop drawings to include the following information:
 - .1 Dimensional outlines, sections and details of all equipment.
 - .2 Detailed Bill of Materials.
 - .3 Equipment layout details.
 - .4 Equipment labeling details.
 - .5 Terminal block arrangements.
 - .6 All equipment specifications and instruction manuals (digital meters, relays, etc.). Supplier to provide a cross reference indicating which specifications refer to which panel.
 - .7 Instructions for the mounting of the control panels/junction boxes.
- .3 For control panels and field termination junction boxes, provide a layout and wiring diagram, complete with a detailed Bill of Materials.
- .4 Submit data for operations and maintenance manuals. Include in manuals information based on the following requirements:
 - .1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification extension and expansion of any portion or feature of the installation.
- .5 Provide "Record" wiring and schematic diagrams and general arrangement drawings for control panels and junction boxes including a bill of materials.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Each control panel, remote I/O panel and termination junction box must be supplied, completely tested and ready for terminating field cables. This includes all hardware (terminal blocks, relays, power supplies, pushbuttons, etc.), terminal blocks (for power supplies and field I/O), wire ducts, internal panel wiring etc., as required.
- .2 All indoor control panels and termination junction boxes are to be either wall mounted or free-standing depending on the panel size and be NEMA 4X rated and reinforced plastic for installations in non-hazardous areas, use NEMA 4X, 316 stainless steel, increased safety enclosures rated for Class 1 Zone 2 for hazardous area installations. All conduits must be bottom entry. Top entry cables are acceptable for control panels and PLC I/O cabinets located in electrical rooms only. Provide free-standing panels with at least 300mm floor stands.
- .3 All outdoor control panels and termination junction boxes are to be either wall mounted or mounted on unistrut frames and be NEMA 4X rated and of 316 SS construction rated for Class 1 Zone 2. All conduits must be bottom entry.
- .4 Inside all panels and junction boxes, label terminal blocks, terminal block strips, and all internal wire conductors in accordance with the panel fabricator standards.
- .5 All NEMA 4x panel and junction box hardware (hinges, latches, etc.) must be 316 SS. Provide all panels and junction boxes complete with a back mounting plate.
- .6 Provide at least a 32 mm clearance between the terminal blocks and the plastic wiring duct. Wire ducts to be slotted and complete with covers. Wiring ducts to be a minimum size of 25 mm wide x 75 mm high (supplier to determine if a larger size is required).

2.1 GENERAL
(Cont'd)

- .7 Generally, terminate field wiring on the right hand side (or bottom side) of terminal strips, and internal panel wiring, or multi-conductor homerun cables (for intermediate junction boxes), shall be terminated on the left hand side (or top side) of terminal strips.
- .8 Wire analog and digital signals within the same panel or junction box to separate terminal strips.
- .9 Completed relay control panels and junction boxes, hazardous area junction boxes to have CSA approval.
- .10 All panels and junction boxes must be adequately sized to accommodate the required hardware, terminal blocks, wire ducts, etc., as well as the number of cables/conduits.
- .11 Individually label all panels and junction boxes with a lamicoid tag on the outside of the door and include the cabinet tag number and its associated description. Nameplates to have a white background with black undercut lettering (316 SS screw mounted). Minimum lettering size to be 25 mm.
- .12 All pushbutton and switch legend plates to be white (anodized or engraved) on a black background, except emergency stops, which shall have a red background.
- .13 All panels and junction boxes to include a drawing pocket to be installed on the inside of the door to hold "As Built" termination drawings.
- .14 All panels and junction boxes to have an adequately sized pre-drilled and tapped copper ground bar and to be provided with a grounding lug for a #6 AWG external ground connection. Where applicable, control panels will also have a separate "isolated" copper ground bar for grounding of analog type 4-20 mA control signal cabling.
- .15 Terminal blocks to be rated for at least 600V, 35A, minimum 6mm wide, capable of accepting a 10AWG conductor size, DIN rail mounted, complete with white marking tags with black lettering.
 - .1 Acceptable manufacturers: Weidmuller WDU4, or approved equivalent.
- .16 Control wiring circuit breaker type terminal blocks to be rated for 250V, up to 16A, single pole, pushbutton operated, DIN rail mounted, complete with white marking tags with black lettering.

2.1 GENERAL
(Cont'd)

- .16 (Cont'd)
- .1 Acceptable manufacturers: Weidmuller 4201 Series, or approved equivalent.
- .17 Arrange terminal blocks so that no more than two (2) wires are terminated on any one (1) terminal block (including field wiring). The use of "wire jumpers" between terminal blocks will not be permitted. Only terminal block vendor approved "cross-connection systems" can be used for cross wiring between panel terminal blocks.
- .18 Panel internal wiring to be 16 AWG type TEW as a minimum. All 120 VAC power and control wiring to be black (#14AWG minimum). All 120 VAC neutral wiring to be white (#14AWG minimum). All DC digital signal wiring to be blue (#16AWG minimum). All analog signal wiring to be twisted, pair (Bk/Wh) or triad (Bk/Wh/Rd), shielded (#16AWG minimum). All ground wiring to be green (#14AWG minimum). Provide stranded copper wiring throughout. Segregate AC and DC wiring and install on separate terminal strips.
- .19 Control relays to have either 24 VDC or 120 VAC operating coil as required, plug-in socket, minimum 15 amp @ 120 VAC rated contacts (2 form 'C') and LED indicator.
- .1 Acceptable materials: Allen Bradley 700-HB Series, or approved equivalent.
- .20 For breaker circuits, provide 120 VAC, single pole distribution circuit breakers, toggle type, DIN rail mounted, continuous current rating as required, 10 kA interrupting capacity.
- .1 Acceptable product: Weidmuller 9926 series or approved equivalent.
- .21 For fused circuits, provide Class CC HRC fuses, complete with a 600V, 30A fuse holder, single pole, blown fuse indicator.
- .1 Acceptable product: Mersen Cat. No. USCC1I or approved equivalent.
- .22 Intrinsically safe relays shall be dual channel, 120 Vac input voltage, 1 form 'C' contact per channel (rated 5A @ 120 VAC), Phoenix type P1-EX-ME-2NAM-COC-120VAC or approved equivalent.

2.2 RELAY CONTROL
PANEL

- .1 Provide and install the relay control panels as indicated on the electrical drawings.

2.2 RELAY CONTROL PANEL
(Cont'd)

- .2 Refer to the Electrical drawings for related control schematics.
- .3 Provide 20% spare terminals for each terminal strip.

2.3 TERMINATION JUNCTION BOXES

- .1 Generally, instrumentation and control conduits will run directly from the field device to the associated control panel. Where junction boxes are indicated, or otherwise deemed necessary, provide as follows:
 - .1 Provide sufficient terminals to accommodate spare wires plus 20% additional unused terminals.
 - .2 Provide junction boxes with hinged covers.
 - .3 For junction boxes 200 mm square or less, boxes with screw or hinged covers may be used.
 - .4 Minimum NEMA 4X enclosure rating, use PVC enclosure in interior non-hazardous areas. Use 316SS, increased safety assemblies for hazardous areas and in exterior installations.

2.4 PLANT PLC PANEL

- .1 Part of Owner pre-selected equipment.
- .2 Handle, store and install equipment as specified by the manufacturer and as indicated on the drawings.

2.5 COMMUNICATION RACK

- .1 Supply and install communication rack in electrical room.
- .2 Suitable for wall mounting, complete with swinging front, hinged door.
- .3 Supply and install necessary network switch, patch panel, horizontal wireway and power distribution unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install control panels, remote I/O panel and field termination junction boxes.
- .2 Install unarmoured communications cables in conduit systems in accordance with Section 26 05 34.

3.1 INSTALLATION
(Cont'd)

- .3 Terminate cables and equipment per the drawings and the manufacturer's instructions and pre-selected equipment shop drawings.
- .4 Terminate ethernet, fibre and serial communications cables with the appropriate connector and test. The splitting of cable pairs between different jacks is not permitted.
- .5 Ground cabling, patch panels, racks and equipment as per manufacturer's instructions (use min. #6).
- .6 Terminate each conductor with the appropriate connector and test.
- .7 Mount and position equipment, etc., in such a way as to allow for easy access for maintenance purposes.
- .8 Store materials in a manner to ensure the preservation of their quality and fitness for the work, and to facilitate inspection by the Consultant at any time. Keep equipment clean and protected against damages, dirt and moisture.

3.2 TESTING

- .1 Panel fabricator to test (power-up) all panel components and auxiliary devices to confirm functionality, verify all internal panel wiring, and conduct functionality testing in accordance with the control schematics prior to delivery to site. Provide test reports to the Consultant.
- .2 Test communication system cables in accordance with the manufacturer's requirements.
- .3 Field test the fibre optic cable after installation. Conduct attenuation and OTDR testing.
- .4 Provide a hard copy of test results.
- .5 Refer to specification section 40 90 00 for additional testing.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This Section covers the supply, delivery, installation, testing and placement into operation of a shaftless screw conveyor system as specified herein and as shown on the drawings. The work includes providing all labour, tools, and additional equipment and materials necessary to complete the installation of the screw conveyor system.
- 1.2 INTENT .1 The intent of these specifications is to provide the mechanical and electrical works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material, or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.
- 1.3 DESIGN CRITERIA .1 It is intended that this system be capable of handling dewatered sludge. The dewatered sludge shall contain 15% to 30% dry weight solids, weighing 1050 kg/m³. The inclined screw conveyor shall receive sludge from the centrifuge and discharge into a bin (by others). The screw conveyor shall be capable of moving 2400 kg/hour. The screw conveyor system shall include ribbon flights to handle sticky, viscous dewatered sewage sludge. The screw conveyor system will be supported and suspended from the building structure as indicated on the plans. The conveyor shall be sized by manufacturer to suit application and shall not operate at more than 30 rpm.
- .1 The Bin Room is a Zone 1 electrically classified area.
- .2 The Sludge Dewatering Room is a non-hazardous area.
- .2 The screw conveyor system will receive dewatered sludge from the centrifuge. Discharge chute dimensions are 430 mm x 330 mm. Coordinate with pre-selected equipment supplier as required.
- .3 Provide conveyor designed and manufactured to handle dewatered sludge. The torque capacity of the drive unit to be sufficient to start the conveyor with 100% trough loading.

1.3 DESIGN CRITERIA
(Cont'd)

- .4 The "spring effect" (compression or elongation) of the spiral must not exceed 6/7 mm per meter of length at maximum load conditions.
- .5 Have the manufacturer demonstrate by submission of calculations that at 100% trough loading, the stress in the auger does not exceed 30% of the (Shear Strength) value in the extreme outer fibers of the spiral.
- .6 There shall be no internal or external bearings other than those in the drive.

1.4 QUALIFICATIONS
OF EQUIPMENT
SUPPLIERS

- .1 All items of equipment supplied must be produced by companies regularly engaged in manufacturing this type of equipment and who maintain service and parts departments from which service, repairs and replacements may be obtained quickly at all times. Mechanical details of equipment offered must have been tried and tested by the actual construction and operation of mechanisms of the exact type and of comparable size and operating in similar service.

1.5 IDENTIFICATION
OF EQUIPMENT

- .1 Fit process equipment with the manufacturer's identification nameplates indicating size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power motors, all factory supplied. Identification nameplates to include metric units.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00 for all process equipment to the Consultant for review prior to shipment.

1.7 MAINTENANCE
MANUALS

- .1 Provide Operation and Maintenance data for inclusion in the Operations and Maintenance manuals, in accordance with Section 01 00 00.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Shaftless screw conveyors to be new and of current manufacture and be designed to transfer, dewatered municipal sludge as shown on the drawings. Provide conveyors constructed in accordance with CEMA 350 dimensional tolerance standards.
 - .1 Trough and chutes: stainless steel 304L.
 - .2 Covers: 12 GA minimum 304L SS.
 - .3 Drives and end plates: 13 mm minimum 304 LL SS drive, 10 mm non-drive.
 - .4 Spiral flight: cold-formed carbon based micro-alloy, Brinnell 225 Min.
 - .5 Wear liner: UHWM 10 mm thick minimum.
 - .6 Hardware: Type 316 stainless steel.
 - .7 Cover fasteners: Type 316 SS bolts.
 - .8 Drive shaft: AISI 1045.
 - .9 Number of inlet chutes:
 - .1 Incline Conveyor: one (1)
 - .10 Number of discharge chutes:
 - .1 Incline Conveyor: one (1)
- .2 The incline conveyor will include a liquid drain c/w valve and a 100 mm diameter liquid overflow port, both located at the inlet chute/hopper.

2.2 SCREW CONVEYOR
SYSTEM

- .1 Spiral manufacturing process:
 - .1 Structural integrity, fabrication process. Spiral flighting to be hot-rolled micro-alloy steel bar cold formed into the final diameter, pitch and the specified physical properties in a two-stage fabrication process to eliminate spiral neck down and outside diameter micro-cracking. The two-stage fabrication process first consists of tightly cold rolling on a mandrel to the desired diameter at zero pitch using a device to control the plastic flow and outside diameter neck-down or cracking. The second stage consists of pulling the closely wound spiral in tension to the specified pitch in a device permitting free rotation of the spiral during the pulling process. Spirals manufactured in single forming operations of rolling to diameter and pitch simultaneously will not be accepted. Have the spiral manufacturer (not the supplier or reseller) issue a certification of the above fabrication process.

2.2 SCREW CONVEYOR
SYSTEM

(Cont'd)

- .1 (Cont'd)
- .2 Spiral flighting to consist of one spiral, cold formed in sections from two continuous flat hot-rolled bars of 50 mm x 20 mm (1") minimum thickness, with a minimum cross sectional area of 1000 mm², 80,000 psi minimum yield strength, and 225 minimum Brinnell. Material must be corrosion resistant micro-alloy steel bar and concentric to within 1 mm.
- .3 Spirals formed from cut plate are not permitted. Single spirals of any width are not acceptable. Spirals to be cold formed into the final diameter and pitch in two separate forming stages to reduce spiral neck-down and eliminate spiral cracking. Single stage rolling and pitch formation is not acceptable.
- .4 The spiral must be rolled in such a way as to limit "neck down" of the outside edge of the cold rolled spiral to 10% of the thickness of the inside edge of the spiral. The spiral edges must be smooth in the as-rolled condition and not show cracks or grinding marks when tested with a dye-penetrant.
- .5 Spiral flighting to be connected to the drive shaft by welding the spirals to a 6 mm minimum circular torque plate properly reinforced with a curved gusset plate for 180°. Bore a separate connection plate with a hole equal to the shaft and the drive shaft and concentrically weld to the plate to effectively transmit torque and bolted to the torque plate.
- .6 Weld spiral connections according to AISC B-U3-GF (double V groove) and be full penetration welds. Weld flights in a jig to assure true alignment.
- .7 Provide a certification from the spiral manufacturer confirming the above manufacturing process with the submittal.
- .2 Trough and liner:
- .1 Construction: materials to be 304L stainless steel U-trough with neoprene gasketting at each trough flange and 12 GA stainless steel covers. Trough to have two (2) cross braces every 3 m and be lined with 10 mm minimum wear resistant UHMW with 304 L stainless steel retainer bars welded to the trough at 180° along the trough. Do not apply fasteners that penetrate the trough.
- .2 Trough to have a 100 mm drain at the lowest point.
- .3 Cover the portion of the trough not covered by a filling chute by a bolted 304L stainless steel cover in maximum 1.8 m sections.

2.2 SCREW CONVEYOR
SYSTEM

(Cont'd)

- .2 (Cont'd)
- .4 Conveyor to have standard trough end plates with split gland seal at the drive end.
- .5 All components including saddles and supports must be type 304L stainless steel except the drive unit and spiral. All stainless steel welds must be passivated.
- .6 Equip trough with 304 L stainless steel filling and discharge chutes at the areas as shown on the plan drawings.
- .3 Drive: drive unit to be a hollow shaft mounted gear motor rated a minimum AGMA Class II, single or double reduction or triple reduction. Provide TEFC 600 V, 60 Hz, 3 phase (inverter duty) constant speed drive, running at approximately 20-30 rpm. The discharge end of the incline conveyor are located in a Zone 1 electrically classified area. Provide NORD Gear Corporation Unibase, or equivalent, shaft mounted drive hollow shaft design. (V-belt driven speed reducer, or chain driven reducers not permitted.) Shaft to be at least 38 mm minimum diameter welded to spiral and with sealed housing at tail and connected to the spiral to effectively transmit torque from the drive shaft to the flight. Pipe welded to the spiral ID are not acceptable.
- .4 Supports: design structural members for support or suspension such that the ratio of the un-braced length to the least radius of gyration (slenderness ratio) does not exceed 20 for compression and 240 for tension. Stresses must not exceed AISC allowable stresses by more than 1/3 when subject to 2X the running torque of the drive motor.
- .5 Controls and accessories:
- .1 Equip each conveyor with a zero speed switch with a time delayed detection device.
- .2 Equip each conveyor with emergency stop cables on both sides of the conveyor with one switch per 30 metres of conveyor length. Cable to be orange plastic coated safety cable mounted through eyebolt spaced no more than 3 metres.
- .3 Equip each conveyor with an electric high-torque limiter switch shall be installed to prevent accidental overloading of the spiral. Tsubaki or equivalent.
- .4 Have the screw conveyor manufacturer provide a single screw conveyor control panel constructed to NEMA 4X standards to operate system. Screw conveyor control panel to provide "H-O-A", "On" and "Off" selectors for the screw conveyor.

2.2 SCREW CONVEYOR
SYSTEM
(Cont'd)

- .5 (Cont'd)
- .5 The control panel PLC processor and I/O cards must be Allen-Bradley, Compact Logix or Control Logix series with the ability to communicate via Ethernet communications network.
- .1 Control panel short circuit rating shall be a minimum of 25 kAIC.
- .2 Control panel to include all intrinsically safe components to operate the equipment located in the cake storage room.
- .3 The main conveyor control panel will be located in the process area.
- .4 Provide the Owner with the latest electronic copy of the PLC logic.
- .6 Locate motor starters in the control panel.
- .7 When in "auto" mode, the system will receive an on/off input from the main plant PLC indicating that either one or both centrifuges are running. The system will receive an "open" input indicating which inlet drain gate should be in the open position. The system will determine which discharge chute should be open to fill the two (2) bins. The system must provide a bin full signal to notify the operator and plant PLC when a bin is full.

2.3 SPARE PARTS

- .1 The following spare parts and safety equipment to be supplied:
- .1 One (1) set of end seals.
- .2 One (1) set of UHMW bearing sleeves.

2.4 ACCEPTABLE
MANUFACTURERS

- .1 Claro, MLM, Spirac, Spiral or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION -
GENERAL

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.

3.1 INSTALLATION -
GENERAL
(Cont'd)

- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using epoxy anchors or other approved fastening methods.
- .6 Coordinate location and provide items for embedding into cast-in-place concrete.
- .7 Provide small connecting pipework, fittings and valves whether shown on the Drawings or not, but required for proper functioning and servicing of the equipment. Do such work in accordance with manufacturer's instructions at no additional cost to the Contract. Where pipe is connected to equipment make connection without straining pipe or equipment during joining procedure.
- .8 Coordinate necessary plumbing supply and drain connections with Divisions 22 and 40.
- .9 Coordinate necessary electrical connections and wiring with Division 26.

3.2 LUBRICATION

- .1 Conduct the complete initial lubrication of all equipment in accordance with the equipment manufacturer's recommendations.

3.3 RESPONSIBILITY
OF TEMPORARY TRAIL
USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Consultant.
- .2 The guarantee period will not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used prior to acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust, and other foreign materials during temporary usage.

3.4 INSPECTION,
TESTING AND
START-UP

- .1 Provide the services of competent serviceperson, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation.
 - .3 That the equipment has been properly lubricated with the correct lubricants.
- .2 Include the costs for the provision for the conveyor manufacturer's representative to perform on-site installation inspection, start-up and commissioning with the supply of the equipment.
- .3 Have the equipment manufacturer's representative fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .4 Advise in writing at least two (2) weeks in advance of the proposed date for testing and start-up. All tests shall be conducted in the presence of the Consultant.
- .5 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Equipment described herein was pre-selected by the Owner. At this time, it is anticipated that the equipment will be required on-site by late fall 2017 (to be confirmed with Contractors proposed schedule). The Contractor will be responsible for placement of purchase order, shipping, receiving, unloading, storing, insuring, and coordination of sub-trades. The pre-selected quotation documents including product specifications are available for viewing in Appendix A herein.
- .2 This Section describes the requirements for supplying all ancillary material, tools and labour to install, test, and commission the selected screening equipment. Dewatered screenings will be discharged to a screenings disposal bin (supplied by others). The work generally includes the inspection, installation, testing, start-up of the complete system.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.
- .2 Become thoroughly familiar with all the requirements and components of the pre-selected equipment, necessitated by the Contractor's failure to ascertain the requirements for unloading, including, storing, insuring assembly, installing, and wiring.
- .3 Ascertain from the Supplier the full extent of fieldwork in accordance with manufacturer's instructions and obtain all details, dimensions, and any other information necessary for the complete installation.
- .4 Ascertain from the Supplier the key construction milestones for their inspection of the work. Advise the Supplier and the Consultant of the status of the work, and coordinate the inspection of the installation of the Supplier.

1.2 INTENT
(Cont'd)

- .5 An allowance for the cost of the inspection, commissioning and operator training has been made in the purchase price for the pre-selected equipment. However, if additional trips are required of the Supplier due to the Contractor's work not being prepared, the cost of the additional trips will be borne by the Contractor.

1.3 DESIGN
REQUIREMENTS (FOR
INFORMATION)

- .1 The fine screening unit will consist of a spiral assembly, screen basket assembly, transport tube assembly, press zone assembly, discharge assembly, drive system, tank assembly, and associated controls.
- .2 The screen will be used to capture suspended solids from the bypass flow prior to discharge to the receiving environment.
- .3 Unit designed to receive influent through a pipe on the tank assembly. The influent will be directed to the internal surface of the screen basket where the larger solids will be retained. The spiral will transport the solids up the screen basket through the transport tube and into the press zone where they will be dewatered. The dewatered solids will then be discharged to a receptacle (provided by others).
- .4 System requirements are as follows:
 - .1 No. of units: one (1).
 - .2 Application: fine screening (6mm).
 - .3 Peak Flow: 85.6 L/s (1360 USgpm).
 - .4 Influent solids concentration: 150 mg/L.
- .5 Mechanical system to be designed to operate in a heated and ventilated Zone 1 electrically classified area. Control panel to be located in a non-classified area.

1.4 SHOP DRAWINGS

- .1 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .2 One (1) digital copy of the drawings will be supplied to the Contractor for use during construction.

1.4 SHOP DRAWINGS
(Cont'd)

- .3 Provide any additional required shop drawings as specified in Section 01 00 00.
- .4 Include details of equipment assembly, fabrication, control and installation.

1.5 OPERATION AND
MAINTENANCE MANUALS

- .1 Coordinate operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Section 01 00 00.
- .2 The Equipment Supplier will provide three (3) sets of operation and maintenance data for incorporation into the Operation and Maintenance Manuals.

1.6 DELIVERY,
STORAGE AND
HANDLING

- .1 Coordinate with the Owner to have Equipment delivered to site. Provide all labour, personnel, and equipment as required to facilitate receipt of equipment. Store Equipment according to the manufacturer's recommendations.
- .2 Dispose and remove packaging materials as required. Contact Equipment Supplier to determine how equipment will be packaged.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 The Equipment of this Section has been pre-selected by the Owner. Full Equipment specifications are available for viewing as per Section 01 00 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.

3.1 INSTALLATION
(Cont'd)

- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.2 RESPONSIBILITY
OF TEMPORARY TRIAL
USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period will not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.3 INSPECTION,
TESTING AND
START-UP

- .1 The Equipment Supplier or their designated representative has agreed to provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the Equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation;
- .2 The Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Advise in writing at least one (1) week in advance of the proposed date for testing and start-up. Conduct all tests in the presence of the Consultant.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .5 A minimum period of four (4) days onsite for skilled supervision and instruction and a minimum of two (2) trips to the site are provided by the equipment manufacturer as part of the Equipment package pre-selected by the Owner.

3.4 PERFORMANCE,
TESTING AND
COMMISSIONING

- .1 When installation is complete and before any equipment is operated, instruct the supplier to commission the equipment. The Equipment Supplier has agreed to provide the services of a skilled technical representative at the site to carry out the following work:
 - .1 Check the installation as to its workmanship.
 - .2 Perform further tests to confirm that the equipment is in accordance with the intent of this specification.
 - .1 Confirm equipment, including all component parts operate as intended.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Equipment described herein was pre-selected by the Owner. At this time, it is anticipated that the equipment will be required on-site by late fall 2017 (to be confirmed with Contractors proposed schedule). The Contractor will be responsible for placement of purchase order, shipping, receiving, unloading, storing insuring, and coordination of sub-trades. The pre-selected quotation documents including product specifications are available for viewing in Appendix A herein.
- .2 This Section describes the requirements for supplying all ancillary material, tools and labour to install, test, and commission a pre-selected ultraviolet disinfection system.

1.2 RELATED WORK

- .1 Cast-in-place concrete: Section 03 30 00
- .2 Miscellaneous metals: Section 05 50 00
- .3 Plant piping, valves and appurtenances: Section 40 05 10
- .4 Electrical: Division 26

1.3 DESIGN CRITERIA
(FOR INFORMATION)

- .1 UV - SBR Effluent:
 - .1 Peak Flow: 58 L/s (920 USgpm).
 - .2 Total suspended solids: 25 mg/L, 30 day average of grab samples.
 - .3 Annual effluent temperature range: 0 to 29°C.
 - .4 Ultraviolet Transmittance of 253.7 nm: 60%, minimum.
 - .5 Effluent standard to be achieved (average): 200 fecal coliform/100ml, 30 day geometric mean of consecutive daily grab samples.
 - .6 Upstream process: SBR (secondary).
 - .7 Provide the UV equipment in a type 304 stainless steel channel.
 - .8 Coordinate peak SBR decant flow requirement as required.
 - .9 Carefully space the lamp array configuration both vertically and horizontally with all lamps parallel to each other and to the effluent flow.

1.4 SHOP DRAWINGS

- .1 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .2 One (1) digital copy of the drawings will be supplied to the Contractor for use during construction.
- .3 Provide any addition required shop drawings as specified in Section 01 00 00.
- .4 Include details of equipment assembly, fabrication, control and installation.

1.5 DELIVERY,
STORAGE AND
HANDLING

- .1 Coordinate with the Supplier to have Equipment delivered to site. Provide all labour, personnel, and equipment as required to facilitate receipt of equipment. Store equipment according to the manufacturer's recommendations.
- .2 Dispose and remove packaging materials as required. Contact Equipment Supplier to determine how equipment will be packaged.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 The Equipment of this Section has been pre-selected by the Owner. Full Equipment specifications are available for viewing as per Section 01 00 00.

PART 3 - EXECUTION

3.1 DELIVERY

- .1 Coordinate delivery of pre-selected equipment to the Site. Provide all labour and equipment to safely and efficiently unload and store pre-selected equipment.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Make available all instructions issued at time of shop drawing issue on site when required.

3.2 INSTALLATION
(Cont'd)

- .2 Take all necessary field dimensions to confirm accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY
OF TEMPORARY TRIAL
USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period will not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.4 INSPECTION,
TESTING AND
START-UP

- .1 The Equipment Supplier or their designated representative has agreed to provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the Equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation;
- .2 The Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Advise in writing at least one (1) week in advance of the proposed date for testing and start-up. Conduct all tests in the presence of the Consultant.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .5 A minimum period of one (1) trip of one (1) eight (8) hour day onsite for skilled supervision and instruction are provided by the equipment manufacturer as part of the Equipment package pre-selected by the Owner.

3.5 PERFORMANCE,
TESTING AND
COMMISSIONING

- .1 When installation is complete and before any equipment is operated, instruct the supplier to commission the equipment. The Equipment Supplier has agreed to provide the services of a skilled technical representative at the site to carry out the following work:
 - .1 Check the installation as to its workmanship.
 - .2 Perform further tests to confirm that the equipment is in accordance with the intent of this specification.
 - .1 Confirm equipment, including all component parts operate as intended.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Equipment described herein was pre-selected by the Owner. At this time, it is anticipated that the equipment will be required on-site by late fall 2017 (to be confirmed with Contractors proposed schedule). The Contractor will be responsible for placement of purchase order, shipping, receiving, unloading, storing insuring, and coordination of sub-trades. The pre-selected quotation documents including product specifications are available for viewing in Appendix A herein.
- .2 This Section describes the requirements for supplying all ancillary tools and labour to install, test, and commission the aeration blower system including the two (2) SBR blowers and one (1) digester/sludge holding tank blower.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.

1.3 DESIGN
REQUIREMENTS (FOR
INFORMATION)

- .1 Use aeration blowers to provide low pressure air to an aeration system which provide oxygen to the SBR and digester/sludge holding tanks. The aeration diffusers are mounted in tanks with a maximum side water depth of 5.0m. Blowers, starters and controls will be housed in a heated control building in close proximity to the tankage. The blowers will draw air from outside through an intake pipe without any treatment.
-

1.3 DESIGN
REQUIREMENTS (FOR
INFORMATION)
(Cont'd)

- .2 Package blower: three (3) rotary lobe, positive displacement blowers, package assemblies complete with drive, check valve, relief valve, inlet filter/silencers, discharge silencer, support frames, sound enclosure and all accessories as described in this Section. Under normal operations, there is one (1) blower operating for the SBR, one (1) blower for the digester/sludge holding tank, and one (1) common standby. Where practical blower sizing will be consistent such that they can sub in as required (sized for largest capacity required).
- .3 Each package unit consists of a blower, sound enclosure, motor, v-belts and cover, inlet filter/silencer, discharge silencer and relief valve, flexible connections, all mounted on a steel support frame which will then be mounted on vibration isolators to be secured to a concrete base. Make discharge connections to distribution piping with flexible rubber connection.
 - .1 Blower: rotary lobe, heavy duty, positive displacement blower with vertical inlet/outlet connections and replaceable bearings having a minimum B-10 life of 100,000 hours.

1.4 SHOP DRAWINGS

- .1 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .2 Two (2) hard copies and one (1) digital copy of the drawings will be supplied to the Contractor for use during construction.
- .3 Provide shop drawings as specified in Section 01 00 00.
- .4 Include details of equipment assembly, fabrication, control and installation.
- .5 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.

1.5 OPERATION AND
MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Section 01 00 00.

<u>1.5 OPERATION AND MAINTENANCE MANUALS (Cont'd)</u>	.2	The Equipment Supplier will provide three (3) sets of operation and maintenance data for incorporation into the Operation and Maintenance Manuals.

<u>1.6 STORAGE AND HANDLING</u>	.1	Store Equipment according to recommendations. Provide all labour, personnel and Equipment to move on Site.

	.2	Dispose and remove packaging materials as required.

PART 2 - PRODUCTS

<u>2.1 GENERAL</u>	.1	The Equipment of this Section has been pre-selected by the Owner. Full Equipment specifications are provided in Appendix A herein.

PART 3 - EXECUTION

<u>3.1 DELIVERY</u>	.1	Coordinate delivery of pre-selected equipment to the Site. Provide all labour and equipment to safely and efficiently unload and store pre-selected equipment.

<u>3.2 INSTALLATION</u>	.1	Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
	.2	Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
	.3	Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.

3.2 INSTALLATION
(Cont'd)

- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY
OF TEMPORARY TRIAL
USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period shall not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.4 INSPECTION,
TESTING AND START-
UP

- .1 The Equipment Supplier or their designated representative has agreed to provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the Equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.

3.4 INSPECTION,
TESTING AND START-
UP
(Cont'd)

- .1 (Cont'd)
 - .2 That the equipment is now ready for permanent operation.
- .2 The Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Advise in writing at least one (1) week in advance of the proposed date for testing and start-up. Conduct all tests in the presence of the Consultant.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .5 A minimum of one (1) trip, one (1) eight (8) hour day onsite for skilled supervision and instruction are provided by the equipment manufacturer as part of the Equipment package purchased by the Owner.

3.5 PERFORMANCE,
TESTING AND
COMMISSIONING

- .1 When installation is complete and before any equipment is operated, instruct the supplier to commission the equipment. The Equipment Supplier has agreed to provide the services of a skilled technical representative at the site to carry out the following work:
 - .1 Check the installation as to its workmanship.
 - .2 Perform further tests to confirm that the equipment is in accordance with the intent of this specification.
 - .1 Ensure the equipment, including all component parts operate as intended.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Equipment described herein was pre-selected by the Owner. At this time, it is anticipated that the equipment will be required on-site by late fall 2017 (to be confirmed with Contractors proposed schedule). The Contractor will be responsible for placement of purchase order, shipping, receiving, unloading, storing insuring, and coordination of sub-trades. The pre-selected quotation documents including product specifications are available for viewing in Appendix A herein.
- .2 The work of this section includes furnishing all labor, materials, tools and equipment necessary to install, test, and commission an in-line Influent Grinder as specified herein and as shown on the drawings.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.
 - .2 Become thoroughly familiar with all the requirements and components of the pre-selected equipment, necessitated by the Contractor's failure to ascertain the requirements for unloading, including, storing, insuring assembly, installing, and wiring.
 - .3 Ascertain from the Supplier the full extent of fieldwork in accordance with manufacturer's instructions and obtain all details, dimensions, and any other information necessary for the complete installation.
 - .4 Ascertain from the Supplier the key construction milestones for their inspection of the work. Advise the Supplier and the Consultant of the status of the work, and coordinate the inspection of the installation of the Supplier.
-

1.2 INTENT
(Cont'd)

- .5 An allowance for the cost of the inspection, commissioning and operator training has been made in the purchase price for the pre-selected equipment. However, if additional trips are required of the Supplier due to the Contractor's work not being prepared, the cost of the additional trips shall be borne by the Contractor.

1.3 REFERENCES

- .1 ASTM A536-84(R2014), Standard Specification for Ductile Iron Castings.
- .2 NEMA MG1-2014, Motors and Generators.
- .3 IEEE 112-04, IEEE Standard Test Procedures for Polyphase Induction Motors and Generators.
- .4 CSA C22.1-15, Canadian Electrical Code.

1.4 DESIGN
REQUIREMENTS (FOR
INFORMATION)

- .1 Provide one (1) in-line, electric, twin shaft design grinder capable of operating continuously and designed to process municipal wastewater. Grinder will be located in a non-classified area. Grinders must be capable of operating at zero flow conditions. Grinders to have a minimum capacity of 107 L/s (1700 USgpm), maximum head loss of 20.5 kPa.
- .1 Casing: corrosion resistant ASTM A536 ductile iron or stainless steel of sufficient strength, weight, and metal thickness to insure long life, accurate alignment, and reliable operation. Provide casing with 250 mm ANSI 125 pound suction and discharge flanges.
- .2 Cutters and Spacers: made of AISI 4130 heat treated alloy steel and hardened to a minimum of 45-50 Rockwell "C". Cutters to be a minimum of 5-tooth design. Cutters shall be placed on the shafts in a one-to-one ratio to the spacers and shall be in helical formation.
- .3 Shafts: made of AISI 4140 heat treated hexagon steel with a tensile strength rating of 149,000 psi. The driven shaft will rotate at approximately two thirds the speed of the drive shaft. The two shafts will counter rotate and be equipped with spacers and intermeshing cutters. The slow speed shaft of the grinder and the shafts of the reducer and motor to be in a direct line with each other and have two and three piece couplings. Single shafted units with stationary cutting rack will not be acceptable.

1.4 DESIGN
REQUIREMENTS (FOR
INFORMATION)
(Cont'd)

- .1 (Cont'd)
 - .4 Bearings and Seals: protect the bearing/seal combination from the process flow. Bearing to be either nylon acetal sleeve type or Conrad type ball bearings. Seals shall consist of neoprene v-ring with stainless steel grit check or replaceable cartridge type featuring tungsten carbide on tungsten carbide sealing surface. In either case the seals must not require external flush. Seal must be capable of withstanding pressures of 414 kPa (60 psig) and vacuums of 350 mm (14") of mercury.
 - .5 Provide all specified equipment from one manufacturer. The cutter and drive system must be removable as one assembly, leaving the housing inline.

1.5 RELATED WORK

- .1 Painting: Section 09 91 23
- .2 Plant piping, valves and appurtenances: Section 40 05 10
- .3 Electrical: Division 26

1.6 SHOP DRAWINGS

- .1 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .2 Two (2) hard copies and one (1) digital copy of the drawings will be supplied to the Contractor for use during construction.
- .3 Provide any addition required shop drawings as specified in Section 01 00 00.
- .4 Include details of equipment assembly, fabrication, control and installation.
- .5 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .6 All electrical panels and components to be CSA approved.

1.7 DELIVERY,
STORAGE AND
HANDLING

- .1 Coordinate with the Owner to have Equipment delivered to site. Provide all labour, personnel, and equipment as required to facilitate receipt of equipment. Store Equipment according to the manufacturer's recommendations.
- .2 Dispose and remove packaging materials as required. Contact Equipment Supplier to determine how equipment will be packaged.

PART 2 - PRODUCTS

2.1 SLUDGE GRINDER
(ONE REQUIRED)

- .1 Coordinate delivery of pre-selected equipment to the Site. Provide all labour and equipment to safely and efficiently unload and store pre-selected equipment.

PART 3 - EXECUTION

3.1 INSTALLATION -
GENERAL

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to achieve accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Consultant.
- .2 The guarantee period will not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used prior to acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust, and other foreign materials during temporary usage.

3.3 INSPECTION,
TESTING AND
START-UP

- .1 The Equipment Supplier or their designated representative has agreed to provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the Equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation;
- .2 The Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Advise in writing at least one (1) week in advance of the proposed date for testing and start-up. Conduct all tests in the presence of the Consultant.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .5 A minimum of one (1) trip, one (1) eight (8) hour day onsite for skilled supervision and instruction are provided by the equipment manufacturer as part of the Equipment package pre-selected by the Owner.

3.4 PERFORMANCE,
TESTING AND
COMMISSIONING

- .1 When installation is complete and before any equipment is operated, instruct the supplier to commission the equipment. The Equipment Supplier has agreed to provide the services of a skilled technical representative at the site to carry out the following work:
 - .1 Check the installation as to its workmanship.
 - .2 Perform further tests to confirm that the equipment is in accordance with the intent of this specification.
 - .1 Confirm equipment, including all component parts operate as intended.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Equipment described herein was pre-selected by the Owner. At this time, it is anticipated that the equipment will be required on-site by late fall 2017 (to be confirmed with Contractors proposed schedule). The Contractor will be responsible for placement of purchase order, shipping, receiving, unloading, storing insuring, and coordination of sub-trades. The pre-selected quotation documents including product specifications are available for viewing in Appendix A herein.
- .2 This Section describes the requirements for supplying all ancillary tools and labour to install, test, and commission the WAS and sludge pumps.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.

1.3 DESIGN
REQUIREMENTS (FOR
INFORMATION)

- .1 Submersible Dry Mount Pumps:
 - .1 Provide pumping equipment required to waste activated sludge and feed the sludge dewatering equipment as part of the SBR equipment scope of supply. The pumps must be submersible dry mount centrifugal sewage pumps rated to meet wasting and sludge feed requirements. Three (3) pumps: two (2) WAS, one (1) sludge feed.

1.3 DESIGN
REQUIREMENTS (FOR
INFORMATION)
(Cont'd)

- .2 Pump drives: squirrel-cage induction type design, housed in a watertight chamber of maximum efficiency and durability. Motor shall be designed for continuous duty capable of 15 starts per hour, with Class F insulation, high efficiency. Motors to have a service factor of 1.15 for continuous service at 38°C ambient. Motor ratings must be such that rated nameplate values of horsepower and full load current will not be exceeded nor shall the motors run into the service factor area. The motors must be suitable to operate from 208V, 3 phase, 60 Hz power supply. The motors must comply with NEMA standard MG1-12.53(a) and (b) based on IEEE-112, Method B. Pump starters provided by others. Pumps to be rated for operation in Class 1, Zone 2.
- .3 Pumps: bronze fitted construction, bronze impeller, cast-iron body, high grade SAE 1045 steel shaft or equal, tandem mechanical seals with Type 304 stainless steel metal parts and vertical flexible coupled.

1.4 SHOP DRAWINGS

- .1 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .2 Two (2) hard copies and one (1) digital copy of the drawings will be supplied to the Contractor for use during construction.
- .3 Provide shop drawings as specified in Section 01 00 00.
- .4 Include details of equipment assembly, fabrication, control and installation.

1.5 OPERATION AND
MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Section 01 00 00.
- .2 The Equipment Supplier will provide three (3) sets of operation and maintenance data for incorporation into the Operation and Maintenance Manuals.

1.6 STORAGE AND
HANDLING

- .1 Store Equipment according to recommendations. Provide all labour, personnel and Equipment to move on Site.
- .2 Dispose and remove packaging materials as required.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 The Equipment of this Section has been pre-selected by the Owner. Full Equipment specifications are provided in Appendix A herein.

PART 3 - EXECUTION

3.1 DELIVERY

- .1 Coordinate delivery of pre-selected equipment to the Site. Provide all labour and equipment to safely and efficiently unload and store pre-selected equipment.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.

3.2 INSTALLATION
(Cont'd)

- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY
OF TEMPORARY TRIAL
USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period shall not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.4 INSPECTION,
TESTING AND START-
UP

- .1 The Equipment Supplier or their designated representative has agreed to provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the Equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation.
- .2 The Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.

3.4 INSPECTION,
TESTING AND START-
UP
(Cont'd)

- .3 Advise in writing at least one (1) week in advance of the proposed date for testing and start-up. Conduct all tests in the presence of the Consultant.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .5 A minimum of one (1) trip, one (1) eight (8) hour day onsite for skilled supervision and instruction are provided by the equipment manufacturer as part of the Equipment package purchased by the Owner.

3.5 PERFORMANCE,
TESTING AND
COMMISSIONING

- .1 When installation is complete and before any equipment is operated, instruct the supplier to commission the equipment. The Equipment Supplier has agreed to provide the services of a skilled technical representative at the site to carry out the following work:
 - .1 Check the installation as to its workmanship.
 - .2 Perform further tests to confirm that the equipment is in accordance with the intent of this specification.
 - .1 Ensure the equipment, including all component parts operate as intended.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Equipment described herein was pre-selected by the Owner. At this time, it is anticipated that the equipment will be required on-site by late fall 2017 (to be confirmed with Contractors proposed schedule). The Contractor will be responsible for placement of purchase order, shipping, receiving, unloading, storing insuring, and coordination of sub-trades. The pre-selected quotation documents including product specifications are available for viewing in Appendix A herein.
- .2 This Section describes the requirements for supplying all ancillary material, tools and labour to install, test, and commission the following pre-selected equipment: one (1) solid bowl centrifuge for sludge dewatering of thickened waste activated sludge and all apputenances required for an operational sludge dewatering system; one (1) polymer preparation and feed system.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.
- .2 Become thoroughly familiar with all the requirements and components of the pre-selected equipment, necessitated by the Contractor's failure to ascertain the requirements for unloading, including, storing, insuring assembly, installing, and wiring.
- .3 Ascertain from the Supplier the full extent of fieldwork in accordance with manufacturer's instructions and obtain all details, dimensions, and any other information necessary for the complete installation.
- .4 Ascertain from the Supplier the key construction milestones for their inspection of the work. Advise the Supplier and the Consultant of the status of the work, and coordinate the inspection of the installation of the Supplier.

1.2 INTENT
(Cont'd)

- .5 An allowance for the cost of the inspection, commissioning and operator training has been made in the purchase price for the pre-selected equipment. However, if additional trips are required of the Supplier due to the Contractor's work not being prepared, the cost of the additional trips will be borne by the Contractor.

1.3 DESIGN CRITERIA
PERFORMANCE
REQUIREMENTS
(FOR INFORMATION)

- .1 Under normal operating conditions, gravity thickened waste activated sludge (minimum 0.85%, maximum 1.25% and average 1.0% total solids) will be pumped to the dewatering equipment.
- .2 Size the dewatering system for operation 2-days per week and 5 hours per day on average. The system shall be designed for continuous operation under the following conditions:
- .1 Design flow (inlet): 2.2 L/S (35 USgpm).
 - .2 Design solids loading rate (inlet): 100 kg/hr.
 - .3 Average inlet feed sludge concentration: 1.0% solids.
 - .4 Feed sludge temperature: 8 - 25°C.
 - .5 Solids capture (with polymer addition): +90%.
 - .6 Finished sludge cake: >16 to 21% total solids.
 - .7 Minimum cake solids: >16% TS.
 - .8 Minimum Recovery: >95%SS.
 - .9 Maximum Polymer Dosage: <10-15 kg (active)/dry ton.
- .3 The unit will be installed in a heated and ventilated building. Space limitations are a consideration.
- .4 Equipment Supplier to provide points of discharge and typical placement of interconnecting pipes and electrical connections.
- .5 A control panel will control and indicate the status of all components in the sludge dewatering system. All activities of the dewatering system shall be operable in an automatic mode without supervision.
- .6 Include a skid-mounted liquid emulsion polymer preparation and feed system to feed polymer into the feed sludge prior to entering the dewatering equipment.

1.4 SHOP DRAWINGS

- .1 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .2 One (1) digital copy of the drawings will be supplied to the Contractor for use during construction.
- .3 Provide any additional required shop drawings as specified in Section 01 00 00.
- .4 Include details of equipment assembly, fabrication, control and installation.

1.5 OPERATION AND MAINTENANCE MANUALS

- .1 Coordinate operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Section 01 00 00.
- .2 The Equipment Supplier will provide three (3) sets of operation and maintenance data for incorporation into the Operation and Maintenance Manuals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Coordinate with the Owner to have Equipment delivered to site. Provide all labour, personnel, and equipment as required to facilitate receipt of equipment. Store Equipment according to the manufacturer's recommendations.
- .2 Dispose and remove packaging materials as required. Contact Equipment Supplier to determine how equipment will be packaged.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 The Equipment of this Section has been pre-selected by the Owner. Full Equipment specifications are available for viewing as per Section 01 00 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.2 RESPONSIBILITY
OF TEMPORARY TRIAL
USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period will not be affected by temporary trial use of the equipment.

3.4 PERFORMANCE,
TESTING AND
COMMISSIONING
(Cont'd)

- .1 (Cont'd)
 - .1 Check the installation as to its workmanship.
 - .2 Perform further tests to confirm that the equipment is in accordance with the intent of this specification.
 - .1 Confirm equipment, including all component parts operate as intended.

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Equipment described herein was pre-selected by the Owner. At this time, it is anticipated that the equipment will be required on-site by late fall 2017 (to be confirmed with Contractors proposed schedule). The Contractor will be responsible for placement of purchase order, shipping, receiving, unloading, storing insuring, and coordination of sub-trades. The pre-selected quotation documents including product specifications are available for viewing in Appendix A herein.
- .2 This Section describes the requirements for supplying all ancillary tools and labour to install, test, and commission a frequency batch reactor (SBR) treatment system for the Parrsboro WWTF. The equipment includes a process control system, oxygen transfer system, effluent decanter, automatic valves. Instrumentation, in basin air piping and supports.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.

1.3 DESIGN
REQUIREMENTS (FOR
INFORMATION)

- .1 The SBR system and associated equipment will be designed based upon the design parameters below and operate in the extended air mode. Raw wastewater will be transferred to the SBR's via dedicated forcemain. Prior to discharge, the wastewater will flow through an in-line grinder.
- .2 Treated effluent will be withdrawn from the upper portion of the SBR with a solids excluding decanter and be disinfected prior to being discharged to the receiving water. Sludge will be wasted automatically (periodic basis) by submersible WAS pump to an aerated digester/sludge holding tank.
- .3 Design the SBR system based on the following site and raw wastewater characteristics:
 - .1 Average flow: 700,000 L/d (185,000 UGgpd).

1.3 DESIGN
REQUIREMENTS (FOR
INFORMATION)
(Cont'd)

- .3 (Cont'd)
 - .2 Peak daily flow: 2,500,000 L/d (660,000 UGgpd).
 - .3 Influent BOD5 at Avg. flow: 145 mg/L.
 - .4 Influent BOD5 at Pk. flow: 60mg/L.
 - .5 Effluent BOD5: 25mg/L.
 - .6 Influent TSS at Avg. flow: 145mg/L.
 - .7 Influent TSS at Pk. flow: 60mg/L.
 - .8 Effluent suspended solids: 25mg/L.
 - .9 TKN influent: 22mg/L.
 - .10 Un-ionized ammonia effluent: <1.25.
 - .11 Minimum HRT: 1d (24 hours).
- .4 Design the digester/sludge holding tank based on the following criteria:
 - .1 Sludge yield: 1.0 kg/kg BOD removed.
 - .2 Waste sludge concentration: 0.85%.
 - .3 Waste sludge VSS: 70%.
 - .4 Gravity thickened sludge concentration: 1.25%.
 - .5 Design volume: 150m³.

1.4 SHOP DRAWINGS

- .1 Copies of the approved shop drawings are provided for viewing as per Section 01 00 00 and includes details of equipment assembly, control, and installation.
- .2 Two (2) hard copies and one (1) digital copy of the drawings will be supplied to the Contractor for use during construction.
- .3 Provide shop drawings as specified in Section 01 00 00.
- .4 Include details of equipment assembly, fabrication, control and installation.

1.5 OPERATION AND
MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Section 01 00 00.
- .2 The Equipment Supplier will provide three (3) sets of operation and maintenance data for incorporation into the Operation and Maintenance Manuals.

1.6 STORAGE AND
HANDLING

- .1 Store Equipment according to recommendations. Provide all labour, personnel and Equipment to move on Site.

1.6 STORAGE AND
HANDLING
(Cont'd)

- .2 Dispose and remove packaging materials as required.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 The Equipment of this Section has been pre-selected by the Owner. Full Equipment specifications are provided in Appendix A herein.

PART 3 - EXECUTION

3.1 DELIVERY

- .1 Coordinate delivery of pre-selected equipment to the Site. Provide all labour and equipment to safely and efficiently unload and store pre-selected equipment.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
-

3.2 INSTALLATION
(Cont'd)

- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY
OF TEMPORARY TRIAL
USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period shall not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.4 INSPECTION,
TESTING AND START-
UP

- .1 The Equipment Supplier or their designated representative has agreed to provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the Equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation.
- .2 The Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.

3.4 INSPECTION,
TESTING AND START-
UP
(Cont'd)

- .3 Advise in writing at least one (1) week in advance of the proposed date for testing and start-up. Conduct all tests in the presence of the Consultant.
- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .5 A minimum of three (3) trips, twelve (12) eight (8) hour days onsite for skilled supervision are provided by the equipment manufacturer as part of the Equipment package purchased by the Owner.

3.5 PERFORMANCE,
TESTING AND
COMMISSIONING

- .1 When installation is complete and before any equipment is operated, instruct the supplier to commission the equipment. The Equipment Supplier has agreed to provide the services of a skilled technical representative at the site to carry out the following work:
 - .1 Check the installation as to its workmanship.
 - .2 Perform further tests to confirm that the equipment is in accordance with the intent of this specification.
 - .1 Ensure the equipment, including all component parts operate as intended.

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT
CONTRACT 161039.00**

ADDENDUM NO. 1

(to be added to and made part of the Tender Documents)
The following changes or modifications shall be made to the Tender Documents:

FOR CLARIFICATION

Please see the attached Geotechnical Report. This report does not constitute a part of the Contract Documents and is for information only.

