

**TECHNICAL SPECIFICATIONS:
UPGRADE OF NEQOTKUK WASTEWATER TREATMENT
FACILITY
Tobique First Nation, NB**

Specifications



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Project No.: 2308072.001
Client No.: F-23-NQ-01
April 2025

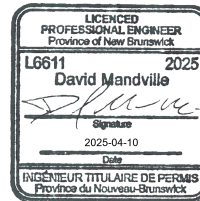
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END OF SECTION

Page Count

Division 00 - Procurement and Contracting Requirements

Section 00 01 07 - CONSULTANT TEAM AND SEALS	1
Section 00 01 10 - TABLE OF CONTENTS	5
Section 00 01 15 - LIST OF DRAWING SHEETS	2
Section 00 21 13 – INSTRUCTIONS TO BIDDERS	9
Section 00 31 00 - AVAILABLE PROJECT INFORMATION	2
Section 00 41 45 - BID FORM	4
CCDC 2 – STIPULATED PRICE CONTRACT (2020)	30
Section 00 70 50 – AMENDMENTS TO AGREEMENT	2
Section 00 71 50 – AMENDMENTS TO DEFINITIONS	2
Section 00 73 00 – SUPPLEMENTARY CONDITIONS	3
Section 00 73 63 - CONTRACT SECURITY REQUIREMENTS	1

Division 01 - General Requirements

Section 01 11 00 - SUMMARY OF WORK	3
Section 01 14 00 - WORK RESTRICTIONS	3
Section 01 25 00 - SUBSTITUTION PROCEDURES	2
Section 01 26 00 - CONTRACT MODIFICATION PROCEDURES	5
Section 01 29 00 - PAYMENT PROCEDURES	3
Section 01 31 19 - PROJECT MEETINGS	3
Section 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION	4
Section 01 33 00 - SUBMITTAL PROCEDURES	5
Section 01 35 29.06 - HEALTH AND SAFETY REQUIREMENTS	4
Section 01 35 31 - FIRE SAFETY REQUIREMENTS	2
Section 01 35 43 - ENVIRONMENTAL PROCEDURES	5
Section 01 40 00 - QUALITY REQUIREMENTS	3
Section 01 52 00 – CONSTRUCTION FACILITIES	2
Section 01 56 00 - TEMPORARY BARRIERS AND ENCLOSURES	1
Section 01 57 00 - TEMPORARY CONTROLS	3
Section 01 61 00 - COMMON PRODUCT REQUIREMENTS	3
Section 01 71 00 - EXAMINATION AND PREPARATION	3
Section 01 73 00 - EXECUTION	3
Section 01 74 00 - CLEANING AND WASTE MANAGEMENT	2
Section 01 77 00 - CLOSEOUT PROCEDURES	6
Section 01 78 00 - CLOSEOUT SUBMITTALS	8
Section 01 79 00 – DEMONSTRATION AND TRAINING	2
Section 01 91 13 – GENERAL COMMISSIONING (CX) REQUIREMENTS	9
Section 01 91 41 – COMMISSIONING TRAINING	3

Division 02 – Demolition

Section 02 41 15 – REMOVALS	4
-----------------------------------	---

Division 03 – Concrete

Section 03 10 00 - CONCRETE FORMING AND ACCESSORIES	5
-----------------------------------------------------------	---

Section 03 20 00 - CONCRETE REINFORCING	6
Section 03 30 00 - CAST-IN PLACE CONCRETE.....	17
Section 03 35 00 - CONCRETE FINISHING	4

Division 04 – Masonry

Section 04 05 00 – COMMON WORK RESULTS FOR MASONRY	6
Section 04 05 13 - MASONRY MORTARING AND GROUTING.....	5
Section 04 05 19 – MASONRY ANCHORAGE AND REINFORCING	7
Section 04 22 00 – CONCRETE UNIT MASONRY	8

Division 05 – Metals

Section 05 50 00 – METAL FABRICATIONS	7
---------------------------------------------	---

Division 06– Wood and Plastics

Section 06 10 00 – ROUGH CARPENTRY	7
Section 06 17 53 - SHOP FABRICATED WOOD TRUSSES.....	12

Division 07– Thermal and Moisture Protection

Section 07 13 52 - MODIFIED BITUMINOUS SHEET WATERPROOFING	5
Section 07 21 13 - BUILDING INSULATION.....	5
Section 07 26 00 – VAPOUR RETARDERS	3
Section 07 27 00 - AIR BARRIERS.....	3
Section 07 46 13 – PREFORMED METAL SIDING	5
Section 07 61 00 – SHEET METAL ROOFING.....	4
Section 07 62 00 – SHEET METAL FLASHING AND TRIM	3
Section 07 92 00 - JOINT SEALANTS.....	7

Division 08– Openings

Section 08 11 00 - METAL DOORS AND FRAMES	6
Section 08 71 00 - DOOR HARDWARE.....	7

Division 09– Finishes

Section 09 91 99 - PAINTING	6
-----------------------------------	---

Division 10 – Specialties

Section 10 81 00 – SUPPLY AND INSTALLATION OF NEW BLOWERS.....	17
Section 10 81 01 – SUPPLY AND INSTALLATION OF WWTP AERATION SYSTEM.....	17
Section 10 90 00 - AIR PIPING SYSTEMS.....	9
Section 10 90 10 - WWTP ACCESSORIES	4

Division 20 – General Mechanical

Section 20 05 01 - COMMON WORK RESULTS FOR MECHANICAL	18
Section 20 05 53.01 - MECHANICAL IDENTIFICATION	5

Division 22 – Plumbing and Heating

Section 22 05 05 - INSTALLATION OF PIPEWORK	5
Section 22 05 17 - PIPE WELDING	4
Section 22 05 20 - METERS AND GAUGES FOR WASTEWATER SYSTEM	3
Section 22 05 23.01 - VALVES - BRONZE	6
Section 22 05 23.05 - BUTTERFLY VALVES	3
Section 22 05 23.06 - WASTEWATER VALVES	3
Section 22 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	8
Section 22 07 15 - THERMAL INSULATION FOR PIPING	7
Section 22 08 01 - PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEMS	2
Section 22 08 02 - CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS	2
Section 22 11 16 - DOMESTIC WATER PIPING	6
Section 22 13 18 - DRAINAGE WASTE AND VENT PIPING - PLASTIC	5
Section 22 20 13 - PRESSURE PIPING	6
Section 22 42 01 - PLUMBING SPECIALTIES AND ACCESSORIES	10

Division 23 – Air Distribution

Section 23 05 93 - TESTING, ADJUSTING AND BALANCING FOR VENTILATION	5
Section 23 07 13 - DUCT INSULATION	5
Section 23 31 13.01 - METAL DUCTS - LOW PRESSURE TO 500 PA	6
Section 23 33 00 - AIR DUCT ACCESSORIES	5
Section 23 33 15 - DAMPERS - OPERATING	3
Section 23 34 00 - HVAC FANS	4
Section 23 37 20 - LOUVRES, INTAKES AND VENTS	3

Division 26 – Electrical

Section 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL	17
Section 26 05 20 - WIRE AND BOX CONNECTORS (0-1000 V)	2
Section 26 05 21 - WIRES AND CABLES (0-1000 V)	4
Section 26 05 22 - CONNECTORS AND TERMINATIONS	1
Section 26 05 28 - GROUNDING - SECONDARY	5
Section 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	3
Section 26 05 31 - SPLITTERS, JUNCTION, PULL BOXES AND CABINETS	2
Section 26 05 32 - OUTLET BOXES, CONDUIT BOXES AND FITTINGS	3
Section 26 05 34 - CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS	4
Section 26 12 16.01 - DRY TYPE TRANSFORMERS UP TO 600 V PRIMARY	3
Section 26 24 16.01 - PANELBOARDS BREAKER TYPE	4
Section 26 27 26 - WIRING DEVICES	5
Section 26 28 13.01 - FUSES - LOW VOLTAGE	2

Section 26 28 16.02 - MOULDED CASE CIRCUIT BREAKERS	3
Section 26 28 20 – GROUND FAULT CIRCUIT INTERRUPTERS – CLASS A	3
Section 26 28 23 - DISCONNECT SWITCHES - FUSED AND NON-FUSED	3
Section 26 29 10 – MOTOR STARTERS TO 600 V	3
Section 26 50 00 - LIGHTING	5
Section 26 52 00 - EMERGENCY LIGHTING	3
Section 26 53 00 - EXIT SIGNS.....	2
Section 26 82 39 – ELECTRIC UNIT HEATERS	3

Division 31 - Earthwork

Section 31 11 00 – CLEANING AND GRUBBING.....	5
Section 31 23 00 - EXCAVATION AND FILL FOR FOUNDATIONS.....	10
Section 31 23 33.01 – EXCAVATING, TRENCHING AND BACKFILLING	15

Division 32 - Exterior Improvements

Section 32 11 16.01 - GRANULAR SUB-BASE.....	6
Section 32 11 23 - AGGREGATE BASE COURSES.....	6
Section 32 31 13 - CHAIN LINK FENCES AND GATES.....	9
Section 32 91 19.13 - TOPSOIL PLACEMENT AND GRADING	5
Section 32 92 19.16 - HYDRAULIC SEEDING.....	8

Division 33 – Utilities

Section 33 00 01 – SLUDGE REMOVAL AND DEWATERING.....	6
Section 33 05 16 - MANHOLES AND CATCH BASIN STRUCTURES	9
Section 33 11 16 - SITE WATER UTILITY DISTRIBUTION PIPING	7
Section 33 31 13 – PUBLIC SANITARY UTILITY SEWAGE PIPING	12
Section 33 41 00 – STORM UTILITY DRAINAGE PIPING	4

Division 35 – Waterway and Marine Construction

Section 35 42 19 – PRESERVATION OF WATER COURSES AND WETLANDS	2
---------------------------------------------------------------------	---

Division 40 – Process Integration

Section 40 05 00 – COMMON WORK RESULTS FOR PROCESS INTEGRATION.....	9
Section 40 05 13 – INSTRUMENTATION – CONTROL PANELS.....	2

Division 42 – Process Mechanical

Section 42 80 00 – SUPPLY AND INSTALLATION OF UV SYSTEM	9
---------------------------------------------------------------	---

Neqotkuk	TABLE OF CONTENTS	Section 00 01 10
Upgrade of Neqotkuk		Page 5 of 5
Wastewater Treatment Facility		April 2025
Neqotkuk, NB		Project No. 2308072.001

Appendices

- Appendix A – Geotechnical Investigation Report
- Appendix B – Sludge Survey Report

END OF SECTION

Cover Sheet

CIVIL

C01	OVERALL LOCATION PLAN AND GENERAL NOTES
C02	EXISTING CONDITIONS AND REMOVALS PLAN
C03	EXISTING CONDITIONS AND REMOVAL SECTIONS
C04	NEW UV BUILDING SITE SERVICING AND GRADING PLAN
C05	NEW UV BUILDING BY-PASS MH AND PIPING - PLAN AND PROFILE
C06	NEW AERATION PLAN AND PROFILE
C07	AERATION SYSTEM TYPICAL DETAILS
C08	BAFFLE TYPICAL DETAILS
C09	CONSTRUCTION TYPICAL DETAILS

ARCHITECTURAL

A01	NEW UV BUILDING, FLOOR PLAN AND DETAILS
A02	NEW UV BUILDING, ARCHITECTURAL ELEVATIONS
A03	NEW UV BUILDING, TYPICAL CONSTRUCTION DETAILS