TO THE SPECIFICATIONS

SECTION 00 21 10 – INFORMATION TO TENDERERS

Page 3, within subsection 21, delete “(902) 423-3938, or email (tenders@cbcl.ca)” and replace with “(902) 667-1352”.

SECTION 00 41 13 – TENDER FORM

Page 2, within the item for Alternative Prices change “PVC” to “Ductile Iron”

SECTION 24 24 19 – MOTOR CONTROL CENTRE

Page 2, within subsection 2.1.5 delete “600” and replace with “208”; also delete “4-wire” and replace with “3-wire”.

SECTION 26 29 13 – MOTOR SOFT STARTERS

Page 3, within subsection 2.3.3 delete “600” and replace with “208”.

Page 3, within subsection 2.3.6.3 delete “RS-232/485” and replace with “Ethernet”.

Page 6, within subsection 2.4.7.1 delete “600” and replace with “208”

SECTION 33 20 00 – WELL PUMP SYSTEM

Page 2, within subsection 2.1.1 delete “230V” and replace with “208V”.

SECTION 33 65 73 – CONCRETE ENCASED DUCTBANKS

Add new Section 33 65 73 – Concrete Encased Duct Banks, dated June 5, 2017, attached.

SECTION 33 65 76 – DIRECT BURIED UNDERGROUND CABLE DUCTS

Add new Section 33 65 76 – Direct Buried Underground Cable Ducts, dated June 5, 2017, attached.

SECTION 41 12 13 – SCREW CONVEYOR SYSTEM

Page 1, within subsection 1.3.1 delete “(by others)” and replace with “(bin will be provided by others).”

Page 1, within subsection 1.3.1.1 delete “zone 1” and replace with “Class 1 zone 2 (Canadian Electrical Code)”.

Page 1, delete subsection 1.3.1.2 and replace with the following:

- .2 The sludge dewatering room is also a Class 1 zone 2 electrically classified area.

Page 5, within subsection 2.2.3 delete “600” and replace with “208”; also after “TEFC” add “explosion proof motor rated for Class 1, zone 2”.

Page 5, within subsection 2.2.5.4 after “4X” add “(explosion proof, rated for Class 1, zone 2)”.

Page 6, delete subsection 2.2.5.7 and replace with the following:

- .7 When in “auto” mode, the system will receive an on/off input from the main plant PLC indicating the centrifuge is running.

Aaron Baillie, P.Eng.
CBCL Limited
June 5, 2017

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Installation of Cables in Trenches and Ducts: Section 26 05 44
<u>1.2 REFERENCES</u>	.1	CAN/CSA-A3000-13, Cementitious Materials Compendium.
	.2	CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
	.3	CAN/CSA-G30.18-09(R2014), Billet-Steel Bars for Concrete Reinforcement.
	.4	ASTM D1056-14, Standard Specification for Flexible Cellular Materials, Sponge or Expanded Rubber.
<u>1.3 SHOP DRAWINGS</u>	.1	Submit shop drawings for precast manholes in accordance with Section 01 00 00.

PART 2 - PRODUCTS

<u>2.1 PVC DUCTS</u>	.1	PVC ducts, type DBII, encased in reinforced concrete.
<u>2.2 PVC DUCT FITTINGS</u>	.1	Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
	.2	Expansion joints where ducts exit the ground.
	.3	Rigid PVC 5 degree angle couplings.
<u>2.3 CABLE RACKS</u>	.1	Hot dipped galvanized cable racks and supports.
	.2	12 x 100 mm preset inserts for rack mounting.

<u>2.4 CABLE PULLING EQUIPMENT</u>	.1	Pulling iron: galvanized steel rods, size and shape as indicated.
	.2	Pull rope: 6 mm stranded polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

<u>2.5 MARKERS</u>	.1	Refer to Section 26 05 44 for markers.

PART 3 - EXECUTION

<u>3.1 INSTALLATION GENERAL</u>	.1	Install underground duct banks including formwork.
	.2	Build duct bank 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 connection points before ducts are laid and confirm 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 ducts at not less than 190 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. 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.
-

3.1 INSTALLATION
GENERAL
(Cont'd)

- .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. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .14 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .15 Immediately after placing of concrete, 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. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .16 Install four (4) 3 m lengths of 10M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings. Wire rods to 10M dowels at manhole or building and support from duct spacers. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.
- .17 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 MARKERS

- .1 Install markers as specified in Section 26 05 44.

- 3.3 INSPECTIONS .1 Inspection of duct will be carried out by the
Consultant concrete and duct cleanouts when the
Consultant is present.

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Installation of Cables in Trenches and Ducts: Section 26 05 44
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA) .1 CSA C22.2 No. 211.2-06(R2016), Rigid PVC Conduit.
<u>1.3 SUBMITTALS</u>	.1	Make submittals in accordance with Section 01 00 00.
	.2	Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for solvent cement. Indicate VOC content.

PART 2 - PRODUCTS

<u>2.1 PVC DUCTS AND FITTINGS</u>	.1	Rigid PVC duct: to CSA C22.2 No. 211.2, with moulded fittings, for direct burial.
	.2	Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.
	.3	Rigid PVC 90° and 45° bends.
	.4	Rigid PVC 5° angle couplings.
	.5	Expansion joints where conduits exit ground.
<u>2.2 SOLVENT WELD COMPOUND</u>	.1	Solvent cement for PVC duct joints.
<u>2.3 CABLE PULLING EQUIPMENT</u>	.1	6 mm stranded polypropylene pull rope, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.
-

2.4 MARKERS .1 Refer to Section 26 05 44 for markers.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install duct in accordance with manufacturer's instructions.
 - .2 Clean inside of ducts before laying.
 - .3 Confirm 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.
 - .8 Install markers as specified in Section 26 05 44.

March 10, 2017

Mr. Aaron Baillie, P.Eng.

CBCL Limited

1489 Hollis Street, PO Box 606

Halifax, NS B3J 2R7

Dear Mr. Baillie,

**Re: Geotechnical Investigation - Proposed Wastewater Treatment Plant, North Site
Parrsboro, NS**

This is our geotechnical investigation report for the proposed wastewater treatment plant on the north side of Two Islands Road in Parrsboro, NS. The subsurface conditions at this new location are generally similar to the previous location on the south side of the road. Conventional foundations can be used provided that the founding level is not too deep below existing grade and that the overall site is not raised too much. There are compact to very dense sand and gravel layers at shallow depths and weaker sand, silt and clay layers at greater depths.

The subsurface conditions encountered within the proposed building area generally consist of fill overlying native soil. The fill ranged in thickness from 0.9 m to 1.2 m. The native soil generally consists of compact to very dense sand/gravel overlying loose to compact sand and firm to stiff silt/clay. Groundwater was encountered at depths between 1.7 m and 1.8 m at the time of drilling. Bedrock was not encountered in the boreholes. Boreholes were advanced to depths of up to 17.4 m.

The subsurface conditions encountered within the proposed forcemain route generally consist of fill overlying native soil. The fill was 3.2 m thick. The native soil consists of loose to compact sand. Groundwater was encountered at a depth of 1.8 m at the time of drilling. Bedrock was not encountered in the borehole. The borehole was advanced to a depth of 5.6 m.

The main findings/recommendations from our investigation are as follows:

- Based on the work at the previous site, we understand that tank depths could be approximately 3.0 m for the treatment plant. The tank depth should not extend deeper than 3.0 m.
- Excavation of the existing fill down to the native soil will be required in the building area. Approved structural fill should be placed in lifts to design grade as required.
- It is understood that finished grades for the building will be near existing grades. If the finished building or exterior gravels are raised by more than a nominal amount (say 0.6 m)

then settlement of the underlying soil may occur. We should be informed when site grades are finalized.

- Excavated existing fill material should be reused on-site if possible. Sorting out of oversized material and construction debris from the fill will be required prior to reuse. Organic material should be reused in landscape areas or exported off-site. Material that is exported off-site will have to be reviewed for environmental conditions and taken to a licensed treatment facility if contaminants are found in the soil.
- In the proposed forcemain trench, any unsuitable fill or weak zones should be over-excavated by 600 mm and replaced with approved fill in lifts. Once the final forcemain location is known, several test pits should be completed along the forcemain route to confirm the fill condition.
- In the proposed paved areas, the areas should be cut to the design subgrade elevation and proof-rolled. Any weak or soft zones should be replaced with approved fill.
- Geotechnical inspection of earthworks is recommended (and is required for building permits).

Please contact us if you have any questions.

Thank you,



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1.0 INTRODUCTION

We have conducted a geotechnical investigation for the proposed wastewater treatment plant on the north side of Two Islands Road in Parrsboro, Nova Scotia, at the request of CBCL Limited. The purpose of this investigation was to evaluate the subsurface conditions at the site and to provide recommendations for site development and foundation design.

This report presents all of our findings and our recommendations for general site work. This report includes recommendations for geotechnical works only.

2.0 SITE DESCRIPTION AND GEOLOGY

The proposed wastewater treatment plant is located on the north side of Two Islands Road, in Parrsboro, Nova Scotia. The site is bordered on the north and west by the Parrsboro Aboiteau, on the south by Two Islands Road and residential properties, and the east by wooded area.

The site is currently grass covered with a treed area on the east side of the site. The site is generally flat with slopes adjacent the Aboiteau.

Photograph A shows a view from the southwest side of the site looking northeast.

Geologic mapping indicates that bedrock in the area is fluvial sandstone, calcrete limestone, conglomerate, or mudstone of the Parrsboro Formation, which is part of the Cumberland Group.



Photograph A: View from the southwest side of the site looking northeast.

3.0 SUMMARIZED SUBSURFACE CONDITIONS

The field program consisted of three boreholes (BH1 to BH3) completed between February 20 and 23, 2017. The borehole locations are shown in Figure A (Drawing 1, appended, is a complete location plan).

The boreholes were conducted using a tracked drill rig. Representative samples were taken during the field work and the conditions at the boreholes were logged in detail. The soil conditions encountered at the site are described in detail on the appended Borehole Records and summarized in the following paragraphs and Table A.



Figure A: Borehole Locations

The subsurface conditions encountered within the proposed building area generally consist of fill overlying native soil. The fill ranged in thickness from 0.9 m to 1.2 m. The native soil generally consists of compact to very dense sand/gravel overlying loose to compact sand and firm to stiff silt/clay. Groundwater was encountered at depths between 1.7 m and 1.8 m at the time of drilling. Bedrock was not encountered in the boreholes. Boreholes were advanced to depths of up to 17.4 m.

The subsurface conditions encountered within the proposed forcemain route generally consist of fill overlying native soil. The fill was 3.2 m thick. The native soil consists of loose to compact sand. Groundwater was encountered at a depth of 1.8 m at the time of drilling. Bedrock was not encountered in the borehole. The borehole was advanced to a depth of 5.6 m.

Grain size testing conducted on four samples of the native soil shows 1% to 49% gravel, 37% to 75% sand, and 13% to 48% fines (silt and clay). Moisture content testing was conducted on several samples of the native soil and results ranged from 7.6% and 26.6%. The grain size curves are shown in Figure 1 in the appendix.

Table A: Summary of Findings

Location	Elevation¹ (m)	Depth to Native Soil (m)	Groundwater Depth² (m)	Depth of Borehole (m)
BH1	8.2	0.9	1.7	17.4
BH2	8.6	1.2	1.8	8.2
BH3	8.4	3.2	1.8	5.6

Notes: ¹Geodetic Datum. Ground surface elevation taken with GPS mapping unit.

²Measured during drilling.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Main Findings

It is understood that the proposed development will consist of a wastewater treatment plant with an associated access road, parking area, and forcemain connection to the sanitary system on Two Islands Road. It is also understood that underground tanks for the wastewater treatment plant are proposed. The subsurface conditions at this new location are generally similar to the previous location on the south side of the road. Conventional foundations can be used provided that the founding level is not too deep below existing grade and that the overall site is not raised too much. There are compact to very dense sand and gravel layers at shallow depths and weaker sand, silt and clay layers at greater depths.

The main findings/recommendations from our investigation are as follows:

- Based on the work at the previous site, we understand that tank depths could be approximately 3.0 m for the treatment plant. The tank depth should not extend deeper than 3.0 m.
- Excavation of the existing fill down to the native soil will be required in the building area. Approved structural fill should be placed in lifts to design grade as required.
- It is understood that finished grades for the building will be near existing grades. If the finished building or exterior gravels are raised by more than a nominal amount (say 0.6 m) then settlement of the underlying soil may occur. We should be informed when site grades are finalized.
- Excavated existing fill material should be reused on-site if possible. Sorting out of oversized material and construction debris from the fill will be required prior to reuse. Organic material should be reused in landscape areas or exported off-site. Material that is exported off-site will have to be reviewed for environmental conditions and taken to a licensed treatment facility if contaminants are found in the soil.
- In the proposed forcemain trench, any unsuitable fill or weak zones should be over-excavated by 600 mm and replaced with approved fill in lifts. Once the final forcemain location is known, several test pits should be completed along the forcemain route to confirm the fill condition.
- In the proposed paved areas, the areas should be cut to the design subgrade elevation and proof-rolled. Any weak or soft zones should be replaced with approved fill.
- Geotechnical inspection of earthworks is recommended (and is required for building permits).

The following sections outline our geotechnical recommendations for site preparation and design.

4.2 Earthworks

Earthworks for this project will involve excavations into fill and native sand/gravel, general site grading, backfilling, and placement of pipe embedment.

4.2.1 Surface Water Control and Erosion Control

Prior to excavations, surface water drainage controls should be provided on the up-gradient side of the site to minimize run-off onto exposed soils. Suitable erosion and sedimentation control measures should be employed. These may include silt fences, check dams in ditches, and granular working pads.

4.2.2 Excavation

Excavation into the site soils will be practical with conventional earth-moving equipment.

Within the proposed building area, the fill is to be excavated down to compact to very dense native sand/gravel, as noted in the Borehole Records, or as determined by field inspection. Approved structural fill should be placed in lifts to design grade if required.

In the proposed paved areas, the area should be cut down to the design subgrade elevation and proof-rolled with a 10-tonne steel drum vibratory roller. Any weak or soft zones should be replaced with approved fill.

In the proposed forcemain trench, any unsuitable fill or weak zones should be over-excavated by 600 mm and replaced with approved fill in lifts.

Temporary excavated side slopes in soil should be stable at one horizontal to one vertical (1H:1V). Material that is planned for re-use should be placed directly in the intended areas or compacted in stockpiles for later use. Unsuitable materials should be used in landscaped areas or wasted off-site.

Excavated existing fill material could be considered for reuse on site if possible; otherwise, this material should be exported off-site and disposed properly. Any fill considered for reuse should be free of organics and debris.

4.2.3 Dewatering of Excavations

With proper surface water controls, dewatering of excavations through the use of ditches and swales draining to sumps would be practical. Several well-established sumps should be considered during excavations.

4.2.4 Fill Placement and Compaction

Fill materials required for the building area should consist of:

- approved, drier portions of the excavated material from the site, or;
- imported, quarried rockfill, or sand and gravel pit run.

Excavated onsite fill could be reused as fill but will require a review during construction and sorting out debris and organics.

The lift thickness used during placement of fills must be compatible with the compaction equipment and the material type to ensure the specified density throughout. The lift thickness should not exceed approximately 450 mm for mass filling and 200 mm for backfilling of foundations and services. The maximum particle size should be no larger than $\frac{2}{3}$ of the lift thickness.

Fill materials should be compacted to the following percentage of maximum Standard Proctor dry density:

• Fill in building areas	100%
• Fill within 300 mm of paved area subgrade	98%
• Fill below 300 mm of paved area subgrade	95%
• Landscaped areas	93%

The fill must be extended laterally beyond the edges of the footings to include the conventional 1H:1V splay.

4.2.5 Slopes and Toe Drainage

Although not expected, permanent fill slopes should be 2H:1V, or lower. Permanent cut slopes should be stable at 3H:1V for slope heights of less than 2 m. Cut slopes of greater heights will require a 300 mm thick granular blanket or deep rooting vegetation to reinforce the slope. A toe drain or swale should be provided for drainage at the base of cut slopes.

4.2.6 Building Area Subgrade

The contractor must take precautions to avoid disturbance of the site soils, or reinstate the material to the required condition. The condition of the subgrade should be reviewed prior to placement of base gravel.

4.2.7 Frost Protection

The building foundation should have a minimum cover of 1.2 m from finished grade or equivalent insulation to provide frost protection. The trench for the forcemain and any underground water/sewer service should meet municipal requirements.

4.2.8 Inspection and Testing

It is recommended that inspection of all footing bearing surfaces be conducted by experienced geotechnical personnel prior to placement of concrete. Inspection and testing is also recommended during site grading, backfilling operations, and placement of pipe bedding/cover.

4.3 Foundations

Shallow footings on the compact to very dense native sand/gravel with a grade slab would be the preferred foundation system. There are limitations on finished grade and tank depths as noted earlier in this report.

4.3.1 Shallow Foundations

For analysis using Limit States Design for footings on soil, we calculated bearing capacities for square and strip footings up to 2 m for a settlement tolerance of 25 mm. Other bearing capacities for other footing sizes (or settlement tolerances) can be provided at your request. Bearing resistance values for square and strip footings founded on structural fill or compact to very dense native sand/gravel are plotted on Figures 2 and 3 in the appendix.

For analysis using the old Working Stress design approach, we recommend an allowable bearing pressure of 150 kPa (3000 psf) for a tolerable settlement of 25 mm and footing size up to 1.5 m; for a footing founded on structural fill or compact to very dense native sand/gravel. This includes a global factor of safety of 3.

Footings on soil should be founded a minimum of 1.2 m below grade for frost protection, or equivalent insulation provided.

4.3.2 Slab on Grade

A conventional grade slab founded on approved structural fill or compact to very dense native sand/gravel is practical for this site. A 150 mm thick layer of Type 1 Gravel is recommended below the floor slab for levelling and support purposes. The gravel should be compacted to 100% Standard Proctor.

For a slab on grade, a perimeter foundation drainage system is recommended, unless the surrounding finished exterior grades are below the floor elevation.

4.4 Pavement Structure

With the subgrade prepared as outlined in Section 4.2, the following pavement structure is recommended.

Table B: Pavement Structure Thicknesses

Material	Standard Duty Pavement ¹	Heavy Duty Pavement
Asphalt Concrete:		
Top Course (C Mix)	75 mm	40 mm
Base Course (B Mix)	-	60 mm
Type 1 Gravel	300 mm	150 mm
Type 2 Gravel	-	200 mm

Notes: ¹Cars and light trucks.

All aggregate and asphalt concrete materials should meet the DTIR Standard Specifications. The gravel should be compacted to 100% of Standard Proctor maximum dry density. Asphalt concrete should be compacted to 92.5% of Maximum Theoretical Relative Density.

4.5 Seismic Classification

The site classification for seismic site response was based on our local experience in the area and our geotechnical investigation.

The recommended site classification for seismic site response, as per Table 4.1.8.4.A of NBCC 2005 is Site Class E.

4.6 Additional Geotechnical Services

Additional geotechnical input at the final design and tendering stage is recommended to ensure that the project fully considered all of the information from the geotechnical investigation.

It is recommended that inspection of the footing bearing surfaces be conducted by Conquest Engineering prior to placement of concrete. Inspection and testing is recommended during site grading and backfilling operations, and during placement of pipe bedding/cover.

5.0 CLOSURE

This report has been prepared for the sole benefit of CBCL Limited. Any use or reliance on this report under any of the following conditions would render this report inapplicable:

- where there have been any change in site conditions; or
- where used for purposes not intended or delineated in this report; or
- where used by third parties without express written agreement of Conquest Engineering.

Any use of, or reliance upon, this report under such circumstances or by such parties is strictly prohibited and without risk or liability to Conquest.

Conquest Engineering used reasonable care, skill, competence and judgment in the preparation of this report. The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. The information and conclusions contained in this report are generally consistent with professional standards for individuals providing similar services at the same time, in the same locale and under like circumstances.

A field investigation is a limited sampling of a site. Some variation between sampling locations should be expected. The conclusions presented in this report represent the best technical judgment of Conquest Engineering based on the data obtained from the work. The conclusions are based on the site conditions observed by Conquest Engineering at the time the work was performed at the specific testing and/or sampling locations, and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil and groundwater conditions, as well as the history of the site reflecting natural, construction and other activities. Due to the nature of the investigation and the limited data available, Conquest Engineering cannot warrant against undiscovered environmental liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein. Further, if there are changes to the proposed work, such as adjustments in founding elevation or building loads, etc., we require that we be notified to allow for review of our recommendations.



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Geotechnical and Materials Engineers

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	-	mixture of soil and humus capable of supporting good vegetative growth
<i>Peat</i>	-	fibrous aggregate of visible and invisible fragments of decayed organic matter
<i>Till</i>	-	unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	-	any materials below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	-	having cracks, and hence a blocky structure
<i>Varved</i>	-	composed of regular alternating layers of silt and clay
<i>Stratified</i>	-	composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	-	>75 mm
<i>Seam</i>	-	2 mm to 75 mm
<i>Parting</i>	-	< 2 mm
<i>Well Graded</i>	-	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
<i>Uniformly Graded</i>	-	predominantly of one grain size

Terminology describing soils on the basis of grain size and plasticity is based on the Unified Soil Classification System (USCS) (ASTM D-2488). The classification excludes particles larger than 76 mm (3 inches). This system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	Greater than 20%

The standard terminology to describe cohesionless soils includes the compactness (formerly “relative density”), as determined by laboratory test or by the Standard Penetration Test ‘N’ – value.

Relative Density	‘N’ Value	Compactness %
<i>Very Loose</i>	<4	<15
<i>Loose</i>	4-10	15-35
<i>Compact</i>	10-30	35-65
<i>Dense</i>	30-50	65-85
<i>Very Dense</i>	>50	>85

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests, or occasionally by standard penetration tests.

Consistency	Undrained Shear Strength (Su)		'N' Value
	Kips/sq.ft.	KPa	
<i>Very Soft</i>	< 0.25	< 12.5	< 2
<i>Soft</i>	0.25 – 0.5	12.5 – 25	2 – 4
<i>Firm</i>	0.5 – 1.0	25 – 50	4 – 8
<i>Stiff</i>	1.0 – 2.0	50 – 100	8 – 15
<i>Very Stiff</i>	2.0 – 4.0	100 – 200	15 – 30
<i>Hard</i>	> 4.0	> 200	> 30

ROCK DESCRIPTION

Rock Quality Designation (RQD)

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on N-size (45 mm) core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from in situ fractures.

RQD	ROCK QUALITY
90 – 100	Excellent, intact, very sound
75 – 90	Good, massive, moderately jointed or sound
50 – 75	Fair, blocky and seamy, fractured
25 – 50	Poor, shattered and very seamy or blocky, severely fractured
0 – 25	Very poor, crushed, very severely fractured

Terminology describing rock mass:

Spacing (mm)	Bedding, Laminations, Bands	Discontinuities
2000 – 6000	<i>Very Thick</i>	<i>Very Wide</i>
600 – 2000	<i>Thick</i>	<i>Wide</i>
200 – 600	<i>Medium</i>	<i>Moderate</i>
60 – 200	<i>Thin</i>	<i>Close</i>
20 – 60	<i>Very Thin</i>	<i>Very Close</i>
< 20	<i>Laminated</i>	<i>Extremely Close</i>
< 6	<i>Thinly Laminated</i>	

Strength Classification	Uniaxial Compressive Strength (MPa)
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

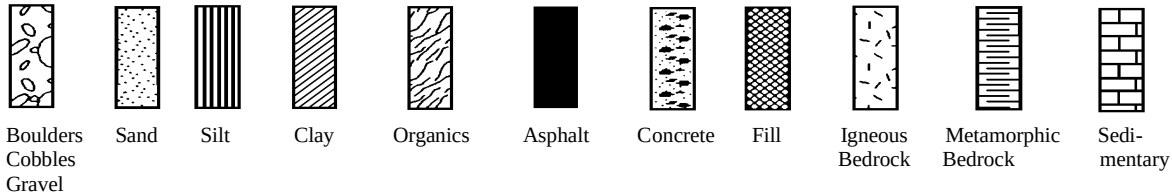
Terminology describing weathering:

<i>Slight</i>	- Weathering limited to the surface of major discontinuities. Typically iron stained.
<i>Moderate</i>	- Weathering extends throughout rock mass. Rock is not friable.
<i>High</i>	- Weathering extends throughout rock mass. Rock is friable.



STRATA PLOT

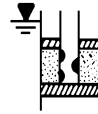
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT



Borehole or
Standpipe



Piezometer

SAMPLE TYPE AND/OR FIELD TESTS

SS	Split Spoon Sample (obtained by performing the Standard Penetration Test)	AS	Auger Sample
ST	Shelby Tube or Thin Wall Tube	BS	Bulk Sample
PS	Piston sample	WS	Wash Sample
DC	Dynamic Cone Penetration	HQ, NQ, BQ, etc.	Rock Core Samples (obtained with the use of standard size diamond drilling bits)
FSV	Field Shear Vane		

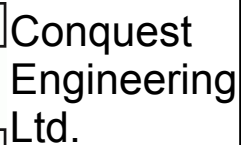
N- VALUE

Numbers in this column are the results of the SPT (Standard Penetration Test): the number of blows of a 140 pound (64kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and 'N' values cannot be presented, the abbreviation SSR (Split Spoon Refusal) will appear in place of a numerical value.

OTHER TESTS

Symbols in this column indicate that the following laboratory tests have been carried out and the results are presented separately.

S	Sieve analysis	H	Hydrometer analysis
G _s	Specific gravity of soil particles	γ	Unit weight
k	Permeability	C	Consolidation
	Single packer permeability test; test interval from depth shown to bottom of borehole	CD	Consolidated drained triaxial
	Double packer permeability test; Test interval as indicated	CU	Consolidated undrained triaxial with pore pressure measurements
	Falling head permeability test using casing	UU	Unconsolidated undrained triaxial
	Falling head permeability test using well point or piezometer	DS	Direct shear
		Q _u	Unconfined compression
		I _p	Point Load Index (I _p on Borehole Records equals I _p (50); the index corrected to a reference diameter of 50 mm)
		MSV	Laboratory Miniature Shear Vane



Project Name: Proposed Wastewater Treatment Plant, North Site

Project No.: 034-223

Client: CBCL Limited

Location: Parrsboro, NS

Water Level Date: Feb 21, 2017

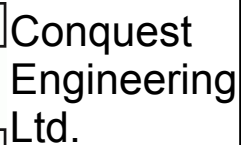
Borehole No.: 1

Page: 1 of 2

Date Drilled: Feb 21, 2017

Datum: Geodetic

[illegible]



Project Name: Proposed Wastewater Treatment Plant, North Site

Project No.: 034-223

Client: CBCL Limited

Location: Parrsboro, NS

Water Level Date: Feb 21, 2017

Borehole No.: 1

Page: 2 of 2

Date Drilled: Feb 21, 2017

Datum: Geodetic

[illegible]



BOREHOLE RECORD

Project Name: Proposed Wastewater Treatment Plant, New Location

Project No.: 034-223

Client: CBCL Limited

Location: Parrsboro, NS

Water Level Date: Feb 23, 2017

Borehole No.: 3

Page: 1 of 1

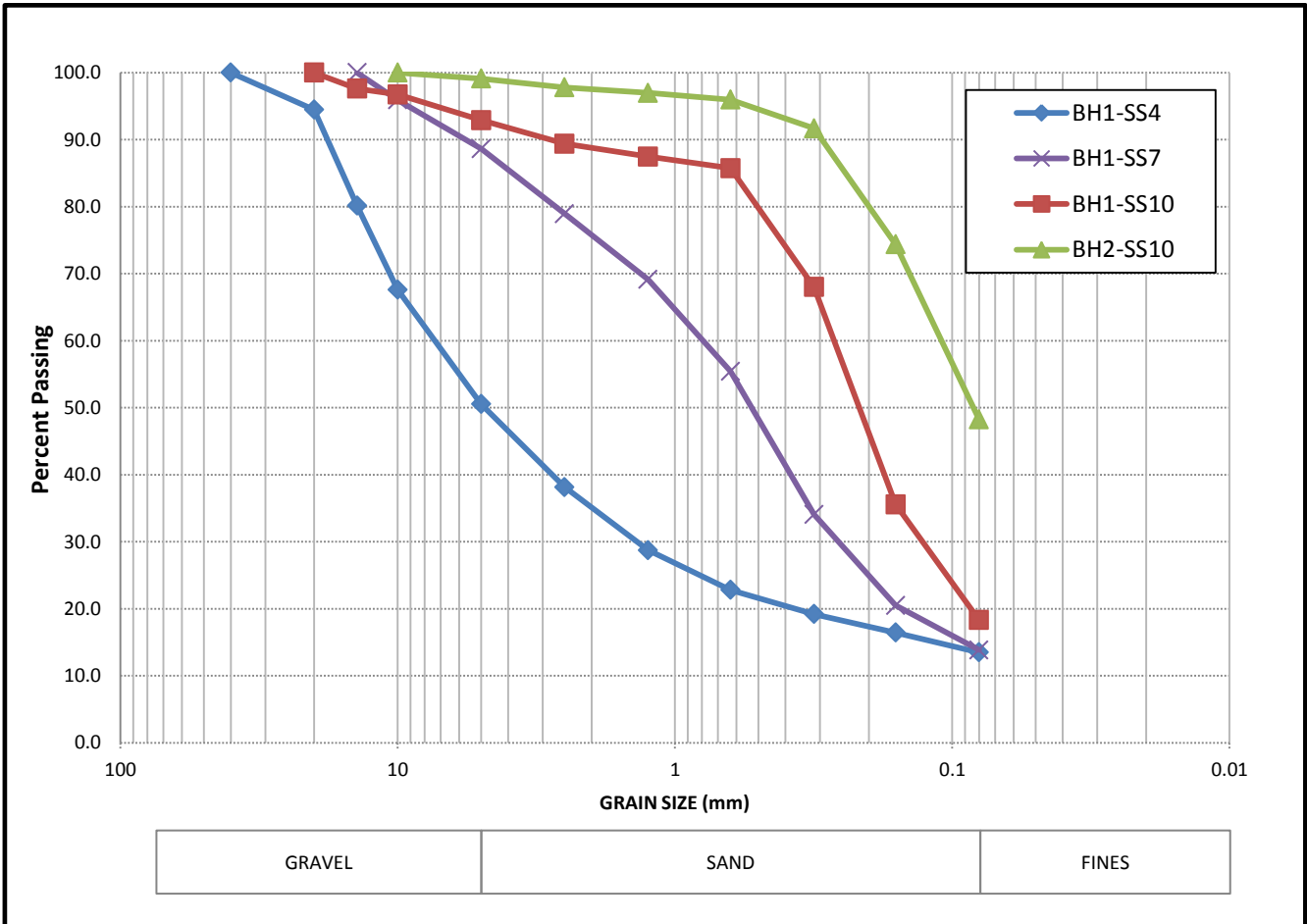
Date Drilled: Feb 23, 2017

Datum: Geodetic

Depth (m)	Water Level (m)	Sample Type	Sample Number	Recovery (mm)	N Value or RQD %	Symbols	SOIL AND/OR ROCK DESCRIPTION	Elevation (m)	Moisture Content (%) Wp ---O--- WL	SPT (N) Blows/300mm
0								8.4		
		SS	1	305	25		FILL: Compact reddish brown silty sand with gravel - grass at surface - organics and topsoil in top 100 mm - cobbles/boulders encountered at 0.9 m - subrounded to subangular clasts - moist to wet			
		SS	2	150	50					
1										
2										
3								5.2		
		SS	3	305	7		SAND: Loose to compact brown silty sand - trace gravel - subrounded to subangular clasts - wet			
4		SS	4	255	7					
		SS	5	305	11					
5		SS	6	305	15			2.8		
6							End of Borehole at 5.6 m - bedrock not encountered - groundwater encountered at a depth of 1.8 m			
7										
8										
9										
10										

Project: Proposed Wastewater Treatment Plant, North Site
Client: CBCL Limited
Project No: 034-223

GRAIN SIZE DISTRIBUTION PLOT



SOIL CLASSIFICATION

Sample No	Depth	Classification	Moisture Content (%)	Gravel (%)	Sand (%)	Silt and Clay (%)
BH1-SS4	2.1 m	Silty gravel with sand	7.6	49	37	13
BH1-SS7	4.0 m	Silty sand	9.7	11	75	14
BH1-SS10	6.4 m	Silty sand	16.2	7	75	18
BH2-SS10	5.5 m	Silty sand	22.6	1	51	48

Conquest Engineering Limited

348 Bluewater Road, Bedford, NS B4B 1J6
Office (902) 835-7313 • Fax (902) 835-1260

Comments: Samples taken from boreholes conducted between February 20 and 23, 2017.

FACTORED ULS BEARING RESISTANCE (STRUCTURAL FILL OR COMPACT TO VERY DENSE NATIVE SAND/GRAVEL)

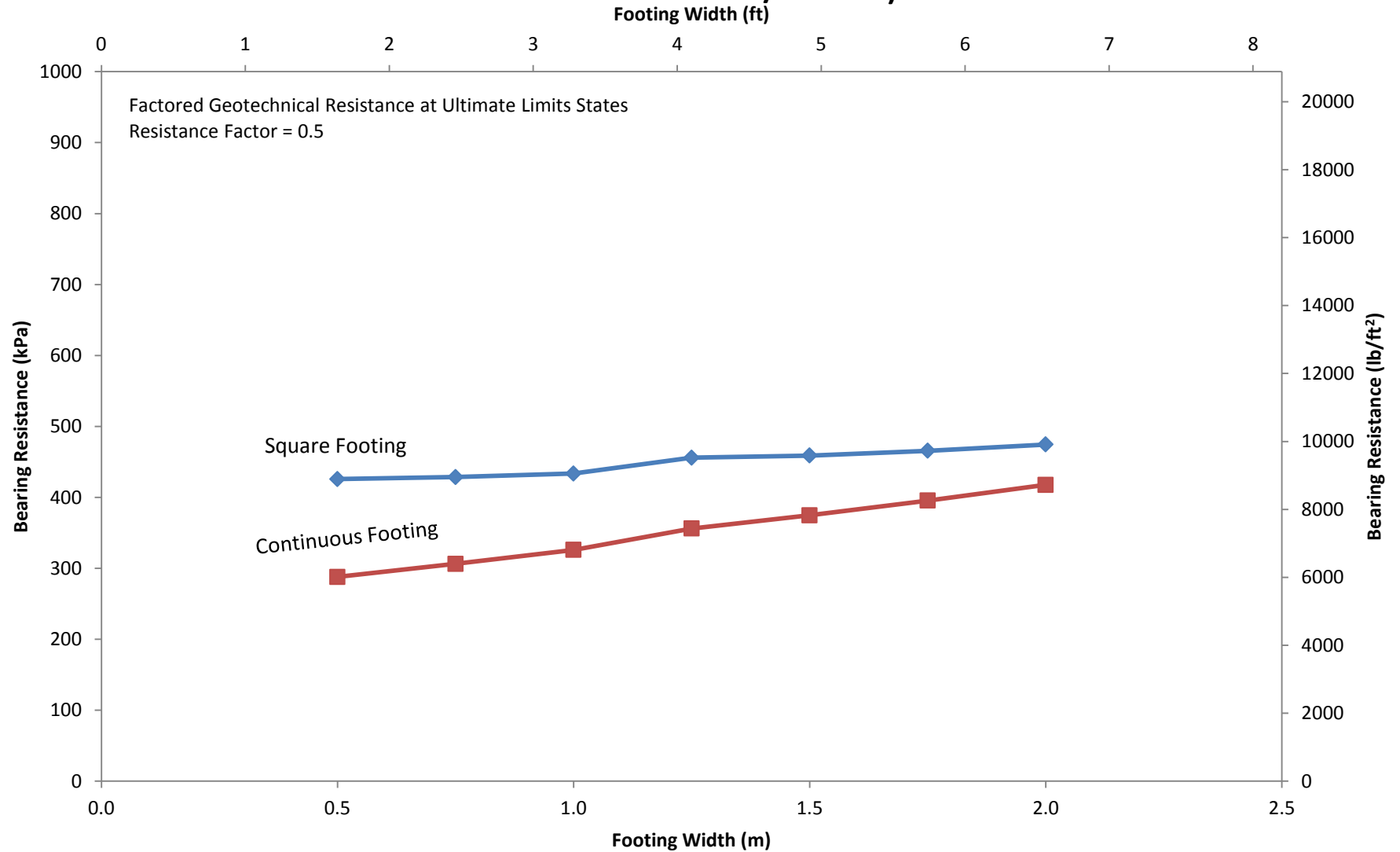


Figure 2

Project # 034-223

SLS BEARING RESISTANCE (STRUCTURAL FILL OR COMPACT TO VERY DENSE NATIVE SAND/GRAVEL)

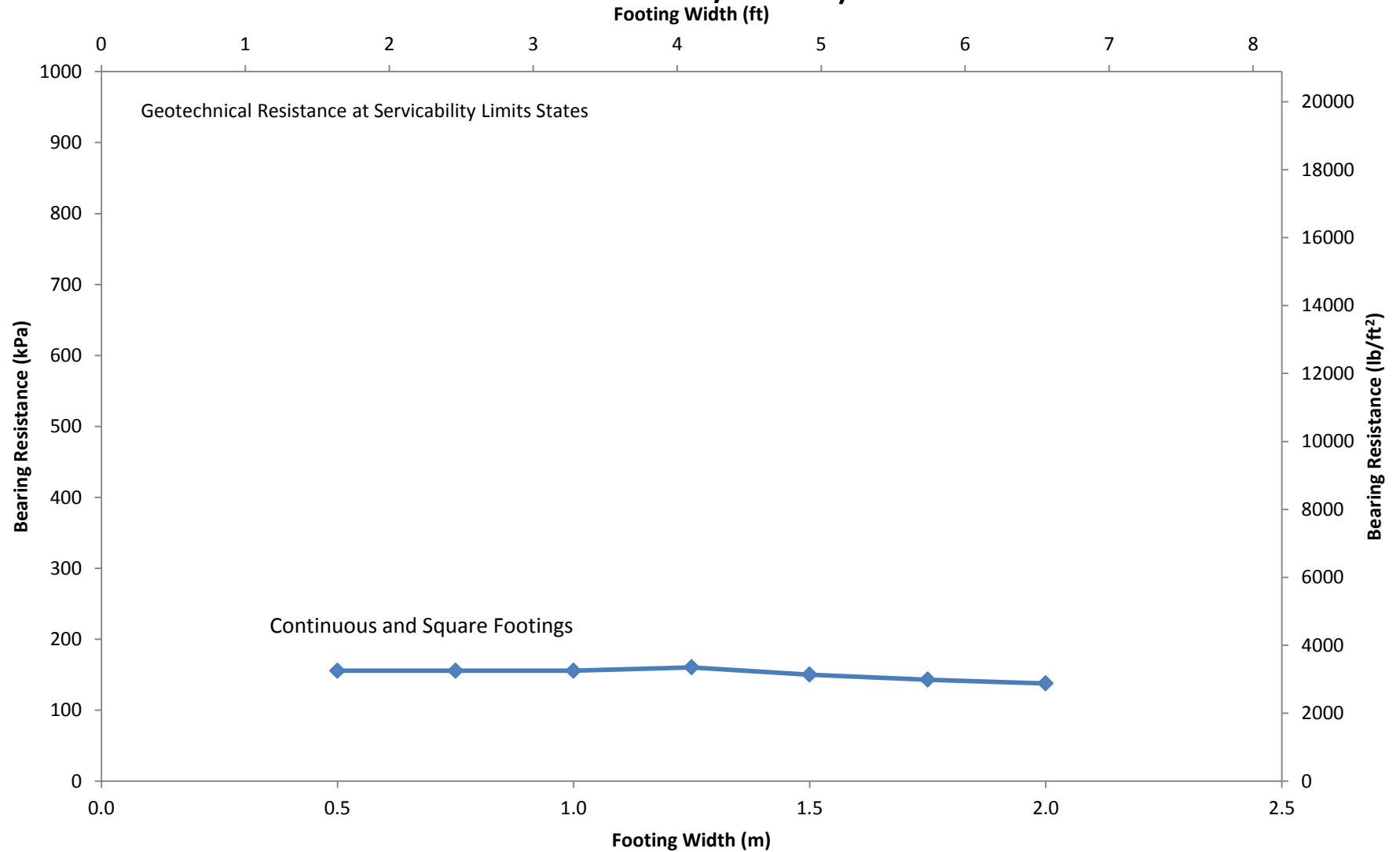


Figure 3

Project # 034-223



LEGEND



APPROXIMATE CONQUEST BOREHOLE (FEB 2017)



**CONQUEST
ENGINEERING
LTD.**
348 Bluewater Road
Bedford, Nova Scotia
B4B 1J6

PROJECT

BOREHOLE LOCATION PLAN

PROPOSED WASTEWATER
TREATMENT PLANT, NEW LOCATION
PARRSBORO, NS

JOB #:

034-223

SCALE:

NTS

DATE:

28-FEB-17

DRAWN BY:

DM

CHECKED BY:

RBM

DOCUMENTS PREPARED BY CONQUEST ENGINEERING LTD. ARE TO BE USED ONLY FOR THE SPECIFIC PROJECT AND SPECIFIC USE FOR WHICH THEY WERE PREPARED. ANY EXTENSION OF USE TO OTHER PROJECTS, BY OWNER, OR ANY OTHER PARTY, WITHOUT THE EXPRESSED, WRITTEN AUTHORIZATION OF CONQUEST ENGINEERING LTD. IS DONE AT THE USER'S OWN RISK. IF USED IN A WAY OTHER THAN WHAT WAS SPECIFICALLY INTENDED, THE OWNER WILL HOLD CONQUEST ENGINEERING LTD. HARMLESS FROM ALL CLAIMS AND LOSSES.

DRAWING:

1

REV:

0

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT
CONTRACT 161039.00**

ADDENDUM NO. 1

Date: June 5, 2017

CONFIRMATION OF RECEIPT

I/We hereby confirm on behalf of

Name of Tenderer

That the above Addendum No. 1 was received by fax on the date stated above.

Signed: _____

Date: _____

Please fax confirmation to CBCL Limited
Attention: Aaron Baillie, P.Eng
Email: aaronb@cbcl.ca

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT**

CONTRACT 161039.00

ADDENDUM NO. 2

(to be added to and made part of the Tender Documents)

The following changes or modifications shall be made to the Tender Documents:

CLARIFICATION FOR PRE-SELECTED SBR EQUIPMENT PACKAGE

Decanter assembly is to be provided by the pre-selected equipment supplier (Parkson)

TO THE SPECIFICATIONS

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

Page 7, delete subsection 2.2.4.2 and 2.2.4.3 and replace with the following:

- .2 Minimum compressive strength at 28 days: 35MPa
- .3 Class of exposure: A1.

Page 7, delete subsection 2.2.4.6 and replace with the following:

- .6 Air Content: 5 to 8%, 3% in areas of floor subjected to the addition of floor hardener.

Page 17, add new subsection 3.13.1 as follows and renumber subsequent subsections:

- .1 Costs for testing to be paid by the Owner.

SECTION 05 50 00 – METAL FABRICATIONS

Page 1, add new subsections 1.1.2.4 and 1.1.2.5 as follows:

- .3 Bollards
- .4 Road access gate.

Page 6, add new subsections 2.4.7 and 2.4.8 as follows:

- .7 Bollards:
 - .1 Fabricate bollards of 150 mm diameter steel pipe, to ASTM A53, galvanized. Fabricate bollards to lengths indicated, fill with concrete and set in concrete foundation.
 - .2 Install bollards where indicated, paint exposed portion yellow, as specified in Section 09 91 23, formula 3.
- .8 Road Access gate: to ASTM A53, galvanized and painted in accordance with Section 09 91 23, same formula as bollards.

SECTION 33 11 00 – WATER MAIN

Add new Section 33 11 00 – Water Main attached.

SECTION 33 35 00 – PRESSURE SEWERS

Add new Section 33 35 00 – Pressure Sewers attached.

SECTION 40 90 00 – PRIMARY PROCESS INSTRUMENTATION DEVICES AND CABLING

Page 1, delete subsection 1.1.2.3 and renumber subsequent subsections.

Page 1, delete subsection 1.1.2.4 (formerly 1.1.2.5) and renumber subsequent subsections.

Page 1, within subsection 1.1.2.4 (formerly 1.1.2.6) after “Assist” add:

“the pre-selected”

Page 4, within subsection 2.1.5 delete “NEMA 12” and replace with “NEMA 2”.

Page 4, within subsection 2.1.7 add the following after “60 Hz”:

“unless indicated otherwise.”

Page 6, within subsection 2.2.2 add the following after “complete with”:

“ss. block and bleed valve”

Page 8, within subsection 2.3.1.4 add the following after “Flygt”:

“ENM-10”

Page 9, delete subsection 2.4.1.3 and 2.4.1.4 and replace with the following:

- .3 Plant inlet flow (FIT/FE 101):
 - .1 Average Flow: 700m³/day.
 - .2 Max. flow: 7500m³/day
 - .3 Pipe Material: Sch. 80 PVC
 - .4 Pipe Dia.: 250mm
 - .5 120 VAC Power supply
- .4 Fine screen flow (FIT/FE 102):
 - .1 Average Flow: 3750m³/day.
 - .2 Max. flow: 7500m³/day
 - .3 Pipe Material: Sch. 80 PVC
 - .4 Pipe Dia.: 250mm
 - .5 120 VAC Power supply

Page 9, add new subsection 2.4.1.5 and renumber subsequent subsections:

- .5 Centrifuge inlet flow (FIT/FE 101):
 - .1 Average Flow: 190m³/day.
 - .2 Max. flow: 1000m³/day
 - .3 Pipe Material: Sch. 80 PVC
 - .4 Pipe Dia.: 40mm
 - .5 24 VDC Power supply

Page 10, within subsection 2.5.1.9 delete “or approved alternate”

Page 10, delete subsection 2.5.2 and replace with the following:

- .2 Suspended Solids Sensors (TSS):
 - .1 Provide and install three (3) TSS sensors; one (1) per SBR tank and one (1) in the digester tank.
 - .1 Provide miscellaneous metals brackets and hardware for installation as required.
 - .2 Sensor to utilize dual-beam infrared/scattered light photometer.
 - .3 Probe must be suitable for use with a universal controller.
 - .4 Provide sensor complete with self-cleaning device to prevent erroneous values and maintenance problems caused by biological activity.
 - .5 Sensor to be factory calibrated and require no calibration prior to use.
 - .6 Sensor to be corrosion resistant and fully submersible.
 - .7 Measurement Range: 0.0 to 10,000 mg/L.
 - .8 Accuracy: <5% of reading.
 - .9 Detection limit: 0.001 mg/L.
 - .10 Cable length to suit application. Absolutely no junction boxes within tankage.
 - .11 Standard of Acceptance:
 - .1 Hach Company – SOLITAX Probe complete with SC200 analyzer and sunshield.

Page 11, within subsection 2.5.2.12, after “HACH Model” add:

“SC, Probe.”

SECTION 40 91 00 – PROCESS CONTROL SYSTEM EQUIPMENT

Page 6, delete subsection 2.5 and replace as follows:

2.5 COMMUNICATION <u>RACK</u>	.1 Supply and install communication rack in lab. .2 Suitable for wall mounting, complete with swinging front for rear access to rack mounted equipment. .3 Supply and install the necessary network switch, patch panel, horizontal walkway, power distribution unit and equipment shelf. All items must be suitable for rack mounting in 19” rails.

APPENDIX A – PRE-SELECTED EQUIPMENT SHOP DRAWINGS

Add the pre-selected equipment Shop Drawings as found in the following link:

<https://www.dropbox.com/sh/3t2bwd5xr8150rd/AAD8vP7EqsLOC9TC07H7VOYSa?dl=0>

TO THE DRAWINGS

DRAWING A001 - ROOF PAN

Delete one downspout on each side of the building, regrade gutter to one side of the building.

DRAWING A002 – BUILDING SECTIONS AND DETAILS

Add the following note to Section A-A and B-B:

“Install 50mm THK rigid insulation from top of foundation wall to 1200mm below grade. Cover insulation with cementitious board from underside of siding to 200mm below grade”

DRAWING C500 – OVERALL SITE PLAN

Update STP site plan to show water service connection per revised Drawing C504.

DRAWING C501 – ACCESS ROAD

Add the following note “Finish subgrade is approximate based on geotechnical report. Actual subgrade to be determined in the field and confirmed by engineer.”

DRAWING C502 – ACCESS ROAD

Add the following note “Finish subgrade is approximate based on geotechnical report. Actual subgrade to be determined in the field and confirmed by engineer.”

DRAWING C503 – PLAN AND PROFILES

Update STP site plan to show water service connection per revised Drawing 504

DRAWING C504 – TREATMENT SITE LAYOUT AND GRADING PLAN

Replace drawing C504 with revised drawing C504 dated June 7, 2017, attached.

DRAWING C506 – DETAILS 1

Replace drawing C506 with revised drawing C506 dated June 7, 2017, attached.

DRAWING C507 – DETAILS 2

Replace drawing C507 with revised drawing C507 dated June 7, 2017, attached.

DRAWING E201 – LEGENDS AND HAZARDOUS AREA CLASSIFICATION

Replace drawing E201 with revised drawing E201 dated June 7, 2017, attached.

DRAWING E202 – SITE PLAN AND DETAILS

Replace drawing E202 with revised drawing E202 dated June 7, 2017, attached.

DRAWING E203 – BUILDING EQUIPMENT LAYOUTS

Replace drawing E203 with revised drawing E203 dated June 7, 2017, attached.

DRAWING E204 – SINGLE LINE AND RISER DIAGRAMS

Replace drawing E204 with revised drawing E204 dated June 7, 2017, attached.

DRAWING E205 – DETAILS

Replace drawing E205 with revised drawing E205 dated June 7, 2017, attached.

DRAWING E206 – DETAILS

Replace drawing E206 with revised drawing E206 dated June 7, 2017, attached.

DRAWING E207 – SCHEDULES

Replace drawing E207 with revised drawing E207 dated June 7, 2017, attached

DRAWING E208 – CABLING DIAGRAM (SHEET 1 OF 2)

Replace drawing E208 with revised drawing E208 dated June 7, 2017, attached.

DRAWING E209 – CABLING DIAGRAM (SHEET 2 OF 2)

Replace drawing E209 with revised drawing E209 dated June 7, 2017, attached.

DRAWING E210 - SCHEMATICS

Replace drawing E210 with revised drawing E210 dated June 7, 2017, attached.

DRAWING E211 – SCHEMATICS AND DETAILS

Replace drawing E211 with revised drawing E211 dated June 7, 2017, attached.

DRAWING M001 – BUILDING PLUMBING AND DRAINAGE

Modify PLAN – DOMESTIC WATER as per MSK001. Add PLUMBING NOTE number 9 as follows: “NO PIPING SHALL BE RUN IN THE ELECTRICAL ROOM.”

DRAWING M002 – BUILDING PLUMBING DETAILS AND SCHEDULES

Modify Detail 1 as per MSK002, dated June 7, 2017, attached.

DRAWING M003 – BUILDING HEATING AND VENTILATION

Replace drawing M003 with revised drawing M003 dated June 8, 2017, attached.

DRAWING P001 – PROCESS FLOW DIAGRAM

Remove “Not for Construction” stamp from title block.

DRAWING P002 – LEGENDS AND SCHEDULES

Remove “Not for Construction” stamp from title block.

DRAWING P003 – PROCESS AND INSTRUMENTATION DIAGRAM

Delete drawing P003 and replace with attached P003 dated June 7, 2017.