STRUCTURAL

S01	NEW UV BUILDING, FOUNDATION PLAN AND SECTIONS
S02	NEW UV BUILDING, MASONRY PLAN AND DETAILS
S03	NEW UV BUILDING, MASONRY ELEVATIONS
S04	NEW UV BUILDING, ROOF PLAN
S05	NEW UV BUILDING, STAIR SECTIONS AND DETAILS
S06	NEW UV BUILDING, SECTIONS AND DETAILS

MECHANICAL

M01	EXISTING BLOWER BUILDING, REMOVALS PLAN
M02	EXISTING BLOWER BUILDING, NEW BLOWER INSTALLATION PLAN
M03	EXISTING BLOWER BUILDING, MECHANICAL SECTIONS
M04	NEW UV BUILDING, VENTILATION PLAN SCHEDULES AND DETAILS
M05	NEW UV BUILDING, VENTILATION SCHEMATICS
M06	NEW UV BUILDING - FLOOR PLAN, SECTION AND DETAIL

ELECTRICAL

E01	ELECTRICAL SITE PLAN, LEGEND AND DETAILS.
E02	BLOWER BUILDING DEMOLITION PLAN
E03	BLOWER BUILDING NEW WORK, SINGLE LINE DIAGRAM AND DETAILS
E04	NEW UV BUILDING LAYOUT, SINGLE LINE DIAGRAM AND DETAILS
E05	NEW UV BUILDING SCHEDULES

PROCESS INTEGRATION

P01	P&ID LEGEND 1
P02	P&ID LEGEND 2
P03	P&ID LEGEND 3
P04	P&ID BLOWER BUILDING

P05	P&ID UV BUILDING
I01	DRAWING INDEX
I02	SYMBOL LEGEND
I03	I/O TERMINAL BLOCK DETAILS
I04	120VAC POWER RAIL DETAIL
I05	BLOWER BUILDING CONTROL PANEL WWTF_CP01 BILL OF MATERIALS
I06	NETWORK DIAGRAM
I07	BLOWER BUILDING CONTROL PANEL WWTF_CP01 EXTERIOR LAYOUT
I08	BLOWER BUILDING CONTROL PANEL WWTF_CP01 INTERIOR LAYOUT
I09	BLOWER BUILDING WWTF_CP01 120VAC WIRING DIAGRAM 1
I10	BLOWER BUILDING WWTF_CP01 120VAC WIRING DIAGRAM 2
I11	BLOWER BUILDING WWTF_CP01 24VDC WIRING DIAGRAM 1
I12	BLOWER BUILDING WWTF_CP01 24VDC WIRING DIAGRAM 2
I13	BLOWER BUILDING WWTF_CP01 COMPACTLOGIX RACK 0 SLOT 0-1: CPU & DIGITAL INPUT CARD
I14	BLOWER BUILDING WWTF_CP01 COMPACTLOGIX RACK 0 SLOT 2: DIGITAL INPUT CARD
I15	BLOWER BUILDING WWTF_CP01 COMPACTLOGIX RACK 0 SLOT 3: DIGITAL INPUT CARD
I16	BLOWER BUILDING WWTF_CP01 COMPACTLOGIX RACK 0 SLOT 4: DIGITAL OUTPUT CARD
I17	BLOWER BUILDING WWTF_CP01 COMPACTLOGIX RACK 0 SLOT 5: ANALOG INPUT CARD
I18	BLOWER BUILDING WWTF_CP01 COMPACTLOGIX RACK 0 SLOT 6: ANALOG INPUT CARD
I19	BLOWER BUILDING WWTF_CP01 COMPACTLOGIX RACK 0 SLOT 7: ANALOG OUTPUT CARD
I20	UV BUILDING MARSHALLING PANEL WWTF_JB01 BILL OF MATERIALS
I21	UV BUILDING MARSHALLING PANEL WWTF_JB01 EXTERIOR LAYOUT
I22	UV BUILDING MARSHALLING PANEL WWTF_JB01 INTERIOR LAYOUT
I23	UV BUILDING WWTF_JB01 MARSHALLING WIRING DIAGRAM 1
I24	UV BUILDING WWTF_JB01 MARSHALLING WIRING DIAGRAM 2
I25	ANTENNA DETAILS

END OF SECTION

Part 1 General

1.1 BIDDING PROCESS REQUIREMENTS

- .1 This Section provides Bidders with specific information on the requirements of this Contract that apply to the bidding process including the submission and evaluation of bids. Bidders are to review this information carefully. Bidders are also required to review the entire Specification document and Drawings to ensure they are aware of all requirements of this Project.

1.2 BID CALL

- .1 Bids will be received in the manner, addressed to, and before the closing time as prescribed by the Bid Call.
- .2 Bid submission instructions are detailed in the BID SUBMISSION article herein.
- .3 Bid submission is to be done electronically via email, the time for submission shall be determined by the time on the receiving computer system of party receiving the submission based on the clock of the receiving server.
- .4 Bids received after the specified bid closing time will not be accepted. Bids in format will not be accepted and will be returned unopened.
- .5 The *Owner* reserves the right to extend the bid closing time or cancel the Bid Call by addendum.
- .6 Bids will not be opened publicly with Bidders present.
- .7 Immediately following the close of the bidding period and bid opening, the opening committee will review all submissions and prepare a summary report that will be made available to all Bidders via email.
- .8 The lowest or any bid will not necessarily be accepted.
- .9 The award of the *Contract*, if any, will not be made at the bid opening.

1.3 BID DOCUMENT AVAILABILITY

- .1 Bid Documents are made available for the purpose of obtaining bids for this project. It does not confer a license to use the Bid Documents for any other purpose.
- .2 Bid documents may only be obtained from the location named in the Advertisement for Bids.

1.4 EXAMINATION OF BID DOCUMENTS

- .1 Examine the Bid Documents and promptly notify the person designated to receive inquiries of any perceived errors, omissions, conflicts or discrepancies in the Bid Documents.

1.5 SITE EXAMINATION

- .1 Bidders shall visit the site and familiarize themselves with conditions affecting the Work before submitting a bid.
- .2 No claims will be entertained for Bidders' misunderstanding of the site conditions or work requirements resulting from their unfamiliarity with existing conditions.
- .3 Refer to Section 00 31 00 - Available Project Information which identifies available information pertaining to the Project.
- .4 By inference of the "Concealed or Unknown Conditions" GC in the General Conditions of the Contract, Bidders shall include in their bid price for non-concealed and known conditions that are either visible or can be reasonably inferred from a site examination at the Place of the Work before bid submission.

1.6 BID FORM SUPPLEMENTS

- .1 Submit the following Bid Form Supplements together with the Bid Form:
 - .1 Bid security as specified.
 - .2 Signed Copies of each Addendum.
 - .3 Signed Copy of an NBCSA Letter of Good Standing, COR certification, in accordance with SAFETY CERTIFICATION and Section 01 35 29.06 – Health and Safety Requirements.
- .2 The Owner may, after the bid closing time and before contract award, require any Bidder to submit additional supplementary information about any aspect of the Bidder's bid to verify compliance with the Bid Documents.

1.7 BID SECURITY

- .1 Submit with the bid a bid bond in an amount of not less than 10% of the bid price.
- .2 The bid bond shall be in favour of the Owner and shall be signed, sealed, and dated by both Bidder and surety.
- .3 Bid Bond must be signed by a principal of the company submitting a bid.
- .4 Bid Bonds must be good for a minimum of 30 days from bid closing date.
- .5 Bid Bonds shall be purchased from a New Brunswick resident agent of an Insurance Company licensed to do business in the Province of New Brunswick whose bonds are acceptable and payable to the Owner.
- .6 Bid Bond shall be accompanied by a letter from an Insurance Company licensed to do business in the Province of New Brunswick advising that this Company will undertake to issue a Performance Bond for the sum equal to fifty percent (50%) of the bid price of the Contract and a Labour and Material Payment Bond of equal value. This letter must be endorsed by an authorized signing officer and must bear the seal of the bonding Company.
- .7 Upon request, bid bonds of unsuccessful Bidders will be returned after the successful Bidder has entered into a contract with the Owner and provided the specified contract security, or earlier at the Owner's discretion.

1.8 BIDDER DEFAULT AND FORFEITURE OF BID SECURITY

- .1 If a Bidder whose bid is accepted by the Owner in writing, without conditions, and within the acceptance period specified in the Bid Documents, refuses or fails within 15 calendar days after the date of issuance of the written acceptance of the bid, to sign a formal agreement with the Owner for the performance of the Work and to provide contract performance security as specified in the Bid Documents, the Bidder will be liable to the Owner for the difference in money between the Bidder's bid price and the amount for which the Owner legally contracts with another party to perform the Work, if the latter amount is in excess of the former, up to the maximum amount of the bid security provided.

1.9 CONTRACT SECURITY

- .1 Refer to Section 00 73 63 – Contract Security Requirements.

1.10 TAXES

- .1 The AFNWA is HST exempt. The selected contractor will receive a copy of the HST exemption letter.

1.11 CONTRACT TIME

- .1 The Bidder, in submitting a bid, agrees to attain Substantial Performance of the Work by the date specified in the Bid Form, which will become the Contract Time under the Contract.

1.12 SUBSTITUTIONS

- .1 Where the Bid Documents specify particular Products by proprietary name, Bidders shall base their bids on the named Products only. The Consultant will not consider requests for approval of substitutions during the bid period. Refer to Section 01 25 00 – Substitution Procedures for substitutions after contract award.

1.13 ALTERNATIVES

- .1 Do not submit unsolicited alternatives. Alternative products or equipment from that specified will not be considered during the bid period.

1.14 BID FORM SIGNING

- .1 Complete the Bid Form as follows:
 - .1 Incorporated Company: Provide company name and name and signature of the duly authorized signing representative(s). Insert under each signature the representative's capacity to act on behalf of the company. Affix corporate seal. If Bid is signed by officials other than President and Secretary of company, or President-Secretary-Treasurer of company, copy of by-law resolution of Board of Directors authorizing them to do so must also be submitted with Bid in Bid envelope.
 - .2 Joint Venture: Each entity within the joint venture shall execute the Bid Form as specified.

- .3 Partnership: Provide name of partnership and name and signature of duly authorized representatives of the partnership.
- .4 Sole Proprietorship: Provide name of sole proprietorship and name and signature of sole proprietor in the presence of a witness who shall also sign.

1.15 BID SUBMISSION

- .1 Bidders are cautioned to carefully read the Bid Documents to understand any restrictions applying to this procurement.
- .2 Bidders are solely responsible for delivery of their bids in manner and time prescribed.
- .3 Each item on the form must be completed, unless noted otherwise. Incomplete bids will be rejected.
- .4 Offers submitted after the closing time will not be opened.
- .5 The lowest or any bid will not necessarily be accepted. The award of the contract, if any, will not be made at the bid opening.
- .6 Bids will be received in electronic form only. Bid submission, with all required documents combined into one PDF format file, must be sent as an attachment via email to AFNWA Procurement Department:

procurement@afnwa.ca

- .1 Email subject for Bid Submission shall be in this format:
 - .1 BID SUBMISSION – Bidder’s Company Name –
Owner’s Project/Reference Number – Project Name
 - .2 Original Bid documents (paper format) are not required.
- .7 Only emailed submissions will be accepted. Submissions are to go only to AFNWA Procurement Department.
- .8 Time for submission shall be determined by the time on the receiving computer system of the party receiving the submission based on the clock of the receiving server.
- .9 Ensure offers are executed and dated and are received at the time, date and method as stipulated in the Advertisement.