DRAWING P004 – WWTP SITE SERVICES AND PROPOSED LAYOUT

Delete drawing P004 and replace with attached P004 dated June 7, 2017.

Refer to Pre-Selected Equipment Shop Drawing package for limits of Scope of Supply.

DRAWING P005 – WWTP TANKAGE SECTIONS

Remove “Not for Construction” stamp from title block.

Refer to Pre-Selected Equipment Shop Drawing package for limits of Scope of Supply

DRAWING P006 – WWTP TANKAGE SECTION

Remove “Not for Construction” stamp from title block.

All equipment such as valves, meters, process equipment etc. to be provided with additional pipe supports where housekeeping pads are not specified. Equipment shall not be self-supported by flanged connections.

DRAWING P007 - DETAILS

Delete drawing P007 and replace with attached P007 dated June 7, 2017.

DRAWING S001 – BUILDING FOUNDATION PLAN

Add equipment pad at UV equipment location. See Section 4/P06 for location and Detail 4/S008 for pad details.

DRAWING S002 – BUILDING ROOF FRAMING PLAN

Add “(Post Disaster)” to the end of the title of the design load block.

Add note: “to design wind loads indicated - (Includes $I_w=1.25$)”

DRAWING S003 – BUILDING SECTIONS

Revise perimeter foundation wall thickness from 360 to 200.

Detail 2: Revise gravels around sump pit to have underslab gravels continuous and remaining material select backfill.

DRAWING S007 – SECTIONS AND DETAILS

Plan Detail 1 – revise reinforcing as follows: 15M @ 300 TUL and BLL to read 15M @ 200 TUL and BLL.

Aaron Baillie, P.Eng.
CBCL Limited
June 8, 2017

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing water mains and services. Work includes supply, installation and testing of pipe, fittings and service connections, and disinfection.

1.2 RELATED
SECTIONS

- .1 Concrete: Section 03 30 00
- .2 Metal Fabrications: Section 05 50 00
- .3 Excavating, Trenching and Backfilling: Section 31 23 10
- .4 Precast Manholes, Catch Basins and Structures: Section 33 39 00

1.3 REFERENCE
STANDARDS

- .1 ANSI/ASME B16.1-2015, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
- .2 ANSI/AWWA C104/A21.4-2016, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- .3 ANSI/AWWA C110/A21.10-2012, Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., (75mm Through 1200mm) for Water and Other Liquids.
- .4 ANSI/AWWA C111/A21.10-2012, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- .5 AWWA C115/A21.15-11, Flanged Ductile Iron Pipe With ductile Iron or Gray-Iron Threaded Flanges.
- .6 ANSI/AWWA C151/A21.51-2009, Ductile-Iron Pipe, Centrifugally Cast, for Water.
- .7 ANSI/AWWA C153/A21.53-2011, Ductile-Iron Compact Fit-tings, 3 in. Through 24 in. (76mm Through 610mm) and 54 in. Through 64 in. (1400mm Through 1600mm) for Water Service.
- .8 AWWA C219-11, Bolted, Sleeve-Type Couplings for Plain-End Pipe.

- .9 ANSI/AWWA C509-15, Resilient-Seated Gate Valves for Water Supply Service.
- .10 ANSI/AWWA C600-2010, Installation of Ductile Water Mains and Their Appurtenances.
- .11 ANSI/AWWA C606-15, Grooved and Shouldered Joints.
- .12 ANSI/AWWA C651-14, Disinfecting Water Mains.
- .13 ANSI/AWWA C800-14, Underground Service Line Valves and Fittings.
- .14 ANSI/NSF 61-2016, Drinking Water System Components - Health Effects.
- .15 ASME B18.2.1-2012, Square, Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head and Lag Screws.
- .16 ASTM A183-14, Carbon Steel Track Bolts and Nuts.
- .17 ASTM A276-16A, Stainless and Heat-Resisting Steel Bars and Shapes.
- .18 ASTM B62-15, Composition Bronze or Ounce Metal Castings.
- .19 ASTM B418-16A, Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
- .20 AWWA B300-10, Hypochlorites.
- .21 AWWA B301-10, Liquid Chlorine.
- .22 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Board and Pipe Coverings.
- .23 CAN/CSA B137 Series-17, Thermoplastic Pressure Piping Compendium.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 00 for:
 - .1 Pipe and service pipe.
 - .2 Valves and valve boxes.
 - .3 Couplings.

1.5 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 00 00 for pipe.

1.6 HANDLING AND STORAGE

- .1 Handle and store pipe, valves and fittings, in such manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.
- .3 Store material to prevent retention of water and damage by freezing.

1.7 SCHEDULING OF WORK

- .1 Coordinate and organize work to minimize interruptions to existing services.
- .2 Notify the Consultant, water utility and building occupants a minimum of 24 hours in advance of planned interruptions in service.
- .3 Do not interrupt water service except between 10:00 a.m. and 4:00 p.m. local time, unless otherwise authorized.
- .4 Notify the Fire Department of any planned or accidental interruption to water service.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- .1 Pipe: to AWWA C151, cement mortar lined.
- .2 Fittings: to AWWA C110 or C153, cement mortar lined, minimum pressure rating 1035 kPa for cast, 1720 for ductile iron.
- .3 Cement Mortar Lining: to AWWA C104. Provide internal seal coat.
- .4 Joints: gasketed mechanical or push-on to AWWA C111; flanged where indicated, to AWWA C110 with Class 125 flanged ends to ANSI/ASME B16.1.

2.2 GATE VALVES

- .1 Buried: to AWWA AWWA C509 up to 300mm, minimum working pressure rating 1380 kPa and as follows:
 - .1 Body: cast-iron to AWWA C509 or ductile iron to AWWA C515 with mechanical joint ends.
 - .2 Mechanism (AWWA C509, C515): wedge disc with resilient rubber seat ring and machined seating surface, non-rising spindle, and O-ring seals.
 - .3 Direction of opening: counter-clockwise.
 - .4 Operating nut: 50mm square.
 - .5 Provide centering disc.
- .2 Chamber: to AWWA C509 up to 300mm, minimum working pressure rating 1380 kPa and as follows:
 - .1 Body: cast-iron with Class 125 flanged ends to ANSI/ASME B16.1.
 - .2 Mechanism (AWWA C509): wedge disc with resilient rubber seat ring and machined seating surface, O.S. & Y., rising stem and hand wheel.
 - .3 Direction of opening: counter-clockwise.

2.3 VALVE BOXES

- .1 Valve Boxes:
 - .1 Cast-iron, slide type, adjustable for depth of pipe below finished grade or composite valve box.
 - .2 Covers marked "Water".
 - .3 Lugged to prevent turning and rolling of cover, and cover notched to suit.

2.4 SERVICE PIPE
AND FITTINGS

- .1 Polyethylene pipe: to CAN/CSA B137, AWWA C901, NSF 61, type PE, Series 160 or 200.
- .2 Joints: compression type, minimum pressure rating 1035 kPa. For polyethylene pipe, to CAN/CSA B137, with stainless steel liner.
- .3 Corporation stop: brass to ASTM B62 and NSF 61-G, compression type, inlet threads to AWWA C800.
- .4 Curb stop and drain: brass to ASTM B62 and NSF 61-G, compression type joints and O-ring seal.
- .5 Service clamp: bronze body, confined O-ring seal cemented in place and straps suitable for

connecting main. Outlet tapped and threaded to AWWA C800.

- .6 Service box: adjustable type, cast-iron bottom section, cast-iron lid with recessed pentagon nut and internal stem to suit depth of bury. Service box to have appropriate foot piece.

2.5 GASKETS AND
BOLTS FOR FLANGES

- .1 Gaskets: unless otherwise specified, supply full face one piece red virgin rubber gaskets of 3mm thickness for all flange joints.
- .2 Bolts: unless otherwise specified, all steel bolts and nuts to be American Standard threads of the coarse thread series, conforming to ANSI B18.2.1. Bolts, heads and nuts to be hexagonal. Length of any bolt to be such that it will not project beyond nut more than 10mm or less than 5mm and no bolt to be less than diameter of the hole in which it fits by more than 3mm. Bolts to be utilized for all flanged joints unless otherwise indicated. Studs or stub bolts may be used for certain connections only when approved by the Consultant.

2.6 COUPLINGS

- .1 Mechanical joint sleeve type: to AWWA C110 for use on new ductile iron pipe. Provide spacer ring between pipe ends.
- .2 Grooved and shoulder type: to AWWA C606 with malleable iron housing, halogenated butyl gasket and heat treated, plated carbon steel bolts and nuts to ASTM A183.
- .3 Collar type: steel with minimum pressure rating 1035 kPa, appropriate to the type and size of pipe being joined, epoxy-coated with type 316 stainless steel bolts and nuts.

2.7 THRUST
RESTRAINT

- .1 Thrust blocks and anchors: 20 MPa concrete and 15 M, Grade 400 reinforcing steel where indicated.
- .2 Mechanical joint restraint device: (100mm to 600mm) ductile iron follower gland to AWWA C153 and C111 with multiple wedge restraining mechanism, minimum pressure working rating 2410

kPa and minimum safety factor of 2:1. Lugs to have twist-off torque nuts.

<u>2.8 DISINFECTANT</u>	.1	Sodium hypochlorite or calcium hypochlorite: to AWWA B300.
	.2	Liquid Chlorine: to AWWA B301.
<u>2.9 REDUCING AGENT</u>	.1	Hydrogen Peroxide, 35% by mass commercial grade.
<u>2.10 INSULATION</u>	.1	Insulation: to ULC S701, Type 4, extruded polystyrene.
<u>2.11 MARKER STAKE</u>	.1	Timber, 40mm x 90mm.
<u>2.12 MARKER TAPE</u>	.1	Detectable metallic tape, 50mm wide, clearly marked as follows: .1 "CAUTION - BURIED WATER LINE", coloured blue.
<u>2.13 GEOSYNTHETIC</u>	.1	Synthetic fibre, rot proof, unaffected by action of oil or salt water and not subject to attack by insects or rodents. Non-woven construction, with minimum thickness of 2mm and minimum density of 200 g/m ² .
<u>2.14 ANODE PACKS</u>	.1	Zinc anodes, to ASTM B418 as directed, complete with clamps.
<u>2.15 PROTECTIVE COATING</u>	.1	Anti-corrosion petrolatum paste, tape and mastic.

PART 3 - EXECUTION

<u>3.1 PREPARATION</u>	.1	Inspect products for defects and remove defective products from site.
	.2	Confirm pipe, fittings, valves and hydrants are clean before installation.

3.2 EXCAVATION,
BEDDING AND
BACKFILLING

- .1 Perform excavation, bedding and backfilling to Section 31 23 10.

3.3 PIPE
INSTALLATION

- .1 Lay and join pipe, fittings, and valves as specified herein and according to manufacturer's published instructions.
- .2 Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
 - .1 Horizontal Alignment: 150mm
 - .2 Vertical Alignment: 75mm
- .3 Face bell ends in direction of laying. On grades of 5% or greater lay pipe up grade. Above 16% grade, install gradient thrust restraint.
- .4 Do not exceed maximum joint deflection recommended by manufacturer.
- .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
- .6 Install gaskets in accordance with manufacturers published instructions. Use only lubricant supplied by manufacturer. During cold weather store gaskets in heated area to promote flexibility.
- .7 Align pipes before joining.
- .8 Support pipes as required to promote concentricity until joint is completed.
- .9 Keep pipe joints free from mud, soil, gravel or other foreign materials.
- .10 Avoid displacing gasket or contaminating with soil, petroleum products or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
- .11 Complete each joint before laying next length of pipe.
- .12 Where deflection at joints is permitted,

deflect only after spigot is fully inserted in bell.

- .14 At structures provide flexible joint not more than 1 m from outside face of structure. Support pipe between structure wall and first joint with 20 MPa concrete.
- .15 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating and leave smooth beveled edge.
- .16 Provide concrete thrust blocks to undisturbed ground on all tees, bends, plugs and caps or as indicated on Project Documents. Construct as indicated and keep joints and couplings free of concrete.
- .17 Install mechanical joint restraint to AWWA C111 and tighten lug nuts until all wedges are in firm contact with pipe surface. Continue to tighten alternating between bolts until lug nuts twist off.
- .18 Install polyethylene tube or sheet on all ductile-iron pipe and fittings and install zinc anodes on all valves, as indicated.

3.4 UNDERCROSSING

- .1 Provide shop drawings showing proposed method of installation for pipe in undercrossing.
- .2 Excavate working pit according to reviewed shop drawings.
- .3 Dewater area of excavation and undercrossing.
- .4 Place jacking, boring or tunneling equipment in working pit to approved line and grade of the proposed pipe.
- .5 Install encasing pipe to proposed line and grade as indicated.
- .6 Use mechanical or welded type joints for encasing pipe.
- .7 After encasing pipe has been installed, check

line and grade.

- .8 Remove any soil that remains in the casing pipe.
- .9 Insert pipe into encasement pipe, starting from the working pit.
- .10 Place pipe one (1) length at time outside encasement pipe. Maneuver pipe into position.
- .11 Use approved blocking method to guide pipe in correct alignment.

3.5 VALVES AND
VALVE BOXES

- .1 Install valves at locations indicated.
- .2 On direct buried valves, install valve boxes centered over operating nut, using centering disc, and true to line and grade.

3.6 CONNECTIONS
TO EXISTING MAIN

- .1 Connect new mains to existing mains as indicated.
- .2 Prior to cutting into existing main, verify outside diameter and type of pipe. Do not cut main unless all items required to complete connection are on hand.
- .3 Valves on existing system will be operated only by the water utility.

3.7 SERVICE
CONNECTIONS

- .1 Install services at locations indicated.
- .2 Do not tap closer than 1000mm to adjacent service or pipe joint. Tap water main and install corporation stops at 2:00 o'clock or 10:00 o'clock positions using type of connection and tapping method appropriate for type, size and pressure of water main.
- .3 Lay service pipe from water main to curb stop in evenly graded trench with bedding as indicated.

- .4 Install curb stops at street line, or where indicated. Confirm that curb stop is properly oriented.
- .5 Leave corporation stop fully open. Operate curb stop to ensure flow, then close curb stop and leave closed.
- .6 Install service box over curb stop with top flush with finished grade.
- .7 Place temporary marker stake at end of each service lateral, extending from pipe end at pipe level to 600mm above grade. Paint exposed portion of stake BLUE with designation WATER in black.

3.8 HYDROSTATIC
AND LEAKAGE
TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
- .3 Test after services and hydrants are installed.
- .4 Backfill prior to testing.
- .5 Notify the Consultant at least 24 hours in advance of all proposed tests. Perform tests in presence of the Consultant.
- .6 Open all valves in test section.
- .7 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air vacuum release valves are installed. After testing, remove corporation stops and install plugs.
- .8 Fill concrete pipe 24 hours before testing to allow for absorption.
- .9 Apply test pressure of 1035 kPa or pressure equal to 1.5 times working pressure, whichever is greater, measured at lowest point in test section. Conduct the test over a full two (2) hour period, maintaining a constant test

pressure. No leakage is permitted by the test process.

- .10 Locate and repair defects if test fails. Retest.
- .11 Repair visible leaks regardless of test results.

3.9 FLUSHING,
DISINFECTION AND
BACTERIOLOGICAL
TESTING

- .1 Chlorinate water system to AWWA C651 only after system has been successfully pressure tested. Notify the Consultant 24 hours in advance of flushing and disinfection. Have chlorination test witnessed by the Consultant.
- .2 Use the continuous feed method of completely filling the main with potable water, removing air pockets, then flushing the completed main to remove particulates, and refilling the main with potable water that has been chlorinated to 25 mg/L. After a 24 hour holding period in the main, there must be a free chlorine residual of not less than 10 mg/L.
- .3 Before the main is chlorinated, fill with potable water to eliminate air pockets and flush to remove particulates. The flushing velocity in the main must not be less than 0.91 m/sec. Flush water mains with potable water through available outlets until particulates have been removed. The size and number of taps should conform to Table 3 of AWWA C651 as provided here.

Pipe Diameter	Flow Required to Produce 0.91 m/s (approx.) Velocity in Main		Size of Tap			Number 65mm Hydrant Outlets
			25mm	38mm	50mm	
mm	gpm	l/s	Number of Taps on Pipe			
100	120	7.4	1	-	-	1
150	260	16.7	-	1	-	1
200	470	29.7	-	2	-	1
250	730	46.3	-	3	2	1
300	1060	66.7	-	-	2	2
400	1880	118.6	-	-	5	2

- .4 Slowly open and close valves and hydrants to ensure thorough flushing.

- .5 If satisfactory results cannot be achieved by flushing, swab pipe by approved methods and re-flush.
- .6 Disinfect water mains upon completion of flushing using chlorine solution distributed throughout entire system.
- .7 Inject 1% chlorine solution through a corporation stop in the top of newly laid pipe, at point close to where main is being filled and at rate proportional to filling rate. Prepare stock chlorine with concentration of 1% free chlorine by volume as follows:

Product	Amount Of Compound	Quantity Of Water
100% Chlorine	1.0 kg	100 litres
Liquid bleach 5.25% Cl	1.0 litres	3.5 litres
Liquid bleach 10.5% Cl	1.0 litres	8.0 litres

- .8 Do not use calcium hypochlorite and chlorinated lime when water temperature is less than 5°C.
- .9 The following table indicates the quantity of 1% chlorine stock solution required to produce an initial 25 mg/L concentration in 100m of pipe by diameter.

Pipe Diameter (mm)	100% Chlorine grams	1% Chlorine Stock Solution (litres)
100	19.6	2.0
150	44.2	4.4
200	78.5	7.9
250	122.7	12.3
300	176.7	17.7
350	240.5	24.1
400	314.2	31.4
450	397.6	39.8
500	490.9	49.1
600	706.9	70.7
750	1104.5	10.4

- .10 Operate valves, hydrants and appurtenances while the main contains chlorine solution.
- .11 Take water samples at all termination points, in suitable sequence, to test chlorine residual. When tests indicate minimum chlorine residual of 25 mg/L, leave system charged with disinfectant solution for 24 hours. At the end of this 24 hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L. If the residual has fallen below 10 mg/L, the system shall be re-chlorinated.
- .12 Disposing of chlorinated water:
 - .1 In areas directly connected to a wastewater treatment facility, discharge chlorinated waste into the wastewater treatment facility. Provide prior notice and receive permission from the wastewater treatment facility operator to discharge.
 - .2 In all other wastewater sewer sheds:
 - .1 Dechlorinate the chlorinated water using calcium thosulphate (CaS_2O_3) as outlined in AWWA C655. Once the chlorinated is neutralized, it can be discharged to a wastewater or storm water system or the environment.
 - .2 When disposing to the environment, the disposal of the dechlorinated solution must be at least 100m from the nearest watercourse.
- .13 Bacteriological samples are to be obtained from a test sampling tap or a water service connection if available. Take samples from every 370m of new water main, plus one (1) set from the end of the line and from every branch (see AWWA C651, Section 5.1). If service connections are not available, a hydrant lead may be tapped to provide the required sampling location.
- .14 Collect samples in accordance with Appendix A of Nova Scotia Environment's "Guidelines for Monitoring Public Drinking Water Supplies". Have analysis done by an independent lab in accordance with the guidelines.

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- .15 Should any of the test results be positive, repeat disinfection, flushing, sampling and analysis.
- .16 After testing and submission of the written results for the passing of the bacteriological tests, remove the corporation stops and install plugs. Check visually for leakage after plugs are installed with water main under normal operating pressure.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 This section specifies requirements for constructing pressure sewers and appurtenances. Work includes supply, installation and testing of pipe, fittings and service connections.
- 1.2 RELATED SECTIONS .1 Concrete: Section 03 30 00
.2 Metal Fabrications: Section 05 50 00
.3 Excavating, Trenching and Backfilling: Section 31 23 10
.4 Precast Manholes, Catch Basins and Structures: Section 33 39 00
- 1.3 REFERENCE STANDARDS .1 ANSI/ASME B16.1-2015, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
.2 ANSI/AWWA C509-2015, Resilient-Seated Gate Valves for Water and Sewerage Systems.
.3 ANSI/AWWA C900-16, Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution
.4 CAN/CSA B137 Series-13, Thermoplastic Pressure Piping Compendium.
- 1.4 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 00 00.
- 1.5 CERTIFICATES .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 00 00 for all pipe used in the Work.
.2 For fusion butt jointing for polyethylene pipe provide certification that personnel are trained by manufacturer in current methods and use of equipment.
-

<u>1.6 HANDLING AND STORAGE</u>	.1 Handle and store pipe, valves, fittings, in such a manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore. Do not damage coatings or linings. .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

PART 2 - PRODUCTS

<u>2.1 POLYVINYL CHLORIDE PIPE AND FITTINGS</u>	.1 Pipe and Joints: to, AWWA C900 or AWWA C905, CAN/CSA B137, cast-iron outside diameter, gasketed bell-end Joint. .2 SDR 25, pressure class 160. .3 Fittings: .1 PVC: to CAN/CSA B137. .2 Gray or ductile-iron: to AWWA C110 and C153, cement mortar lined, minimum pressure rating 1035 kPa for cast, 1720 kPa for ductile iron. .3 Cement mortar lining: to AWWA C104. Provide internal seal coat as required. .4 Joints, mechanical or push-on: to AWWA C153.
<u>2.2 THRUST RESTRAINT</u>	.1 Thrust blocks and anchors: 20 MPa Portland cement concrete and 15 M, Grade 400 reinforcing steel where indicated. .2 Mechanical joint restraint device: (100 mm to 600 mm) ductile iron follower gland to AWWA C153 and AWWA C111 with multiple wedge restraining mechanism, minimum pressure working rating 2410 kPa and minimum safety factor of 2:1 Lugs to have twist-off torque nuts.
<u>2.3 RESTRAINED FLANGE ADAPTER</u>	.1 Ductile iron flange adapter with torque limiting screw type gripping wedges, EPDM gaskets and coated with fusion bonded epoxy. .1 Acceptable product: EBAA Series 2100 Mega Flange, or approved equivalent.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Carefully inspect material for defects and remove defective materials from site.
- .2 Immediately before installation, remove any water, debris, and foreign material from interior of pipe, fittings and valves.

3.2 TRENCHING,
BEDDING AND
BACKFILLING

- .1 Do trenching, bedding and backfilling to Section 31 23 10.

3.3 PIPE
INSTALLATION -
GENERAL

- .1 Lay and join pipe, fittings, and valves as specified herein and according to manufacturer's published instructions.
- .2 Face bell ends in direction of laying. On grades of 5% or greater lay pipe up grade.
- .3 Do not exceed maximum joint deflection recommended by manufacturer.
- .4 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
- .5 Join pipes in accordance with manufacturers published instructions. Do not use excessive force to join pipe sections.
- .6 Install gaskets in accordance with manufacturers published instructions. Use only lubricant supplied by manufacturer. During cold weather store gaskets in heated area to assure that gaskets remain flexible.
- .7 Align pipes carefully before joining.
- .8 Support pipes as required to assure concentricity until joint is properly completed.
- .9 Keep pipe joints free from soil or other foreign materials.
- .10 Avoid displacing gasket or contaminating with

dirt, petroleum products or other foreign material. Remove, clean, re- install and lubricate gaskets so disturbed.

- .11 Complete each joint before laying next length of pipe.
- .12 Join polyethylene pipe in accordance with manufacturer's published instructions.
- .13 Where deflection at joints is permitted, deflect only after joint is completed.
- .14 At structures provide flexible joint not more than 1 metre from outside face of structure.
- .15 Cut pipe as required for specials, fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating and leave smooth bevelled edge.
- .16 Provide concrete thrust blocks to undisturbed ground on all tees, bends, plugs and caps. Construct as indicated and keep joints and couplings free of concrete.
- .17 Install mechanical joint restraint to AWWA C111 and tighten lug nuts until all wedges are in firm contact with pipe surface. Continue to tighten alternating between bolts until lug nuts twist off.
- .18 Remove internal welding bead from HDPE pipe joints using a methodology approved by the pipe manufacturer.

3.4 HYDROSTATIC AND
LEAKAGE TESTING

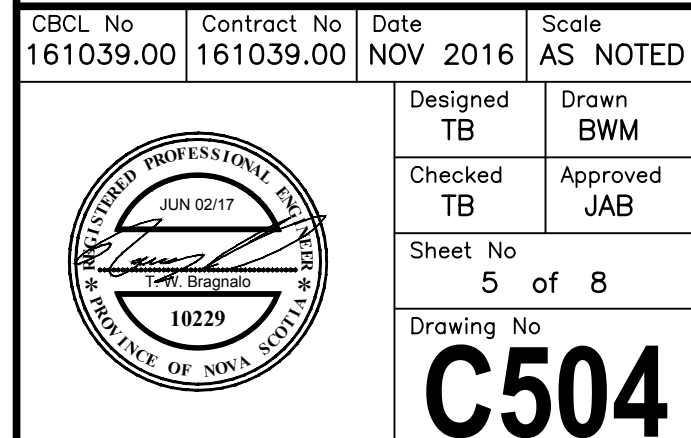
- .1 If water used for flushing or testing is obtained from a potable water supply, the supply is to be continuously separated from the service being flushed or tested by an air gap or a level of protection equal to or greater than that provided by a double check valve backflow prevention device.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
- .3 Notify the Consultant at least 24 hours in advance of all proposed tests. Perform tests in

presence of the Consultant.

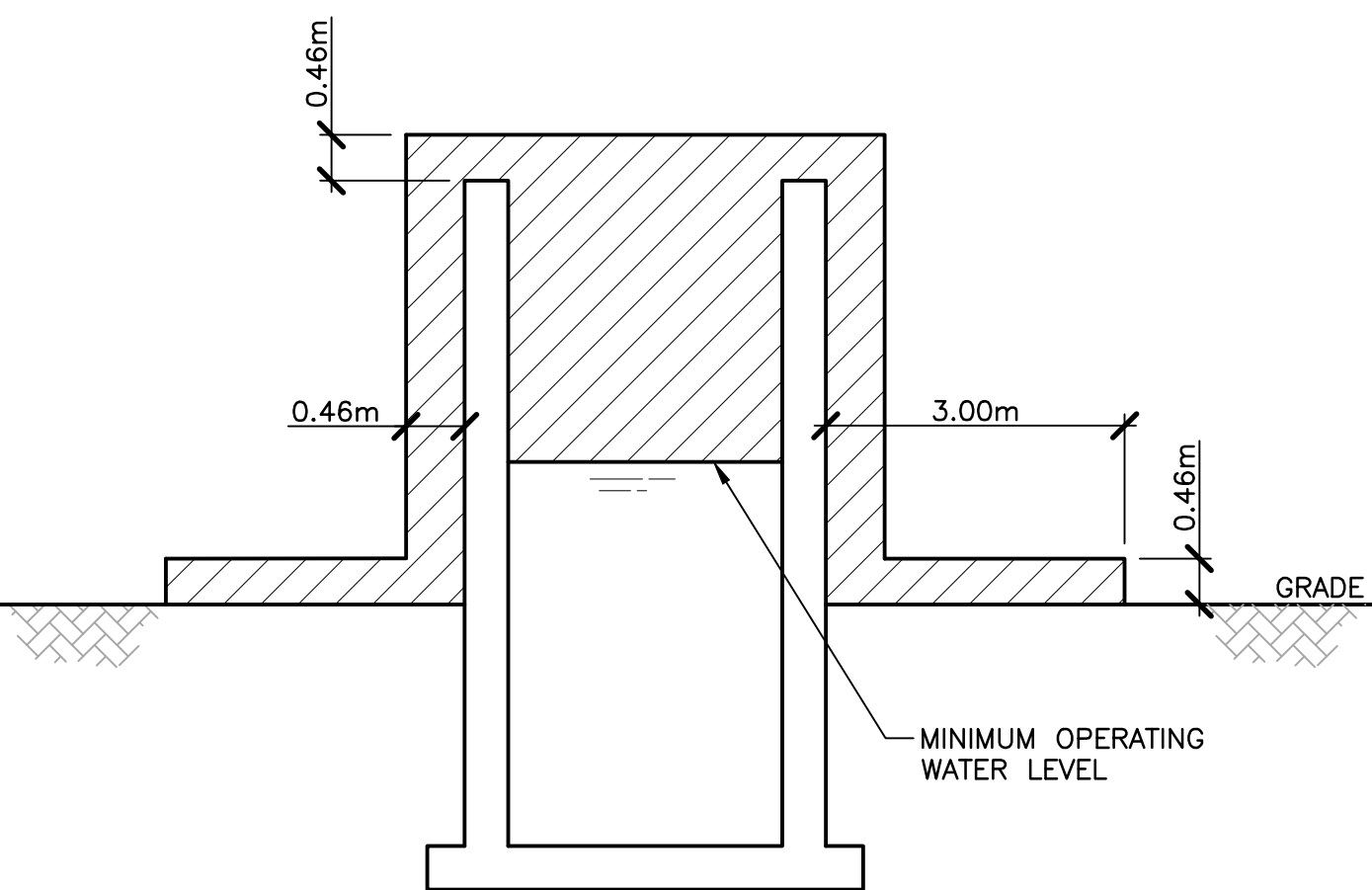
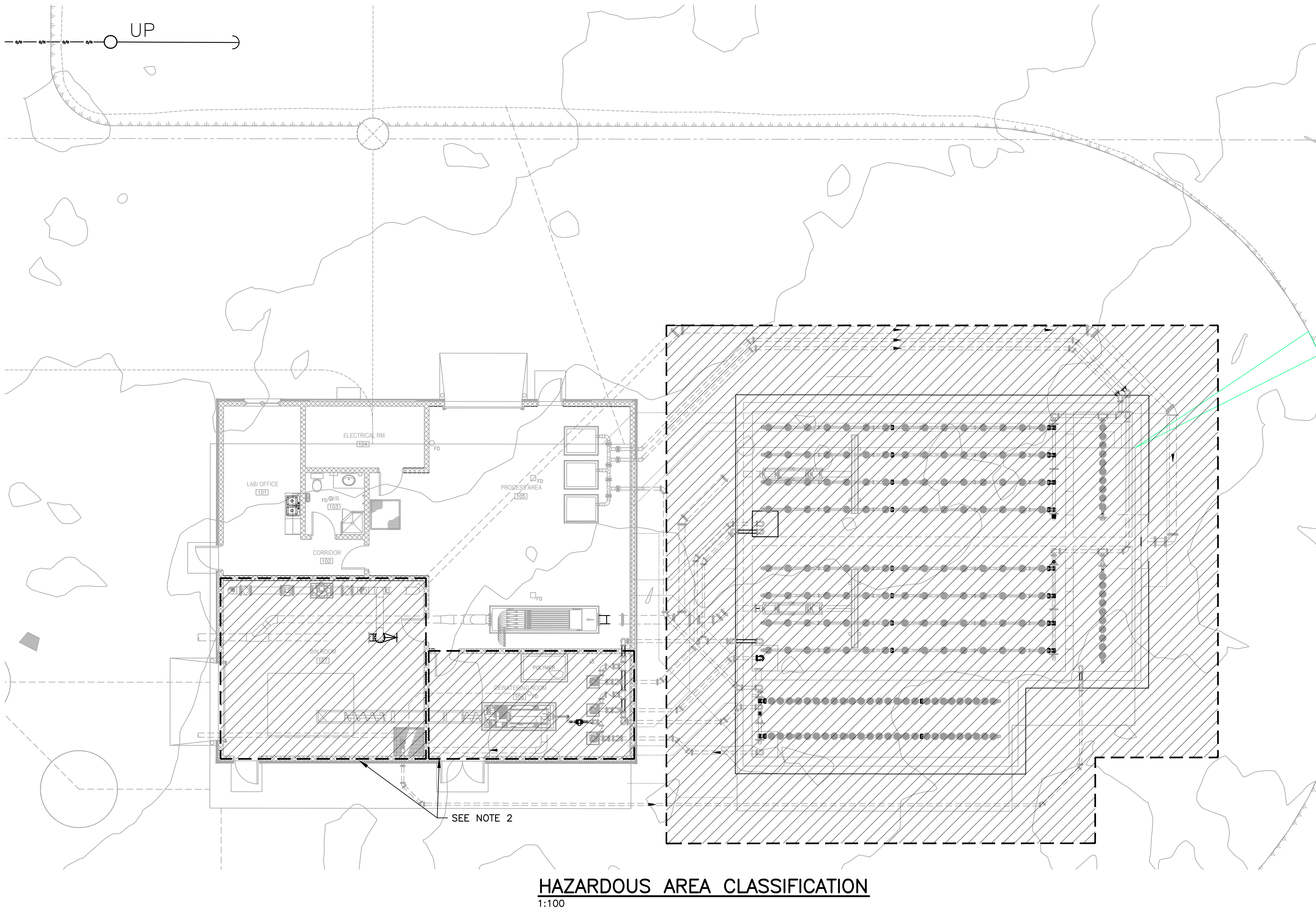
- .4 Open all valves in test section.
- .5 Expel air from main by slowly filling with water. Install corporation stops at high points where no air-vacuum release valves are installed. After testing, remove corporation stops and install plugs.
- .6 Apply test pressure of 1035 kPa or pressure equal to 1.5 times working pressure, whichever is greater, measured at lowest point in test section. Conduct the test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted by the test process.
- .7 Locate and repair defects if test fails. Retest.

3.5 FLUSHING

- .1 If water used for flushing or testing is obtained from a potable water supply, the supply is to be continuously separated from the service being flushed or tested by an air gap or a level of protection equal to or greater than that provided by a double check valve backflow prevention device.
- .2 Notify the Consultant 24 hours in advance of flushing.
- .3 Flush mains with water through available outlets with sufficient flow to produce minimum velocity in main of 1.5 m/s, for 10 minutes. Flush until foreign materials have been removed and water is clear.
- .4 Slowly open and close valves to ensure thorough flushing.



DRAWING NAME: \\N\PROJECTS\161039-00_PARRSBORO WASTEWATER SYSTEM DESIGN\20 CAD\03 ELECTRICAL PLANT\161039-00_E201.DWG LAYOUT NAME: E201 LEGEND AND HAZARDOUS AREA CLASSIFICATION PLOT DATE: Wednesday, June 07, 2017 3:44:17 PM CAD DEBAUSCH, CANINE



HAZARDOUS AREA CLASSIFICATION

LEGEND:

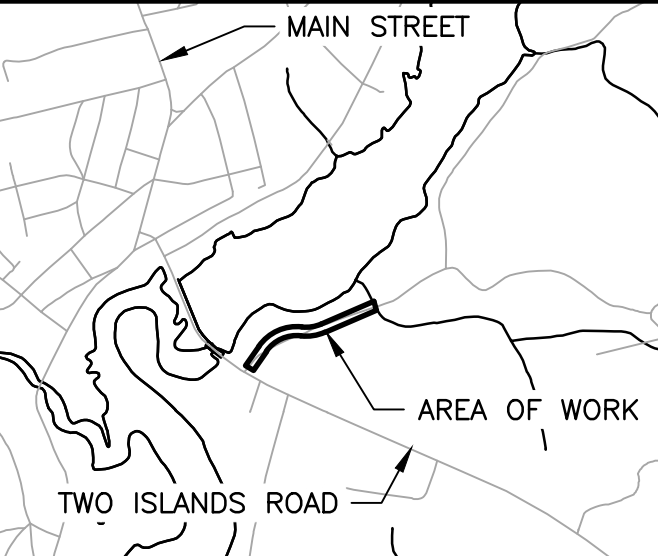
- INDICATES ZONE 2 HAZARDOUS AREA^{A-3}
- INDICATES ZONE 1 HAZARDOUS AREA.

ANNOTATIONS:

- GFI - GROUND FAULT INTERRUPTING
- EX - EQUIPMENT TO HAVE CERTIFICATION FOR INSTALLATION IN CLASS 1 ZONE 2 HAZARDOUS AREA
- STP - SHIELDED TWISTED PAIR
- AFF - ABOVE FINISHED FLOOR ELEVATION
- CTP - DEVICE MOUNTED 150mm ABOVE COUNTER TOP
- WP - WEATHER PROOF
- UP - UTILITY POLE (BY UTILITY)
- U/G - UNDERGROUND

LEGEND:

- STANCHION- OR WALL-MOUNTED FIXTURE (XX=TYPE AS INDICATED)
- ELECTRIC BASEBOARD HEATER
- TOGGLE SWITCH, EX DENOTES RATED FOR CLASS 1 ZONE 2 HAZARDOUS AREA
- TOGGLE-TYPE DISCONNECT SWITCH
- UNFUSED DISCONNECT SWITCH (PLAN)
- UTILITY METER
- RECEPTACLE
- THREE-PHASE MOTOR
- UNIT HEATER
- CONTROL PANEL
- MISCELLANEOUS ELECTRICAL EQUIPMENT
- 'LB' TYPE CONDUIT FITTING
- PHOTOCCELL
- DOMESTIC HOT WATER HEATER
- ELECTRICAL FORCED FLOW HEATER
- UNDERGROUND CONDUIT
- CIRCUIT BREAKER
- TRANSFORMER
- MISCELLANEOUS EQUIPMENT
- PANELBOARD
- UNFUSED DISCONNECT SWITCH (SINGLE LINE)
- MOTOR STARTER (FVNR)
- JUNCTION BOX
- ELECTRONIC OVER LOAD RELAY WITH ADJUSTABLE OVER LOAD SETTING AND AUXILIARY CONTACTS
- MOTOR (XX = EQUIPMENT ID NUMBER)
- INSTRUMENT LOCATION.
 - LSH - LEVEL SWITCH HIGH
 - LSL - LEVEL SWITCH LOW
 - AIT - ANALYTICAL INDICATING TRANSMITTER
 - LT - LEVEL TRANSMITTER
 - FIT - FLOW INDICATING TRANSMITTER
- CCTV CAMERA C/W WEATHERPROOF ENCLOSURE, WALL BRACKET, AND ADJUSTABLE LENS
- TRAP PRIMER ELECTRICAL CONNECTION
- RECESSED LIGHT FIXTURE LX INDICATES TYPE IN FIXTURE SCHEDULE.
- SURFACE MOUNTED LIGHT FIXTURE, LX INDICATES TYPE IN FIXTURE SCHEDULE.
- LOW VOLTAGE (UNLESS OTHERWISE INDICATED) THERMOSTAT
- LINE VOLTAGE SMOKE DETECTOR WITH 120V CONTACT WIRE TO PLC SUPERVISORY SYSTEM.
- LINE VOLTAGE RATE-OF-RISE HEAT DETECTOR WITH 120V CONTACT WIRE TO PLC SUPERVISORY SYSTEM.
- WALL MOUNTED MAGNETIC MOTOR STARTER.



KEY PLAN

1:5000

NOTES:

- ALL ELECTRICAL PENETRATIONS FROM A NON-HAZARDOUS AREA TO A HAZARDOUS AREA SHALL BE SEALED AND MADE GAS TIGHT.
- DEWATERING ROOM 106 AND BIN ROOM 107 ARE CLASS 1 ZONE 2 HAZARDOUS AREAS. ALL WIRING AND ELECTRICAL INSTALLATION IS TO BE COMPLETE TO MEET THE REQUIREMENTS OF THE LATEST EDITION OF THE CANADIAN ELECTRICAL CODE FOR INDICATED HAZARDOUS SPACE. SOME PRE-SELECTED PROCESS EQUIPMENT WILL NOT BE RATED FOR THE CLASS 1 ZONE 2 SPACE HENCE THE VENTILATION RATE HAS BEEN DESIGNED TO REMOVE THE HAZARDOUS SPACE AS LONG AS THERE IS SUFFICIENT AIR FLOW. WIRING TO SUCH PROCESS EQUIPMENT IS TO BE INSTALLED AS THOUGH IT CONTINUES TO BE A HAZARDOUS SPACE IN ORDER TO SEAL OFF GAS FROM OTHER SPACES.



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
B	ISSUED FOR APPROVAL	MAY 23/17	JAB
A	ISSUED FOR 50% REVIEW	MAY 01/17	JAB

Revision or Issue

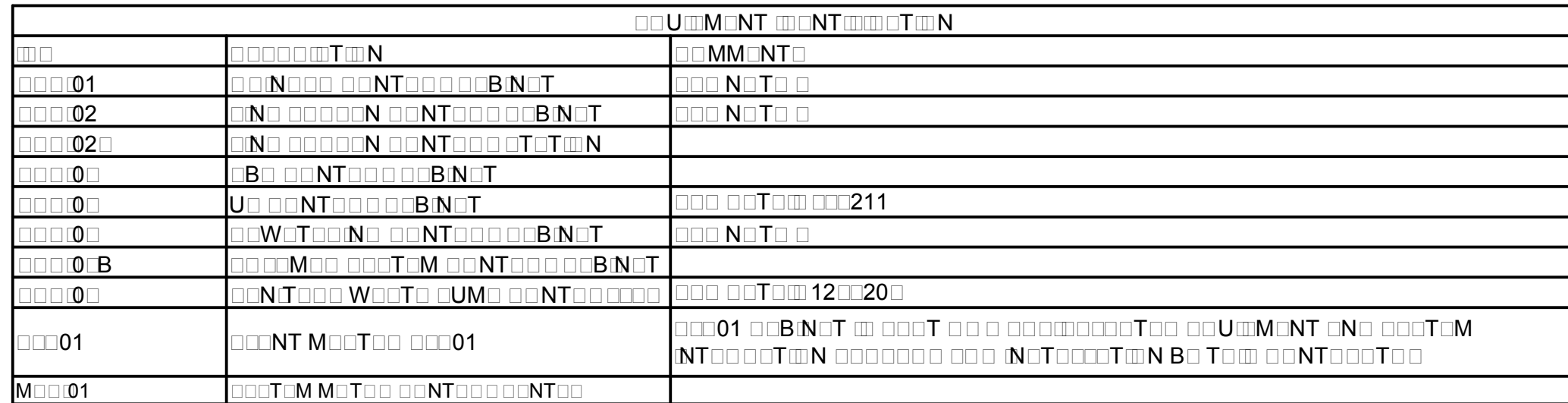
MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER SYSTEM - TREATMENT PLANT

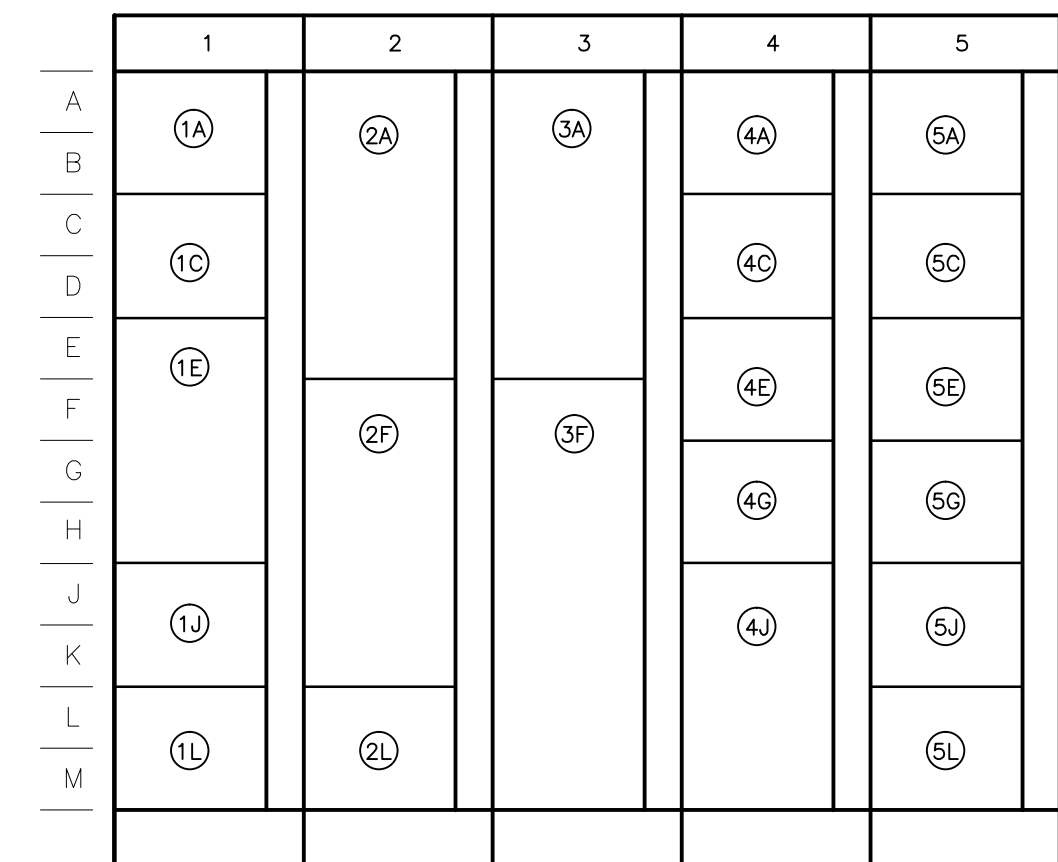
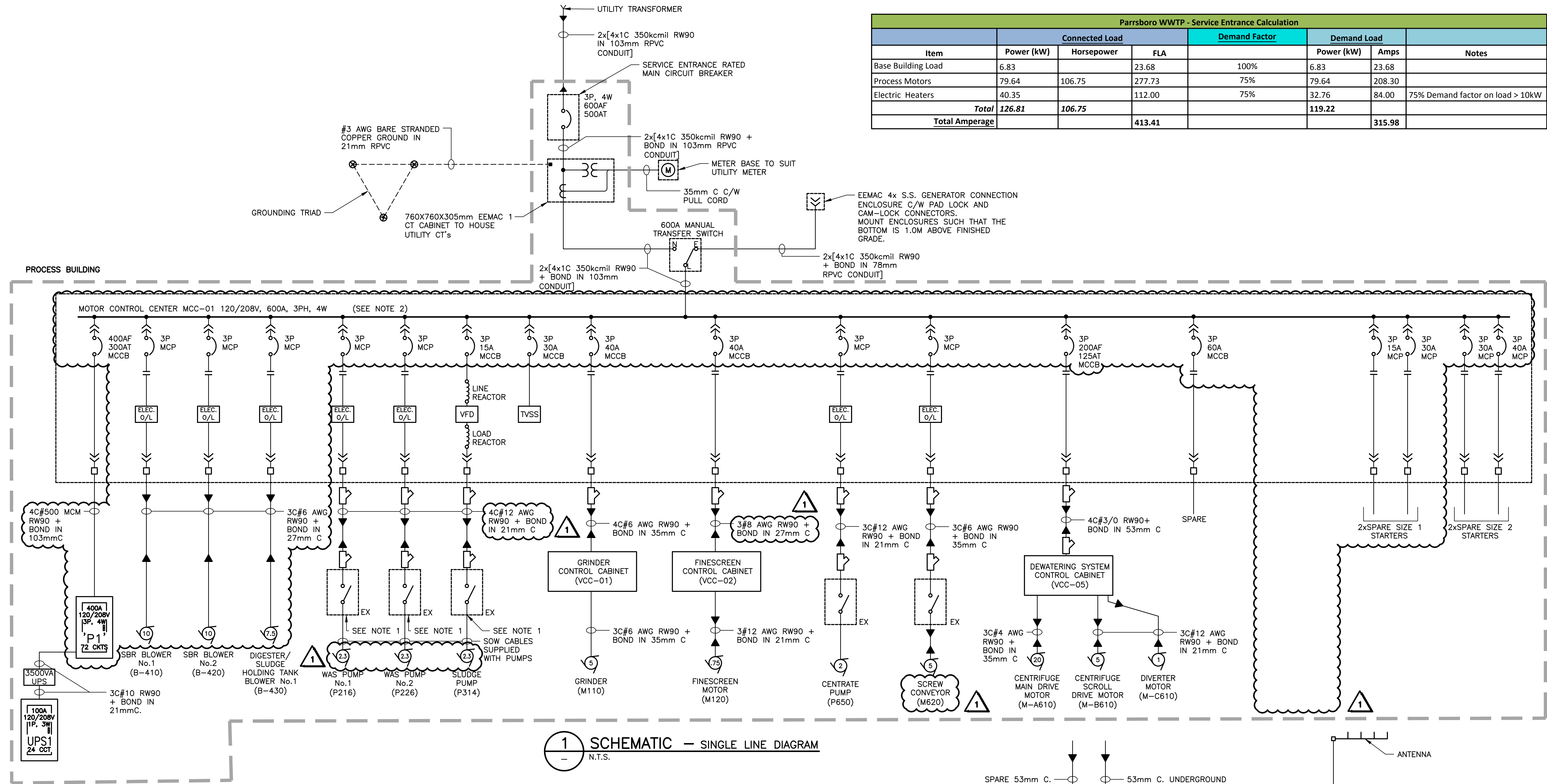
ELECTRICAL LEGEND AND HAZARDOUS AREA CLASSIFICATION



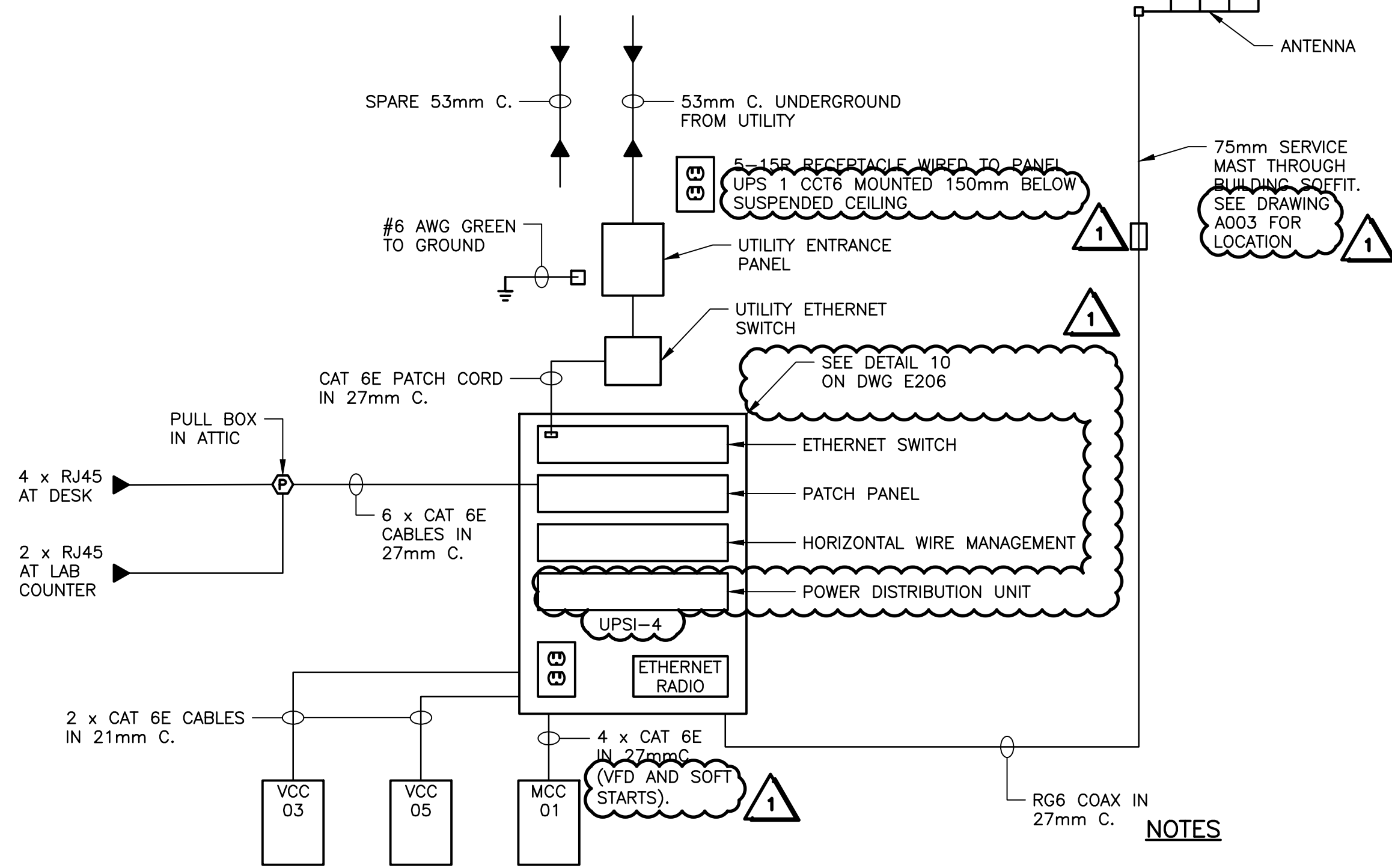
CBCL No 161039.00	Contract No 161039.00	Date NOV 2016	Scale AS NOTED
Designed ROC	Drawn RdJ	Checked ROC	Approved JAB
Sheet No 1 of 11		Drawing No E201	



DRAWING NAME: C:\PROJECTS\161039-00_PARRSBORO WASTEWATER SYSTEM DESIGN\20 CAD\16 ELEC\TREATMENT PLANT\161039-00_E204.DWG LAYOUT NAME: E204 SINGLE LINE & RISER DIAGRAMS DATE: Wednesday, June 07, 2017 2:18:44 PM CAL DESIGNS: CHAYNE



- 1A MAIN LUGS
10 TVSS
15 PANEL P1 BREAKER
16 P216
2A B430
2F B420
2L VCC01
3A B410
3F P314
4A VCC02
4F P650
4L M620
4O SPACE
- 4A VCC05
5A SPARE SIZE 1
5O SPARE SIZE 1
5E SPACE
5F SPARE SIZE 2
5L SPARE SIZE 2
5L 3P 60 AMP BREAKER



Parrsboro WWTTP - Service Entrance Calculation						
Item	Connected Load			Demand Factor	Demand Load	
	Power (kW)	Horsepower	FLA		Power (kW)	Amps
Base Building Load	6.83		23.68	100%	6.83	23.68
Process Motors	79.64	106.75	277.73	75%	79.64	208.30
Electric Heaters	40.35		112.00	75%	32.76	84.00
Total	126.81	106.75			119.22	
Total Amperage			413.41			315.98

KEY PLAN

1:5000

NOTES

- SUPPLY AND INSTALL THREAD HUB, TRANSIT ASSEMBLY AND CABLE BLOCKS TO SUIT CABLE. MATERIALS TO BE ACCEPTABLE FOR CLASS 1 ZONE 2 HAZARDOUS SPACE.
- THE MCC IS TO BE SUPPLIED WITH NO BOTTOM PLATES TO ALLOW ENTRANCE OF UNDER SLAB CONDUITS. MOUNT MCC ON GALVANIZED STEEL CHANNELS (MINIMUM 50mm HIGH) TO PROVIDE ADEQUATE CLEARANCE FOR INSTALLATION OF EYE FITTINGS.