1.16 BID MODIFICATION AND WITHDRAWAL

- .1 A bid, including the Bid Form and Bid Form supplements, submitted in accordance with these bidding requirements may be modified or withdrawn, provided the modification or withdrawal request:
 - .1 is received no less than 1 hour prior to the bid closing time,
 - .2 is in the form of an email sent to the address and with the email subject and format stated above, in accordance with the BID SUBMISSION article herein,
 - .3 and is signed by a duly authorized person.
- .2 For bid closing time purposes, the official time of receipt of bid modifications or withdrawal requests submitted electronically via email will be determined by the time on the receiving computer system of the party receiving the submission, based on the clock of the receiving server.

- .3 If a bid is withdrawn, a new bid may be submitted in accordance with the specified requirements, provided it is received before the bid closing time.
- .4 When submitting a modification directing a change in a bid price, do not reveal the original amount nor the revised amount:
 - .1 On stipulated price bids, state only the amount to be added to or deducted from the original bid price.
 - .2 On unit price bids, state only the amount to be added to or deducted from each original unit price or lump sum in the Schedule of Prices. The Owner will adjust extended amounts and the total bid price as required by the modification.
- .5 When submitting a second or more modifications related to a particular bid price, ensure that there is no ambiguity as to the intended bid price. The written modification shall clearly indicate whether:
 - .1 the bid price first submitted is being modified and any previous modifications are to be disregarded, or
 - .2 a revised bid price derived from a previous modification is being modified.
- .6 State all addendum numbers received, if different from what was indicated on originally submitted Bid Form.
- .7 The Owner will assume no responsibility or liability for modifications or withdrawals that are, for any reason, delayed, illegible, unclear as to intent, ambiguous, contrary to these instructions, or otherwise improperly received. The Owner may disregard improperly received modifications or withdrawals.

1.17 BIDDING IRREGULARITIES

- .1 Bids with Bid Forms that are improperly prepared, signed or submitted contrary to these Instructions to Bidders, or that contain added conditions or other irregularities of any kind, may, at the Owner's discretion, be rejected as non-compliant.
- .2 **The Owner may accept or waive a minor and inconsequential irregularity. The determination of what is, or is not, a minor and inconsequential irregularity, the determination of whether or not to accept or waive such an irregularity, and the final determination of whether the bid is compliant, will be at the Owner's sole discretion.**
- .3 The following irregularities relate to what are considered mandatory bidding requirements. These will not be considered minor and inconsequential and will cause the bid to be rejected as non-compliant:
 - .1 Bid or Bid Form Supplement is received after the specified bid closing time.
 - .2 Required Bid Form or Bid Form Supplement is missing.
 - .3 Bid Form or Bid Form Supplement is not in the form provided or required.
 - .4 Bid bond is improperly completed or executed, if such improper completion or execution may render the bid bond unenforceable.
 - .5 A bid price is illegible, ambiguous or unclear.
 - .6 One or more conditions are added to or submitted with the bid, the effect of which is a material modification of the Bid Documents.

- .7 Failure to indicate in the Bid Form the addendum number(s) of all addenda received.
- .8 Failure to comply with any other bidding requirement expressly characterized as mandatory in elsewhere in the Bid Documents.

1.18 BID ACCEPTANCE PERIOD

- .1 Bids shall remain open to acceptance by the AFNWA and shall be irrevocable until another Bidder enters into a contract with the AFNWA for performance of the Work or until expiry of the bid acceptance period stated in the Bid Form, whichever occurs first.
- .2 After bid closing and before expiry of the bid acceptance period stated in the Bid Form, the AFNWA may request all Bidders to agree to an extension of the originally specified bid acceptance period. In such case the bid acceptance period will be extended subject to the Bidder, whose bid the AFNWA wishes to accept, having agreed in writing to the extension.

1.19 BID ACCEPTANCE

- .1 The lowest or any bid will not necessarily be accepted, and the AFNWA may reject all bids.
- .2 The Contract will be established if and when the successful Bidder receives from the AFNWA a written notification accepting the bid without any conditions. If the AFNWA written notification accepting the bid contains, or is subject to, any conditions, the Contract will be established if and when the Bidder accepts all such conditions in writing or when the parties execute the agreement.
- .3 If the lowest compliant bid exceeds the Owner's budget, and the Owner is unwilling or unable to award a Contract at the bid price, the Owner may:
 - .1 negotiate, with the lowest compliant Bidder only, changes to the Bid Documents and a reduced bid price acceptable to AFNWA, or
 - .2 invite the three lowest compliant Bidders (only) to re-bid on modified Bid Documents under a new bid call.

1.20 INTERPRETATION AND MODIFICATION OF BID DOCUMENTS

- .1 If an inquiry requires an interpretation or modification of the Bid Documents, the response to that inquiry will be issued in the form of a written Addendum only, to ensure that all Bidders base their bids on the same information.
- .2 Replies to inquiries or interpretations or modifications of the Bid Documents made by e-mail, verbally, or in any manner other than a written Addendum, will not form part of the Bid Documents and will not be binding.

1.21 ADDENDA

- .1 Addenda may be issued to modify the Bid Documents in response to Bidder inquiries or as may be considered necessary.
- .2 All addenda issued during the bid period will become part of the Bid Documents.
- .3 No addenda will be issued later than 2 Working Days before the bid closing time.

- .4 Each Bidder shall ascertain before bid submission that it has received all addenda issued during the bid period and shall indicate in the Bid Form the addendum number(s) of all addenda received.

1.22 INQUIRIES

- .1 Direct all inquiries in writing, via e-mail to:
- Attention:** **Katty Mae Rodrigo, TGIT**
kattymae.rodrigo@englobecorp.com
- CC:** **Mohamed Osman, P.Eng.,**
mohamed.osman@afnwa.ca
Kyle McConnell, P.Eng.,
Kyle.mcconnell@englobecorp.com
- .2 Submit inquiries as early as possible in the bid period and not less than 3 Working Days before the bid closing time. Inquiries received after this time may not receive a response at the discretion of the Departmental Representative.