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
B	ISSUED FOR APPROVAL	MAY 23/17	JAB
A	ISSUED FOR 50% REVIEW	MAY 01/17	JAB

Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER SYSTEM - TREATMENT PLANT

ELECTRICAL

SINGLE LINE & RISER DIAGRAMS



CBCL No	Contract No	Date	Scale
161039.00	161039.00	NOV 2016	AS NOTED



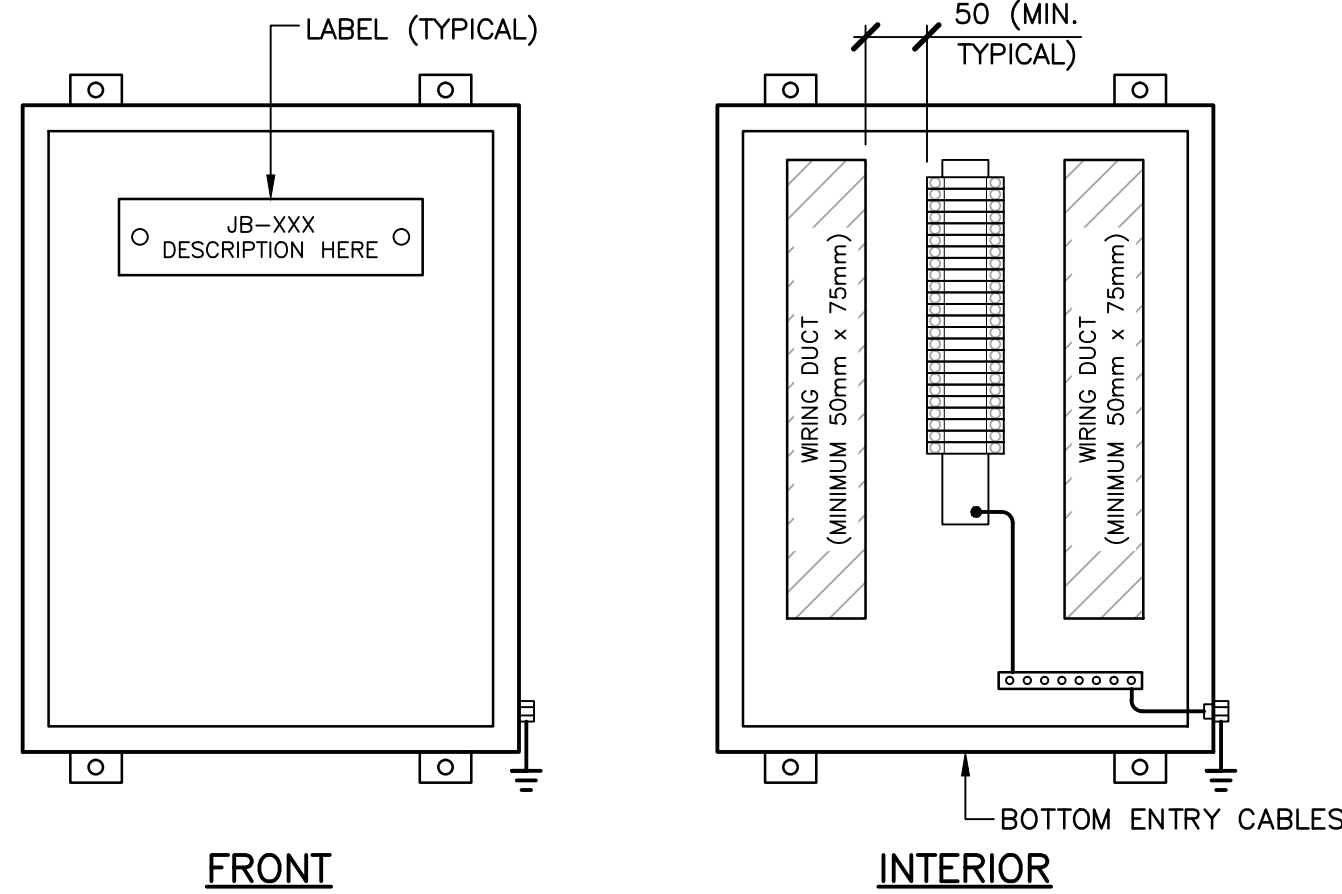
Designed	Drawn
RJD	RJD
Checked	Approved
ROC	JAB

Sheet No
4 of 11

Drawing No
E204

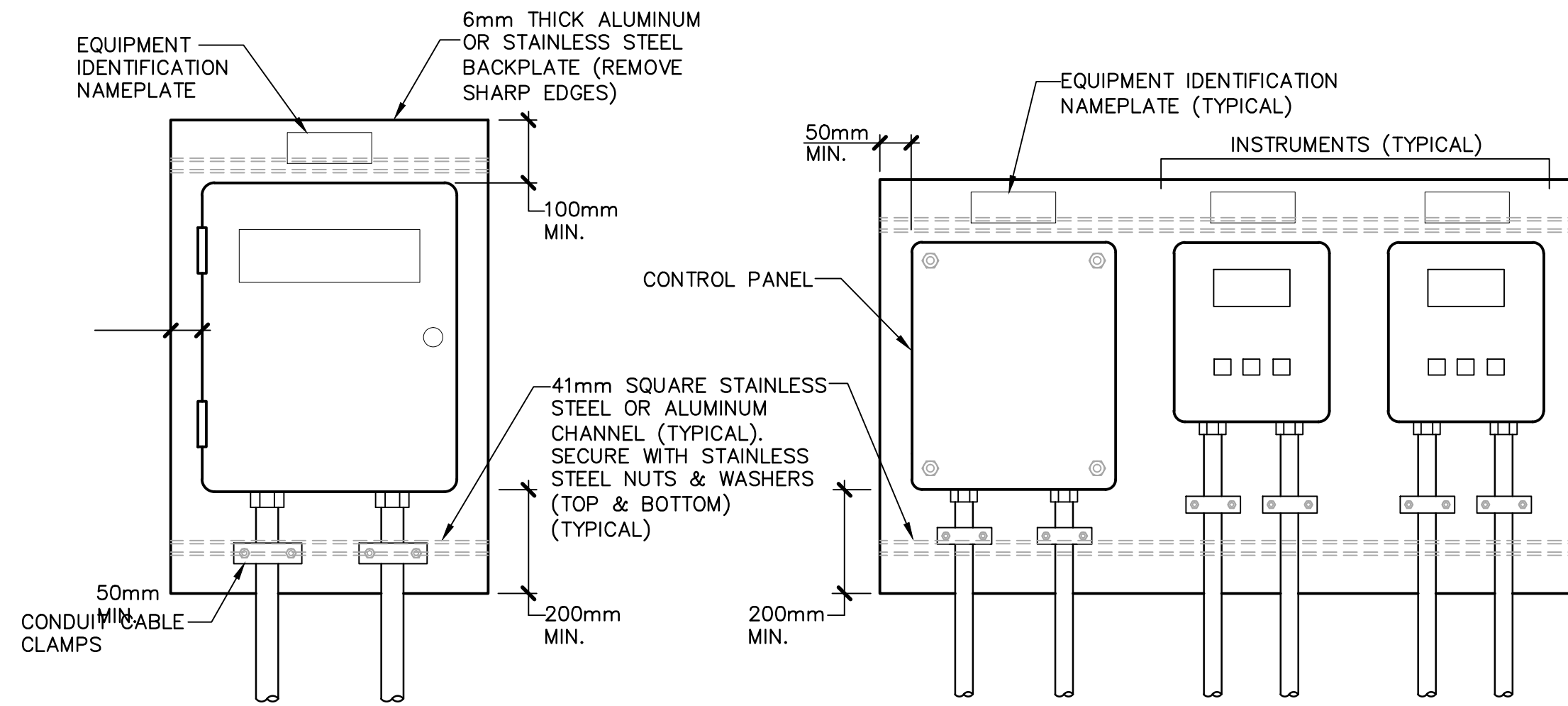
NOTES

- TELECOMMUNICATION EQUIPMENT AND DATA RACK TO BE MOUNTED HIGH ON WALL IN LAB

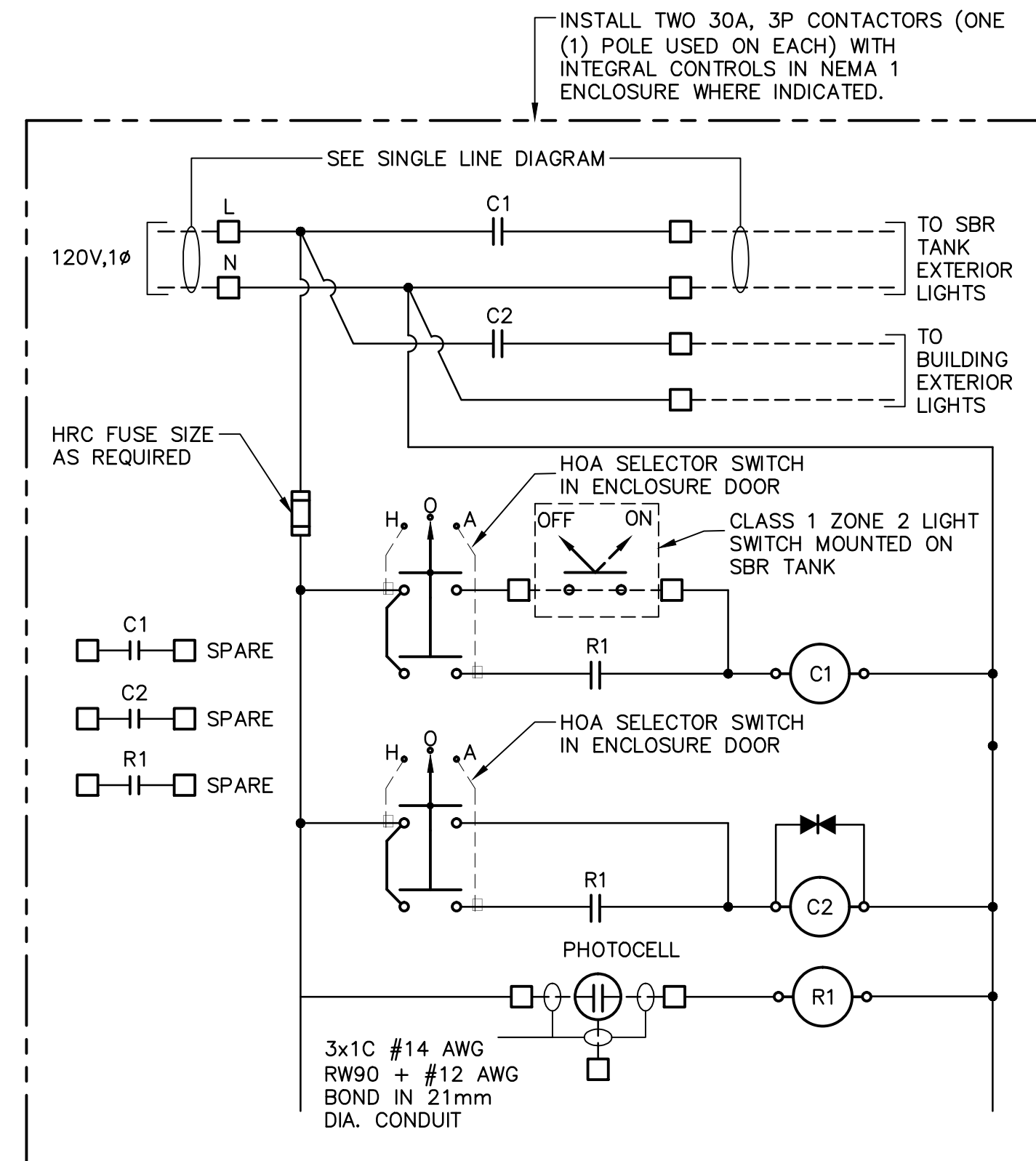


- NOTES:
1. THIS LAYOUT DRAWING APPLIES TO INSTRUMENTATION TERMINATION JUNCTION BOXES. THE ABOVE LAYOUT IS TO BE USED AS A GUIDE ONLY. REFER TO THE CABLING DRAWINGS TO DETERMINE THE REQUIRED NUMBER OF TERMINAL BLOCKS IN EACH FIELD JUNCTION BOX.
 2. REFER TO SPECIFICATION FOR MATERIAL REQUIREMENTS.

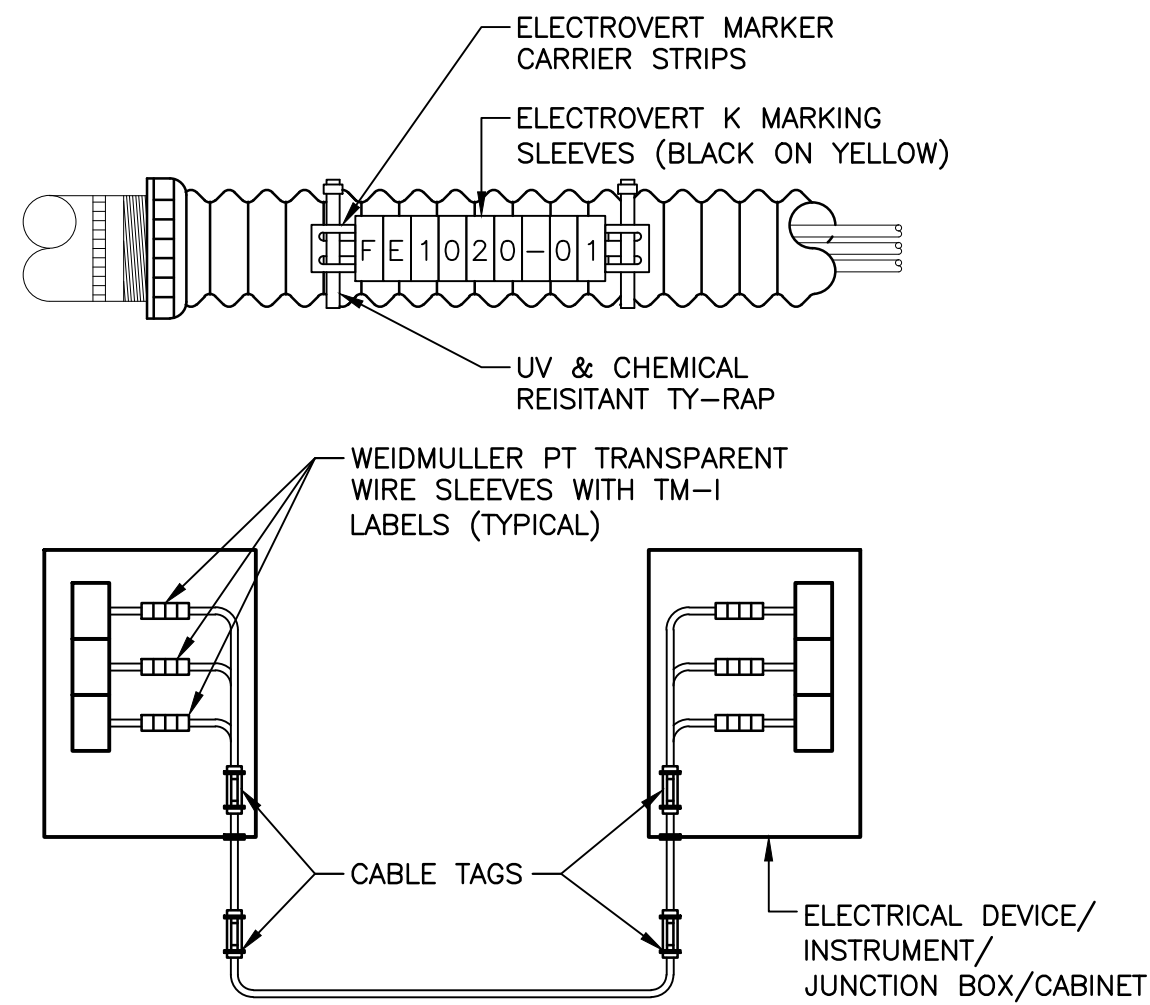
1 TYPICAL INSTRUMENTATION TERMINATION JUNCTION BOX LAYOUT
N.T.S.



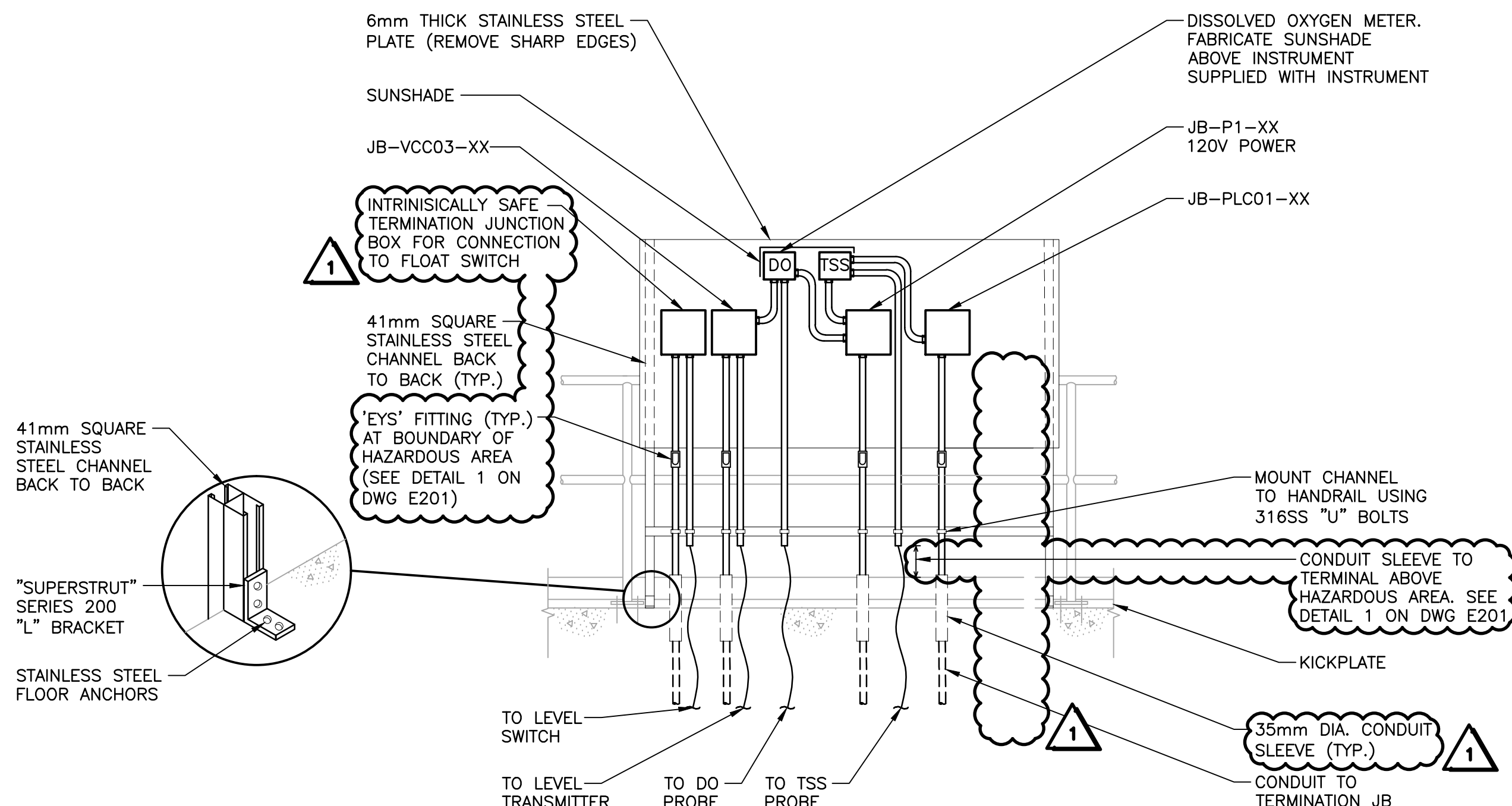
2 DETAIL— CONTROL PANEL/MAJOR JUNCTION BOX/INSTRUMENTATION MOUNTING
N.T.S. (SEE NOTES 1 & 2)



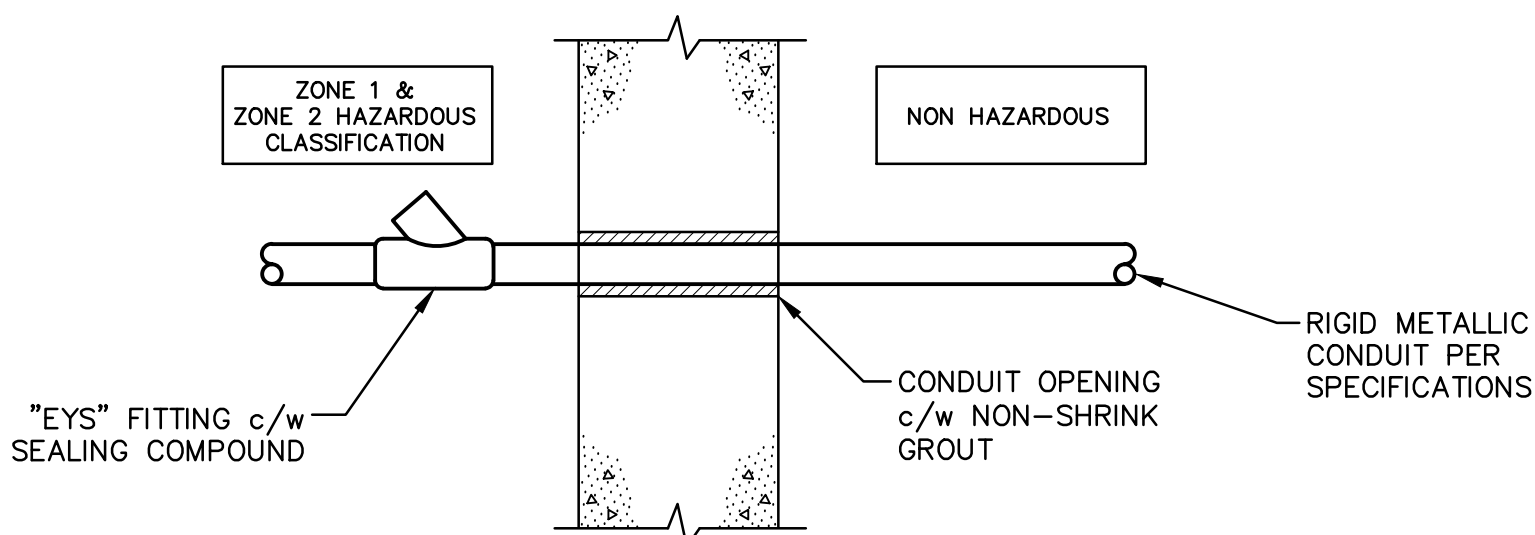
3 SCHEMATIC EXTERIOR LIGHTING CONTROL PANEL
N.T.S.



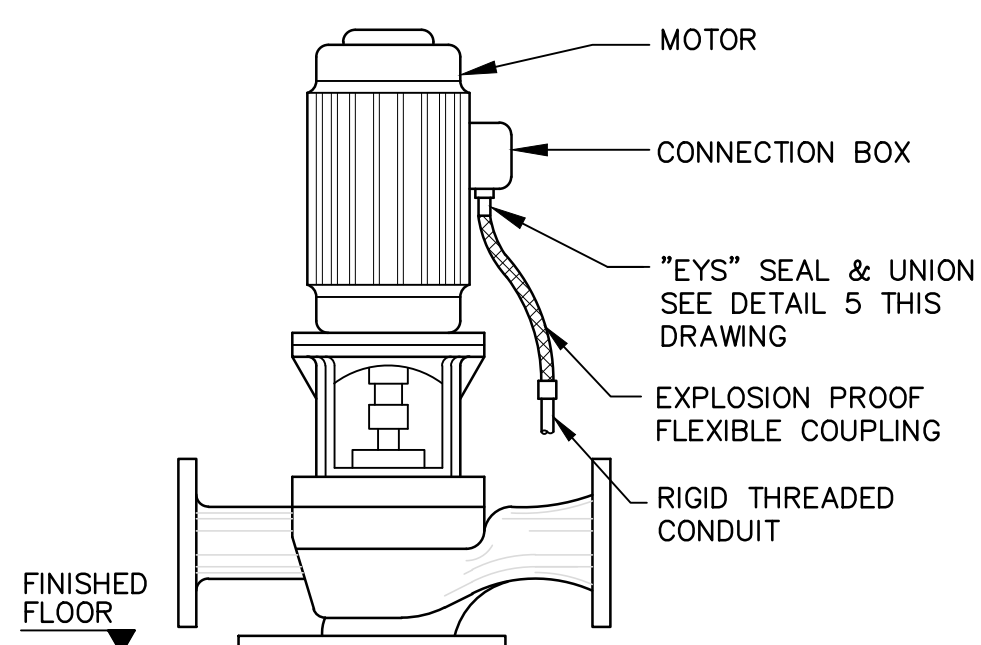
4 DETAIL CABLE & CONDUCTOR IDENTIFICATION
N.T.S. TYP. FOR ALL CABLE AND CONDUIT RUNS



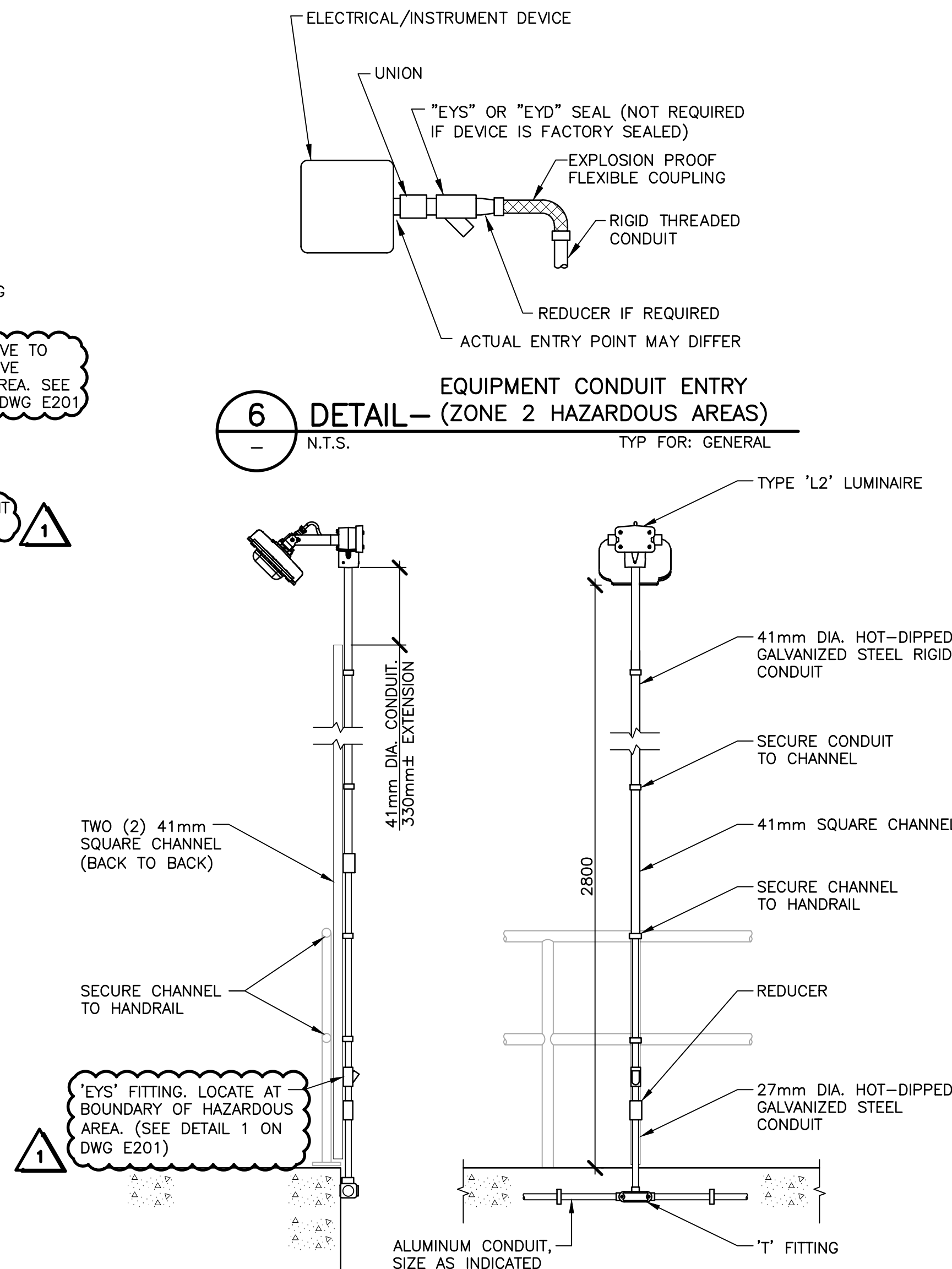
5 DETAIL SBR GUARDRAIL JUNCTION BOX MOUNTING (TYPICAL OF 3)
N.T.S.



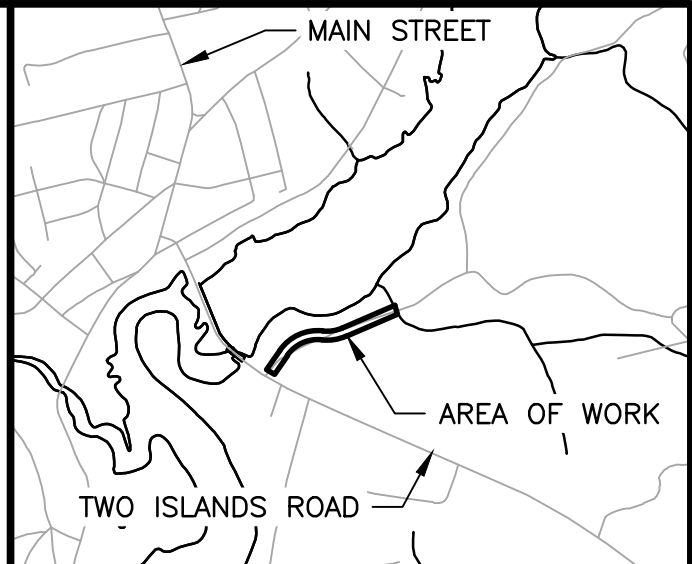
7 DETAIL— CONDUIT THROUGH WALL—HAZARDOUS TO NON—HAZARDOUS AREA (TYPICAL)
N.T.S.



8 DETAIL— TYPICAL CABLE/CONDUIT CONNECTION AT MOTORS (ZONE 1/2 HAZARDOUS AREAS)
N.T.S.



9 DETAIL SBR WALKWAY LIGHTING
N.T.S.



KEY PLAN
1:5000

- NOTES:
1. WALL MOUNT BACKPLATE OR PROVIDE A VERTICAL SUPPORT STRUCTURE COMPRISED OF 41mm U-SHAPED STRUT (BACK TO BACK).
 2. IN ZONE 1/2 HAZARDOUS AREAS, PROVIDE ELECTRIC SEALS IN ACCORDANCE WITH THE LATEST EDITION OF THE CANADIAN ELECTRICAL CODE.



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
B	ISSUED FOR APPROVAL	MAY 23/17	JAB
A	ISSUED FOR 50% REVIEW	MAY 01/17	JAB

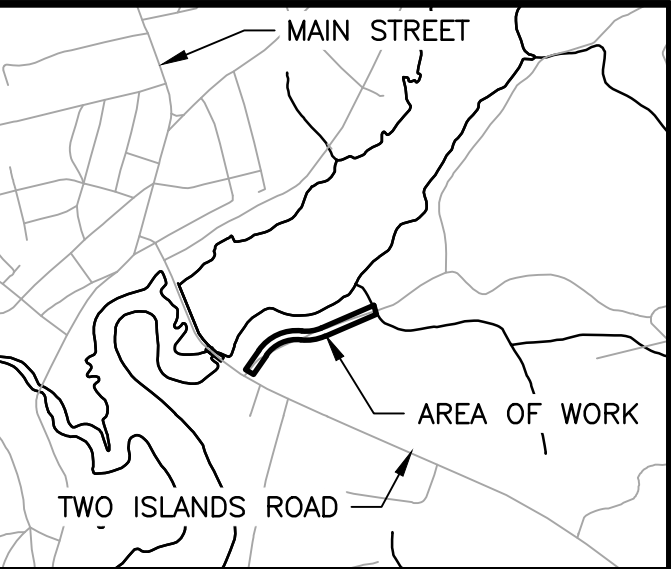
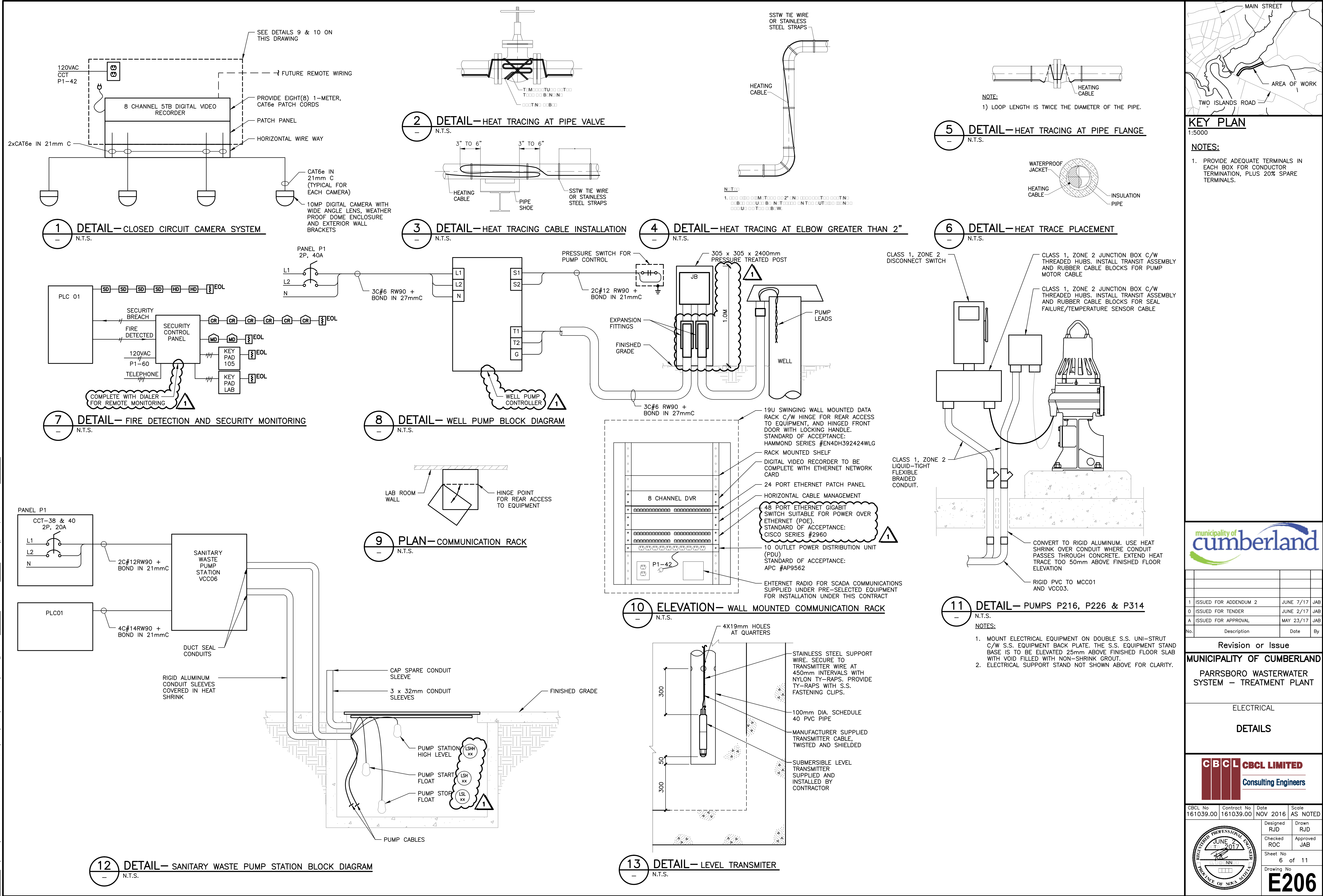
Revision or Issue
MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM – TREATMENT PLANT

ELECTRICAL
DETAILS



CBCL No 161039.00	Contract No 161039.00	Date NOV 2016	Scale AS NOTED
Designed RJD	Drawn RJD	Checked ROC	Approved JAB
Sheet No 5 of 11	Drawing No E205		

DRAWING NAME: \\N:\PROJECTS\161039.00_PARRSBORO WASTEWATER SYSTEM DESIGN\20 CAD\10 ELECTRICAL PLANT\101039.00.E206.DWG LAYOUT NAME: E206 DETAILS ELEC DATE: Wednesday, June 07, 2017 2:19:41 PM CAL DESIGNS: CHANNE



KEY PLAN

1:5000

- NOTES:**
1. PROVIDE ADEQUATE TERMINALS IN EACH BOX FOR CONDUCTOR TERMINATION, PLUS 20% SPARE TERMINALS.



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
A	ISSUED FOR APPROVAL	MAY 23/17	JAB

Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER SYSTEM – TREATMENT PLANT

ELECTRICAL

DETAILS



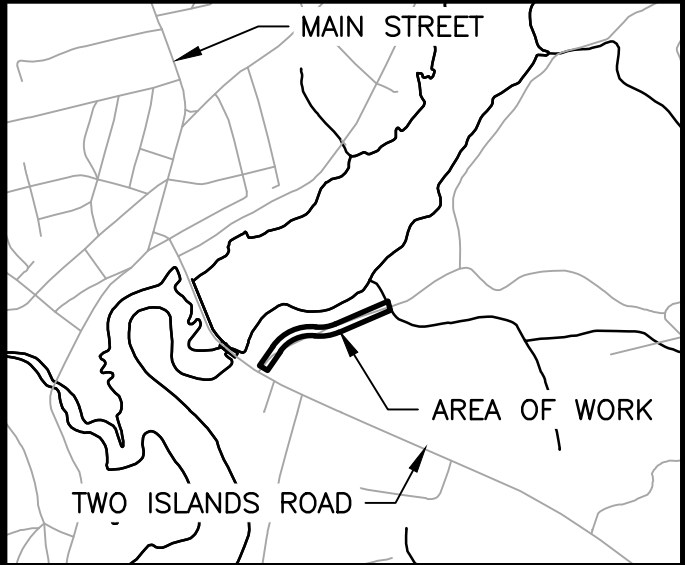
CBCL No 161039.00	Contract No 161039.00	Date NOV 2016	Scale AS NOTED
Designed RJD	Drawn RJD	Checked ROC	Approved JAB
Sheet No 6 of 11		Drawing No E206	

LIGHTING SCHEDULE						
LUMINAIRE TYPE	SUPPLY VOLTAGE	LAMP SOURCE	NUMBER OF LAMPS	LAMP WATTAGE	GENERAL DESCRIPTION	STANDARD OF ACCEPTANCE
L1	120VAC	LED	N/A	33W	WALL MOUNTED AREA LIGHT. MOUNT AT 2500mm ABOVE FINISHED SLAB UNLESS INDICATED OTHERWISE.	PHILIPS KEENE WALL PACK MEDIUM 313 LED (P/N: 313-LED-36L-530-NW) OR APPROVED EQUIVALENT
L2	120VAC	LED	N/A	29W	ENCLOSED AND GASKETED, SUITABLE FOR STANCHION MOUNTING IN WET AND CORROSIVE ENVIRONMENT	DIALIGHT DUROSITE LED AREA LIGHT (P/N: STW3C2N545) OR APPROVED EQUIVALENT
L3A	120VAC	LED	N/A	80W	LOW PROFILE ENCLOSED AND GASKETED LINEAR FIXTURE.	LITHONIA LIGHTING FEM LED CEILING/SUSPENDED MOUNT VAPOUR TIGHT FIXTURE (P/N: FEM L48 10000LM IMAFL MD 120 GZ10 40K 80CR)
L3B	120VAC	LED	N/A	80W	LOW PROFILE ENCLOSED AND GASKETED LINEAR FIXTURE C/W EMERGENCY BATTERY BACKUP	LITHONIA LIGHTING FEM LED CEILING/SUSPENDED MOUNT VAPOUR TIGHT FIXTURE (P/N: FEM L48 10000LM IMAFL MD 120 GZ10 40K 80CR1 BSL722)
L4	120VAC	LED	N/A	66W	LOW PROFILE, ZONE 2 RATED, LINEAR FIXTURE C/W EMERGENCY BATTERY BACKUP.	DIALIGHT SAFESITE LED LINEAR LOW PROFILE, SURFACE MOUNT, ZONE 2 RATED FIXTURE (P/N: LPD3B4H2W)
L5A	120VAC	LED	N/A	35W	RECESSED, 2'X4' LED TROFFER	EATON 24GR LED SERIES TROFFER (P/N: 24GR-LD5-48-F1-UNV-L835-CD1-U)
L5B	120VAC	LED	N/A	35W	RECESSED, 2'X4' LED TROFFER C/W EMERGENCY BATTERY BACKUP	EATON 24GR LED SERIES TROFFER (P/N: 24GR-LD5-48-F1-UNV-EL14W-L835-CD1-U)
EX1	120VAC	LED	N/A	2W	WALL MOUNTED POINT LIGHT. MOUNT AT 2500mm ABOVE FINISHED SLAB UNLESS INDICATED OTHERWISE.	AIMLIGHT RPST SERIES (P/N: RPST-1-M-WHT-BAT)
EX2	120VAC	LED	N/A	4W	WALL MOUNTED POINT LIGHT. MOUNT AT 2500mm ABOVE FINISHED SLAB UNLESS INDICATED OTHERWISE.	AIMLIGHT RPZN2 SERIES (P/N: RPZN2-1-GRY-BAT)

ELECTRIC HEATER SCHEDULE					
HEATER TYPE	LOCATION	SERVICE	WATTAGE (kW)	REMARKS	STANDARD OF ACCEPTANCE
BB-1	LAB/OFFICE	208V/1 ϕ /60Hz	2.5	BASEBOARD HEATER; SUPPLY AND INSTALL WALL MOUNTED, LINE VOLTAGE THERMOSTAT TO CONTROL HEATER.	Q/UL9891T-1B-0000000000T000B000B000000T000 #/N/00B:2:0:00
BB-2	WASHROOM	208V/1 ϕ /60Hz	.3	BASEBOARD HEATER C/W BUILT IN THERMOSTAT	Q/UL9891T-1B-0000000000T000B000B000000T000 #/N/00B:0:0:00
EUH-1	PROCESS AREA	208V/3 ϕ /60Hz	5	ELECTRIC UNIT HEATER. SUPPLY AND INSTALL ONE (1) COMMON LOW-VOLTAGE THERMOSTAT AND CONTROL TRANSFORMER TO CONTROL EUH-1, 2 & 3	Q/UL9891T-0000000000N-U:U:0000UNIT000T000 #/N/0000U0:0:00
EUH-2	PROCESS AREA	208V/3 ϕ /60Hz	5	ELECTRIC UNIT HEATER	Q/UL9891T-0000000000N-U:U:0000UNIT000T000 #/N/0000U0:0:00
EUH-3	PROCESS AREA	208V/3 ϕ /60HZ	5	ELECTRIC UNIT HEATER	Q/UL9891T-0000000000N-U:U:0000UNIT000T000 #/N/0000U0:0:00
EUH-4	DEWATERING ROOM	208V/3 ϕ /60Hz	10	CLASS 1 ZONE 2 RATED, ELECTRIC UNIT HEATER. SUPPLY AND INSTALL A WALL MOUNTED LOW-VOLTAGE THERMOSTAT C/W REMOTE SENSING BULB. SEAL PENETRATION INTO HAZARDOUS SPACE. INSTALLATION TO MEET REQUIREMENTS IN CEC FOR CLASS 1 ZONE 2 HAZARDOUS SPACE.	OUELLET OHX SERIES EXPLOSION PROOF INDUSTRIAL UNIT HEATER (P/N: OHX10038)
EUH-5	BIN ROOM	208V/3 ϕ /60Hz	15	CLASS 1 ZONE 2 RATED, ELECTRIC UNIT HEATER. SUPPLY AND INSTALL A WALL MOUNTED LOW-VOLTAGE THERMOSTAT C/W REMOTE SENSING BULB. SEAL PENETRATION INTO HAZARDOUS SPACE. INSTALLATION TO MEET REQUIREMENTS IN CEC FOR CLASS 1 ZONE 2 HAZARDOUS SPACE.	OUELLET OHX SERIES EXPLOSION PROOF INDUSTRIAL UNIT HEATER (P/N: OHX15038)
FF-1	ELECTRICAL ROOM	208V/1 ϕ /60Hz	3	WALL MOUNTED 3kW FAN FORCED HEATER SEE DETAIL 6 ON DRAWING E210	OUELLET OAC SERIES FAN FORCED WALL HEATER (P/N: OACU40000)
NOTES: 1) ALL UNIT HEATERS ARE TO COME WITH WALL MOUNTING BRACKETS.					

[illegible]

120/20 1 0 W 12 MN										UPS1 T N T M M N 0 M N B 0										10000 0 0	
T Wa B a B Wa T T 1 0 0 7 0 11										T Wa B a B Wa T T 1 0 0 7 0 11										2 0 0 0 0 12	
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KEY PLAN

1:5000



1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
A	ISSUED FOR APPROVAL	MAY 23/17	JAB
No.	Description	Date	By

Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER SYSTEM – TREATMENT PLANT

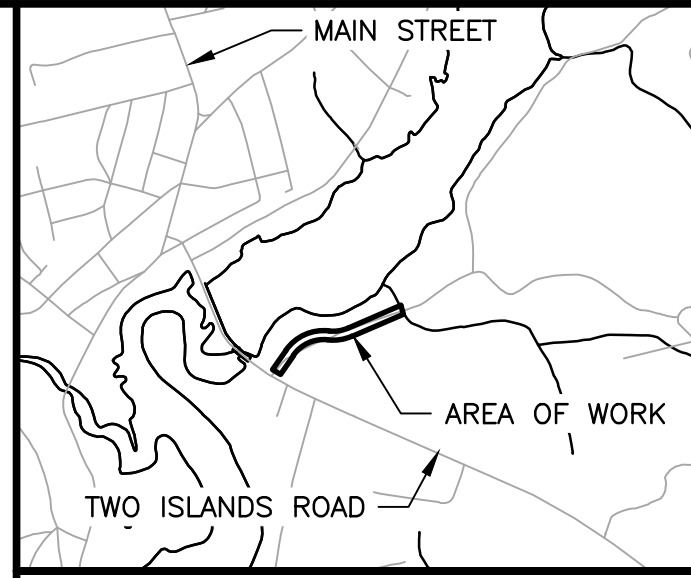
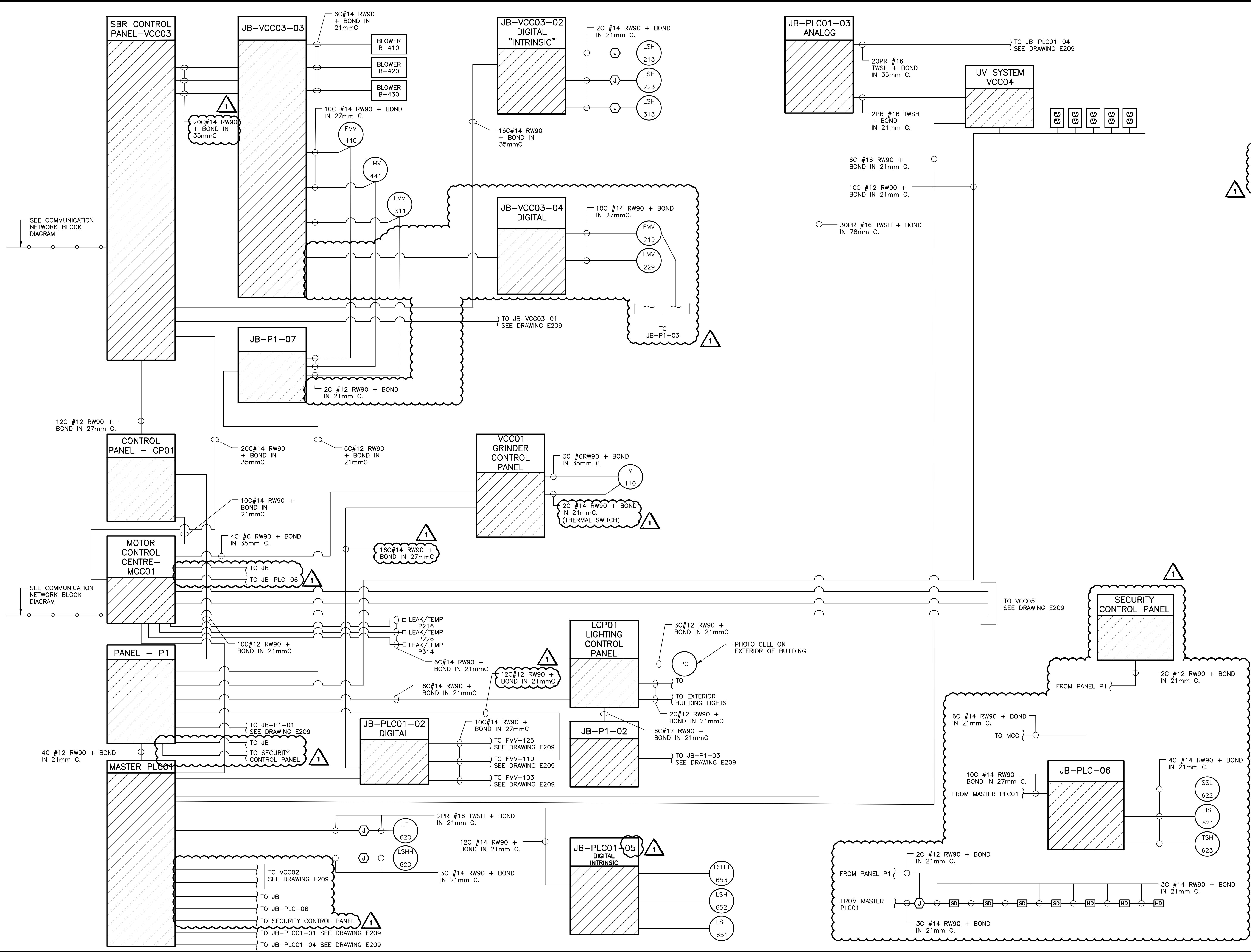
ELECTRICAL

SCHEDULES

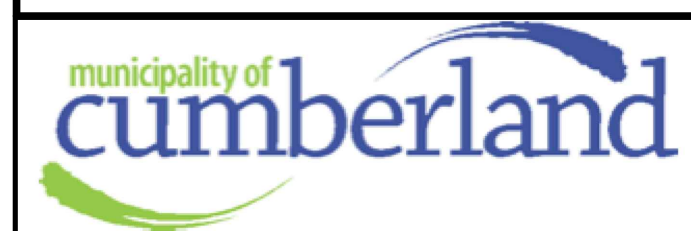


CBCL No 161039.00	Contract No 161039.00	Date NOV 2016	Scale AS NOTED
		Designed RJD	Drawn RJD
		Checked ROC	Approved JAB
		Sheet No 7 of 11	
		Drawing No E207	

DRAWING NAME: \N\PROJECTS\161039.00_PARRSBORO WASTEWATER SYSTEM DESIGN\20 CAD\VB ELECTRICIAN PLANT\161039.00_E208.DWG LAYOUT NAME: E208 CABLING DIAGRAM SHEET 1 OF 2 DATE: DATE: Wednesday, June 07, 2017 2:20:20 PM CAD OPERATOR: CHANNE



KEY PLAN
1:5000
NOTES:
1. POWER SUPPLY TO CONTROL PANEL IS INTERLOCKED TO THE VENTILATION SYSTEM THROUGH CONTROL PANEL CP01.



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 02/17	JAB

Revision or Issue

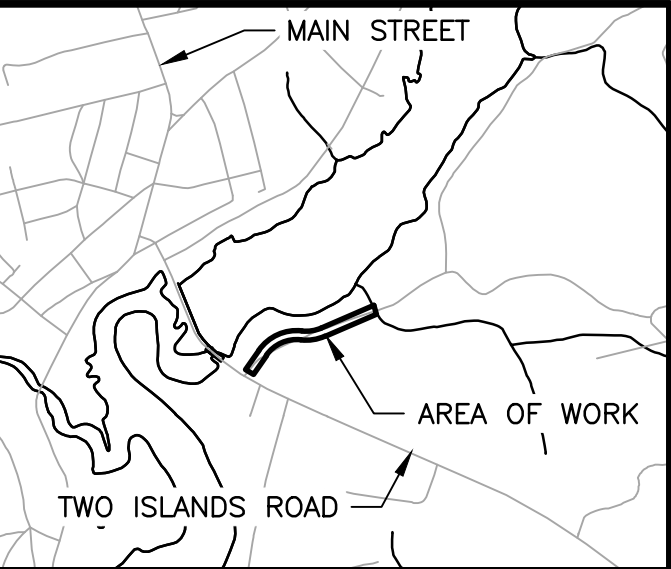
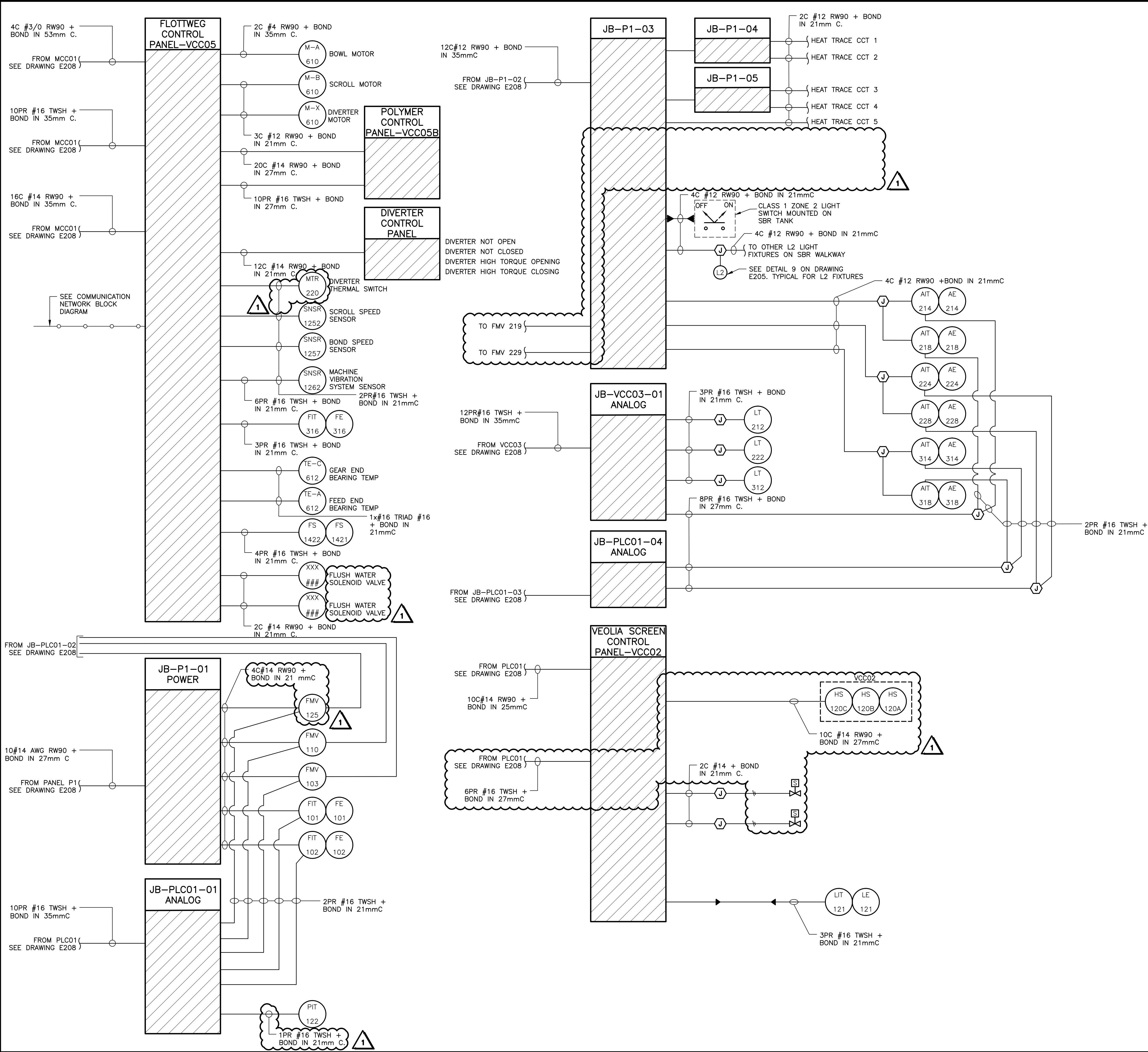
MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM - TREATMENT PLANT

ELECTRICAL
CABLING DIAGRAM
SHEET 1 OF 2



CBCL No 161039.00	Contract No 161039.00	Date JUNE 2017	Scale AS NOTED
Designed ROC	Drawn RJD	Checked ROC	Approved JAB
Sheet No 8 of 11		Drawing No E208	

DRAWING NAME: K:\PROJECTS\161039-00_PARRSBORO WASTEWATER SYSTEM DESIGN\20 CAD\18 ELECTRICAL PLANT\161039-00_E209.DWG LAYOUT NAME: E209.DWG SHEET 2 OF 2 DATE: DATE: Wednesday, June 07, 2017 2:04:47 PM CAD OPERATOR: CHAYNE



KEY PLAN
1:5000



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 02/17	JAB

Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER SYSTEM - TREATMENT PLANT

ELECTRICAL

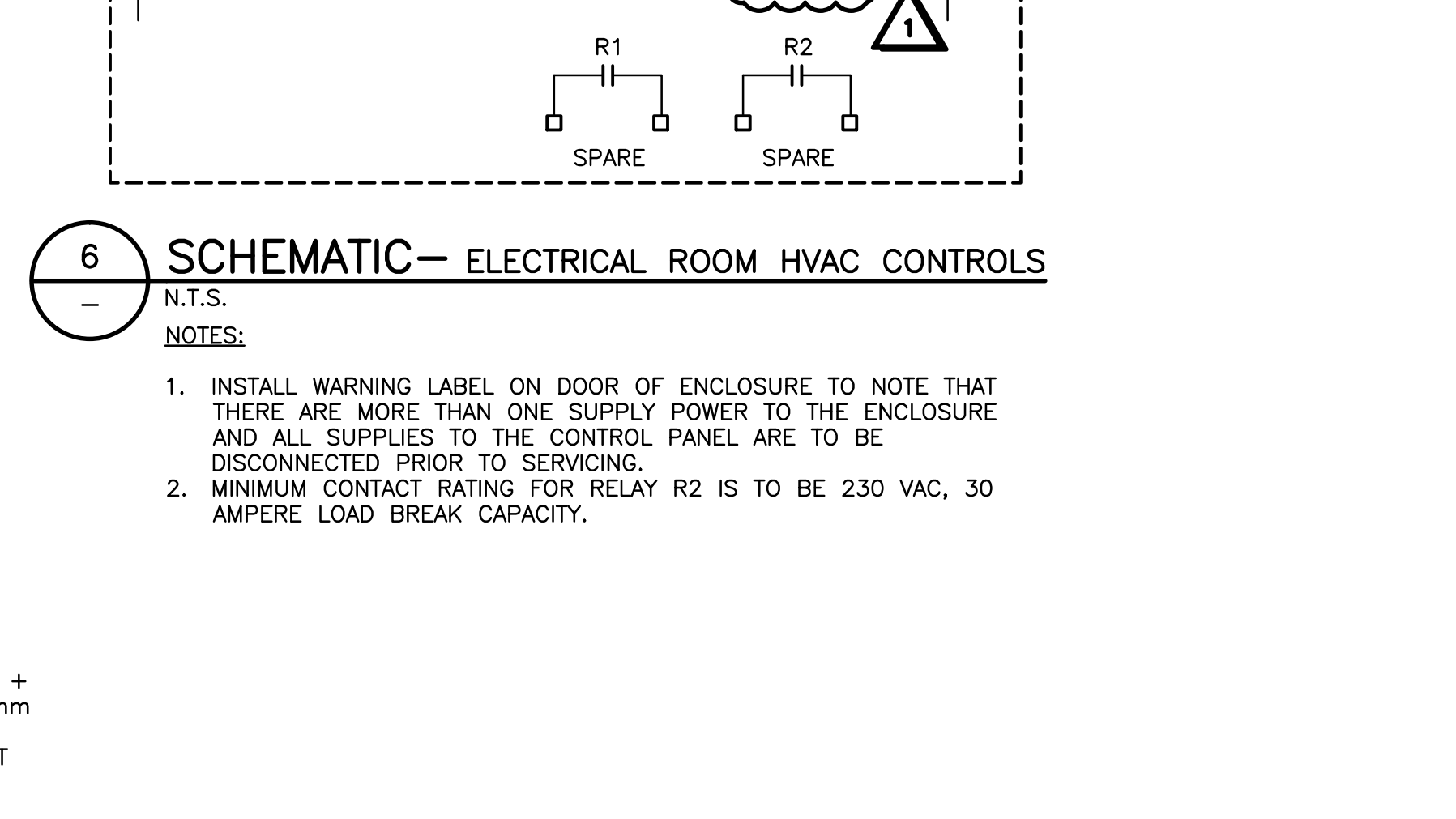
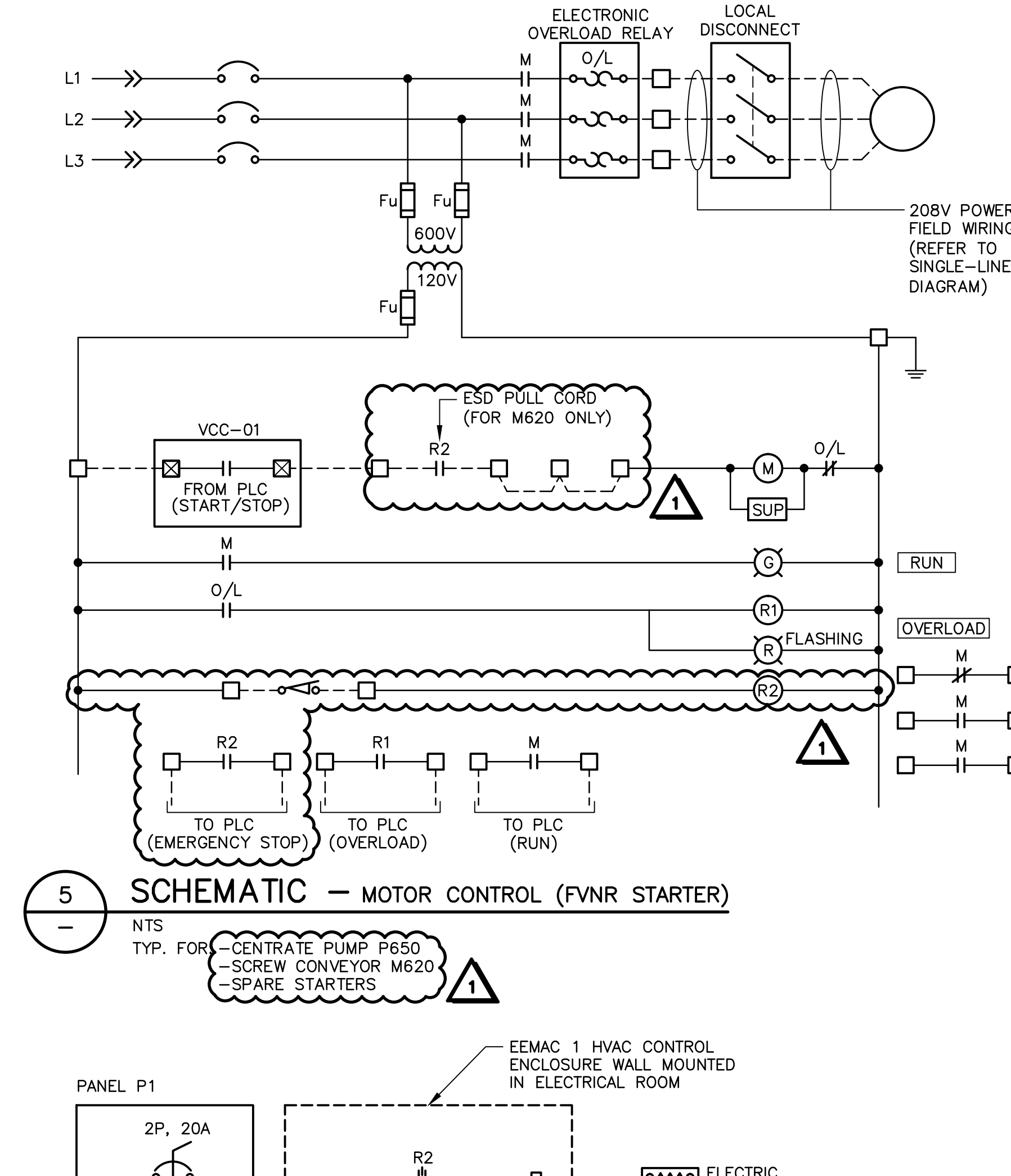
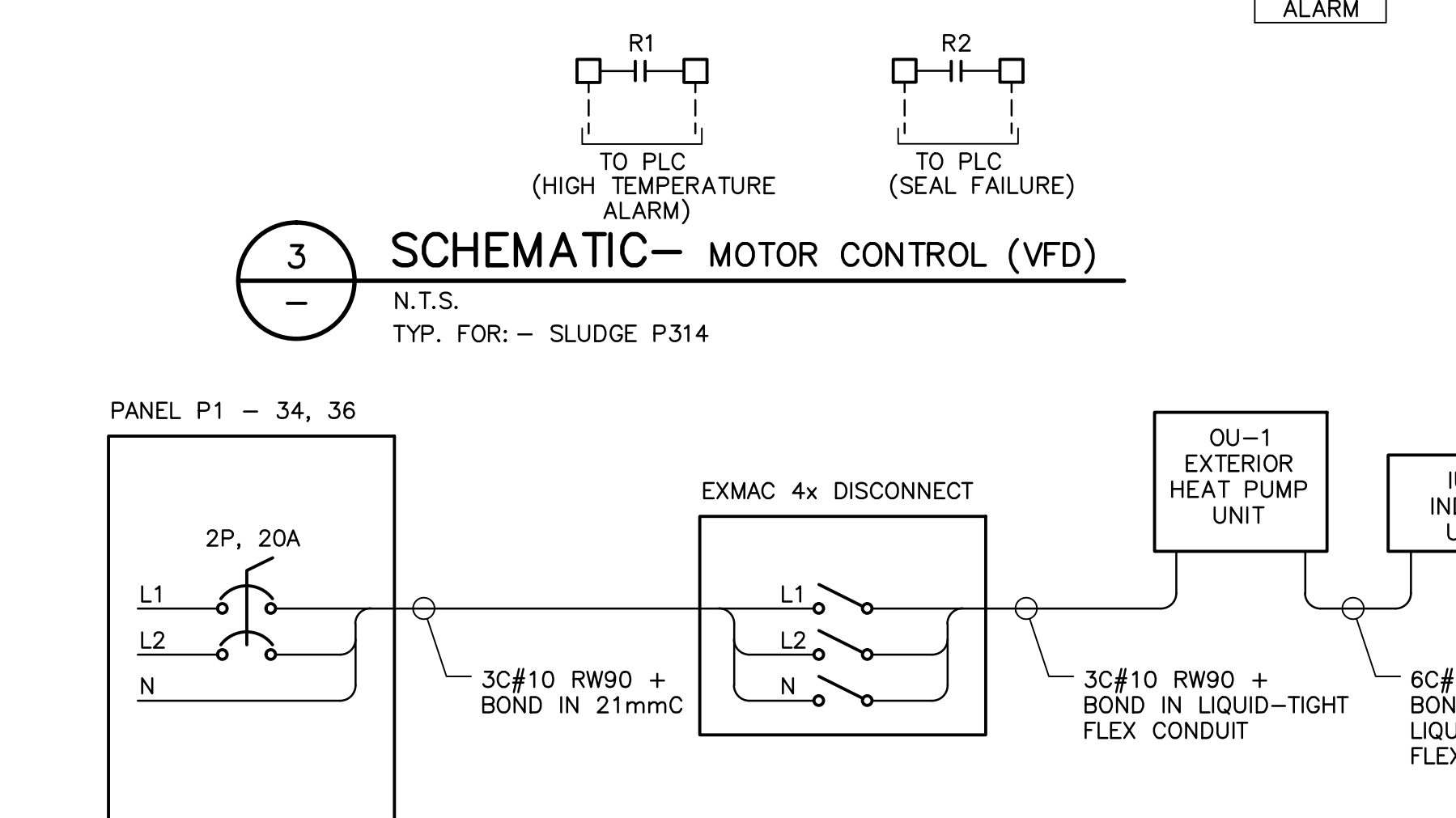
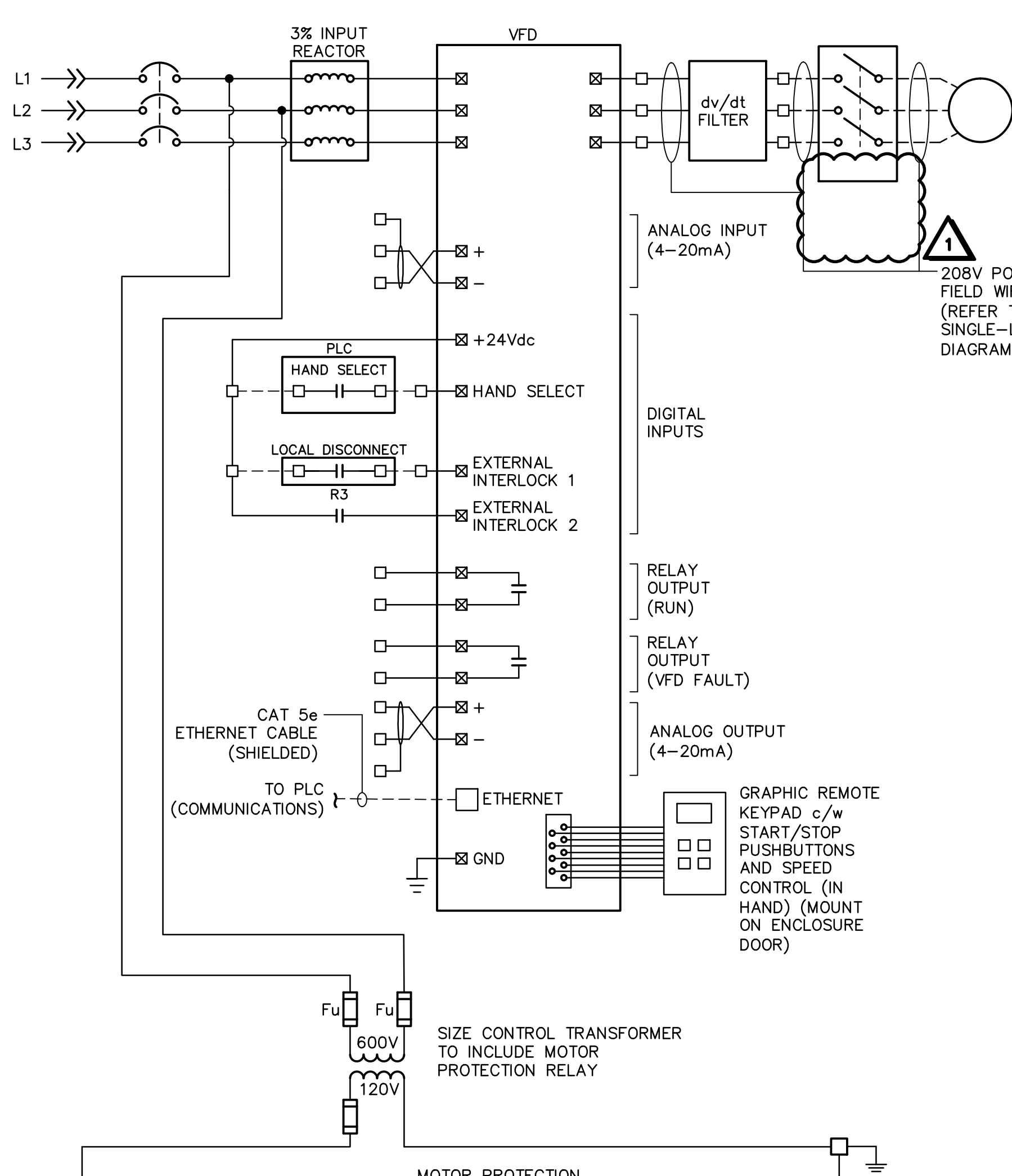
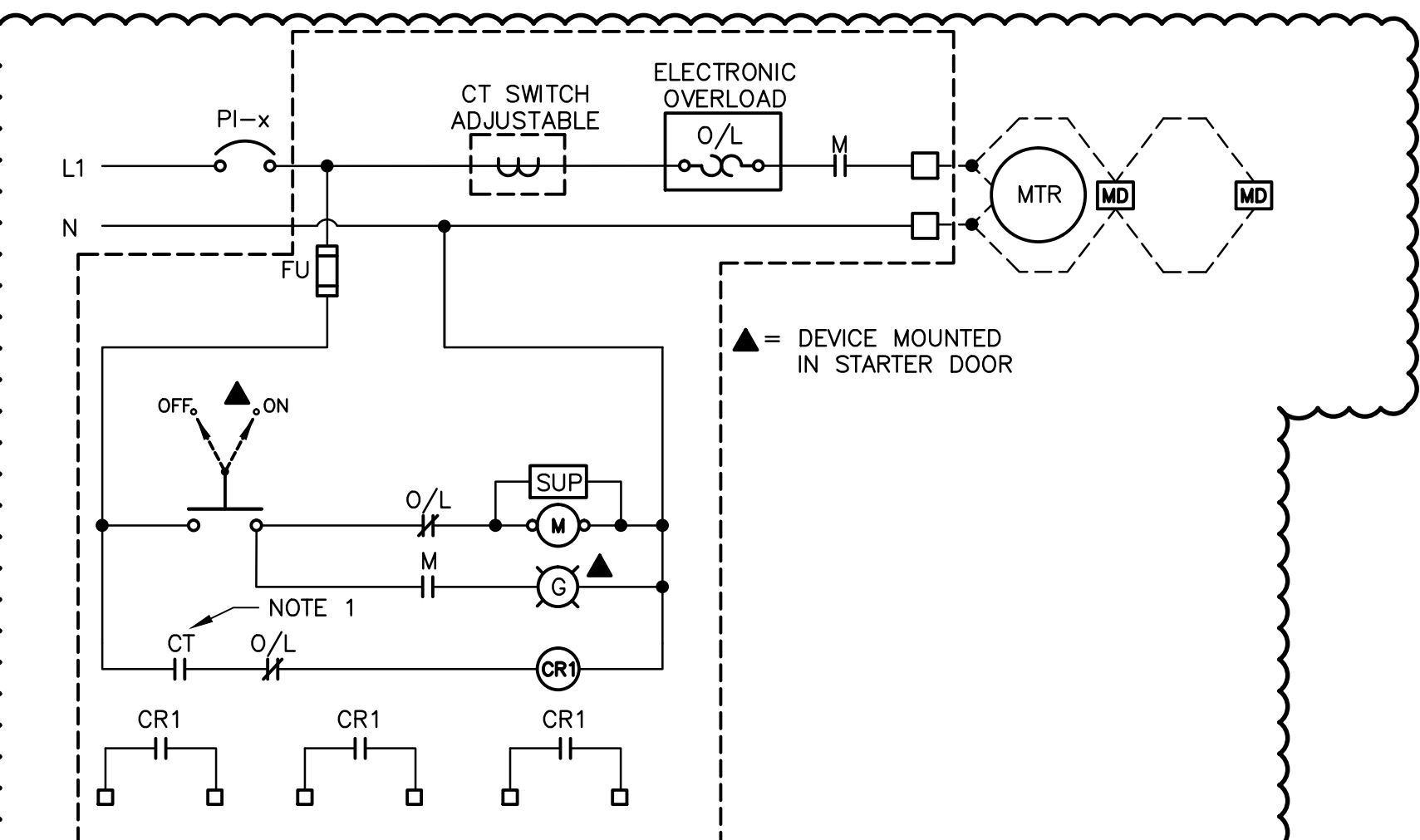
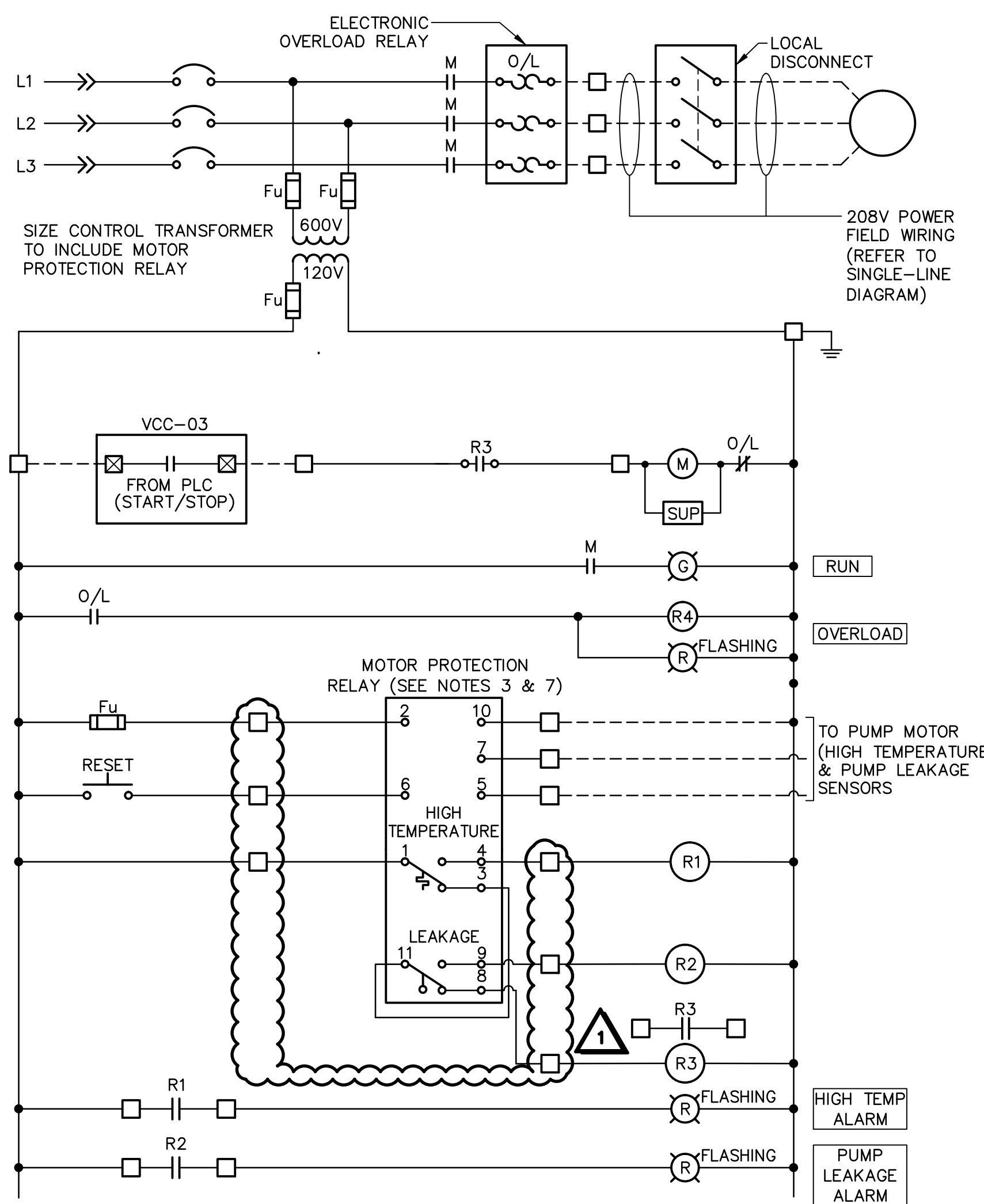
CABLING DIAGRAM

SHEET 2 OF 2



CBCL No 161039.00	Contract No 161039.00	Date JUNE 2017	Scale AS NOTED
Designed ROC	Drawn RJD	Checked ROC	Approved JAB
Sheet No 9 of 11	Drawing No E209		

DRAWING NAME: \\N\PROJECTS\161039.00_PARRSBORO WASTEWATER SYSTEM DESIGN\20 CAD\10 ELEC\TREATMENT PLANT\161039.00_E210.DWG LAYOUT NAME: E210 SCHEMATICS DATE: Wednesday, June 07, 2017 3:59:14 PM CAL DESIGNS: CHANNE



- KEY PLAN
1:5000
- NOTES:
- PROCESS MOTOR CONTROL CABLING IS IDENTIFIED ON THE CABLING DIAGRAMS.
 - MANUFACTURER SUPPLIED MOTOR PROTECTION RELAY SHALL BE SUPPLIED LOOSE TO MCC MANUFACTURER FOR FACTORY INSTALLATION. EXACT RELAY MODEL SHALL BE CONFIRMED DURING CONSTRUCTION.
 - CONTROL SCHEMATIC IS TYPICAL AND IS SHOWN FOR CONTROL PHILOSOPHY ONLY. SHOP DRAWINGS SHALL BE SUBMITTED INDICATING WIRING CONNECTIONS SPECIFIC TO THE MANUFACTURER'S VFD.
 - VFD CONTROL AND MONITORING TO BE VIA ETHERNET/IP CONNECTION. VFD COMMUNICATIONS TO BE COMPATIBLE W/IT PLC CONTROLLER (ALLEN BRADLEY COMPACT LOGIX).
 - VERIFY MOTOR NAMEPLATE AND ADVISE ENGINEER. OVERLOAD RELAY TO MATCH MOTOR NAMEPLATE.



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB

Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER SYSTEM — TREATMENT PLANT

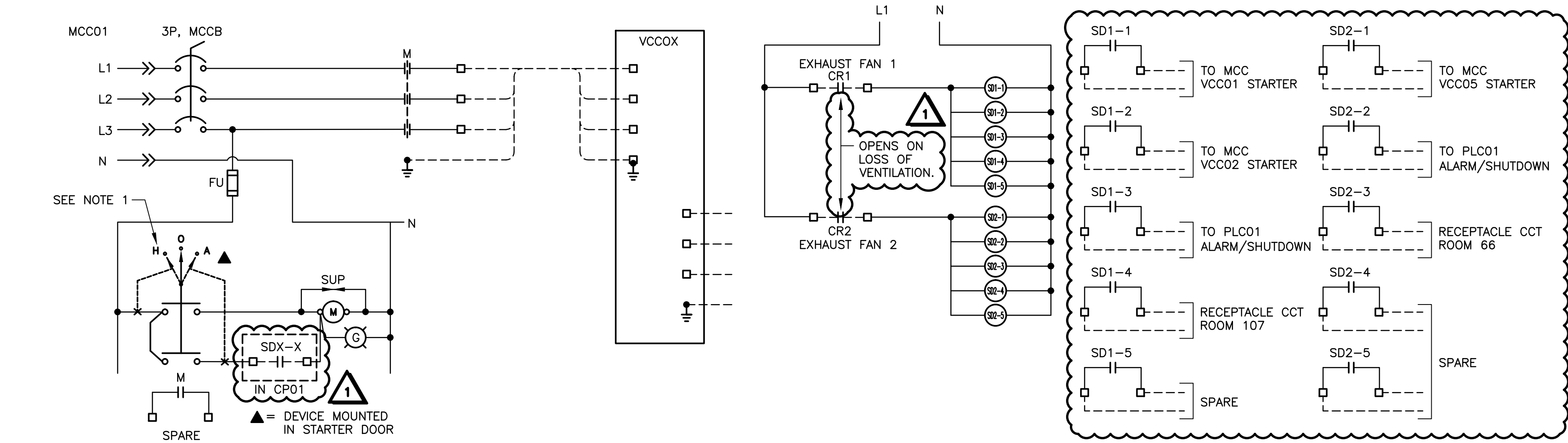
ELECTRICAL

SCHEMATICS



CBCL No 161039.00	Contract No 161039.00	Date NOV 2016	Scale AS NOTED
Designed ROC	Drawn RJD	Checked ROC	Approved JAB
Sheet No 10 of 11	Drawing No E210		

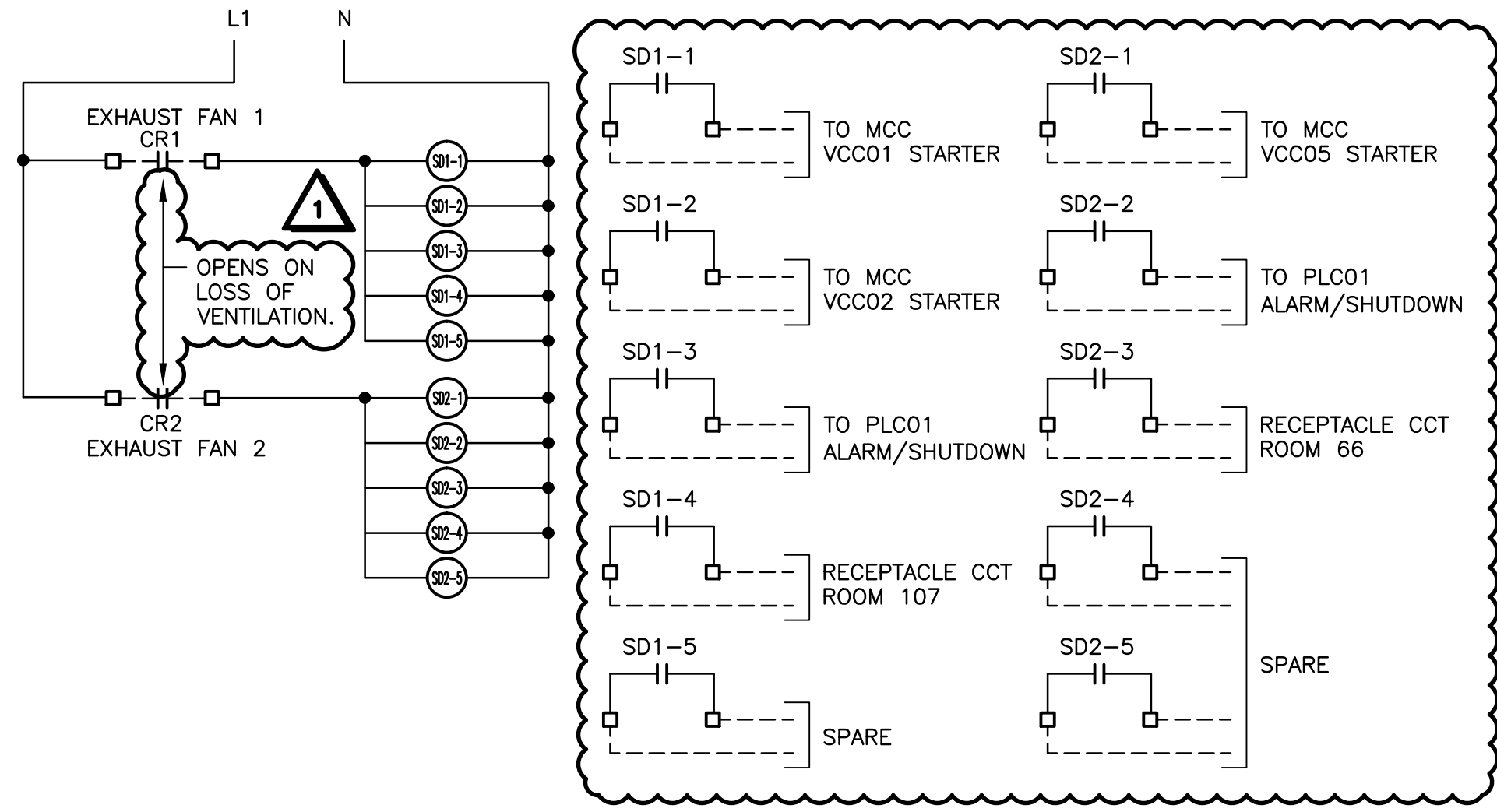
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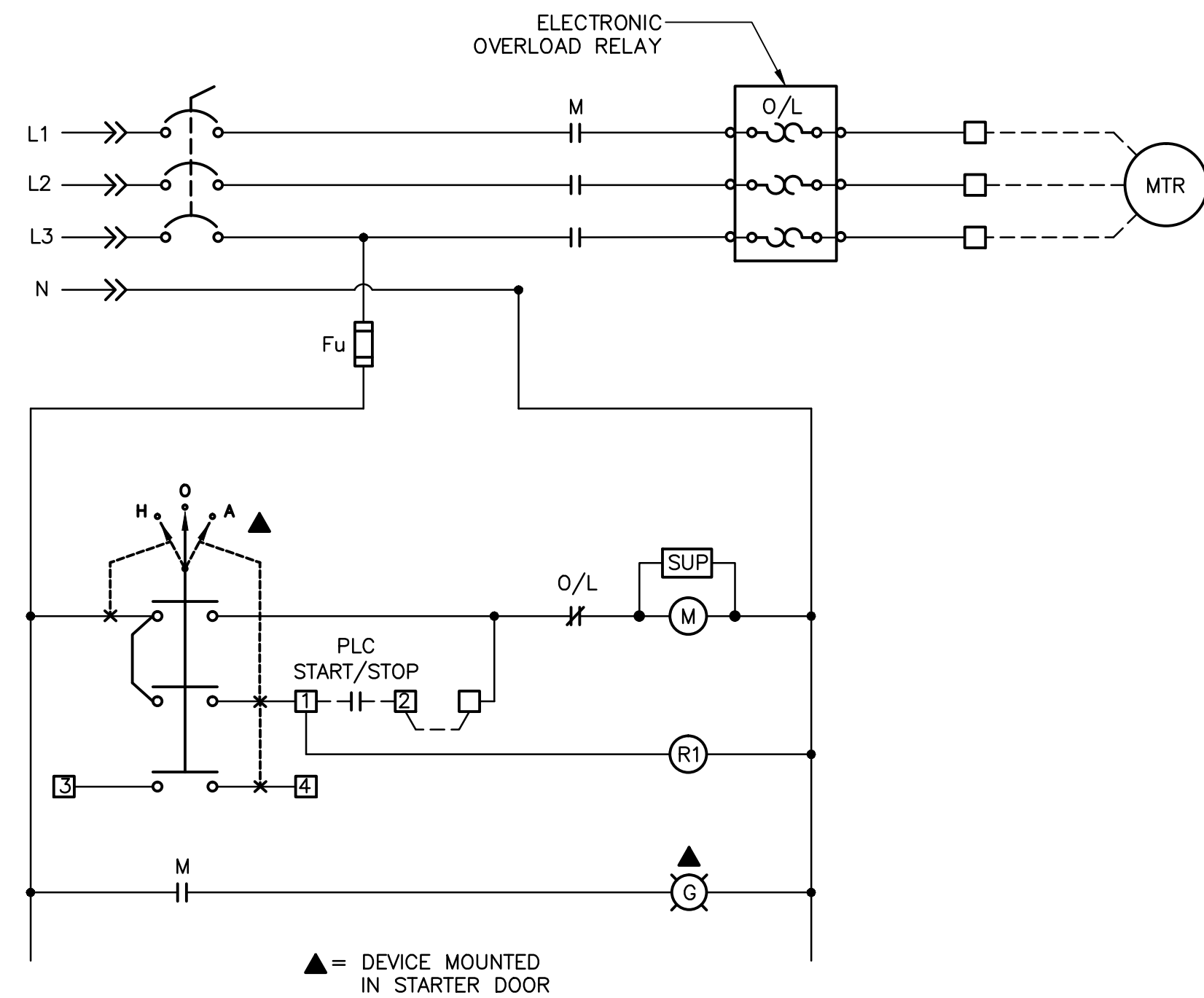
1 SCHEMATIC— MOTOR MCC01—VCC01, VCC02 & VCC05
— N.T.S.

NOTES:

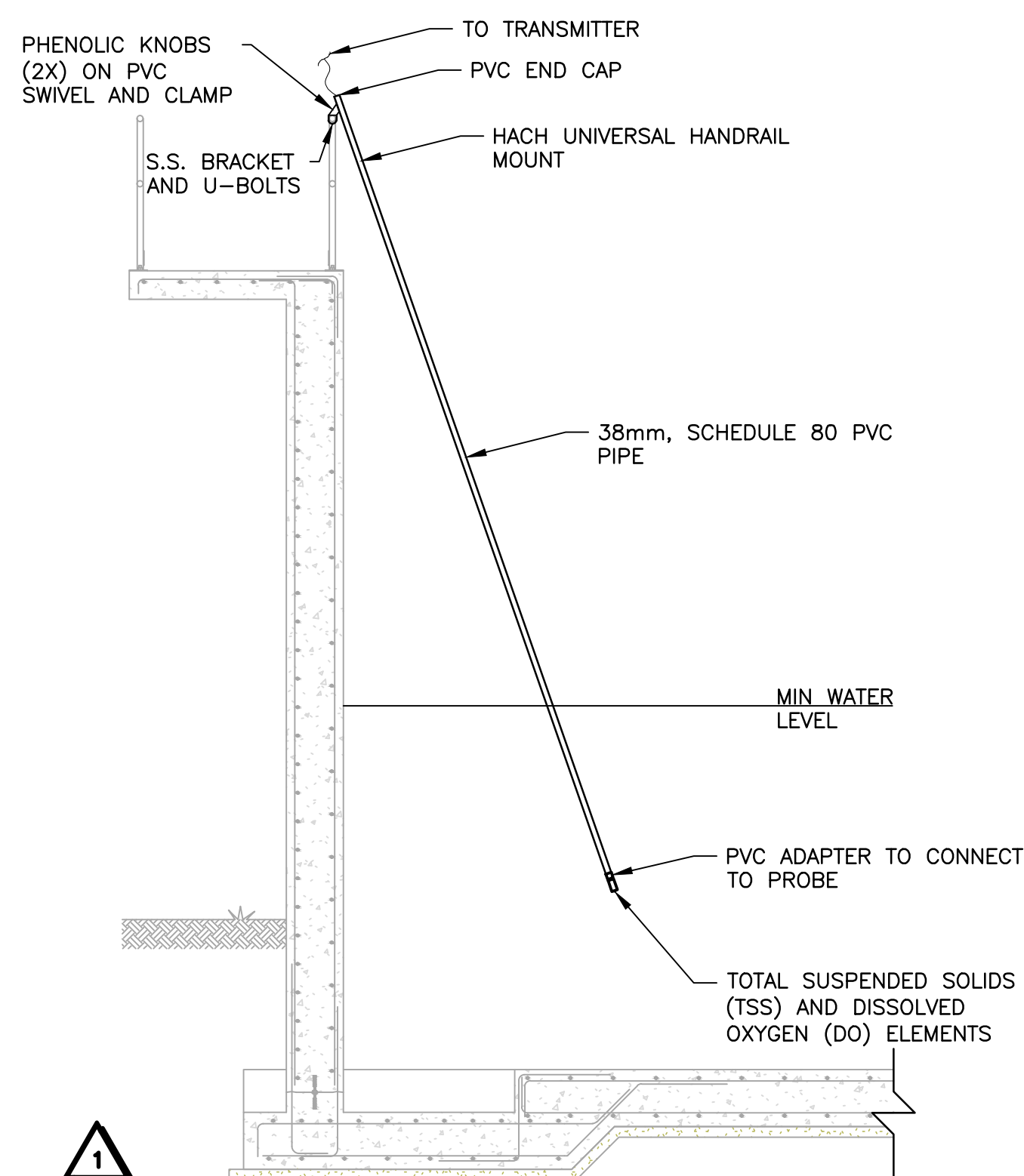
- SUPPLY AND INSTALL A WARNING SIGN ON MOTOR STARTER DOOR TO INDICATE THAT:
"THIS PROCESS EQUIPMENTS IS INSTALLED IN A CLASS 1, ZONE 2 HAZARDOUS SPACE THAT IS BEING VENTILATED TO REMOVE THE HAZARD. IF THE VENTILATION SYSTEM FAILS, THE PROCESS EQUIPMENT IS NOT RATED FOR THE HAZARD AND WILL SHUT DOWN AUTOMATICALLY UNTIL THE VENTILATION SYSTEM IS PUT BACK IN SERVICE. IF THIS EQUIPMENT IS OPERATED WITH THE SELECTOR IN 'HAND', THE AUTOMATIC SHUT DOWN AND PROTECTION DOES NOT EXIST. TO USE EQUIPMENT IN HAND, IT MUST BE DONE UNDER CONTROLLED CONDITIONS AND USING A SAFE WORK PERMIT."
- RELAY SD IS LOCATED IN THE VENTILATION SHUT DOWN CONTROL PANEL. CONTACT SD WILL OPEN WHEN THE CURRENT SWITCH WITHIN THE EXHAUST FAN STARTER OPENS.



2 SCHEMATIC— EQUIPMENT SHUTDOWN CONTROL PANEL (CP01)
— N.T.S.



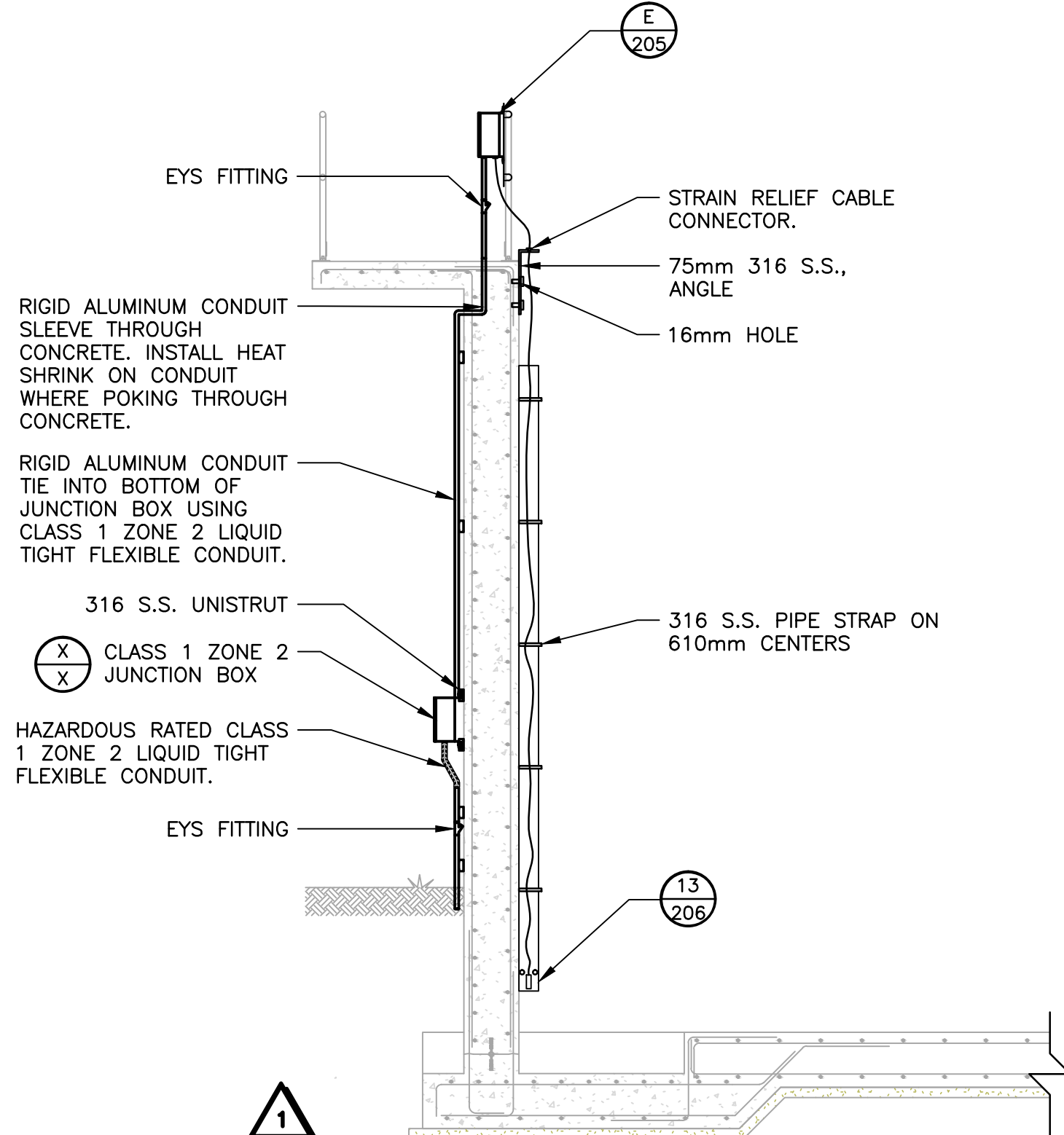
3 SCHEMATIC— MOTORS M410, M470 & M430 (BLOWERS)
— N.T.S.