1.23 SAFETY CERTIFICATION

- .1 Bidders are advised that Safety Certification is a condition of Contract Award for all projects with a bid value greater than \$100,000.00.
- .2 For a bid value greater than \$100,000.00, the contractor shall maintain a Certification of Recognition (COR) Program and it shall remain in force until certificate of final completion.
- .3 Provide Safety Certification in the form of the Provincial Construction Safety Association's Letter of Good Standing, or approved alternative, in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .4 Bids without certification at bid opening may be rejected.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 STATUS OF AVAILABLE PROJECT INFORMATION

- .1 Available *Project* information means information of any type and in any form that is expressly identified as available *Project* information in this Section.
- .2 No available *Project* information forms part of the *Contract Documents* unless copied or transcribed into *Drawings* or *Specifications* or it is expressly listed in the agreement as a *Contract Document*.

1.2 USE AND RELIANCE UPON AVAILABLE PROJECT INFORMATION

- .1 Available *Project* information is made available to Bidders to fulfill the *Owner's* duty to disclose all relevant *Project* information to Bidders.
- .2 Bidders shall interpret and draw their own conclusions about available *Project* information, including consideration of the time when it was created. Available *Project* information may be time sensitive. The *Owner* and *Consultant* assume no responsibility for such interpretations and conclusions.
- .3 Available *Project* information, or any part thereof, shall not be construed as contract requirements unless also reflected in *Drawings* or *Specifications*, and in case of conflict the *Drawings* or *Specifications* shall govern.
- .4 Bidders, acting reasonably, may rely on available *Project* information in preparing their bids, subject to any qualifications stated in such available *Project* information and unless expressly stated otherwise in this Section.

1.3 AVAILABLE PROJECT INFORMATION

- .1 Geotechnical Investigation Report entitled Neqotkuk WWTF Improvements, Geotechnical Investigation, dated November 1, 2024, prepared by Englobe Corp. This report is included in the Bid Documents as Appendix A. This document can be relied upon as is.
- .2 Sludge Survey Report entitled Bathymetric Survey – Summary Report, dated December 10th, 2020 prepared by Crandall, a Division of Englobe Corp. This report is included in the Bid Documents as Appendix B. This document can be relied upon as is.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Contract/Project: 2308072.001/ Client no. F-23-NQ-01
Upgrade of Neqotkuk - Wastewater Treatment Facility – Tobique First Nation,
NB

From (Bidder):

Business name

Postal box number and/or street address

City/town, province and postal code

Phone number

To (Owner): Atlantic First Nations Water Authority
13 Treaty Trail
Millbrook, NS B6L 1W1

We, the undersigned, having examined the Bid Documents for the above-named *Project/Contract*, including all addenda issued, if any, and having examined the *Place of the Work* and conditions affecting the *Work*, hereby offer to perform the *Work* in accordance with the Bid Documents, for the *Stipulated Price*, including all services, materials and allowances indicated, if any. The price amounts indicated are in Canadian dollars. No line entry is provided for Value Added Taxes (VAT) as this project will not have VAT included.

The Contract Price below includes a contingency allowance of \$220,000.00.

CONTRACT PRICE INCLUDING ALL ALLOWANCES \$ _____
(EXCLUDING VAT) (Figures)

(Write out in words)

_____ Dollars and _____ Cents

TOTAL EXCLUDING VAT \$ _____
(Figures)

We, the undersigned, declare that:

- .3 we have examined Addenda No.____ to No.____ inclusively (**signed copies attached**) and our bid price includes all labour, materials, etc., as called for and/or implied by said Addenda, (If no addendum was issued, initial here to confirm: _____)
- .4 we are qualified to perform the *Work* in accordance with the Bid Documents and our bid price covers all of our obligations and things necessary for the performance of the *Work*,
- .5 we agree to attain *Substantial Performance of the Work* within 32 weeks of Contract Award,
- .6 we have arrived at this bid without collusion with any competitor,
- .7 all Bid Form supplements called for by the Bid Documents form an integral part of this bid,
- .8 we acknowledge the requirement for Construction Safety Certification in accordance with the Safety Certification articles in Section 00 21 13 - Instructions to Bidders and Section 01 35 29.06 - Health and Safety Requirements, and
- .9 this bid is open to acceptance and irrevocable until thirty (30) calendar days after the bid closing time.

SIGNATURES

Signed and submitted by:

Business name

Name and title of authorized signing representative

Signature of authorized signing representative

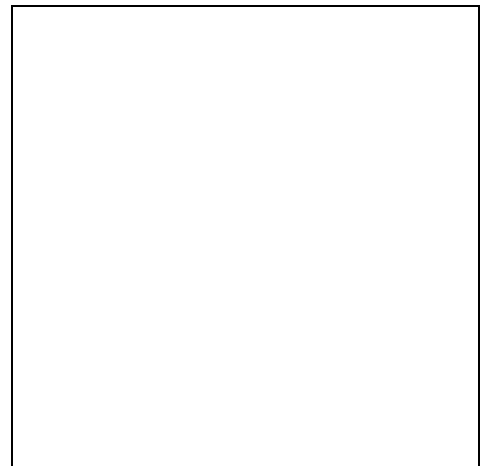
Name of witness (if business is sole proprietorship)

Signature of witness (if business is sole proprietorship)

Name and title of second authorized signing representative (if required)

Signature of second authorized signing representative (if required)

On this _____ day of _____ of the year 20____
Month



Company Seal

END OF SECTION

CCDC 2

Stipulated Price Contract

2 0 2 0

Name of 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 – 2020 except to the extent that any alterations, additions or modifications are set forth in supplementary conditions.