4 DETAIL— INSTRUMENTATION INSTALLATION
— N.T.S.

NOTES:

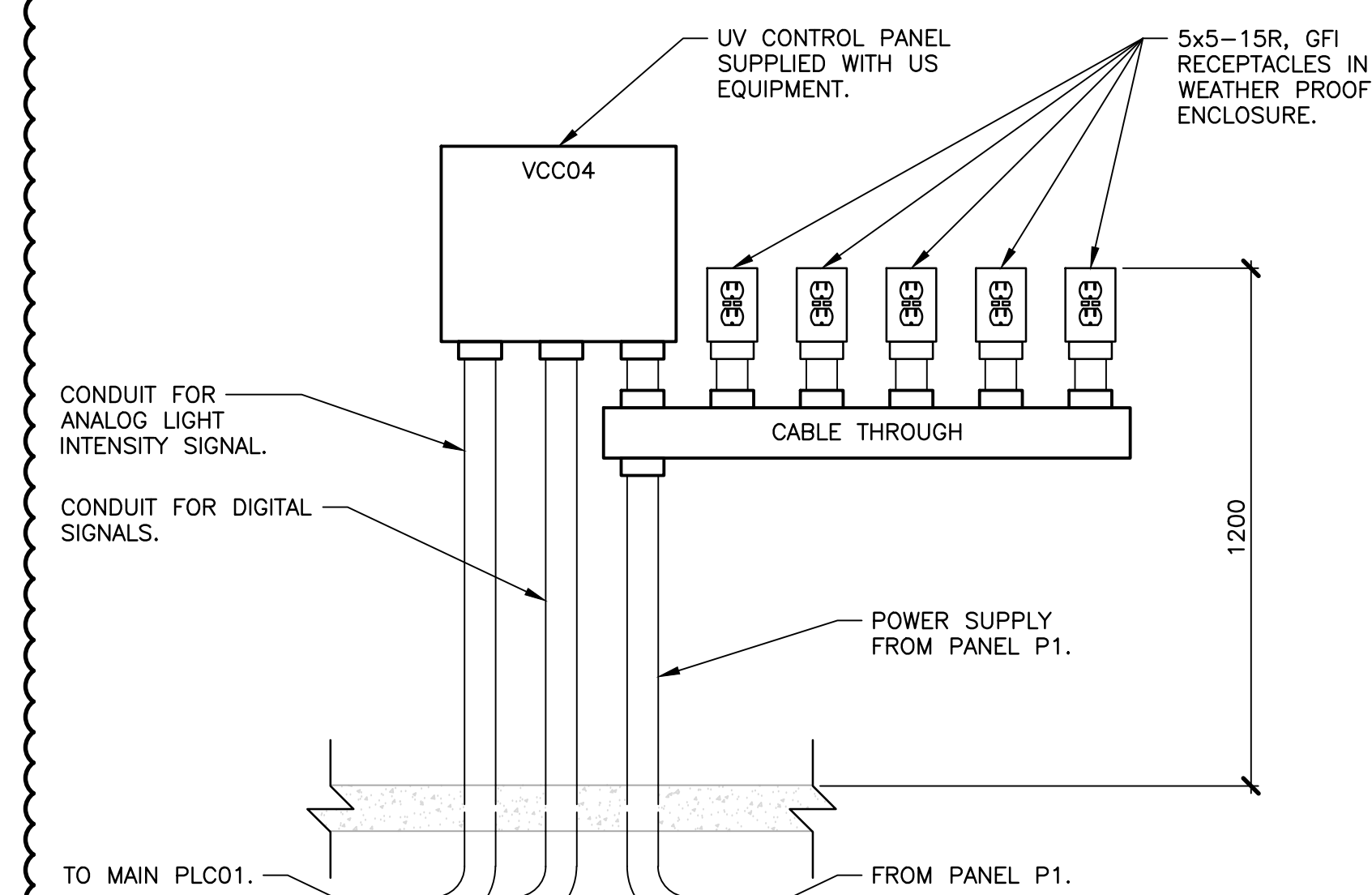
- HACH UNIVERSAL HANDRAIL MOUNT WILL BE SUPPLIED FOR AE214, AE224 AS PART OF THE PRE-SELECTED EQUIPMENT PACKAGE. THE CONTRACTOR IS TO SUPPLY THE REMAINDER.



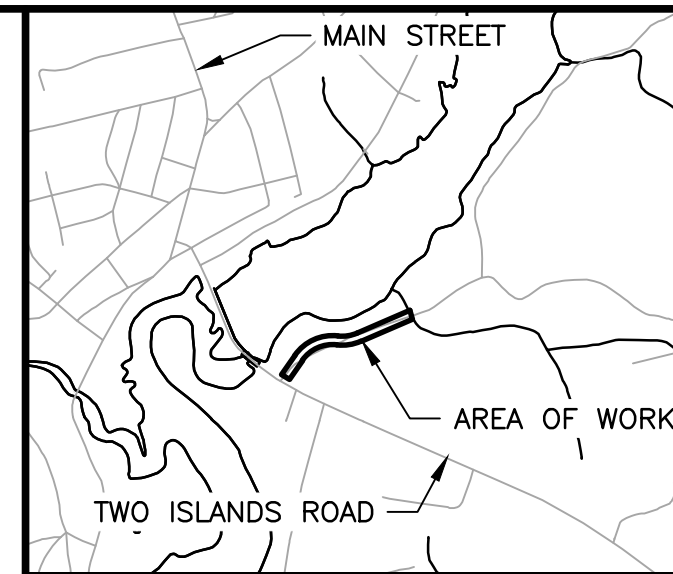
5 DETAIL— INSTRUMENTATION INSTALLATION
— N.T.S.

NOTES:

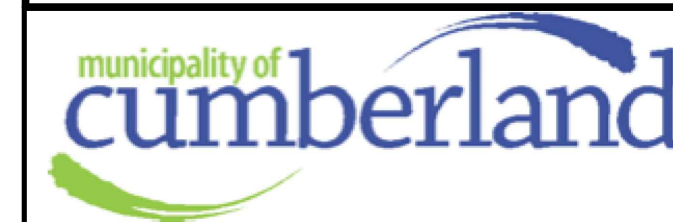
- STANDARD OF ACCEPTANCE FOR LT212, LT222, LT312.



6 DETAIL— UV SYSTEM CONTROL PANEL
— N.T.S.



KEY PLAN
1:5000



No.	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB

Revision or Issue

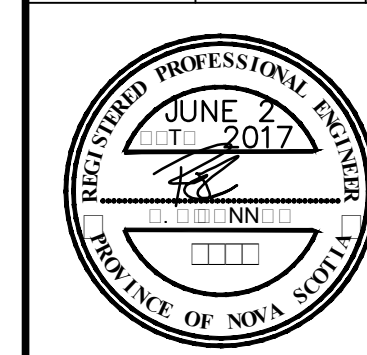
MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER
SYSTEM — TREATMENT PLANT

ELECTRICAL

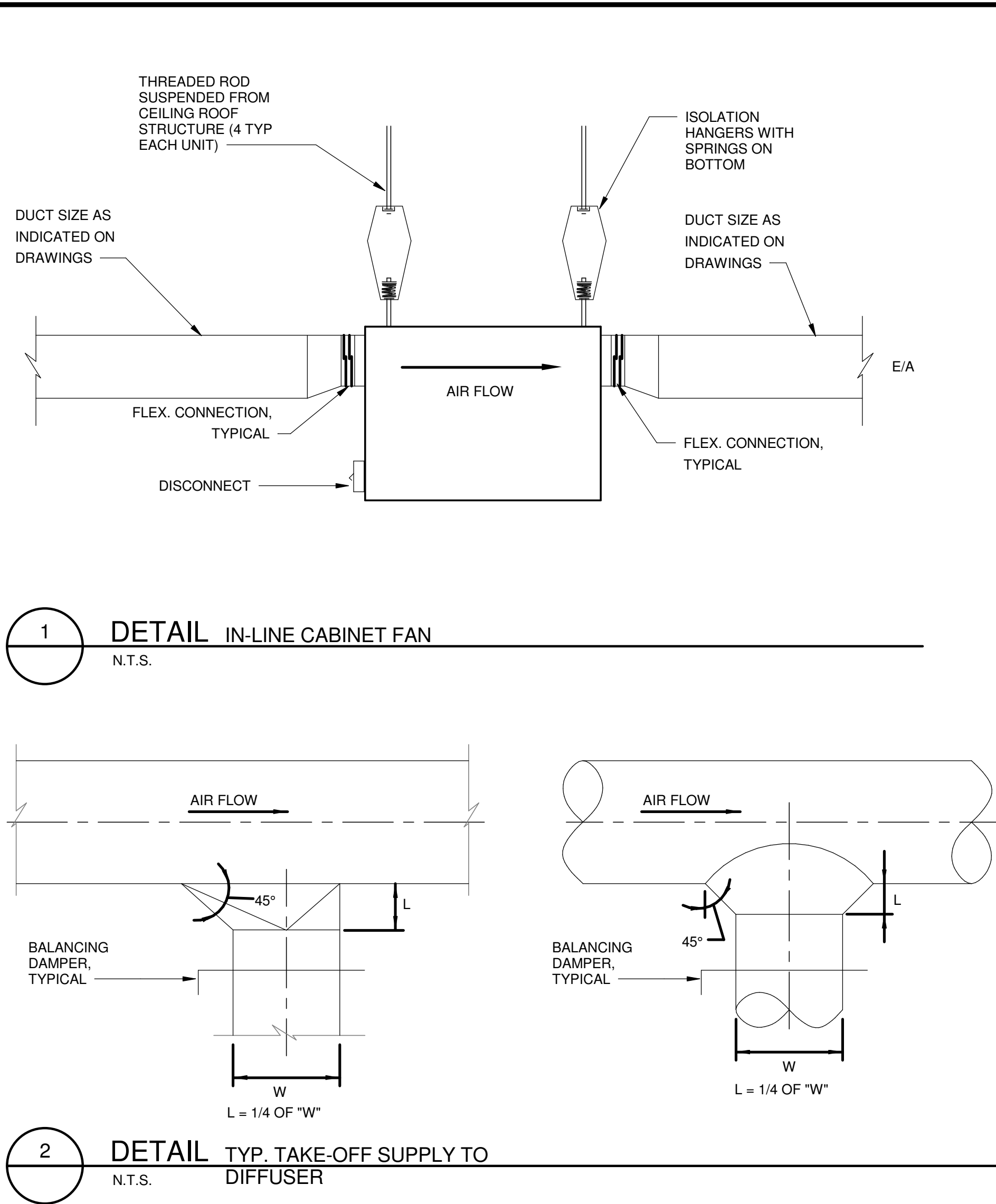
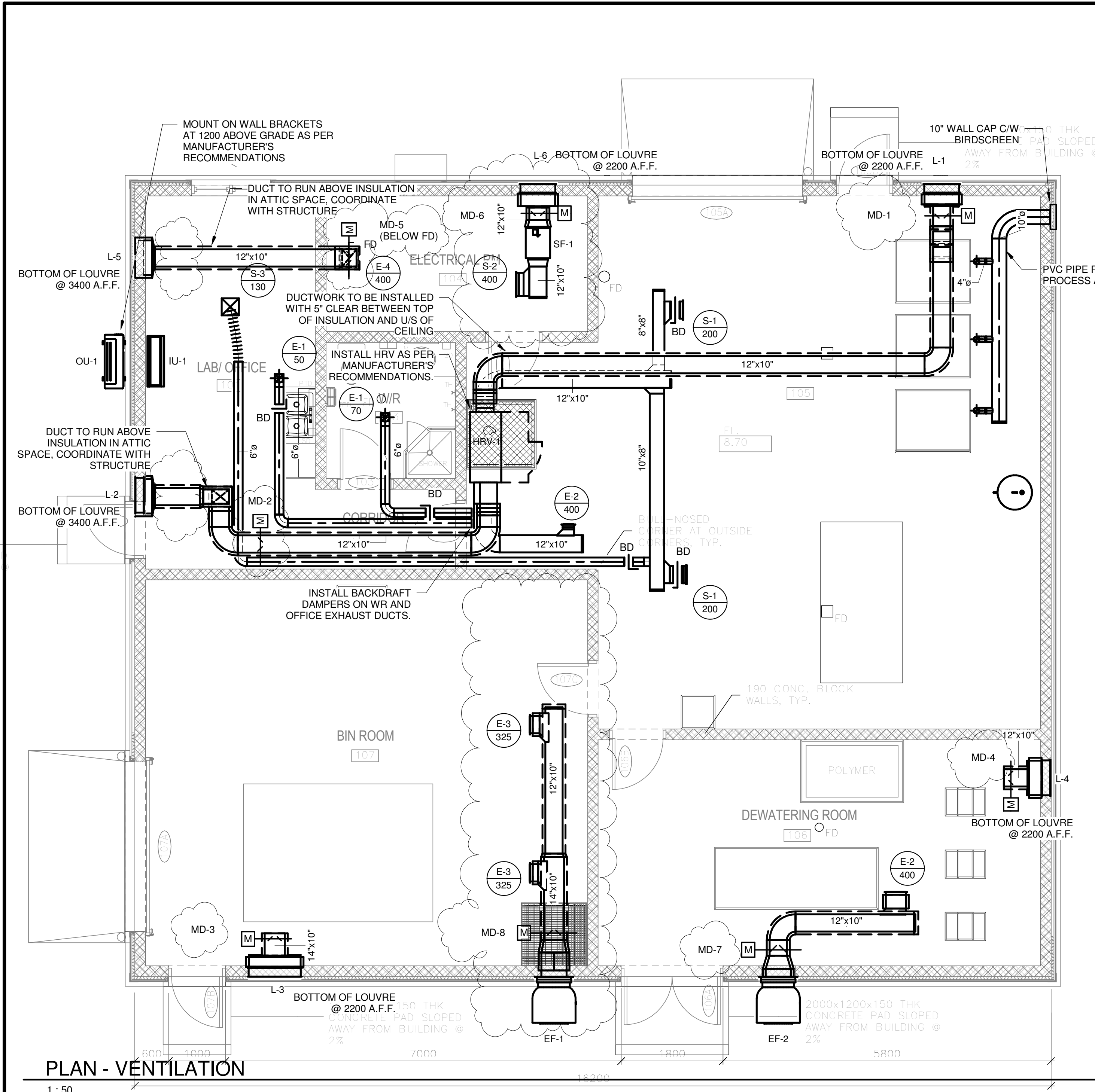
SCHEMATICS & DETAILS



CBCL No	Contract No	Date	Scale
161039.00	161039.00	NOV 2016	AS NOTED



Designed	Drawn
RJD	RJD
Checked	Approved
ROC	JAB
Sheet No	Drawing No
11 of 11	E211



HVAC LEGEND	
	LOW VOLTAGE T'STAT
	LINE VOLTAGE T'STAT
	THERMOSTAT C/W GUARD
	REVERSE ACTING T'STAT
	LOW VOLTAGE CONTROL WIRING
	MOTORIZED DAMPER
	THERMALLY INSULATED DUCT
	SUPPLY DIFFUSER
	RETURN GRILLE
	ACOUSTICALLY LINED DUCT
	BALANCING DAMPER
	BACKDRAFT DAMPER
	FIRE DAMPER
	HUMIDITY SENSOR

1. ALL DUCT PENETRATIONS THROUGH A FIRE AND/OR SMOKE RATED WALL SHALL HAVE A FIRE DAMPER. INSTALLED IN STRICT ACCORDANCE WITH THE ULC RATING. REFER TO ARCHITECTURAL DRAWINGS FOR LOCATIONS OF ALL RATED WALLS. DUCTWORK SHALL BE INSULATED IN ACCORDANCE WITH THE REQUIREMENTS OF THE SPECIFICATIONS.
2. ALL DUCTS TO BE PROPERLY SEALED IN ACCORDANCE WITH SMACNA STANDARDS. DETERMINE THE OPERATING PRESSURE FOR THE SEAL STANDARD BASED ON 1.5 TIMES THE TOTAL FAN STATIC INDICATED ON THE EQUIPMENT SCHEDULES.
3. PROVIDE TURNING VANES FOR ALL 90° SQUARE ELBOWS, REGARDLESS OF WHETHER OR NOT THIS IS DRAWN ON THE PLANS.
4. PROVIDE MAINTENANCE ACCESS TO ALL MECHANICAL COMPONENTS. PROVIDE INSULATED DUCT ACCESS DOORS AS REQUIRED.
5. SECURELY FASTEN ALL MECHANICAL EQUIPMENT TO THE BUILDING STRUCTURE. PROVIDE ALL NECESSARY SECONDARY STRUCTURAL STEEL SUPPORTS. NOTE THAT MECHANICAL SHAFT SHAPES AND SIZES WILL NOT PERMIT THE USE OF STANDARD SMACNA DETAILS FOR PROPER SUPPORT OF MECHANICAL EQUIPMENT. DESIGN AND PROVIDE SECONDARY SUPPORT STEEL TO ENSURE PROPER SUPPORT OF ALL MECHANICAL COMPONENTS WITHIN DUCT SHAFTS.
6. PROVIDE OPPOSED BLADE BALANCING DAMPERS AT ALL FINAL BRANCH DUCT TAKEOFFS, REGARDLESS OF WHETHER OR NOT THESE ARE SHOWN ON THE PLANS. LOCATE DAMPERS TO FACILITATE PROPER BALANCING OF THE SYSTEM.
7. ALL FLOOR MOUNTED MECHANICAL EQUIPMENT SHALL BE PROVIDED WITH A HOUSEKEEPING PAD. PADS SHALL BE AT LEAST 4" (6" FOR AHUs) HIGH AND EXTEND 4" BEYOND THE FOOTPRINT OF THE EQUIPMENT.
8. CONFORM WITH MANUFACTURERS REQUIREMENTS AND THE REQUIREMENTS OF THE NATIONAL BUILDING CODE, SMACNA, AND ASHRAE.

PLAN - VENTILATION
1 : 50

HEAT RECOVERY VENTILATOR SCHEDULE

DESIG.	MANUFACTURER	MODEL	SUPPLY AIRFLOW (cfm)	EXHAUST AIRFLOW (cfm)	STATIC PRESSURE (in.wg)	ELECTRICAL	COMMENTS
HRV-1	RENEWAIRE	HE1XNH	530	520	0.5	208V/1PH/60HZ	c/w VIBRATION ISOLATION

EXHAUST FAN SCHEDULE

DESIG.	DESCRIPTION	MANUFACTURER	MODEL	AIR FLOW (cfm)	STATIC PRESSURE (in.wg)	POWER	ELECTRICAL	COMMENTS
EF-1	BELT DRIVEN WALL EXHAUSTER SIZE 110	TWIN CITY	BCRW	600	.375	0.25 hp		C/W CLASS 1, ZONE 2 RATED MOTOR AND DISCONNECT SWITCH, SPRING ISOLATORS
EF-2	BELT DRIVEN WALL EXHAUSTER SIZE 110	TWIN CITY	BCRW	450	.375	0.25 hp		C/W CLASS 1, ZONE 2 RATED MOTOR AND DISCONNECT SWITCH, SPRING ISOLATORS

SUPPLY FAN SCHEDULE

DESIG.	DESCRIPTION	MANUFACTURER	MODEL	AIRFLOW (cfm)	STATIC PRESSURE (in.wg)	POWER	ELECTRICAL	COMMENTS
SF-1	ELEC RM COOLING FAN	LOREN COOK	SQN-100	400	.25	39 W		c/w ECM MOTOR

GRILLE AND DIFFUSER SCHEDULE

DESIG.	MANUFACTURER	MODEL	DESCRIPTION	SIZE	COMMENTS
E-1	NAILOR	6145V	CEILING MOUNTED FIXED BLADE RETURN GRILLE	6x6	
E-2	NAILOR	6145V	DUCT MOUNTED FIXED BLADE RETURN GRILLE	14x10	
E-3	NAILOR	6145V	DUCT MOUNTED FIXED BLADE RETURN GRILLE	12x10	
E-4	NAILOR	6145V	CEILING MOUNTED FIXED BLADE RETURN GRILLE	SEE COMMENTS	SIZE TO ACCOMMODATE DUCTWORK AND FIRE DAMPER.
S-1	NAILOR	61DV	DUCT MOUNTED DOUBLE DEFLECTION SUPPLY GRILLE	12x6	
S-2	NAILOR	61DV	DUCT MOUNTED DOUBLE DEFLECTION SUPPLY GRILLE	16x8	
S-3	NAILOR	FNS	CEILING DIFFUSER	12x12, 6" NECK	

MOTORIZED DAMPER SCHEDULE

DESIG.	LOCATION	MFGR/MODEL	SIZE (WxH) (in)	COMMENTS
MD-1	ROOM 105	TAMCO 9000 c/w BELIMO ACTUATOR	12x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR
MD-2	LAB/OFFICE 101	TAMCO 9000 c/w BELIMO ACTUATOR	12x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR
MD-3	BIN ROOM 107	TAMCO 9000 c/w BELIMO ACTUATOR	14x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR, CLASS 1, DIV 2 RATED.
MD-4	DEWATERING ROOM 106	TAMCO 9000 c/w BELIMO ACTUATOR	12x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR, CLASS 1, DIV 2 RATED.
MD-5	ELECTRICAL 104	TAMCO 9000 c/w BELIMO ACTUATOR	12x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR
MD-6	ELECTRICAL 104	TAMCO 9000 c/w BELIMO ACTUATOR	12x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR
MD-7	DEWATERING ROOM 106	TAMCO 9000 c/w BELIMO ACTUATOR	12x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR, CLASS 1, DIV 2 RATED.
MD-8	BIN ROOM 107	TAMCO 9000 c/w BELIMO ACTUATOR	14x10	FAIL CLOSED, 120VAC POWER SUPPLY TO ACTUATOR, CLASS 1, DIV 2 RATED.

DUCTLESS HEAT PUMP SCHEDULE

DESIG.	MANUFACTURER	MODEL	COOLING CAPACITY (MBH)	HEATING CAPACITY (MBH)	ELECTRICAL	COMMENTS
IU-1	MITSUBISHI	PKA-A18HA4	8000 - 18000	8000 - 20000	208V/1PH/60HZ	
OU-1	MITSUBISHI	PUZ-A18NHA4	8000 - 18000	800 - 20000	208V/1PH/60HZ	

LOUVRE SCHEDULE

DESIG.	MANUFACTURER	MODEL	SIZE	DEPTH	COMMENTS
L-1	RUSKIN	ELF6375DX	24x12	6	ALUMINUM LOUVRE, DRAINABLE BLADES, COLOUR TO BE SELECTED DURING SHOP DRAWING REVIEW.
L-2	RUSKIN	ELF6375DX	24x12	6	ALUMINUM LOUVRE, DRAINABLE BLADES, COLOUR TO BE SELECTED DURING SHOP DRAWING REVIEW.
L-3	RUSKIN	ELF6375DX	36x12	6	ALUMINUM LOUVRE, DRAINABLE BLADES, COLOUR TO BE SELECTED DURING SHOP DRAWING REVIEW.
L-4	RUSKIN	ELF6375DX	24x12	6	ALUMINUM LOUVRE, DRAINABLE BLADES, COLOUR TO BE SELECTED DURING SHOP DRAWING REVIEW.
L-5	RUSKIN	ELF6375DX	24x12	6	ALUMINUM LOUVRE, DRAINABLE BLADES, COLOUR TO BE SELECTED DURING SHOP DRAWING REVIEW.
L-6	RUSKIN	ELF6375DX	24x12	6	ALUMINUM LOUVRE, DRAINABLE BLADES, COLOUR TO BE SELECTED DURING SHOP DRAWING REVIEW.



No	Description	Date	By
1	ISSUED FOR ADDENDUM 2	JUNE 8/17	AB
0	ISSUED FOR TENDER	JUNE 2/17	AB
B	ISSUED FOR APPROVAL	MAY 23/17	AB
A	ISSUED FOR 50% REVIEW	APR 28/17	AB

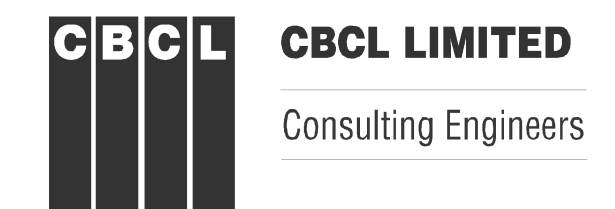
Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER
SYSTEM - TREATMENT PLANT

MECHANICAL

BUILDING HEATING &
VENTILATION

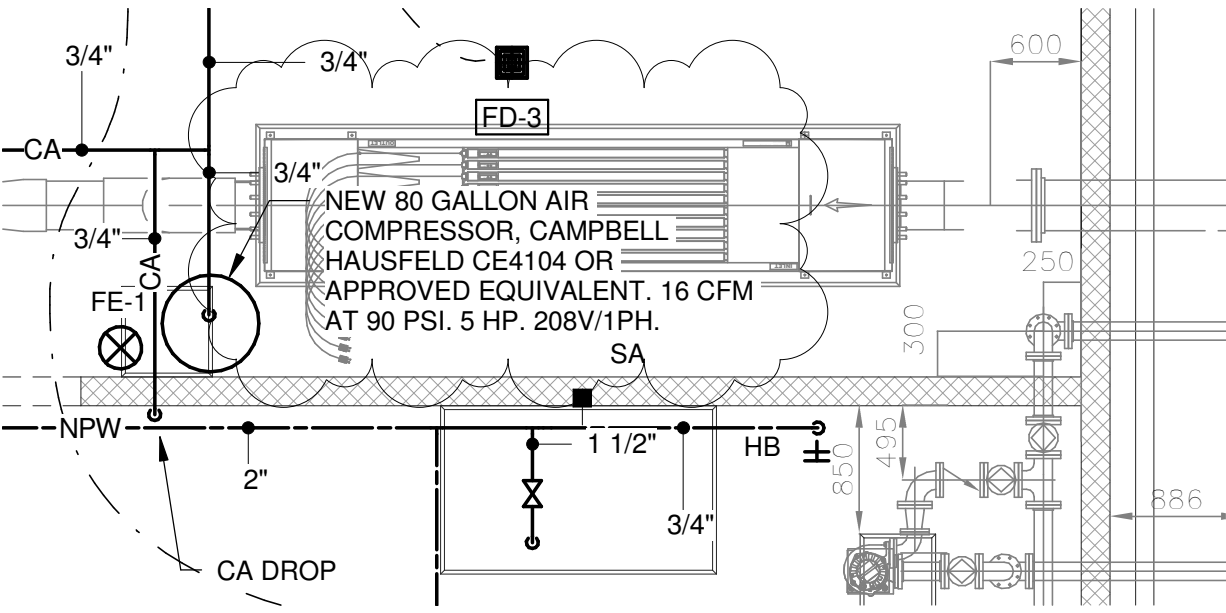


CBCL No	Contract No	Date	Scale
161039.00		APR 2017	As indicated

Stamp	Designed CST	Drawn CST
	Checked SGS	Approved AB
	Sheet No 3	of 3
	Drawing No	



M003

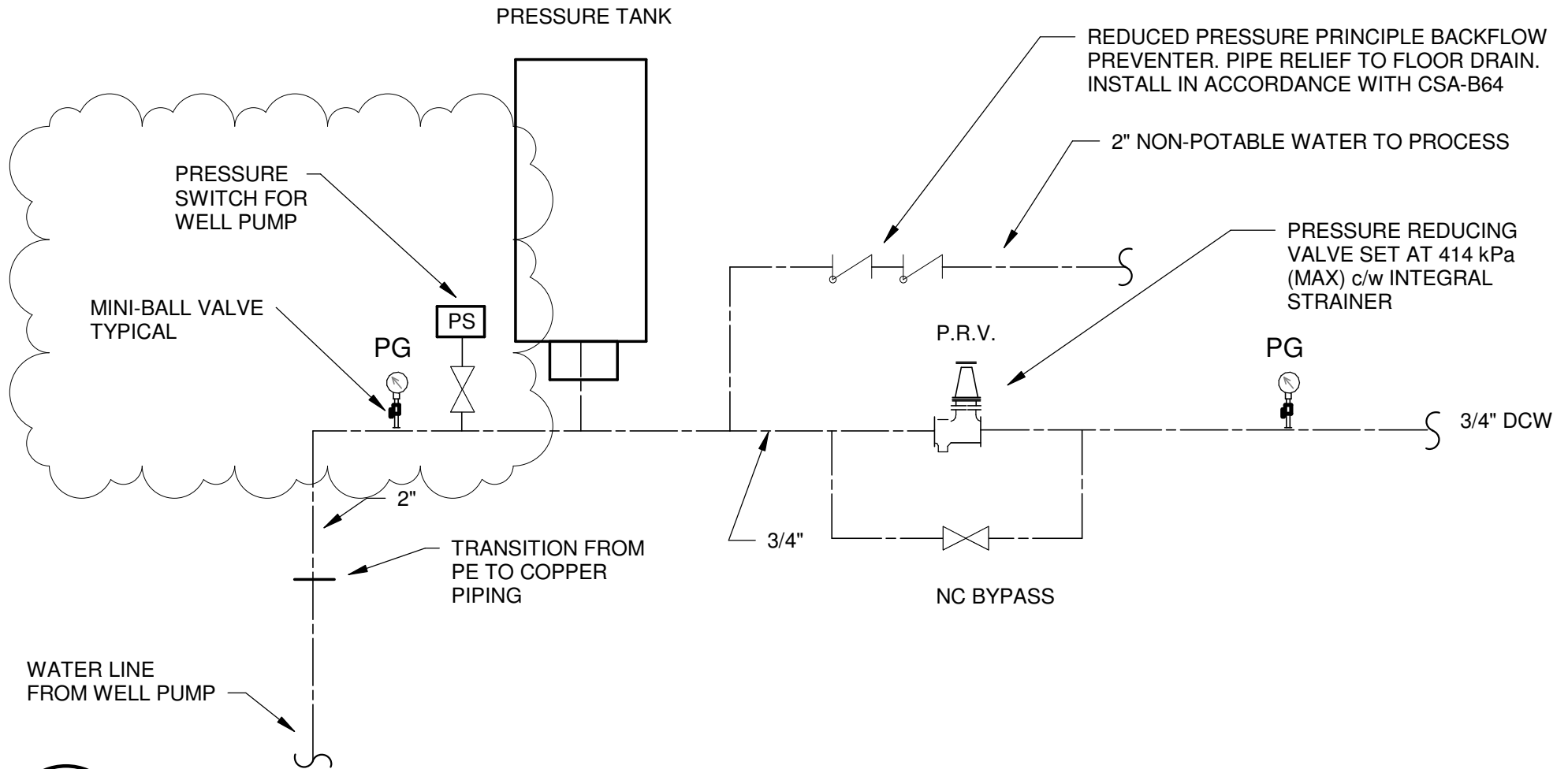


PLAN - DOMESTIC WATER

1 : 50

REFERENCE DRAWING M001

Date 06/07/17	Scale 1 : 50	Designed CST	Drawn CST	Checked SGS	Approved AB	CBCL No 161039.00	Contract No
CBCL LIMITED Consulting Engineers		PARRSBORO WASTEWATER SYSTEM - TREATMENT PLANT					MSK001
		MODIFICATION TO AIR COMPRESSOR					



1

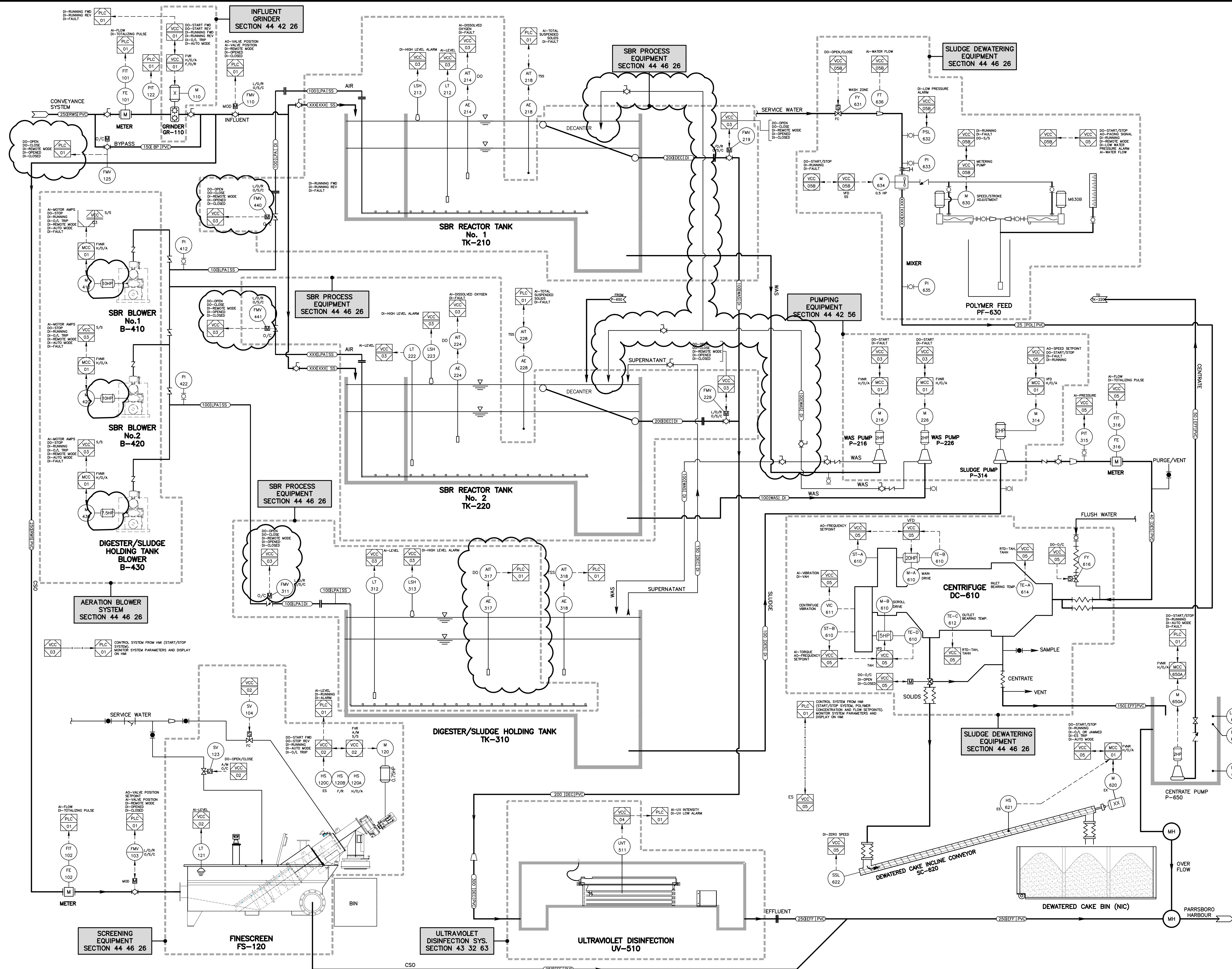
DETAIL WATER ENTRANCE

N.T.S.

REFERENCE DRAWING M002

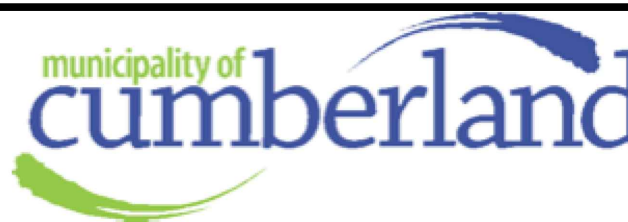
Date 06/07/17	Scale N.T.S.	Designed CST	Drawn	Checked SGS	Approved AB	CBCL No 161039.00	Contract No
 CBCL LIMITED Consulting Engineers	PARRSBORO WASTEWATER SYSTEM - TREATMENT PLANT					MSK002	
	MODIFICATIONS TO WATER ENTRANCE DETAIL						

DRAWING NAME: PARRSBORO WASTEWATER TREATMENT PLANT DESIGN 20 CAD/US PROCESS/161039.DWG LAYOUT NAME: P003 PLANT DATE: June-07-17 12:53:59 PM CAD OPERATOR: MIALCOMBE



NOTES:

1. THE OWNER HAS PRE-SELECTED THE FOLLOWING LIST OF PROCESS EQUIPMENT:
 - INFLUENT GRINDER
 - OVERFLOW FINESCREEN
 - SBR PROCESS EQUIPMENT
 - AERATION BLOWERS
 - UV DISINFECTION SYSTEM
 - WAS PUMPS
 - SLUDGE PUMP
 - DEWATERING CENTRIFUGE
 - POLYMER FEED SYSTEM
2. CONTRACTOR SHALL COORDINATE WITH THE SUPPLIERS OF THE PRE-SELECTED PROCESS EQUIPMENT TO ENSURE THE SCOPE OF SUPPLY IS COMPLETE IN EVERY ASPECT FOR THE EQUIPMENT'S INTENDED USE AND OPERATION OF THE WHOLE. FIELD ROUTE FLUSH/PROCESS WATER REQUIREMENTS AS REQUIRED (FINESCREEN, CENTRIFUGE, POLYMER).



No.	Description	Date	By
E	ISSUED FOR ADDENDUM 2	JUNE 7/17	AB
D	ISSUED FOR TENDER	JUNE 2/17	AB
C	ISSUED FOR APPROVAL	MAY 23/17	AB
B	ISSUED FOR 50% REVIEW	MAY 01/17	AB
A	ISSUED FOR REVIEW	DEC 21/16	DT

Revision or Issue

**MUNICIPALITY OF THE
COUNTY OF CUMBERLAND**
WASTEWATER TREATMENT PLANT

PROCESS PROCESS & INSTRUMENTATION DIAGRAM



CBCL No 161039.00	Contract No -	Date DEC 2016	Scale N.T.S.
Designed DT	Drawn DC	Checked DT	Approved JAB
Sheet No 3 of 7	Drawing No P003		



HYDROTEST PROCEDURE FOR CONCRETE STRUCTURES:

1. WATER TEST CONCRETE TANKS UPON COMPLETION / CURING OF STRUCTURE.
2. PROVIDE LABOUR, EQUIPMENT, ACCESS, WATER (CLEAN, NON-SALINE) AND MATERIALS AS REQUIRED TO PERFORM TESTING.
3. NOTIFY ENGINEER 24 HOURS IN ADVANCE OF TEST. CONDUCT TEST IN PRESENCE OF ENGINEER.
4. DO NOT BACKFILL PRIOR TO TESTING.
5. PLUG ALL INLETS / OUTLETS WITH WATERTIGHT PLUGS.
6. FILL TANKS TO MAXIMUM WATER LEVEL SHOWN ON DRAWINGS.
7. ALLOW TIME FOR INITIAL ABSORPTION.
8. WATER LEVEL IN TANK SHALL NOT DROP MORE THAN 6 MILLIMETERS IN A 12 HOUR PERIOD. A DROP OF MORE THAN 6 MILLIMETERS CONSTITUTES FAILURE.
9. LOCATE AND REPAIR DEFECTS AS REQUIRED. RETEST.
10. REPAIR VISIBLE LEAKS REGARDLESS OF TEST RESULTS.
11. CONSULT WITH ENGINEER REGARDING RETAINING / EMPTYING / DISCHARGING OF WATER FROM TESTED TANK.

GENERAL NOTES:

1. DRAWINGS IN GENERAL ARE TO SCALE BUT FIGURED DIMENSIONS TAKE PRECEDENCE. THE CONTRACTOR ASSUMES FULL RESPONSIBILITY FOR THE ACCURACY OF INFORMATION SCALED FROM THE DRAWINGS.
 2. ALL DIMENSIONS USE METRIC UNITS. DIMENSIONS SHOWN IN MILLIMETERS AND POINT ELEVATIONS AS METERS.
 3. INSTALL AERATION HEADER PURGE ASSEMBLY AS PER MANUFACTURERS INSTRUCTIONS.
- #### NOTES:
1. ALL WORK TO BE CARRIED OUT ACCORDING TO STANDARD INDUSTRY PRACTICE.
 2. ALL WORK IS TO BE EXECUTED IN A SAFE AND ORDERLY MANNER AND IN ACCORDANCE WITH ALL HEALTH AND SAFETY ORDINANCES AND REGULATIONS.
 3. CONTRACTOR TO CHECK AND VERIFY THAT ALL SIZES AND DIMENSIONS ARE CORRECT, AND TO REPORT, IN WRITING, ANY ERRORS OR OMISSIONS TO THE OWNER'S ENGINEER PRIOR TO PROCEEDING WITH THE WORK. THE OWNER HAS PRE-SELECTED THE FOLLOWING LIST OF PROCESS EQUIPMENT:
 - 4.1. INFLUENT GRINDER;
 - 4.2. OVERFLOW FINESCREEN;
 - 4.3. SBR PROCESS EQUIPMENT;
 - 4.4. AERATION BLOWERS;
 - 4.5. UV DISINFECTION SYSTEM;
 - 4.6. WAS PUMPS;
 - 4.7. SLUDGE PUMP;
 - 4.8. DEWATERING CENTRIFUGE; AND
 - 4.9. POLYMER FEED SYSTEM.
 5. CONTRACTOR SHALL COORDINATE WITH THE PRE-SELECTED EQUIPMENT SUPPLIERS TO ENSURE THE SCOPE OF SUPPLY IS COMPLETE IN EVERY ASPECT FOR THE EQUIPMENTS INTENDED USE AND OPERATION ON THE WHOLE. FIELD ROUTE FLUSH/PROCESS WATER REQUIREMENTS AS REQUIRED (FINESCREEN, CENTRIFUGE, POLYMER). ALL EXPOSED LIQUID PROCESS PIPING WITHIN BUILDING FOOTPRINT SHALL BE SCH. 80 PVC. ALL LIQUID PROCESS PIPING BELOW GRADE SHALL BE DUCTILE IRON. ALL BLOWER AIR PIPING ABOVE GRADE/SLAB SHALL BE SCH. 10 SS. ALL BLOWER PIPING BELOW GRADE SHALL BE UNLINED DUCTILE IRON COMPLETE WITH HIGH TEMPERATURE GASKETS.
 7. SEE MECHANICAL DRAWINGS FOR ASSOCIATED BLOWER INTAKE PIPING REQUIREMENTS.
 8. SEE ELECTRICAL DRAWINGS FOR WIRING OF PROCESS EQUIPMENT AND ASSOCIATED APPURTENANCES.



No.	Description	Date	By
E	ISSUED FOR ADDENDUM 2	JUNE 7/17	AB
D	ISSUED FOR TENDER	JUNE 2/17	AB
C	ISSUED FOR APPROVAL	MAY 23/17	AB
B	ISSUED FOR 50% REVIEW	MAY 01/17	AB
A	ISSUED FOR REVIEW	DEC 21/16	DT

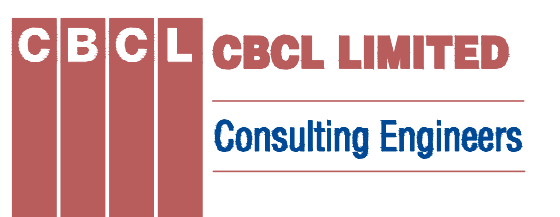
Revision or Issue

MUNICIPALITY OF CUMBERLAND

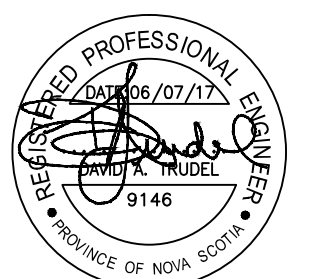
PARRSBORO WASTEWATER SYSTEM – TREATMENT PLANT

PROCESS

WWTP SITE SERVICES PROPOSED LAYOUT



CBCL No 161039.00	Contract No —	Date DEC 2016	Scale 1:50
Designed DAT	Drawn MWB	Checked DAT	Approved JAB
Sheet No 4 of 7	Drawing No P004		



ADDENDUM 2 REVISIONS:

1. TWO (2) NEW 100# ISOLATION PLUG VALVES TO SLUDGE PUMP HEAD.
2. TWO (2) NEW WAS DIVERSION LINES FROM SLUDGE PUMP HEAD TO EACH SBR TANK.
3. TWO (2) NEW 100# PLUG CONTROL VALVES MOUNTED ON WAS DIVERSION LINES AT EACH SBR TANK.
4. HEAT TRACING AND INSULATION ON NEW WAS DIVERSION LINES WHERE EXPOSED.
5. ADJUSTED LOCATION OF SLUDGE PUMPS/HOUSEKEEPING PADS.

DRAWING NAME: PARRSBORO WASTEWATER SYSTEM DESIGN 20 CAD/US PROJECTS\161039.00 SITE SERVICES_P004.DWG LAYOUT NAME: P004_ELE.DWG DATE: JUN-07-17 12:54:11 PM CAD OPERATOR: MBALOMBE

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT
CONTRACT 161039.00**

ADDENDUM NO. 2

Date: June 8, 2017

CONFIRMATION OF RECEIPT

I/We hereby confirm on behalf of

Name of Tenderer

That the above Addendum No. 2 was received by fax on the date stated above.

Signed: _____

Date: _____

Please fax confirmation to CBCL Limited
Attention: Aaron Baillie, P.Eng
Email: aaronb@cbcl.ca

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT
CONTRACT 161039.00**

ADDENDUM NO. 3

(to be added to and made part of the Tender Documents)

The following changes or modifications shall be made to the Tender Documents:

TO THE SPECIFICATIONS

SECTION 00 21 10 – INFORMATION TO TENDERERS

Page 1, within subsection 2 delete “**Friday June 16th, 2017**” and replace with “**Wednesday June 21st, 2017.**”

SECTION 07 46 10 – CEMENT BOARD SIDING

Page 2, delete subsection 2.1.2 and 2.1.3 and replace with the following:

- .2 Type: Traditional Cedar, prefinished (colour to be selected from manufacturer's standard colour range), 127 mm, Horizontal lap joint siding.
 - .1 Acceptable Product: Allura Fiber Cement or approved equivalent.
- .3 Trim: prefinished (colour to be selected from manufacturer's standard), smooth (25 mm thick) texture, nom. 150 mm wide for corner boards, nom. 100 mm wide for door and window trim, nom. 200 mm wide for baseboards and frieze boards.

SECTION 08 36 13.02 – SECTIONAL METAL DOORS

Page 3, delete subsection 2.2 and replace with the following:

2.2 OPERATION

- .1 Operation sequence – Entrance of door:
 - .1 Doors operated by a wall mounted push button controller.
 - .2 If entrapment protection devices are triggered while door is closing, the operator will reverse and return door to open position.
- .2 Operation sequence – Exiting of door:
 - .1 Doors operated by a wall mounted push button controller.
 - .2 If entrapment protection devices are triggered while door is closing, the operator will reverse and return door to open position.

SECTION 08 51 13 – ALUMINUM WINDOWS

Page 1, within subsection 1.1.1 delete “double/double hung” and replace with “casement”.

Page 2, delete subsection 2.1.3 and replace with the following:

- .3 Type 3: casement units with 152mm deep frames complete with high performance drainage sill and flyscreens mounted between the glazing sashes.
 - .1 Acceptable products: Kawneer Series NX-3200, Oldcastle Building Envelope Signature Series 5" Lap Outswinging Casement or approved equivalent.

Page 3, within subsection 2.2.8 delete "double/double hung" and replace with "casement".

SECTION 31 23 10 – EXCAVATING, TRENCHING AND BACKFILLING

Page 10, delete subsection 3.10.4.

SECTION 31 23 13 – SITE GRADING

Page 3, delete subsection 3.2 and replace with the following:

3.2 BUILDING SUBGRADE	.1 Place Structural fill or approved site material under the building. .2 Place Structural Fill in maximum 200 mm layers and compact to a minimum of 100% of the Standard Proctor maximum dry density. .3 Remove glacial till as shown on the drawings and replace any area identified as being soft with approved on site material or structural fill.

SECTION 40 05 10 – PLANT PIPING, VALVES AND APPURTENANCES

Page 9, add new subsection 2.2.7 as follows:

- .7 Actuators: the actuators specified herein are applicable to process valves as identified on the drawings. Size, type of actuator, service and accessories as indicated on the drawings.
 - .1 Intent: it is intended that the valves, actuators and accessories be compatible and form a complete system suitable for the intended operation and operating conditions noted. Have the actuators and valves assembled, factory mounted and tested prior to delivery to the site.
 - .2 General:
 - .1 Required torque must not exceed the maximum output of the actuator under any operating conditions.
 - .2 Emergency manual override (handwheel) operator. Handwheel must be manually de-clutchable and be mechanically independent of the motor.
 - .3 Actuator to have continuous local indication of valve position and have 4:1 adjustable speed control.
 - .4 Actuator to be suitable for remote control and be equipped with open and close limit switches along with six (6) independently adjustable limit switches.
 - .5 Unit to have integral reversing starter and control transformer. Actuator enclosure to be watertight and suitable for hazardous area designation as required.
 - .6 Actuator to have lockable local-off-remote switch and open-stop-close selector switch.
 - .7 Size, service conditions, electrical classification and operating

- characteristics as indicated on the Drawings.
- .8 Open/close duty actuators to be rated for a minimum of 60 starts per hour.
- .9 Modulating duty actuators to be rated for a minimum of 1200 starts per hour in accordance with IEC 34-1.
- .3 Multi-turn Actuators:
 - .1 Actuators to operate on a 208 volt, 3-phase, 60Hz power supply.
 - .2 Actuator to be able to position the valve at any point between fully open and fully closed in response to a 4-20mA input signal . Current monitor relay with isolated contact for remote indication of loss or power, phase failure, over-temperature, and selector “not remote” status
 - .3 Acceptable manufacturers: Rotork, Auma, or approved equivalent.
- .4 Open-close Actuators:
 - .1 Actuators shall operate on a 208 volt, 3-phase, 60Hz power supply.
 - .2 Acceptable manufacturer: Rotork, or approved equivalent.

SECTION 40 90 00 – PRIMARY PROCESS INSTRUMENTATION DEVICES AND CABLING

Page 10, delete subsection 2.5.2.1.1 (TSS sensors - prev. adjusted via addendum #2) and replace with the following:

- .1 Provide miscellaneous metals brackets and/or hardware for wall mount (backboard) installation as required.

SECTION 41 12 13 – SCREW CONVEYOR SYSTEM

Page 5, delete subsection 2.2.3, and replace with the following:

- .3 Drive: drive unit to be a hollow shaft mounted gear motor rated a minimum AGMA Class II, single or double reduction or triple reduction. Provide explosion proof motor rated for Class 1, Zone 2, 208V, 60 Hz, 3 phase (inverter duty) constant speed drive, running at approximately 20-30 rpm. The discharge end of the incline conveyor are located in a Zone 1 electrically classified area. Provide NORD Gear Corporation Unibase, or equivalent, shaft mounted drive hollow shaft design. (V-belt driven speed reducer, or chain driven reducers not permitted.) Shaft to be at least 38 mm minimum diameter welded to spiral and with sealed housing at tail and connected to the spiral to effectively transmit torque from the drive shaft to the flight. Pipe welded to the spiral ID are not acceptable.

Page 5, within subsection 2.2.5.4, delete “NEMA 4X” and replace with “NEMA 7”.

TO THE DRAWINGS

DRAWING A003 – BUILDING ELEVATIONS & SCHEDULES

Within the Room Finish Schedule remove “SV” and replace with VCT (vinyl composition tile).

Within Window Type Detail remove “Butt Mounted in/ps frame” and replace with “butt mounted in /AL frame”

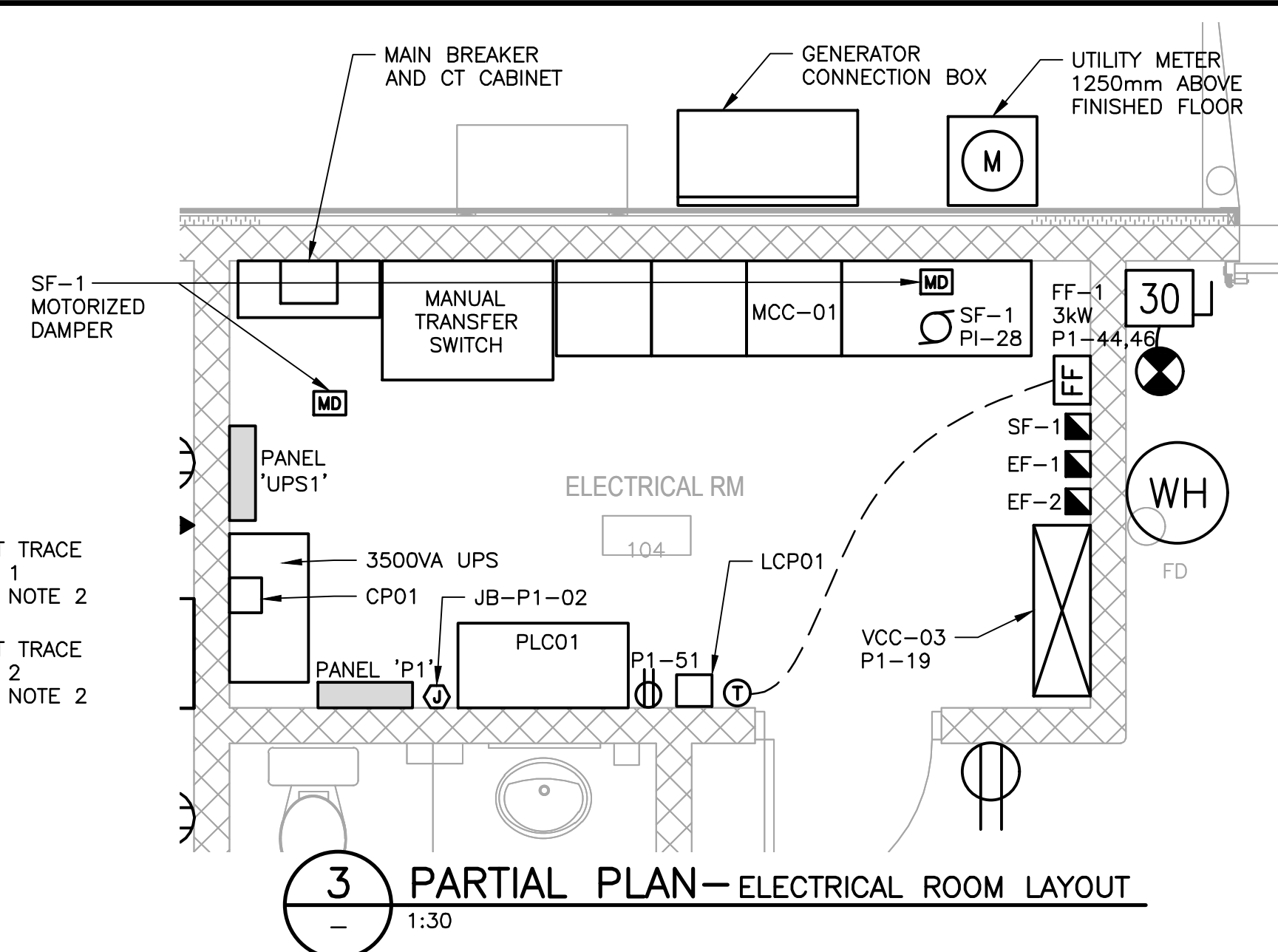
DRAWING E203 – BUILDING EQUIPMENT LAYOUTS

Replace drawing E203 with revised drawing E203 dated June 13, 2017, attached.

DRAWING E207 – SCHEDULES

Replace drawing E207 with revised drawing E207 dated June 13, 2017, attached.

Aaron Baillie, P.Eng.
CBCL Limited
June 13, 2017

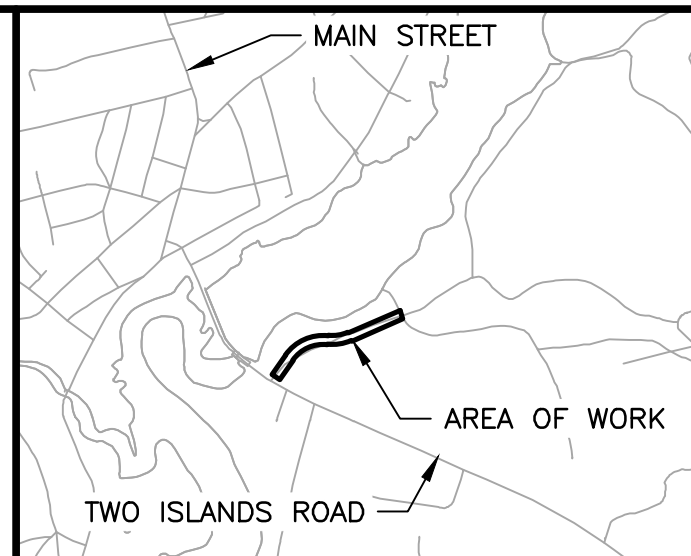
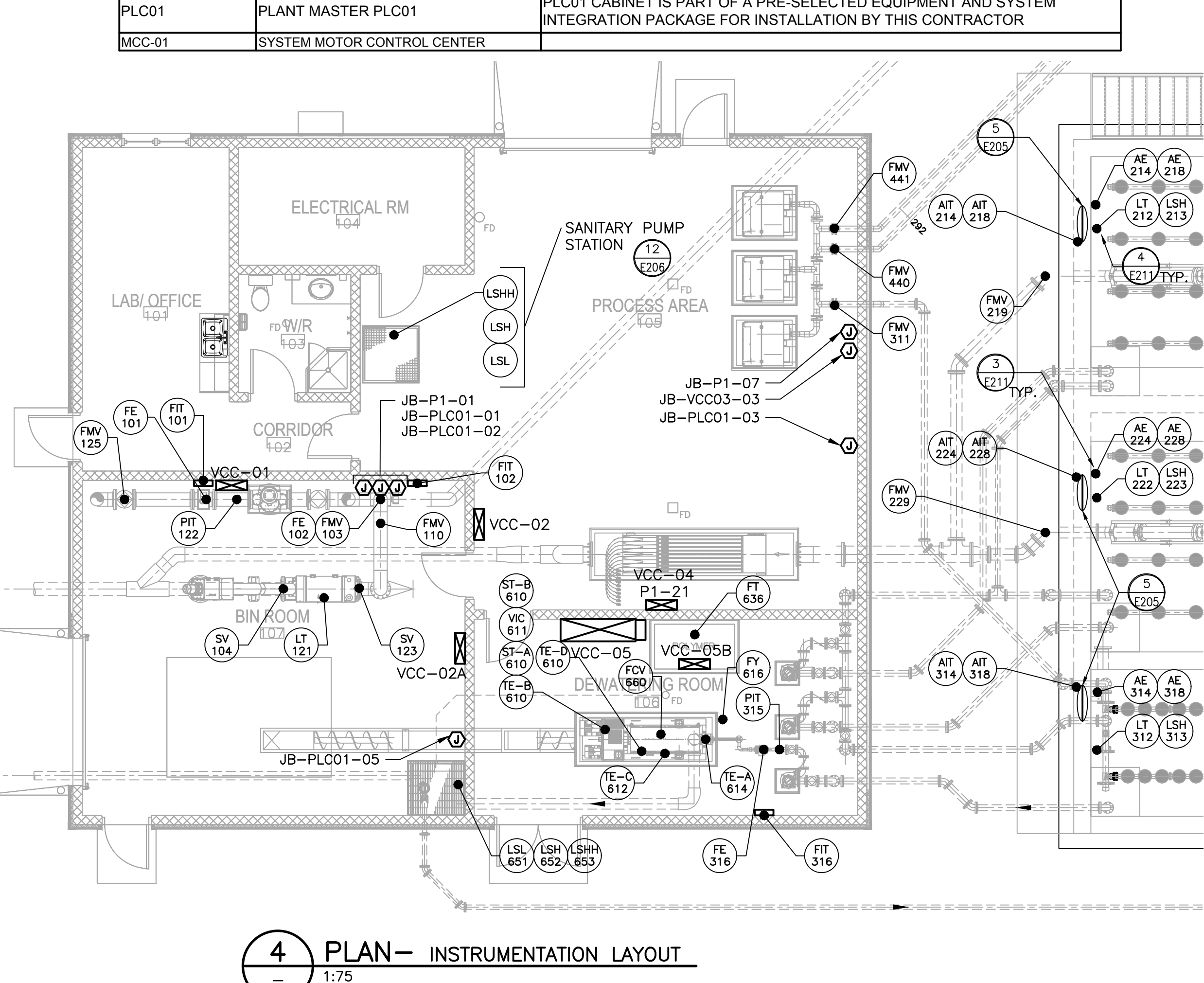
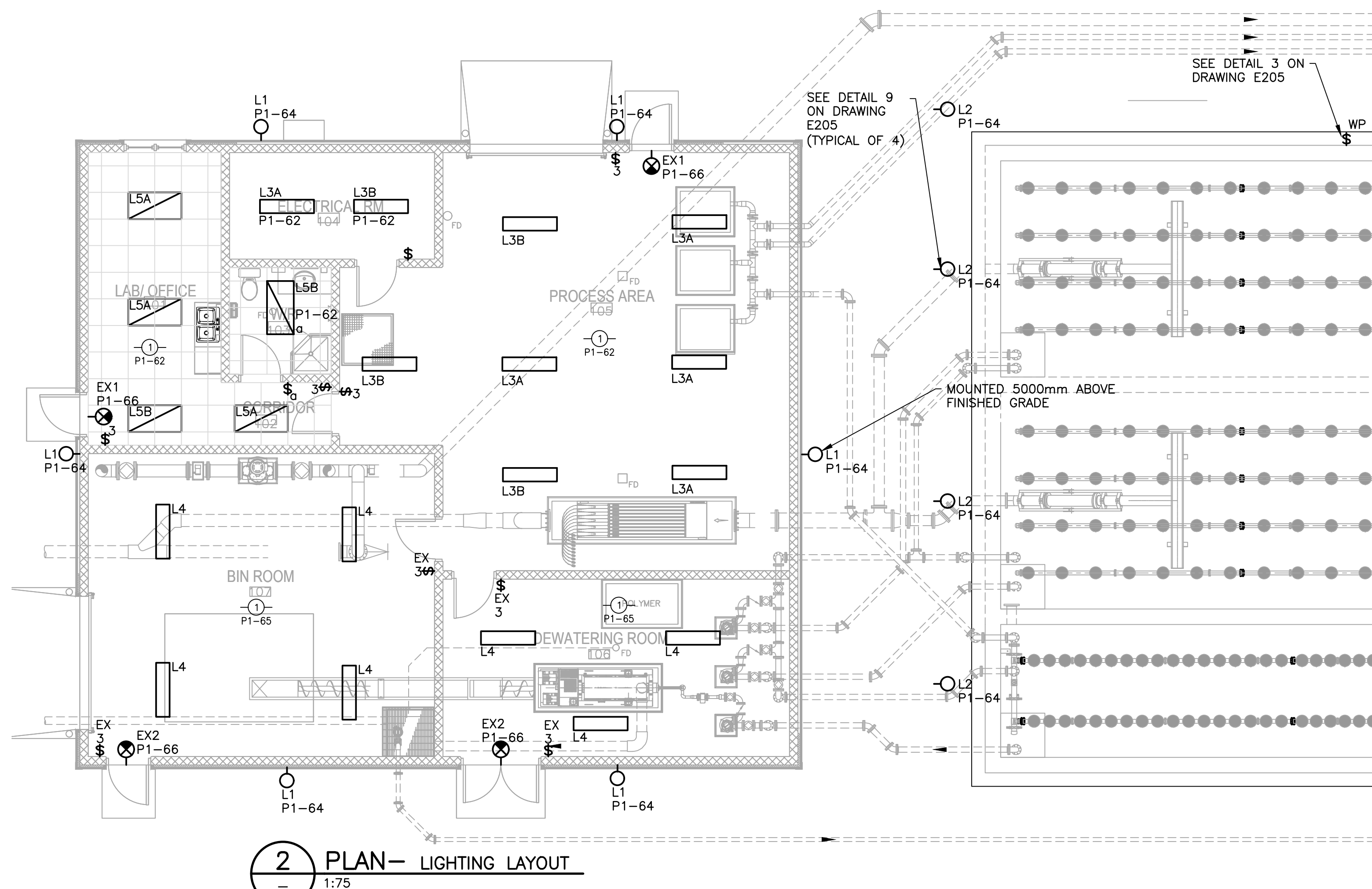


HEAT TRACE BILL OF MATERIALS (TYPICAL)		
DESCRIPTION	QTY	MFG & PART #
HEATING CABLE, SELF-REGULATING, 120V, 10W/ft	AS REQ'D	RAYCHEM
END SEAL KIT, ABOVE INSULATION	11	RAYCHEM E-100-A
POWER KIT, SINGLE ENTRY, c/w JUNCTION BOX	11	RAYCHEM JBS-100-A
GLASS TAPE	AS REQ'D	RAYCHEM GT-66
PIPE STRAP, 25-75mm	AS REQ'D	RAYCHEM PS-3

NOTES:

- HEAT TRACE MATERIALS AND INSTALLATION TO BE SUITABLE FOR INSTALLATION IN CLASS 1, ZONE 2 HAZARDOUS AREA.

EQUIPMENT IDENTIFICATION		
ID#	DESCRIPTION	COMMENTS
VCC-01	GRINDER CONTROL CABINET	SEE NOTE 4
VCC-02	FINE SCREEN CONTROL CABINET	SEE NOTE 4
VCC-02A	FINE SCREEN CONTROL STATION	
VCC-03	SBR CONTROL CABINET	
VCC-04	UV CONTROL CABINET	SEE DETAIL 6, E211
VCC-05	DEWATERING CONTROL CABINET	SEE NOTE 4
VCC-05B	POLYMER SYSTEM CONTROL CABINET	
VCC-06	SANITARY WASTE PUMP CONTROLLER	SEE DETAIL 12, E206
PLC01	PLANT MASTER PLC01	PLC01 CABINET IS PART OF A PRE-SELECTED EQUIPMENT AND SYSTEM INTEGRATION PACKAGE FOR INSTALLATION BY THIS CONTRACTOR
MCC-01	SYSTEM MOTOR CONTROL CENTER	

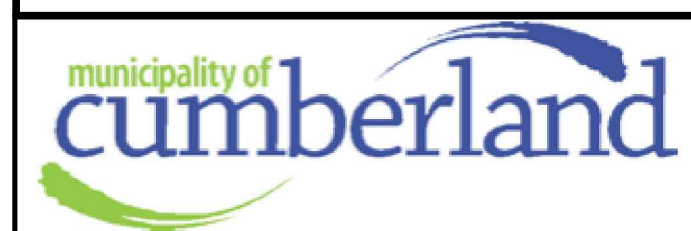


KEY PLAN

1:5000

NOTES:

1. ALL ELECTRICAL PENETRATIONS FROM A NON-HAZARDOUS AREA TO A HAZARDOUS AREA SHALL BE SEALED AND MADE GAS TIGHT.
2. SUPPLY AND INSTALL HEAT TRACING ON INDICATED PIPES BETWEEN THE SBR AND 0.3M BELOW GRADE AS PER THE MANUFACTURER'S RECOMMENDATIONS. SEE HEAT TRACE BILL OF MATERIALS FOR TYPICAL EQUIPMENT.
3. ALL CONDUITS ARE TO BE COMPLETE WITH A GREEN INSULATED BOND CONDUCTOR, SIZED IN ACCORDANCE WITH CEC REQUIREMENTS, MINIMUM #12 AWG.
4. POWER SUPPLY TO CONTROL CABINET WILL BE CONTROLLED BY THE EXHAUST FAN IN THE ROOM. IF THE FAN FAILS, POWER WILL DE-ENERGISE.
5. SUPPLY AND INSTALL A WALL MOUNTED HEATING THERMOSTAT COMPLETE WITH A CAPILLARY TUBE SENSING ELEMENT. MOUNT THERMOSTAT IN NON-HAZARDOUS AREA WITH SENSING ELEMENT MOUNTED 1350mm ABOVE FINISHED FLOOR IN THE HAZARDOUS SPACE. SEAL PENETRATION THROUGH WALL.
6. WIRE RECEPTACLES THROUGH CONTROL PANEL CP01 TO SHUT DOWN POWER ON LOSS OF VENTILATION.



2	ISSUED FOR ADDENDUM NO. 3	JUNE 13/17	JAB
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
B	ISSUED FOR APPROVAL	MAY 23/17	JAB
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No.	Description	Date	By

Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER
SYSTEM - TREATMENT PLANT

ELECTRICAL

BUILDING EQUIPMENT LAYOUTS



CBCL No 161039.00	Contract No 161039.00	Date NOV 2016	Scale AS NOTED



Sheet No
3 of 11

Drawing No. _____

E203

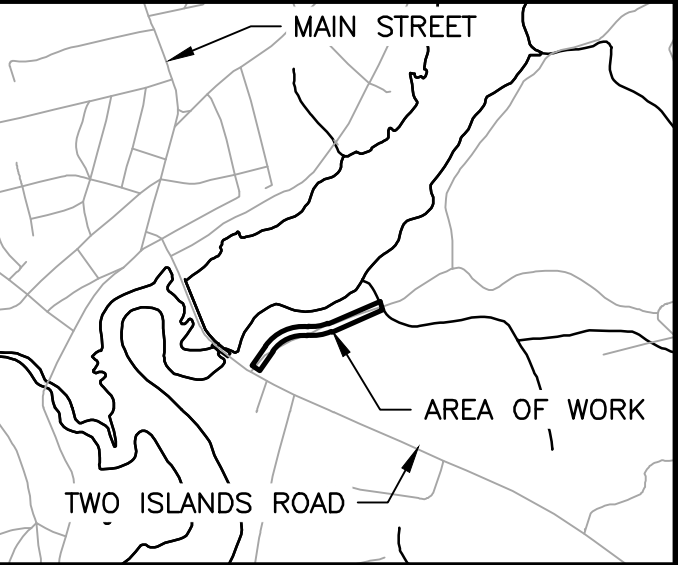
DRAWING NAME: \\PROJECTS\161039-00_PARRSBORO WASTEWATER SYSTEM DESIGN\20 CAD\US ELECTRICAL PLANT\161039-00_E207.DWG LAYOUT NAME: E207 SCHEDULES PLOT DATE: 2016-11-17 7:58:49 AM CAD OPERATOR: RANDREW

LIGHTING SCHEDULE						
LUMINAIRE TYPE	SUPPLY VOLTAGE	LAMP SOURCE	NUMBER OF LAMPS	LAMP WATTAGE	GENERAL DESCRIPTION	STANDARD OF ACCEPTANCE
L1	120VAC	LED	N/A	33W	WALL MOUNTED AREA LIGHT. MOUNT AT 2500mm ABOVE FINISHED SLAB UNLESS INDICATED OTHERWISE.	PHILIPS KEENE WALL PACK MEDIUM 313 LED (P/N: 313-LED-36L-530-NW) OR APPROVED EQUIVALENT
L2	120VAC	LED	N/A	29W	ENCLOSED AND GASKETED, SUITABLE FOR STANCHION MOUNTING IN WET AND CORROSIVE ENVIRONMENT	DIALIGHT DUROSITE LED AREA LIGHT (P/N: STW3C2NS45) OR APPROVED EQUIVALENT
L3A	120VAC	LED	N/A	80W	LOW PROFILE ENCLOSED AND GASKETED LINEAR FIXTURE.	LITHONIA LIGHTING FEM LED CEILING/SUSPENDED MOUNT VAPOUR TIGHT FIXTURE (P/N: FEM L48 10000LM IMAFL MD 120 GZ10 40K 80CRI)
L3B	120VAC	LED	N/A	80W	LOW PROFILE ENCLOSED AND GASKETED LINEAR FIXTURE C/W EMERGENCY BATTERY BACKUP	LITHONIA LIGHTING FEM LED CEILING/SUSPENDED MOUNT VAPOUR TIGHT FIXTURE (P/N: FEM L48 10000LM IMAFL MD 120 GZ10 40K 80CRI BSL722)
L4	120VAC	LED	N/A	66W	LOW PROFILE, ZONE 2 RATED, LINEAR FIXTURE C/W EMERGENCY BATTERY BACKUP.	DIALIGHT SAFESITE LED LINEAR LOW PROFILE, SURFACE MOUNT, ZONE 2 RATED FIXTURE (P/N: LPD3B4H2W)
L5A	120VAC	LED	N/A	35W	RECESSED, 2'X4' LED TROFFER	EATON 24GR LED SERIES TROFFER (P/N:24GR-LD5-48-F1-UNV-L835-CD1-U)
L5B	120VAC	LED	N/A	35W	RECESSED, 2'X4' LED TROFFER C/W EMERGENCY BATTERY BACKUP	EATON 24GR LED SERIES TROFFER (P/N:24GR-LD5-48-F1-UNV-EL14W-L835-CD1-U)
EX1	120VAC	LED	N/A	2W	WALL MOUNTED, PICTOGRAM STYLE EXIT SIGN C/W STEEL BODY AND MINIMUM 90 MINUTE EMERGENCY DURATION	AIMLIGHT RPST SERIES (P/N: RPST-1-M-WHT-BAT)
EX2	120VAC	LED	N/A	4W	CLASS 1 ZONE 2 RATED WALL MOUNTED, PICTOGRAM STYLE EXIT SIGN C/W STEEL BODY AND MINIMUM 90 MIN. EMERGENCY DURATION	AIMLIGHT RPZN2 SERIES (P/N: RPZN2-1-GRY-BAT)

ELECTRIC HEATER SCHEDULE					
HEATER TYPE	LOCATION	SERVICE	WATTAGE (kW)	REMARKS	STANDARD OF ACCEPTANCE
BB-1	LAB/OFFICE	208V/1ϕ/60Hz	2.5	BASEBOARD HEATER; SUPPLY AND INSTALL WALL MOUNTED, LINE VOLTAGE THERMOSTAT TO CONTROL HEATER.	OUELLET RBH SERIES ELECTRIC BASEBOARD HEATER (P/N: RBH2508)
BB-2	WASHROOM	208V/1ϕ/60Hz	.3	BASEBOARD HEATER C/W BUILT IN THERMOSTAT	OUELLET RBH SERIES ELECTRIC BASEBOARD HEATER (P/N: RBH0308)
EUH-1	PROCESS AREA	208V/3ϕ/60Hz	5	ELECTRIC UNIT HEATER. SUPPLY AND INSTALL ONE (1) COMMON LOW-VOLTAGE THERMOSTAT AND CONTROL TRANSFORMER TO CONTROL EUH-1, 2 & 3	OUELLET OAS SERIES INDUSTRIAL UNIT HEATER (P/N: OASU05038)
EUH-2	PROCESS AREA	208V/3ϕ/60Hz	5	ELECTRIC UNIT HEATER	OUELLET OAS SERIES INDUSTRIAL UNIT HEATER (P/N: OASU05038)
EUH-3	PROCESS AREA	208V/3ϕ/60HZ	5	ELECTRIC UNIT HEATER	OUELLET OAS SERIES INDUSTRIAL UNIT HEATER (P/N: OASU05038)
EUH-4	DEWATERING ROOM	208V/3ϕ/60Hz	10	CLASS 1 ZONE 2 RATED, ELECTRIC UNIT HEATER. SUPPLY AND INSTALL A WALL MOUNTED LOW-VOLTAGE THERMOSTAT C/W REMOTE SENSING BULB. SEAL PENETRATION INTO HAZARDOUS SPACE. INSTALLATION TO MEET REQUIREMENTS IN CEC FOR CLASS 1 ZONE 2 HAZARDOUS SPACE.	OUELLET OHX SERIES EXPLOSION PROOF INDUSTRIAL UNIT HEATER (P/N: OHX10038)
EUH-5	BIN ROOM	208V/3ϕ/60Hz	15	CLASS 1 ZONE 2 RATED, ELECTRIC UNIT HEATER. SUPPLY AND INSTALL A WALL MOUNTED LOW-VOLTAGE THERMOSTAT C/W REMOTE SENSING BULB. SEAL PENETRATION INTO HAZARDOUS SPACE. INSTALLATION TO MEET REQUIREMENTS IN CEC FOR CLASS 1 ZONE 2 HAZARDOUS SPACE.	OUELLET OHX SERIES EXPLOSION PROOF INDUSTRIAL UNIT HEATER (P/N: OHX15038)
FF-1	ELECTRICAL ROOM	208V/1ϕ/60Hz	3	WALL MOUNTED 3kW FAN FORCED HEATER SEE DETAIL 6 ON DRAWING E210	OUELLET OAC SERIES FAN FORCED WALL HEATER (P/N: OACU04000)
NOTES: 1) ALL UNIT HEATERS ARE TO COME WITH WALL MOUNTING BRACKETS.					

Power: 120/208 V 3 ø 4 W														PANEL P1				SYM. IC.: 18000 A															
# OF CKTS.: 72														LOCATION ELECTRICAL ROOM										MAINS: 400 A									
INCOMING:														MAIN BKR: 200 A																			
Remarks	Designation										CKT #	Watts	BKR	PHASE			BKR	Watts	CKT #	Designation										Remarks			
														a	b	c																	
	WELL PUMP										1	1000	40 2P	X				30 2P	1500	2	HOT WATER HEATER												
											3	1000			X				1500	4													
	BASEBOARD HEAT LAB										5	1250	20 2P			X	15	150	6	TRAP PRIMER													
											7	1250		X			15		8	SPARE													
	PIPE HEAT TRACE CCT 1, 2 & 3										9	300	15		X			5000	10	EUH-1 PROCESS ROOM 105										4			
	PIPE HEAT TRACE CCT 4 & 5										11	300	15		X	30 3P	5000	12															
	SPARE										13	300	15	X				5000	14														
	SPARE										15	300	15		X			3333	16	EUH-4 DEWATERING ROOM 106													
	SPARE										17	300	15		X	40 3P	3333	18															
	SBR CONTROL PANELVCC03										19	200	15	X				3333	20														
	UV SYSTEM CONTROL PANEL										21	100	15		X			5000	22	EUH-5 BIN ROOM 107													
	UV LAMPS BANK 1										23	900	15		X	60 3P	5000	24															
	UV LAMPS BANK 2										25	900	15	X				5000	26														
	UV LAMPS BANK 3										27	900	15		X	15	550	28	BUILDING SUPPLY AND EXHAUST FANS														
	AIR COMPRESSOR										29		30 2P			X	20 2P	600	30	HRV LAB/PROCESS AREA													
											31			X				600	32														
	UPS 3500VA										33		20 2P		X		20 2P	1150	34	LAB HEAT PUMP													
											35				X		1150	36															
1, 3	RECEPTACLES BIN ROOM 107										37	200	15	X					38	SANITARY WASTE PUMP STATION													
1, 3	RECEPTACLES BIN ROOM 106										39	200	15		X		20 2P		40														
	RECEPTACLES PROCESS AREA 105										41	300	15			X	15	300	42	SPARE													
	RECEPTACLES PROCESS AREA 105										43	300	15	X				20 2P	1500	44	FF-1 WASHROOM HEATER												
	RECEPTACLES LAB										45	300	15		X			1500	46														
	RECEPTACLES LAB										47	300	15			X	15		48	AIT-214, AIT-218													
1	RECEPTACLES EXTERIOR										49	300	15	X			15		50	AIT-224, AIT-228													
	RECEPTACLES ELECTRICAL ROOM										51	300	15		X		15		52	SPARE													
											53					X	15		54	FIT-101													
4	EUH-2 PROCESS ROOM 105										55		20 3P	X			15		56														
											57				X		15		58	SMOKE AND HEAT DETECTORS										2			
											59					X	15	200	60	SECURITY SYSTEM CONTROL PANEL													
4	EUH-3 PROCESS ROOM 105										61		20 3P	X			15	1000	62	INTERIOR LIGHTING, LAB, ELEC., WR.													
											63				X		15	314	64	EXTERIOR LIGHTING													
	INTERIOR LIGHTING										65	800	20			X	15	50	66	EXIT LIGHTING													
	FMV-103, 110 & 125										67			X					68	FMV-311, 440, 441, 219 & 229													
											69				X		15 3P		70														
											71					X			72														
FEEDER:														SOURCE:																			
Remarks:		1) GFCI BREAKER 2) BREAKER PAINTED RED AND LOCKED IN ON POSITION 3) WIRE CIRCUITS THROUGH RELAY IN CP1 TO DISCONNECT POWER WHEN VENTILATION SYSTEM IS NOT OPERATIONAL 4) WIRE UNIT HEAT CONTROLS THROUGH A COMMON CONTROLS TRANSFORMER AND TO VOLTAGE THERMOSTATS												Phase A Total		22383	W	186.5	A														
														Phase B Total		21747	W	181.2	A														
														Phase C Total		19083	W	159.0	A														
														TOTAL		63213	W	175.7	A														

Remarks	Power: 120/208 V 1 ø 3 W										PANEL UPS1										SYM. IC.: 10000 A																												
	# OF CKTS.: 12										LOCATION ELECTRICAL ROOM										MAINS: 60 A																												
	INCOMING:																				MAIN BKR: 60 A																												
	Designation										CKT #		Watts		BKR		PHASE		BKR		Watts		CKT #		Designation																								
	PLC01										1				15		X		a		b		15		2		EXHAUST FANS EF-1 & EF-2																						
	VCC02										3				15				X				15		4		TELECOMMUNICATION RACK																						
	VCC05										5				15		X						15		6		TELECOMMUNICATION RACK SERVICE ENTRANCE																						
											7				15				X				15		8		LAB OPERATOR STATION																						
											9				15		X						15		10																								
											11				15				X		15		12																										
FEEDER:																				SOURCE:																													
Remarks:																														Phase A Total										0 W 0.0 A									
																														Phase B Total										0 W 0.0 A									
																														TOTAL										0 W 0.0 A									



KEY PLAN
1:5000



2	ISSUED FOR ADDENDUM NO. 3	JUNE 13/17	JAB
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
A	ISSUED FOR APPROVAL	MAY 23/17	JAB
No.	Description	Date	By

Revision or Issue	
MUNICIPALITY OF CUMBERLAND	
PARRSBORO WASTERWATER SYSTEM – TREATMENT PLANT	
ELECTRICAL	
SCHEDULES	

CBCL

CBCL LIMITED

Consulting Engineers

CBCL No
161039.00

Contract No
161039.00

Date
NOV 2016

Scale
AS NOTED

DESIGNED
RJD

CHECKED
ROC

DRAWN
RJD

APPROVED
JAB

REGISTERED PROFESSIONAL ENGINEER
DATE 2017
R. O'CONNOR
7785
PROVINCE OF NOVA SCOTIA

SHEET No
7 of 11
Drawing No
E207

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT
CONTRACT 161039.00**

ADDENDUM NO. 3

Date: June 13, 2017

CONFIRMATION OF RECEIPT

I/We hereby confirm on behalf of

Name of Tenderer

That the above Addendum No. 3 was received by fax on the date stated above.

Signed: _____

Date: _____

Please fax confirmation to CBCL Limited
Attention: Aaron Baillie, P.Eng
Email: aaronb@cbcl.ca

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT
CONTRACT 161039.00**

ADDENDUM NO. 4

(to be added to and made part of the Tender Documents)

The following changes or modifications shall be made to the Tender Documents:

TO THE SPECIFICATIONS

SECTION 04 20 00 – MASONRY

Page 3, within subsection 2.1.4 delete “Mortar for brick to match colour of brick of existing building.”

Page 3, delete subsection 2.2.1.1. and renumber subsequent subsections.

SECTION 07 61 00 – STEEL ROOFING

Page 1, within subsection 2.1.1 delete “28 ga” and replace with “26 ga” and delete “profile and colour to match existing roof” and replace with “profile and colour to be selected by the Consultant”.

SECTION 07 62 00 – METAL FLASHING AND TRIM

Page 1, delete subsection 2.1.1.2 and replace with the following:

- .2 Colour to be selected by the Consultant.

Page 1, delete subsection 2.2.3 and replace with the following:

- .2 Colour to be selected by the Consultant.

SECTION 08 36 13.02 – SECTIONAL METAL DOORS

Page 10, delete subsection 3.2.7.

SECTION 08 51 13 – ALUMINIUM WINDOWS

Page 2, within subsection 2.2.2 delete “match the existing building” and replace with “be selected by the Consultant.”

SECTION 08 80 50 – GLAZING

Add new Section 08 80 50 – Glazing dated June 16, 2017, attached.

SECTION 09 21 16 – GYPSUM BOARD

Add new Section 09 21 16 – Gypsum Board dated June 16, 2017, attached.

SECTION 09 91 23 – PAINTING

Page 6, delete subsection 3.2.2.

Page 8, delete subsection 3.6.2 and replace with the following:

- .2 Colour to be selected by the Consultant.

SECTION 10 28 13 – WASHROOM ACCESSORIES

Add new Section 10 28 13 – Washroom Accessories dated June 16, 2017, attached.

SECTION 12 35 53 – FINISH CARPENTRY, ARCHITECTURAL WOODWORK AND CASEWORK

Add new Section 12 35 53 – Finish Carpentry, Architectural Woodwork and Casework dated June 16, 2017, attached

SECTION 22 15 00 – COMPRESSED AIR SYSTEM

Delete Section 22 15 00 – Compressed Air System and replace with new Section 22 15 00, dated June 16, 2017, attached.

SECTION 23 05 54 – MECHANICAL IDENTIFICATION

Page 3, delete subsection 2.3.5 and replace with the following:

- .5 See table below for pipe and valve identification.

SECTION 26 05 00 – ELECTRICAL GENERAL REQUIREMENTS

Page 3, within subsection 1.3.21 delete “existing” and replace with “installed”.

Page 9, delete subsection 1.12.8 and replace with the following:

- .8 Colour code electrical junction boxes and pull boxes in manner approved by the Consultant.

SECTION 26 24 19 – MOTOR CONTROL CENTRE

Page 2, delete subsection 2.1.5 and replace with the following:

- .5 Rating 208V, 60Hz, 3-phase, 4-wire continuous ampere rating and short circuit interrupting rating (momentary RMS symmetrical) as indicated on the drawings.

SECTION 40 05 10 – PLANT PIPING, VALVES AND APPURTENCES

Page 14, delete subsection 3.7.1 and renumber subsequent subsections.

SECTION 40 90 00 – PRIMARY PROCESS INSTRUMENTATION DEVICES AND CABLING

Page 1, delete subsection 1.1.2.3 and renumber subsequent subsections.

Page 18, delete subsection 3.4.5.

TO THE DRAWINGS

DRAWING A001 – FLOOR PLAN, ROOF PLAN AND REFLECTED CEILING PLAN

Within Section C/A001 remove the reference to 19mm birch plywood door fronts c/w 19mm hardwood on all edges.

DRAWING E204 – SINGLE LINE AND RISER DIAGRAMS

Delete Drawing E204 – Single Line & Riser Diagram as released in Addendum No. 2 and replace with new Drawing E204, dated June 16, 2017, attached.

DRAWING E210 – SCHEMATICS

Delete Drawing E210 – Schematics as released in Addendum No. 2 and replace with new Drawing E204, dated June 16, 2017, attached.

DRAWING E211 – SCHEMATICS AND DETAILS

Delete Drawing E211 – Schematics and Details as released in Addendum No. 2 and replace with new Drawing E204, dated June 16, 2017, attached.

DRAWING S002 – BUILDING ROOF FRAMING PLAN

Revise the Prefabricated Truss design snow load from 35kPa to 3.35kPa.

Aaron Baillie, P.Eng.
CBCL Limited
June 16, 2017

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PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section specifies all exterior and interior glazing requirements as per the Door and Frame Schedules.
<u>1.2 RELATED WORK</u>	.1	Sealants: Section 07 92 00
	.2	Hollow Metal Doors, Frames and Hardware: Section 08 11 14
<u>1.3 REFERENCES</u>	.1	CAN/CGSB-12.1-M90, Glass, Safety, Tempered or Laminated.

PART 2 - PRODUCTS

<u>2.1 GLAZING</u>	.1	Glazing: .1 6 mm tempered glass to CAN/CGSB-12.1, single or double glazed as per Door and Frame Schedule.
<u>2.2 GLAZING AND SEALING COMPOUND MATERIALS</u>	.1	Glazing compound and sealant compound as recommended by manufacturer.
<u>2.3 ACCESSORIES</u>	.1	Glazing tape: preformed butyl tape, 10-15 durometer hardness, paper release, black or grey colour, 3 mm thick x 10 mm wide.
	.2	Setting blocks: neoprene, Shore "A" durometer hardness 80, 100 mm long x 6 mm high x width to suit glass thickness.
	.3	Spacer shims: neoprene, Shore "A" durometer hardness 80, 75 mm long x 3 mm thick x 10 mm high.
	.4	Glazing splines: neoprene manufacturer's standard dry glazing splines to suit aluminum extrusions, manufacturer's standard colour.
	.5	Primer-sealers and cleaners: to glass

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manufacturer's standard.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.
- .2 Apply primer-sealer to contact surfaces.
- .3 Place setting blocks as per manufacturer's instructions.
- .4 Install glass, rest on setting blocks, ensure full contact and adhesion at perimeter.
- .5 Install removable stops, without displacing tape or sealant.
- .6 Provide edge clearance of 3 mm minimum.
- .7 Insert spacer shims to center glass in space. Place shims at 600 mm oc and keep 6 mm below sight line.
- .8 Apply cap bead of sealant at perimeter void, each face of glazed units (trim back shim tape where required first).
- .9 Apply sealant to uniform and level line, flush with sightline and tooled or wiped with solvent to smooth appearance.
- .10 Do not cut or abrade tempered, heat treated, or coated glass.

3.2 INSTALLATION

- .1 Dry method - tape/tape:
 - .1 Cut glazing tape to length and install against permanent stop, project 1.5 mm above sightline.
 - .2 Place glazing tape on free perimeter of glass in same manner described above.
 - .3 Install with 10 mm shim at base on interior side for door transoms and side lights.

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3.3 FINISHING .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.

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PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This Section specifies requirements for supplying and installing gypsum board on ceiling where shown on the Drawings.
<u>1.2 RELATED WORK</u>	.1	Rough Carpentry: Section 06 10 00
	.2	Sealants: Section 07 92 00
	.3	Painting: Section 09 91 23
<u>1.3 REFERENCES</u>	.1	ASTM A653/A653M-15, Specification for Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron (Galvannealed) by the Hot-Dip Process.
	.2	ASTM C475-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
	.3	ASTM C840-17, Standard Specification for Application and Finishing of Gypsum Board.
	.4	ASTM C1002-16, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
	.5	ASTM C1047-14A, Accessories for Gypsum Wallboard and Gypsum Veneer Base.
	.6	ASTM C1396-2014, Standard Specification for Gypsum Board.
	.7	CAN/ULC-S102-2010, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
<u>1.4 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.
	.2	Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other

causes.

- .3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.5 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain temperature minimum 10°C, maximum 21°C, for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Fire-rated gypsum board: fire-rated, to ASTM C1396, 15.9 mm thick, 1200 mm wide x maximum practical length, dense gypsum core.
 - .1 Standard of Acceptance: CGC Sheetrock Firecode Core gypsum board panels.
- .2 Steel drill screws: to ASTM C1002.
- .3 Laminating compound: as recommended by manufacturer, asbestos-free.
- .4 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, 0.5 mm base thickness commercial grade sheet steel with Z275 zinc finish to ASTM A653, perforated flanges; one piece length per location.
- .5 Joint compound: to ASTM C475, asbestos-free.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Do application and finishing of gypsum board in

accordance with ASTM C840 except where specified otherwise.

3.2 APPLICATION

- .2 Install work level to tolerance of 1:1200.
- .1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
- .2 Apply single layer gypsum board to metal furring using screw fasteners. Maximum spacing of screws 300 mm o.c.

3.3 INSTALLATION

- .1 Erect accessories straight, plumb and 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 o.c.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .3 Splice corners and intersections together and secure to each member with three (3) screws.
- .4 Install access doors to electrical and mechanical fixtures specified in respective Sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .5 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.
- .6 Finish corner beads, and trim as required with two (2) coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .7 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.

- .8 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .9 Completed installation to be smooth, level and plumb, free from waves and other defects and ready for surface finish.
- .10 Mix joint compound slightly thinner than for joint taping.
- .11 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.
- .12 Allow skim coat to dry completely.
- .13 Remove ridges by light sanding or wiping with damp cloth.
- .14 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of Substantial Completion.

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PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section specifies requirements for accessories in Locker/Washroom, Office, and other areas as shown on Drawings.
<u>1.2 RELATED WORK</u>	.1	Metal Fabrications: Section 05 50 00
	.2	Metal Partitions: Section 10 22 00
<u>1.3 REFERENCES</u>	.1	ASTM A167-99(2009), Stainless and Heat-Resistant Chromium-Nickel Steel Plate, Sheet and Strip.
	.2	ASTM B456-11E1, Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
	.3	ASTM A653/A653M-15, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
<u>1.4 SAMPLES</u>	.1	Submit duplicate samples of each accessory in accordance with Section 01 00 00.
<u>1.5 SHOP DRAWINGS</u>	.1	Submit shop drawings or catalogue illustrations in accordance with Section 01 00 00.
	.2	Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame.
<u>1.6 PROTECTION</u>	.1	Protect finished laminated plastic surfaces during shipment and installation. Do not remove until immediately prior to final inspection.

PART 2 - PRODUCTS

<u>2.1 MATERIALS</u>	.1	Sheet steel: commercial quality to ASTM A653 with ZF001 designation zinc coating.

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- .2 Stainless steel sheet metal: to ASTM A167, Type 304, with A151 No. 4, satin luster finish.
- .3 Stainless steel tubing: Type 304, commercial grade, seamless welded 1.2 mm wall thickness.
- .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.
- .5 Chrome and nickel plating: to ASTM B456 satin finish.
- .6 Manufacturer's or brand names on face of units not acceptable.

2.2 FIXTURES

- .1 Toilet paper dispenser (TPD): double roll type surface mounted, satin finish stainless steel, capacity of 500 double ply roll.
 - .1 Acceptable products: Bobrick B-76867 and Bradley 5234, or approved equivalent.
- .2 Paper towel dispenser (PTD): acceptable products as follows:
 - .1 Automatic feed, 200 mm roll paper towels, translucent cabinet, hinged front refill, surface mounted, approximately 230 mm x 230 mm x 380 mm high. AutoFlow 2 as manufactured by Scott Paper Co.
 - .2 Automated touchless dispenser, motion activated, front load, 355 H x 250 W x 450 D. enMotion as manufactured by Georgia Pacific.
 - .3 Or approved equivalent.
- .3 Soap Dispenser (SD): acceptable products as follows:
 - .1 Wall mounted, all purpose push type dispensing valve suitable for easy flowing anti-bacterial soap, liquid or lotion soaps. Impact-resistant grey polymer finish, with removable inner soap reservoir with approximately 1.5 L capacity. Bobrick B-5050.
 - .2 Digiclean antibacterial foam hand soap, 300H x 120W x 200D approximately, by ECOLAB.
 - .3 Or approved equivalent.

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- .4 Mirror (M): stainless steel angle framed, 6 mm thick glass mirror, size 760 mm high x 610 mm wide
 - .1 (M) Acceptable products: Bobrick B-290 Series, and Bradley 780, or approved equivalent.
- .5 Robe hooks (RH): satin finish stainless steel with 60 mm projection, double robe hook.
 - .1 Acceptable products: Bobrick B-76727 and Bradley 9124, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install and secure accessories rigidly in place as follows:
 - .1 Hollow masonry units: use toggle bolts drilled into cell/wall cavity.
 - .2 Confirm supplementary anchorage, if required, is in place.
- .2 Use tamper proof screws/bolts for fasteners.
- .3 Fill units with necessary supplies shortly before final acceptance of building.

3.2 SCHEDULE OF LOCATION AND QUANTITY

- .1 Locate accessories where indicated on the Project Drawings. Exact locations will be confirmed by Consultant.

END

PART 1 - GENERAL

<u>1.1 WORK INCLUDED</u>	.1	This section includes site applied or fabricated items of finished carpentry including wood trim, work benches and vanities.
	.2	This section also includes mill fabricated items of architectural woodwork including cabinetry.
<u>1.2 RELATED WORK</u>	.1	Sealants: Section 07 92 00
	.2	Hollow Metal Doors, Frames and Hardware: Section 08 11 14
	.3	Resilient tile and base: Section 09 65 00
	.4	Painting: Section 09 91 23
<u>1.3 REFERENCE STANDARDS</u>	.1	Do millwork to Millwork Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC).
	.2	CAN/CSA 0115-M1982(R2001), Hardwood and Decorative Plywood.
	.3	CAN/CSA 0121-17, Douglas Fir Plywood.
	.4	CAN/CSA 0141-05(R2014), Softwood Lumber.
	.5	CAN/CSA 0151-17, Canadian Softwood Plywood.
<u>1.4 SAMPLES</u>	.1	Submit duplicate 300mm x 300mm nominal samples of each type of panelling and each type of solid wood or plywood to receive stain or natural finish.
	.2	Submit duplicate 305mm long samples of each type of trim and moulding.
<u>1.5 PRODUCT DELIVERY, STORAGE AND HANDLING</u>	.1	Do not deliver wood materials to site until storage areas are completed, and conditions are such that no damage or deterioration will occur to them while in storage and during installation.
-

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Softwood lumber: to CSA 0141 and National Lumber Grades Authority requirements, with maximum moisture content of 7% for interior work, yard lumber selected for (natural) paint finish, spruce, pine, fir species, to AWMAC premium grade.
- .2 Hardwood lumber: to National Hardwood Lumber Association (NHLA) requirements, moisture content of maximum 7%, birch species, to AWMAC premium grade.
- .3 Hardwood plywood: to CSA 0115 of thickness indicated, rotary cut face, birch species veneer of finish grade where exposed to view and sound grade where not exposed.
- .4 Canadian softwood plywood: to CSA 0151, S2S where both sides exposed to view and S1S where one side exposed, select grade.
- .5 Douglas fir plywood: to CSA 0121, G2S where both sides exposed to view and G1S where one side exposed, select grade.
- .6 Accessories:
 - .1 Nails and staples: galvanized for exterior work, interior highly humid areas and for treated lumber; plain finish elsewhere.
 - .2 Wood screws: type and size to suit application.
 - .3 Splines: metal.
 - .4 Adhesive: recommended by manufacturer.

2.2 FABRICATION

- .1 General:
 - .1 Assemble architectural woodwork in mill in units as large as possible. Design units to fit together as one unit if site assembly is required.
 - .2 Incorporate services, fixtures and trim in work of this Section as indicated on Drawings or specified in mechanical or electrical, or both. Make necessary cutouts to template information.
 - .3 Edge plywood where specified or indicated with solid wood to match face veneer, with
-

profiled pressure glued edge joint and finished level with plywood surfaces.

- .2 Trim:
 - .1 Rout or groove backs of flat trim members.
 - .2 Kerf backs of wide flat members.
- .3 Fastening:
 - .1 Fasten work with nails generally, but use screws or special fasteners at critical joints where strain, and excessive usage and shrinkage is anticipated, and where required by specified quality grade standards.
 - .2 Glue built-up work as well as nailing and screwing.
 - .3 Blind nail unless impossible.
 - .4 Set finishing nails below finished surfaces.
- .4 Finishing:
 - .1 Finish each surface of work of specified quality grade standard where exposed or semi-exposed. Consider that all visible surfaces are exposed, including underside of work above 1200mm from floor. Consider that underside of work within 1200mm of the floor, tops of work more than 1800mm above the floor, interiors of fitments behind opaque doors and the backs of fitment doors are semi-exposed.
 - .2 Fine sand surfaces level and smooth after fabrication.
- .5 Acceptable manufacturer for pre-fab units:
LongLac - Multi-Core Robert Bury Co. Ltd.

2.3 CABINETWORK

- .1 Cabinets: minimum 16 mm pressed particleboard with laminated melamine finish on all exposed surfaces, colour to be selected by Consultant.
- .2 Cabinet Doors: 19 mm MDF raised panel design with "Sadolin" or "Thermo-foil" finish, colour as selected by Consultant.
- .3 Cabinet hardware:
 - .1 Door hinges: Blum No.71.6630, white finished.
 - .1 Blum hinge: 170 degree, full overlay application, concealed and self-closing.
 - .2 Door catches: magnetic type, white finished.

- .3 Door catches: elbow type, for doors with one-leaf lock, provide on top and bottom of non-lock leaf.
- .4 Drawer slides: Accuride, fully extendable, of quality to operate adequately for size and capacity of drawer, white in finish.
- .5 Pilaster strips: recessed, slotted, pre-finished white steel, with shelf clips to match.
- .6 Drawer and pulls: 100mm centres, 6mm diameter satin aluminum or satin chrome, "D" shape. Blum HB4041.
- .7 Locks: Knappe & Vogt 987 HP. Supply with two (2) keys.
- .8 Coat Hooks: Richelieu Wardrobe Hook BP-6513-140.
- .9 Cabinet hardware is generally noted as white in colour, but final colour selection will be by Consultant.

.4 Refer to the Architectural drawings for details.

2.4 FABRICATION OF CABINETS

- .1 Fabricate cabinets off site as indicated on the drawings.
- .2 Set nails and screws, apply plain 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 Factory finish casework and cabinetwork on all surfaces. On site finishing limited to touch-up only.
- .6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.

2.5 WORK BENCHES

- .1 Softwood lumber: to CSA-0141 and National Lumber Grade requirements, with maximum moisture content of 8% for interior work, yard lumber select for natural finish SPF species.

- .2 Hardwood lumber: to National Hardwood Lumber Association (NHLA) requirements, moisture content of maximum 8% for interior work, birch species.
- .3 Factory finish work benches. On site finishing limited to touch-up only.
- .4 Shop assemble work benches for delivery to site.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Before commencing installation ensure that grounds, strapping and other constructions and surfaces to which work is installed are satisfactory for fitting and adequate for securing work.
- .2 Take site measurements of construction to which work of this Section must conform, and through which access must be made, before work is delivered to site to ensure that adaptation is not required which would result in construction delay.

3.2 INSTALLATION

- .1 General:
 - .1 Do finish carpentry to Quality Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC), except where specified otherwise.
 - .2 Install work plumb, level and straight, and fasten it securely to backing to support itself and anticipated superimposed loads.
 - .3 Install fire-rated doors and frames in accordance with National Fire Codes, Volume 4, produced by National Fire Protection Association (NFPA) 80.
 - .2 Fastening:
 - .1 Position items of finished carpentry work and architectural woodwork accurately, level, plumb, true and fasten or anchor securely.
 - .2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
-

.3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.