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

CCDC 2 STIPULATED PRICE CONTRACT

TABLE OF CONTENTS

AGREEMENT BETWEEN OWNER AND CONTRACTOR

- A-1 The Work
- A-2 Agreements and Amendments
- A-3 Contract Documents
- A-4 Contract Price
- A-5 Payment
- A-6 Receipt of and Addresses for Notices in Writing
- A-7 Language of the Contract
- A-8 Succession

DEFINITIONS

- Change Directive
- Change Order
- Construction Equipment
- Consultant
- Contract
- Contract Documents
- Contract Price
- Contract Time
- Contractor
- Drawings
- Notice in Writing
- Owner
- Other Contractor
- Payment Legislation
- Place of the Work
- Product
- Project
- Ready-for-Takeover
- Shop Drawings
- Specifications
- Subcontractor
- Substantial Performance of the Work
- Supplemental Instruction
- Supplier
- Temporary Work
- Value Added Taxes
- Work
- Working Day

GENERAL CONDITIONS

PART 1 GENERAL PROVISIONS

- GC 1.1 Contract Documents
- GC 1.2 Law of the Contract
- GC 1.3 Rights and Remedies
- GC 1.4 Assignment

PART 2 ADMINISTRATION OF THE CONTRACT

- GC 2.1 Authority of the Consultant
- GC 2.2 Role of the Consultant
- GC 2.3 Review and Inspection of the Work
- GC 2.4 Defective Work

PART 3 EXECUTION OF THE WORK

- GC 3.1 Control of the Work
- GC 3.2 Construction by the Owner or Other Contractors
- GC 3.3 Temporary Work
- GC 3.4 Construction Schedule
- GC 3.5 Supervision
- GC 3.6 Subcontractors and Suppliers
- GC 3.7 Labour and Products
- GC 3.8 Shop Drawings

PART 4 ALLOWANCES

- GC 4.1 Cash Allowances
- GC 4.2 Contingency Allowance

PART 5 PAYMENT

- GC 5.1 Financing Information Required of the Owner
- GC 5.2 Applications for Payment
- GC 5.3 Payment
- GC 5.4 Substantial Performance of the Work and Payment of Holdback
- GC 5.5 Final Payment
- GC 5.6 Deferred Work
- GC 5.7 Non-conforming Work

PART 6 CHANGES IN THE WORK

- GC 6.1 Owner's Right to Make Changes
- GC 6.2 Change Order
- GC 6.3 Change Directive
- GC 6.4 Concealed or Unknown Conditions
- GC 6.5 Delays
- GC 6.6 Claims for a Change in Contract Price

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
- GC 7.2 Contractor's Right to Suspend the Work or Terminate the Contract

PART 8 DISPUTE RESOLUTION

- GC 8.1 Authority of the Consultant
- GC 8.2 Adjudication
- GC 8.3 Negotiation, Mediation and Arbitration
- GC 8.4 Retention of Rights

PART 9 PROTECTION OF PERSONS AND PROPERTY

- GC 9.1 Protection of Work and Property
- GC 9.2 Toxic and Hazardous Substances
- GC 9.3 Artifacts and Fossils
- GC 9.4 Construction Safety
- GC 9.5 Mould

PART 10 GOVERNING REGULATIONS

- GC 10.1 Taxes and Duties
- GC 10.2 Laws, Notices, Permits, and Fees
- GC 10.3 Patent Fees
- GC 10.4 Workers' Compensation

PART 11 INSURANCE

- GC 11.1 Insurance

PART 12 OWNER TAKEOVER

- GC 12.1 Ready-for-Takeover
- GC 12.2 Early Occupancy by the Owner
- GC 12.3 Warranty

PART 13 INDEMNIFICATION AND WAIVER

- GC 13.1 Indemnification
- GC 13.2 Waiver of Claims

CCDC 2 is the product of a consensus-building process aimed at balancing the interests of all parties on the construction project. It reflects recommended industry practices. The CCDC and its constituent member organizations do not accept any responsibility or liability for loss or damage which may be suffered as a result of the use or interpretation of CCDC 2.

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AGREEMENT BETWEEN OWNER AND CONTRACTOR

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

This Agreement made on _____ 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 (insert below the description or title of the Work)

located at (insert below the Place of the Work)

for which the Agreement has been signed by the parties, and for which (insert below the name of the Consultant)

is acting as and is hereinafter called the "Consultant" and

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 *Ready-for-Takeover*, 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 bid 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
- General Conditions

*

** (Insert here, attaching additional pages if required, a list identifying all other Contract Documents e.g. supplementary conditions; Division 01 of the Specifications – GENERAL REQUIREMENTS; Project information that the Contractor may rely upon; technical 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; time schedule)*

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 *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 *Payment Legislation*, and in accordance with legislation and statutory regulations respecting holdback percentages, 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* unless otherwise prescribed by *Payment Legislation* together with such *Value Added Taxes* as may be applicable to such payments,
- .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 Interest

- .1 Should either party fail to make payments as they become due under the terms of the *Contract* or in an award by adjudication, 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 5.2.1 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.

6.2 The delivery of a *Notice in Writing* will be by hand, by courier, by prepaid first class mail, or by other form of electronic communication during the transmission of which no indication of failure of receipt is communicated to the sender.

6.3 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 will 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* will be deemed to have been received on the *Working Day* next following such day.

6.4 A *Notice in Writing* sent by any form of electronic communication will 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 will 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.

6.5 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

email address

Contractor

*name of Contractor**

address

email address

Consultant

*name of Consultant**

address

email address

** If it is intended that a specific individual must receive the notice, 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

OWNER

name of Owner

signature

signature

name of person signing

name and title of person signing

WITNESS

CONTRACTOR

name of Contractor

signature

signature

name of person signing

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*.

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*.

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.

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*.

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*.

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.

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.

Contract Price

The *Contract Price* is the amount stipulated in Article A-4 of the Agreement – CONTRACT PRICE.

Contract Time

The *Contract Time* is the time from commencement of the *Work* to the date of *Ready-for-Takeover* as stipulated in paragraph 1.3 of Article A-1 of the Agreement – THE WORK.

Contractor

The *Contractor* is the person or entity identified as such in the Agreement.

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.

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.

Owner

The *Owner* is the person or entity identified as such in the Agreement.

Other Contractor

Other Contractor means a contractor, other than the *Contractor* or a *Subcontractor*, engaged by the *Owner* for the *Project*.