.4 Replace items of finish carpentry and architectural woodwork with damage to wood surfaces including hammer and other bruises.

.3 Trim:

.1 Install in single lengths except where material limitation makes impossible. Stagger joints where they occur and locate over solid backing for fastening.

.4 Cutting and fitting:

.1 Cut mouldings with sharp true profiles.

.2 Cope trim and mouldings at interior corners and at returns.

.3 Miter trim and mouldings at exterior corners. Glue and lock shop miters that are over 150 mm from heel to point.

.4 Scribe and joint work accurately together, and to other work, to fit tightly and with flat smooth surfaces. Fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects. Install trim or filler panels to close gaps.

.5 Install finishing hardware in accordance with the manufacturer's written instructions.

.6 Cabinetry schedule and installation: install cabinetry hardware, pilaster strips and clips, hinges, drawer slides and pulls, supplied as specified.

3.3 ADJUSTMENT AND CLEANING

.1 Adjust hinged doors to swing freely and easily, to remain stationary at any point of swing, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force. Adjust sliding doors to operate smoothly without binding, and to close evenly and tightly against jambs.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act

positively with the least possible resistance in use. Lubricate hardware if required by supplier's instructions.

- .3 Clean hardware after installation in accordance with supplier's instructions.
- .4 Sand clean woodwork to leave free from finished defects in any exposed part.
- .5 Install resilient base around perimeters of all cabinets/benches as per Section 09 65 00 and as indicated on Architectural Drawings, Room Finish Schedule.
- .6 Caulk sides, tops, bases and countertops of all cabinets/benches as per Section 07 92 00.

Municipality of Cumberland Parrsboro Wastewater System - Treatment Plant Contract No. 161039.00	COMPRESSED AIR SYSTEM Addendum No. 4	Section 22 15 00 Page 1 June 16, 2017

PART 1 GENERAL

<u>1.1 SCOPE OF WORK</u>	.1 This section specifies the supply and installation of a compressed air system complete with packaged compressor, filters, piping and valves. .2 Supply and install a new packaged compressor, complete with filters, piping and valves in the new plant room provided.
<u>1.2 REFERENCES</u>	.1 American Society of Mechanicals (ASME): .1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels-2015. .2 ASME B1.20.1-13, Pipe Threads, General Purpose, Inch-2013 .3 ASME B16.5-17, Pipe Flanges and Flanged Fittings-2013. .4 ASME B16.11-16, Forged Fittings, Socket Welding and Threaded-2016. .5 ASME B31.3-16, Process Piping-2016. .2 American Society for Testing and Materials International (ASTM): .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless. .2 ASTM A181/A181M-14, Standard Specification for Carbon Steel Forgings for General Purpose Piping. .3 Canadian Standards Association (CSA) .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code. .4 International Organization for Standardization (ISO) .1 ISO 8573-1:2010, Compressed Air Part 1: Contaminants and purity classes .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS) .1 Material Safety Data Sheets (MSDS).
<u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u>	.1 Submit shop drawings and product data in accordance with Section 01 00 00.

- .2 Include following: air compressor, filters and valves.

PART 2 PRODUCTS

2.1 AIR COMPRESSOR

- .1 Refer to the Project Drawings.
- .2 Control:
 - .1 Manual control.
- .3 Accessories:
 - .1 Guards and pressure gauges.
- .4 Air intake:
 - .1 Complete with bird screen, replaceable cartridge type intake filter.
- .5 Supply vibration isolation pads as per Section 23 05 48.

2.2 PIPING

- .1 To ASTM A53, Gr. B ERW black steel, schedule 80 (3/4"-2" NPS).
- .2 Fittings: ASME B16.11, CL3000, ASTM A105N, socket welded or threaded.
- .3 Joints: NPS2 and smaller: socket welded or NPT threaded c/w Teflon tape.

2.3 TUBING

- .1 Only to be used for condensate dryer and filters.
- .2 Refer to Section 22 13 18 - Drainage Waste and Vent Piping.

2.4 BALL VALVES

- .1 Three piece design or top entry for ease of in line maintenance.
 - .2 To ASTM A181/A181M, Class 70, carbon steel body socket welded or screwed ends, stainless steel ball and associated trim suitable for compressed air application.
 - .3 Minimum pressure rating: 150 psig at 176°F.
-

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PART 3 EXECUTION

<u>3.1 MANUFACTURER'S INSTRUCTIONS</u>	.1	Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
<u>3.2 COMPRESSOR PACKAGE</u>	.1	Install on vibration isolators on housekeeping pad as indicated.
<u>3.3 COMPRESSED AIR LINE FILTERS</u>	.1	Install as per manufacturer's instructions.
	.2	Position the filters at an elevation to allow for condensate to freely flow from the automatic condensate drain to the oil/water separator.
<u>3.4 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION</u>	.1	Install shut off valves at outlets, major branch lines and in locations as indicated.
	.2	Install unions to permit removal or replacement of equipment.
	.3	Grade piping at 1% slope minimum.
	.4	Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.
	.5	Provide drains from refrigerated air dryers, air line filters and oil/water separator.
	.6	Weld steel piping in accordance with Section 23 05 17 - Pipe Welding and; .1 To ASME B31.3 and requirements of authority having jurisdiction. .2 Weld concealed and inaccessible piping regardless of size.
	.7	Thread piping in accordance with ASME B1.20.1.
	.8	Paint piping and color code compressed air pipe.
<u>3.5 SITE TESTS/INSPECTION</u>	.1	Testing: pressure test new installation in accordance with requirements of Section 23 05 05

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- Mechanical General Requirements, for 4 hour minimum, to 150 psi, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 2 psi.

3.6 CLEANING

- .1 Refer to Section 23 08 02 - Cleaning and Start-Up of Mechanical Systems.
- .2 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.
- .3 Check entire installation is approved by authority having jurisdiction.
- .4 Perform cleaning operations as specified in Section 23 08 02 - Cleaning and Start-up of Mechanical Systems and in accordance with manufacturer's recommendations.
- .5 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.7 FACTORY TESTING

- .1 Inspection and Testing:
 - .1 Test air compressor system to confirm proper operation at rated power supply and for electrical and mechanical integrity prior to shipment.
 - .2 The Equipment Supplier grants the right to inspect the instrumentation and control equipment to any authorized representative of the purchaser or representative before shipment from factory. If inspection is required to give 48 hours' notice in advance of the time when the equipment will be ready for inspection at the factory. The Owner will pay the costs associated with having the testing observed. Include all cost to conduct testing in the stipulated price.
 - .3 Have all equipment tested by the equipment supplier.

3.8 DELIVERY

- .1 Shipment: ship equipment assembled to the greatest extent possible to reduce installation and start-up costs.
- .2 Coordinate deliveries with the Owner.

3.9 RESPONSIBILITY
OF TEMPORARY TRAIL
USAGE

- .1 Obtain written confirmation from the installing contractor that equipment is installed and ready for testing.
- .2 The guarantee period will not be affected by temporary trail use of the equipment.
- .3 Clean and renew equipment and systems used prior to acceptance. Restore to original or new working condition.
- .4 Protect equipment and system openings from dirt, dust, and other foreign materials during temporary usage.

3.10 SITE
INSPECTION, TESTING
AND START-UP

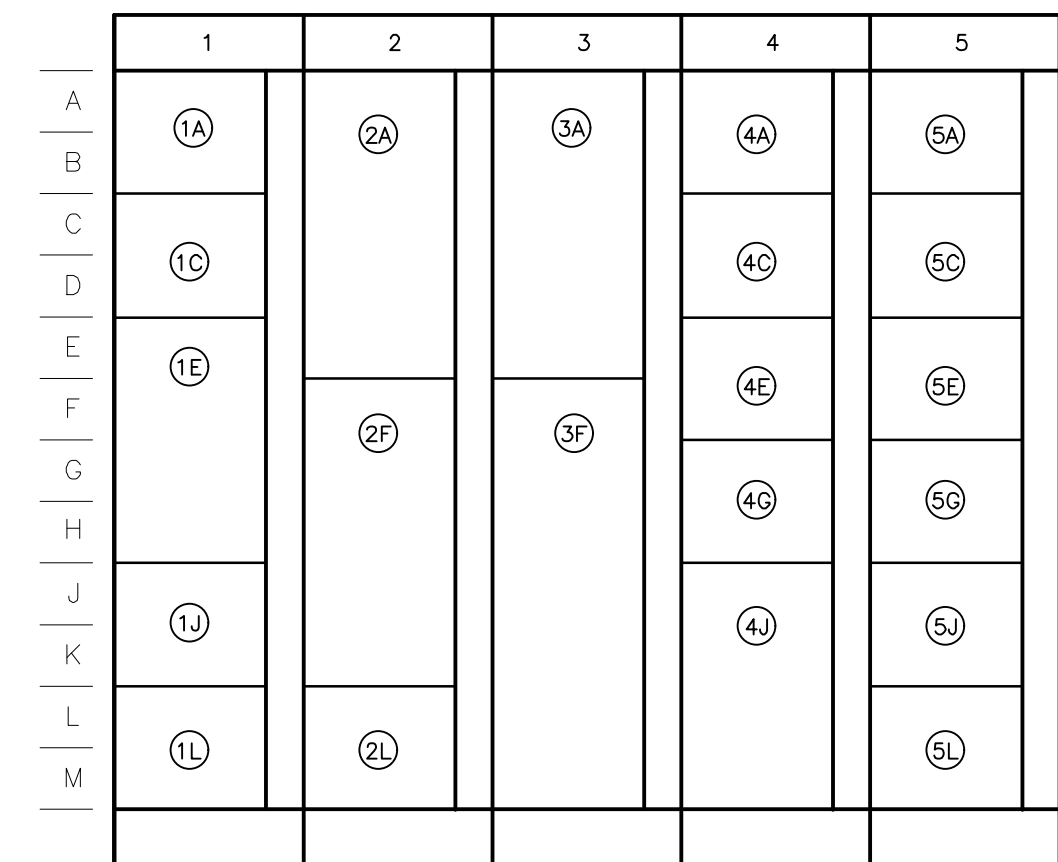
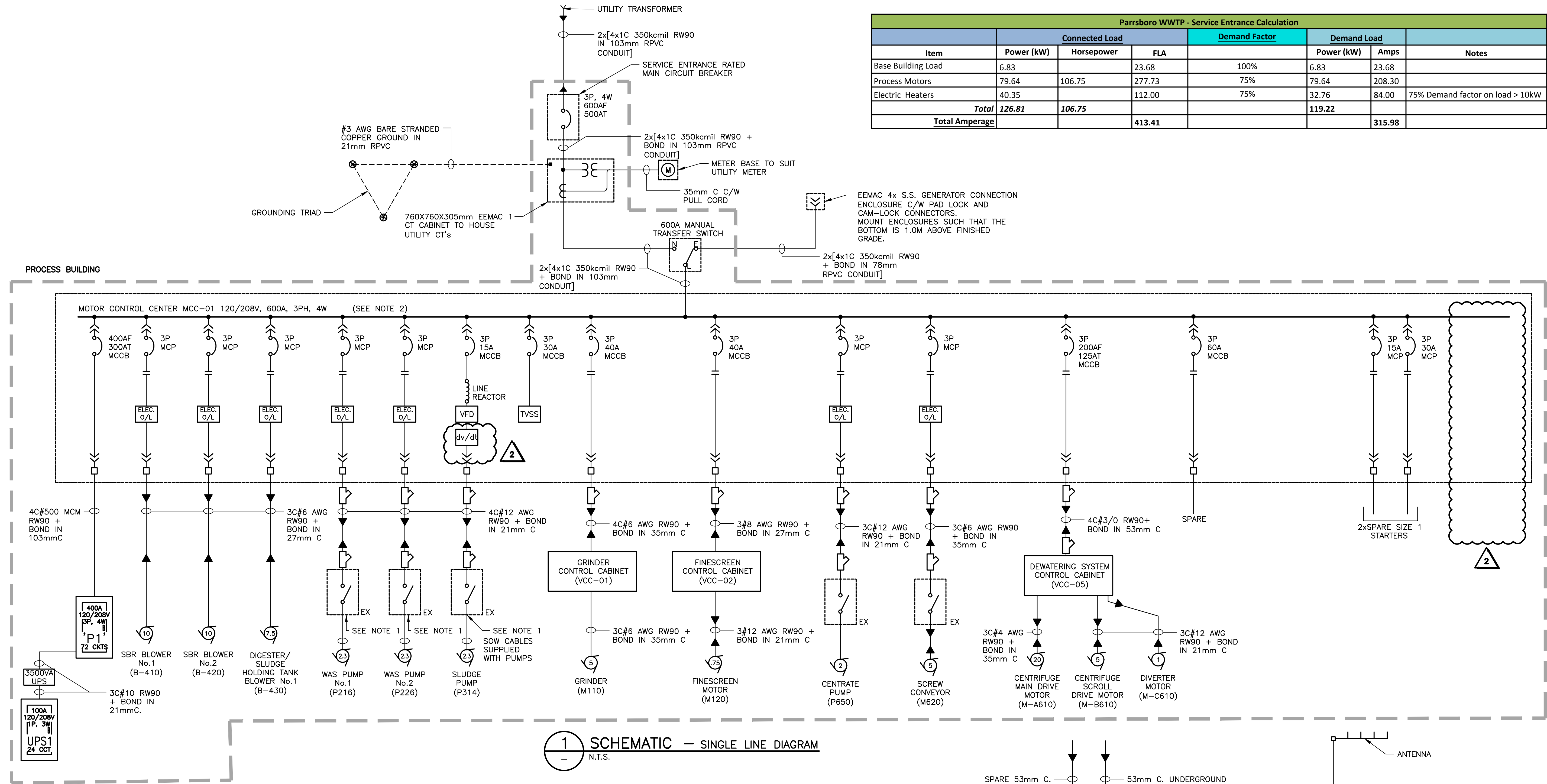
- .1 Provide the services of qualified service personnel, mechanics, or other trained personnel for a minimum of one (1) trip, of one (1) eight (8) hour day on-site to check the complete installation and be present for start-up of the equipment. Provide a written report to the stating the following:
 - .1 That the system is operating in accordance with design specifications.
 - .2 That the equipment has been satisfactorily installed by the Contractor and/or outline any modifications that have been made or are required to be made as a result of the commissioning or testing of the equipment.
 - .3 That the equipment is now ready for permanent operation.
 - .4 That operation, lubrication and maintenance instructions for the equipment have been presented to the Owner.
 - .5 That the equipment has been properly lubricated with the correct lubricants.
 - .2 Have the Equipment Supplier's representative fully instruct permanent operator of equipment in proper operation and maintenance of equipment.
 - .3 Advise the Owner in writing at least one (1) week in advance of the proposed date for testing and start-up. Provide necessary tools, materials and equipment for carrying out tests. Provide water for testing. Conduct tests in the presence of the Owner.
-

- .4 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.

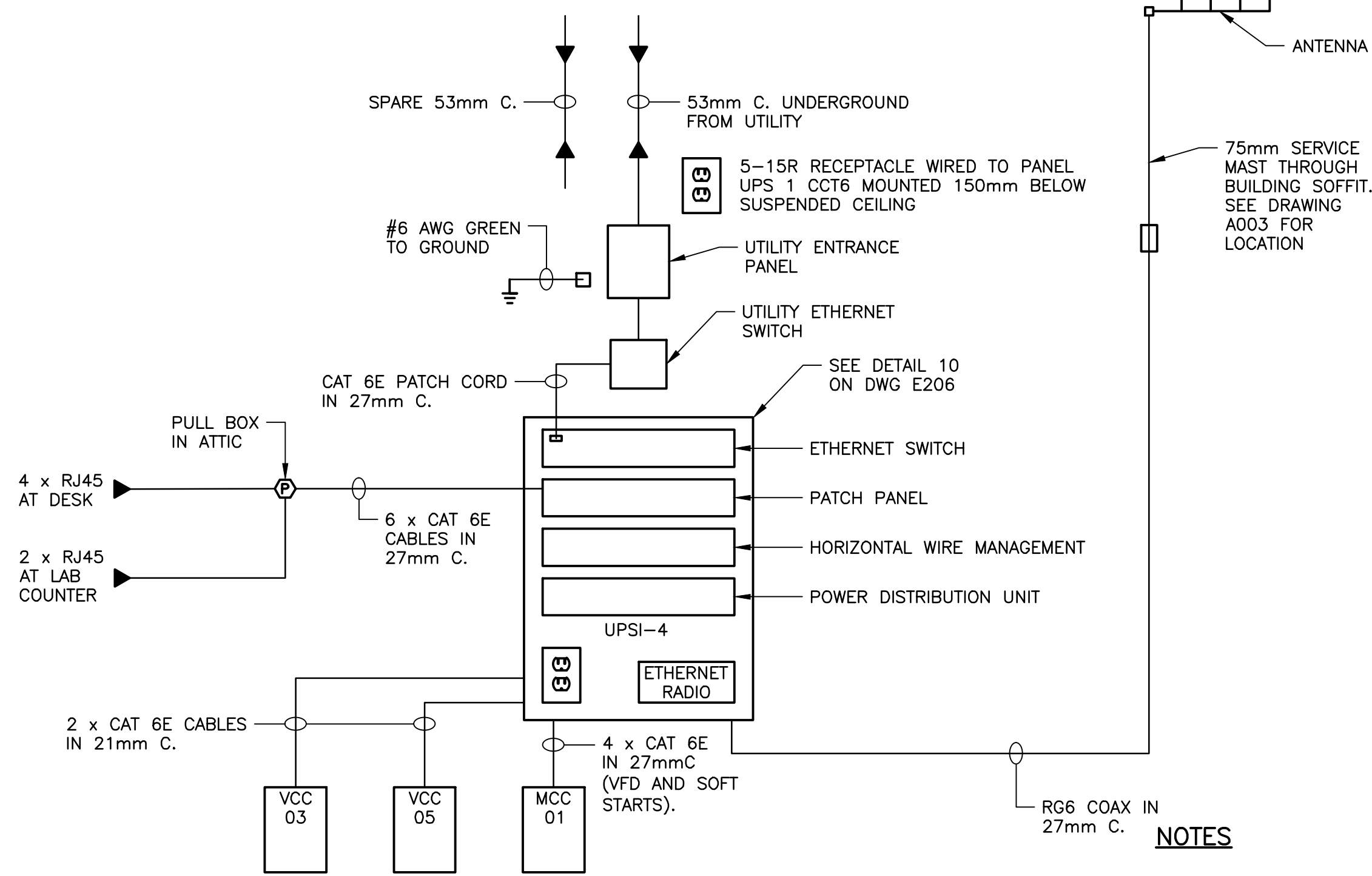
3.11 IDENTIFICATION .1 Locate manufacturer's nameplates so that they are easily read. Do not paint over plates.

3.12 COMMISSIONING .1 Commission in accordance with Section 01 00 00.

DRAWING NAME: PARRSBORO WASTEWATER TREATMENT PLANT E204 SINGLE LINE & RISER DIAGRAMS E204.DWG LAYOUT NAME: E204 SINGLE LINE & RISER DIAGRAMS E204.DWG DATE: 2016-11-17 10:04:43 AM CAD OPERATOR: PARRSBORO



- 1A MAIN LUGS
1C TVSS
1E PANEL P1 BREAKER
1J P216
1L P226
2A B430
2E B420
2J VCC01
2L B410
3P P314
4A VCC02
4E P650
4J M620
4L SPACE
5A VCC05
5C SPARE SIZE 1
5E SPARE SIZE 1
5J SPARE SIZE 2
5L SPARE SIZE 2
6A 3P 60 AMP BREAKER



NOTES

1. TELECOMMUNICATION EQUIPMENT AND DATA RACK TO BE MOUNTED HIGH ON WALL IN LAB

Parrsboro WWTP - Service Entrance Calculation						
Item	Connected Load			Demand Factor	Demand Load	
	Power (kW)	Horsepower	FLA		Power (kW)	Amps
Base Building Load	6.83		23.68	100%	6.83	23.68
Process Motors	79.64	106.75	277.73	75%	79.64	208.30
Electric Heaters	40.35		112.00	75%	32.76	84.00
Total	126.81	106.75			119.22	
Total Amperage			413.41			315.98

KEY PLAN

1:5000

NOTES

- SUPPLY AND INSTALL THREAD HUB, TRANSIT ASSEMBLY AND CABLE BLOCKS TO SUIT CABLE. MATERIALS TO BE ACCEPTABLE FOR CLASS 1 ZONE 2 HAZARDOUS SPACE.
- THE MCC IS TO BE SUPPLIED WITH NO BOTTOM PLATES TO ALLOW ENTRANCE OF UNDER SLAB CONDUITS. MOUNT MCC ON GALVANIZED STEEL CHANNELS (MINIMUM 50mm HIGH) TO PROVIDE ADEQUATE CLEARANCE FOR INSTALLATION OF EYE FITTINGS.



No.	Description	Date	By
2	ISSUED FOR ADDENDUM NO.4	JUNE 16/17	JAB
1	ISSUED FOR ADDENDUM 2	JUNE 7/17	JAB
0	ISSUED FOR TENDER	JUNE 2/17	JAB
B	ISSUED FOR APPROVAL	MAY 23/17	JAB
A	ISSUED FOR 50% REVIEW	MAY 01/17	JAB

Revision or Issue

MUNICIPALITY OF CUMBERLAND

PARRSBORO WASTEWATER SYSTEM - TREATMENT PLANT

ELECTRICAL

SINGLE LINE & RISER DIAGRAMS



CBCL No	Contract No	Date	Scale
161039.00	161039.00	NOV 2016	AS NOTED

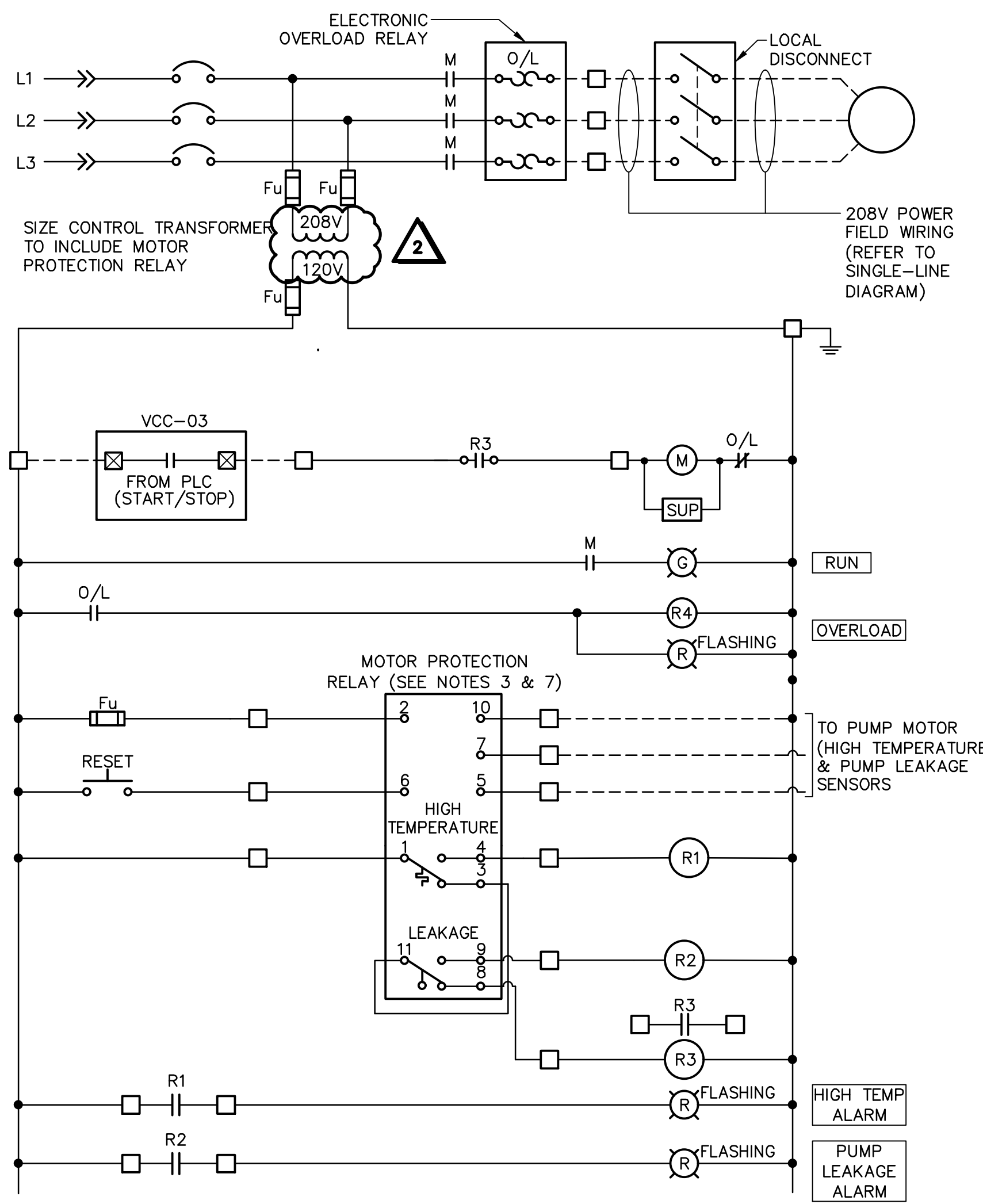


Designed	Drawn
RJD	RJD
Checked	Approved
ROC	JAB

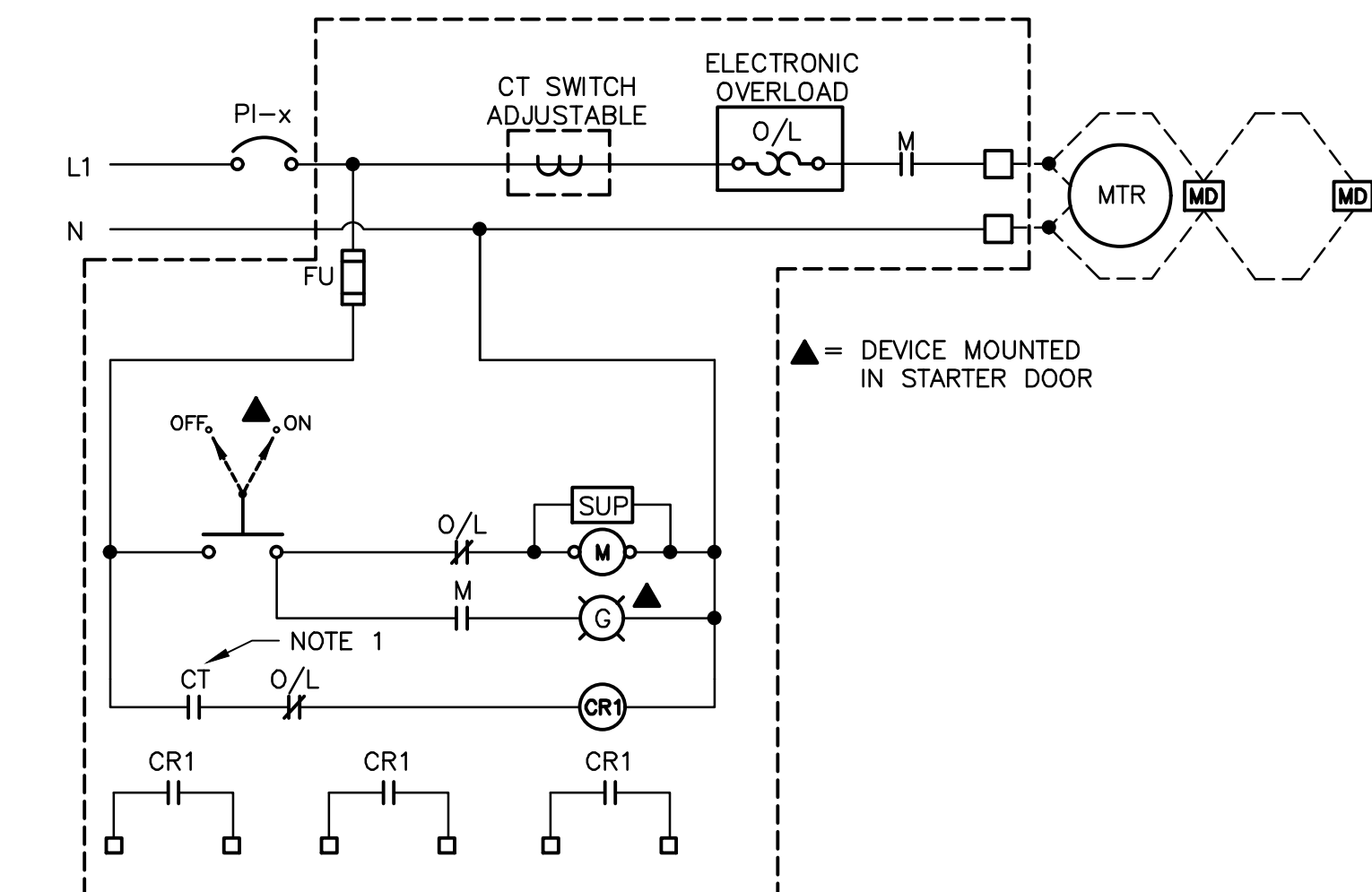
Sheet No
4 of 11

Drawing No
E204

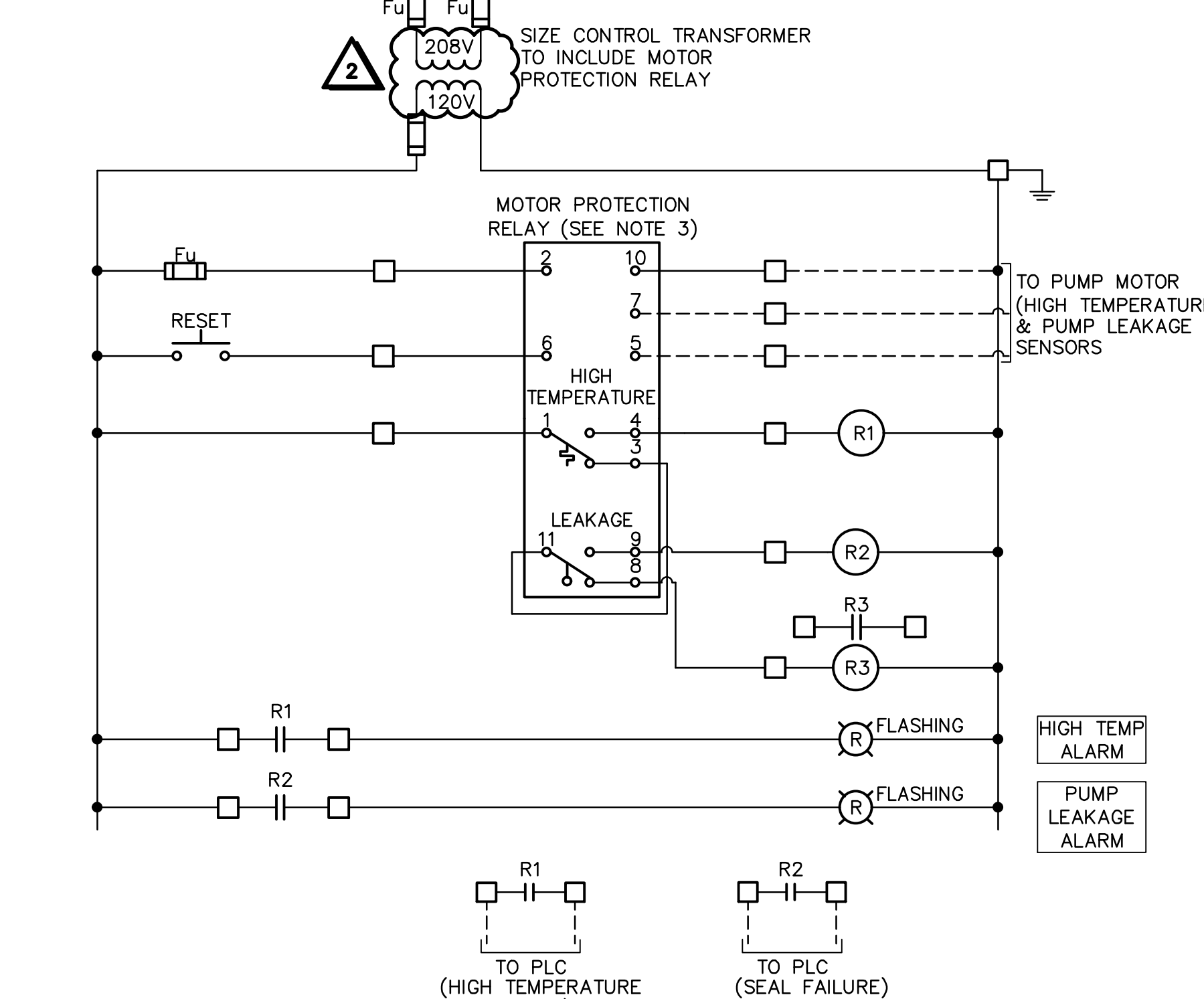
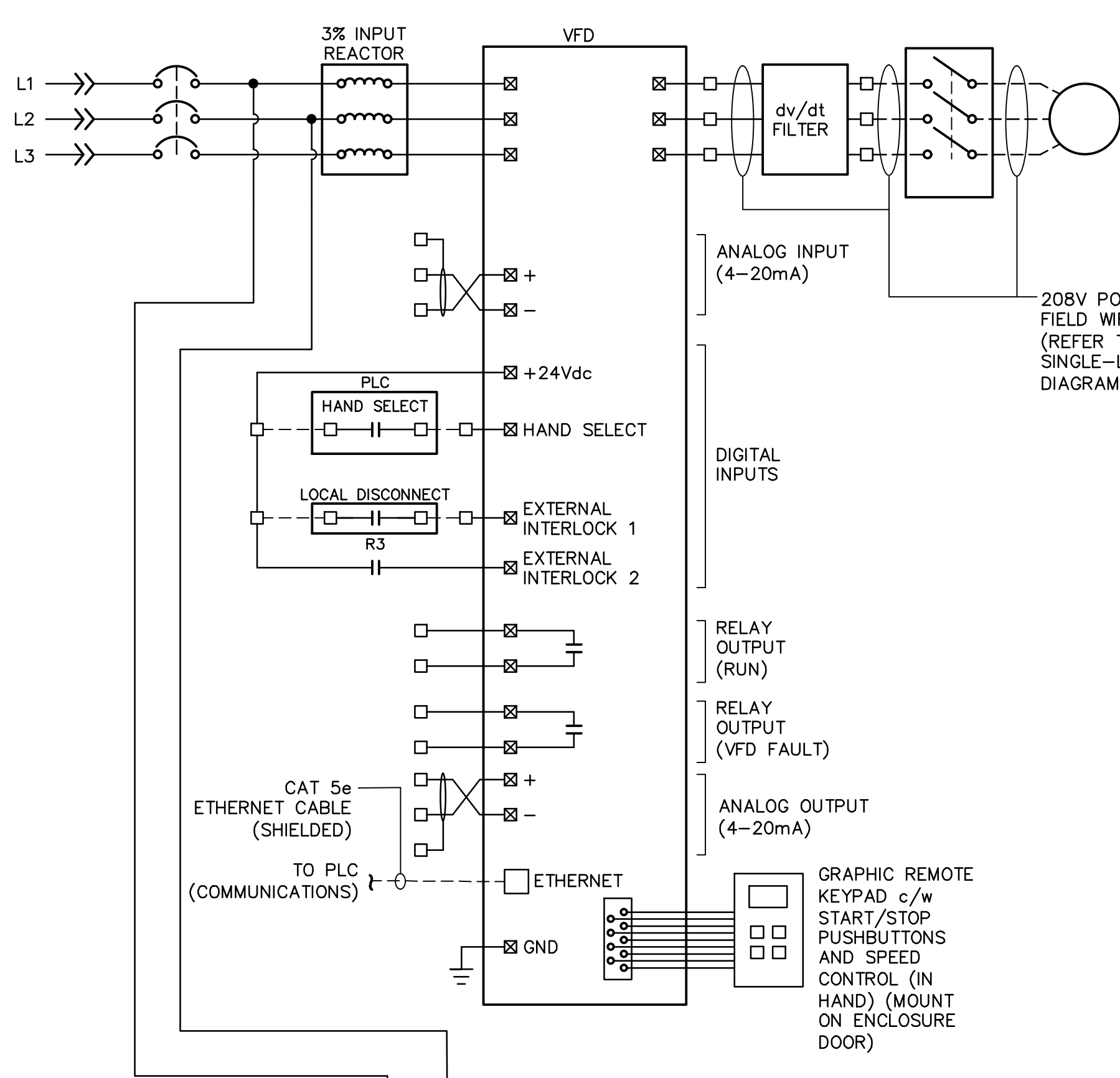
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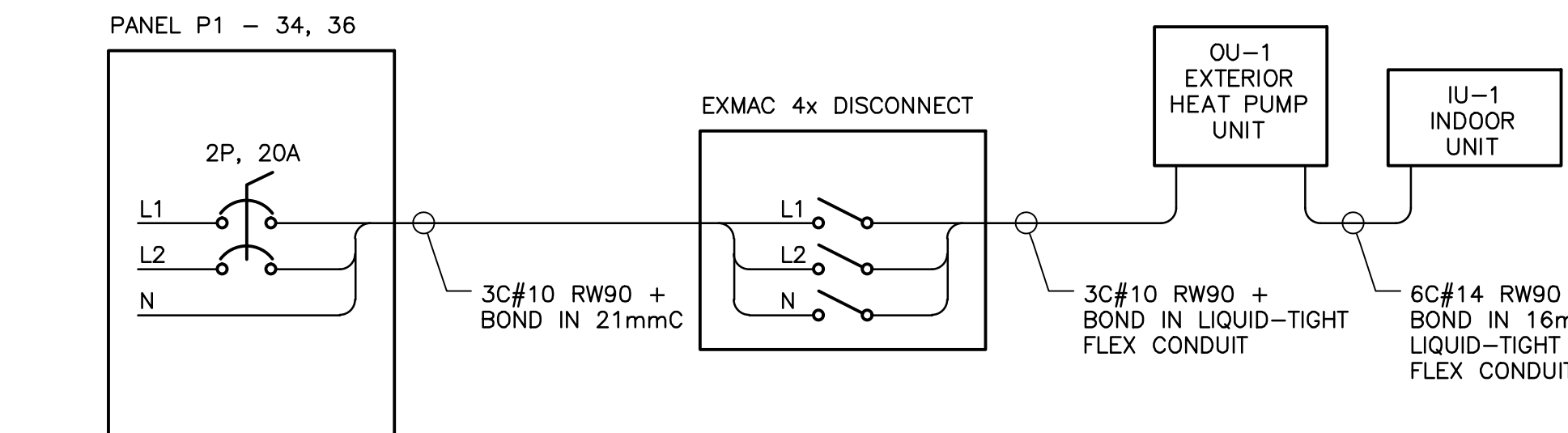
1 SCHEMATIC — MOTOR CONTROL (FVNR STARTER)
NTS
TYP. FOR: — WAS PUMP P216
— WAS PUMP P226
(SEE NOTE 2)



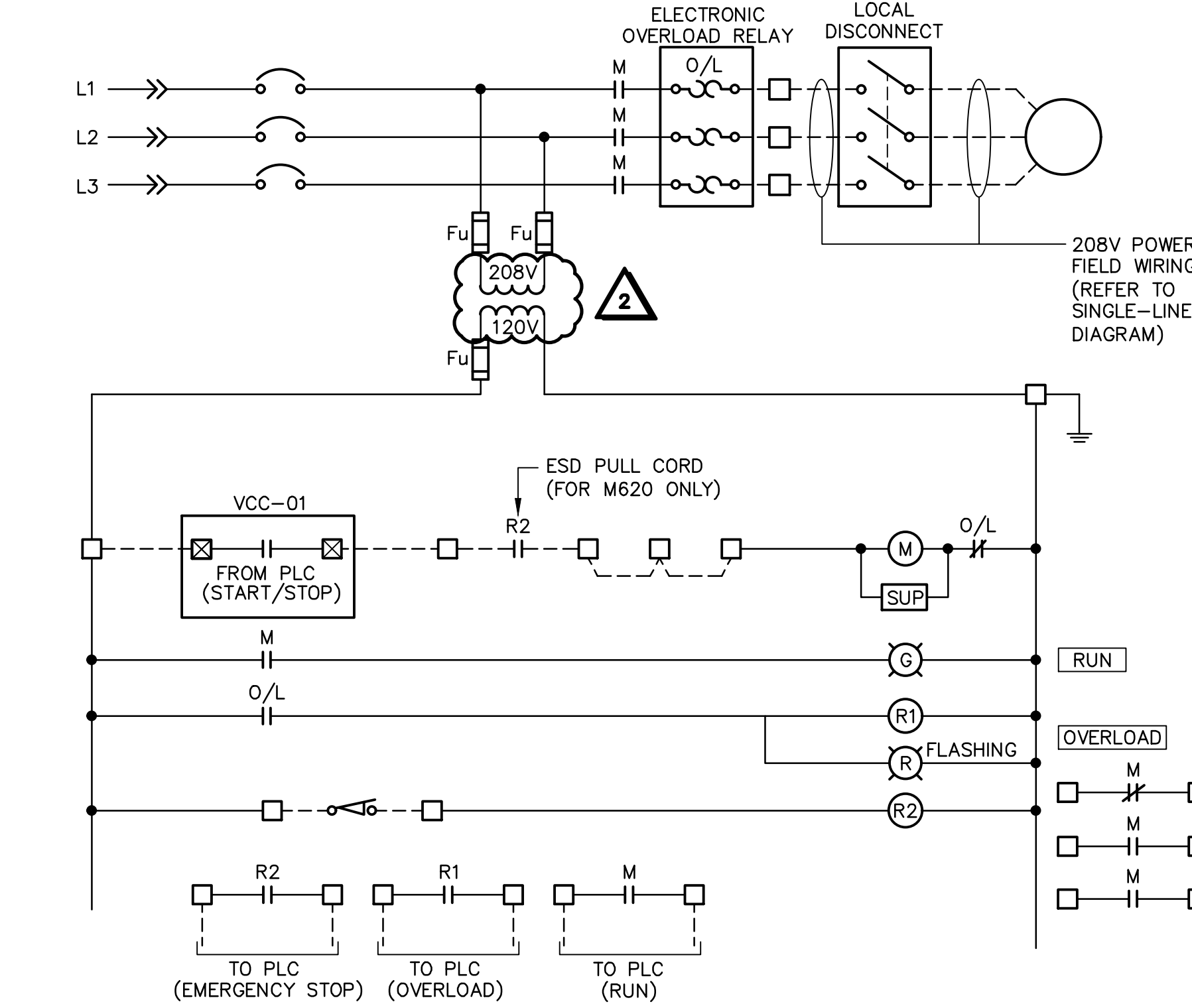
2 SCHEMATIC — EXHAUST FANS EF-1 & EF-2
NOTES:
1. CT RELAY CLOSING WHEN FAN REACHES RATED FLA.



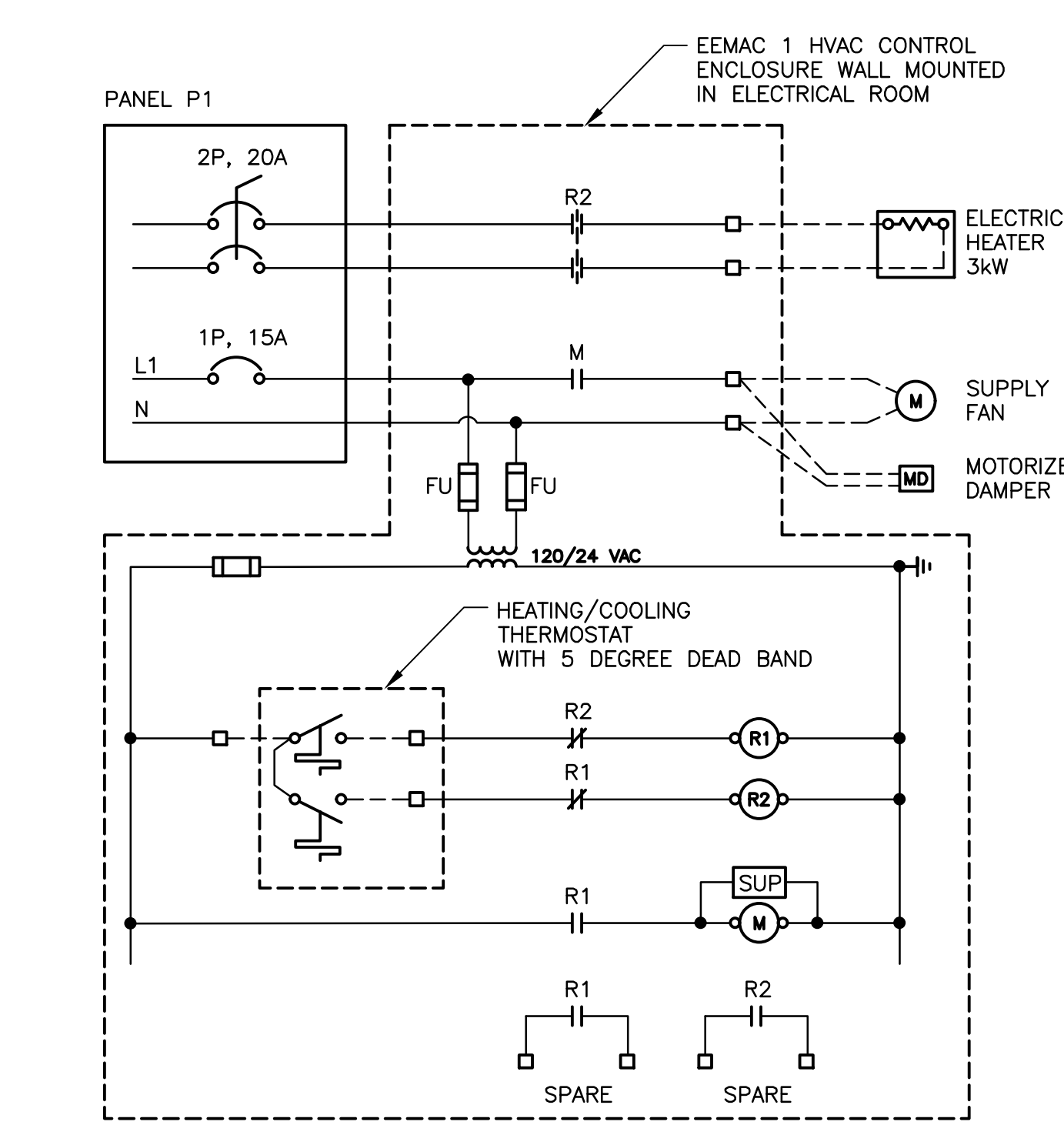
3 SCHEMATIC — MOTOR CONTROL (VFD)
N.T.S.
TYP. FOR: — SLUDGE P314



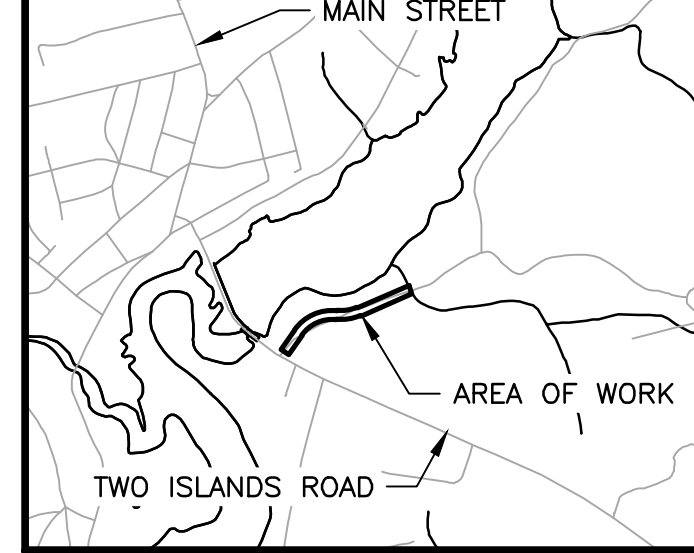
4 SCHEMATIC — LAB HEAT PUMP ELECTRICAL CONNECTION
N.T.S.



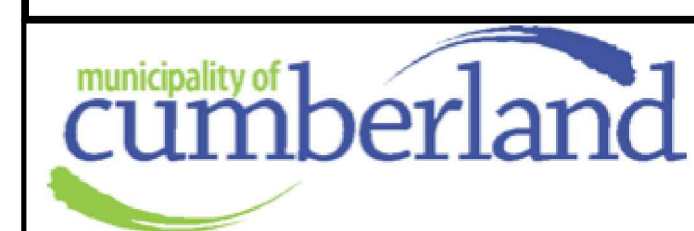
5 SCHEMATIC — MOTOR CONTROL (FVNR STARTER)
NTS
TYP. FOR: — CENTRATE PUMP P650
— SCREW CONVEYOR M620
— SPARE STARTERS



6 SCHEMATIC — ELECTRICAL ROOM HVAC CONTROLS
N.T.S.
NOTES:
1. INSTALL WARNING LABEL ON DOOR OF ENCLOSURE TO NOTE THAT THERE ARE MORE THAN ONE SUPPLY POWER TO THE ENCLOSURE AND ALL SUPPLIES TO THE CONTROL PANEL ARE TO BE DISCONNECTED PRIOR TO SERVICING.
2. MINIMUM CONTACT RATING FOR RELAY R2 IS TO BE 230 VAC, 30 AMPERE LOAD BREAK CAPACITY.



- KEY PLAN**
1:5000
NOTES:
- PROCESS MOTOR CONTROL CABLING IS IDENTIFIED ON THE CABLING DIAGRAMS.
 - MANUFACTURER SUPPLIED MOTOR PROTECTION RELAY SHALL BE SUPPLIED LOOSE TO MCC MANUFACTURER FOR FACTORY INSTALLATION. EXACT RELAY MODEL SHALL BE CONFIRMED DURING CONSTRUCTION.
 - CONTROL SCHEMATIC IS TYPICAL AND IS SHOWN FOR CONTROL PHILOSOPHY ONLY. SHOP DRAWINGS SHALL BE SUBMITTED INDICATING WIRING CONNECTIONS SPECIFIC TO THE MANUFACTURER'S VFD.
 - VFD CONTROL AND MONITORING TO BE VIA ETHERNET/IP CONNECTION. VFD COMMUNICATIONS TO BE COMPATIBLE W/IT PLC CONTROLLER (ALLEN BRADLEY COMPACT LOGIX).
 - VERIFY MOTOR NAMEPLATE AND ADVISE ENGINEER. OVERLOAD RELAY TO MATCH MOTOR NAMEPLATE.



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0	ISSUED FOR TENDER	JUNE 2/17	JAB

Revision or Issue

MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM — TREATMENT PLANT

ELECTRICAL
SCHEMATICS



CBCL No 161039.00	Contract No 161039.00	Date NOV 2016	Scale AS NOTED
Designed ROC	Drawn RJD	Checked ROC	Approved JAB
Sheet No 10 of 11		Drawing No E210	

**MUNICIPALITY OF CUMBERLAND
PARRSBORO WASTEWATER SYSTEM
TREATMENT PLANT
CONTRACT 161039.00**

ADDENDUM NO. 4

Date: June 16, 2017

CONFIRMATION OF RECEIPT

I/We hereby confirm on behalf of

Name of Tenderer

That the above Addendum No. 4 was received by fax on the date stated above.

Signed: _____

Date: _____

Please fax confirmation to CBCL Limited
Attention: Aaron Baillie, P.Eng
Email: aaronb@cbcl.ca