Payment Legislation

Payment Legislation means such legislation in effect at the *Place of the Work* which governs payment under construction contracts.

Place of the Work

The *Place of the Work* is the designated site or location of the *Work* identified in the *Contract Documents*.

Product

Product or Products means material, machinery, equipment, and fixtures forming part of the *Work*, but does not include *Construction Equipment*.

Project

The *Project* means the total construction contemplated of which the *Work* may be the whole or a part.

Ready-for-Takeover

Ready-for-Takeover shall have been attained when the conditions set out in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER have been met, as verified by the *Consultant* pursuant to paragraph 12.1.4.2 of GC 12.1 – READY-FOR-TAKEOVER.

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*.

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*.

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*.

Substantial Performance of the Work

Substantial Performance of the Work is as defined in the lien legislation applicable to the *Place of the Work*.

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*.

Supplier

A *Supplier* is a person or entity having a direct contract with the *Contractor* to supply *Products*.

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*.

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 tax legislation.

Work

The *Work* means the total construction and related services required by the *Contract Documents*.

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

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 The *Contract Documents* are complementary, and what is required by one shall be as binding as if required by all. Performance by the *Contractor* shall be required only to the extent consistent with the *Contract Documents*.
- 1.1.3 The *Contractor* shall review the *Contract Documents* for the purpose of facilitating co-ordination and execution of the *Work* by the *Contractor*.
- 1.1.4 The *Contractor* is not responsible for errors, omissions or inconsistencies in the *Contract Documents*. If there are perceived errors, omissions or inconsistencies discovered by or made known to the *Contractor*, the *Contractor* shall promptly report to the *Consultant* and shall not proceed with the work affected until the *Contractor* has received corrected or additional information from the *Consultant*.
- 1.1.5 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 *Owner* and *Contractor*,
 - the Definitions,
 - Supplementary Conditions,
 - the General Conditions,
 - Division 01 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 amended or later dated documents shall govern over earlier documents of the same type.
 - .5 noted materials and annotations shall govern over graphic indications.
- 1.1.6 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*.
- 1.1.7 Words and abbreviations which have well known technical or trade meanings are used in the *Contract Documents* in accordance with such recognized meanings.
- 1.1.8 References in the *Contract Documents* to the singular shall be considered to include the plural as the context requires.
- 1.1.9 Neither the organization of the *Specifications* nor the arrangement of *Drawings* shall control the *Contractor* in dividing the work among *Subcontractors* and *Suppliers*.
- 1.1.10 *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*.
- 1.1.11 Physical 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*, the *Consultant* or the *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 *Consultant* and the *Contractor*.

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 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 – PAYMENT and GC 5.5 – FINAL PAYMENT.
- 2.2.5 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 perform the *Work* in accordance with the *Contract Documents*.
- 2.2.6 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*.
- 2.2.7 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.
- 2.2.8 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*.
- 2.2.9 The *Consultant's* interpretations and findings will be given in writing to the parties within a reasonable time.
- 2.2.10 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.
- 2.2.11 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*.
- 2.2.12 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*.
- 2.2.13 The *Consultant* will review and take appropriate action upon *Shop Drawings*, samples and other submittals by the *Contractor*, in accordance with the *Contract Documents*.

- 2.2.14 The *Consultant* will prepare *Change Orders* and *Change Directives* as provided in GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.
- 2.2.15 The *Consultant* will conduct reviews of the *Work* to determine the date of *Substantial Performance of the Work* and verify that *Ready-for-Takeover* has been attained.
- 2.2.16 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.
- 2.2.17 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.
- 2.2.18 If the *Consultant*'s engagement is terminated, the *Owner* shall immediately engage a *Consultant* against whom the *Contractor* makes no reasonable objection and whose duties and responsibilities under the *Contract Documents* will be that of the former *Consultant*.

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*, 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 required 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 others 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 was incorporated in the *Work* or 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 finding.

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 THE 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 the *Owner*'s own forces with the *Work* of the *Contract*;
 - .2 enter into separate contracts with *Other Contractors* under conditions of contract which are compatible with the conditions of the *Contract*;
 - .3 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
 - .4 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 co-ordinate and schedule the *Work* with the work of *Other Contractors* or the *Owner*'s own forces that are identified in the *Contract Documents*;
 - .3 participate with *Other Contractors* and the *Owner* in reviewing their construction schedules when directed to do so; and
 - .4 report promptly 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 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.
- 3.2.5 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. In the absence of *Other Contractors* having reciprocal obligations, disputes and other matters in question initiated by the *Contractor* against *Other Contractors* will be considered disputes and other matters in question between the *Contractor* and the *Owner*.
- 3.2.6 Should the *Owner*, the *Consultant*, *Other Contractors*, or anyone employed by them directly or indirectly 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.

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* unless otherwise specified in the *Contract Documents*.
- 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 CONSTRUCTION SCHEDULE

3.4.1 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 3.5 SUPERVISION

3.5.1 The *Contractor* shall provide all necessary supervision and appoint a competent representative who shall be in attendance at the *Place of the Work* while the *Work* is being performed. The appointed representative shall not be changed except for valid reason.

3.5.2 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 3.6 SUBCONTRACTORS AND SUPPLIERS

3.6.1 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 applicable 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 any persons directly or indirectly employed by them as for acts and omissions of persons directly employed by the *Contractor*.

3.6.2 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.

3.6.3 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.

3.6.4 If the *Owner* requires the *Contractor* to change a proposed *Subcontractor* or *Supplier*, the *Contract Price* and *Contract Time* shall be adjusted by the difference occasioned by such required change.

3.6.5 The *Contractor* shall not be required to employ as a *Subcontractor* or *Supplier*, a person or firm to which the *Contractor* may reasonably object.

3.6.6 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 3.7 LABOUR AND PRODUCTS

3.7.1 The *Contractor* shall maintain good order and discipline among the *Contractor*'s employees engaged on the *Work* and employ only workers that are skilled in the tasks assigned.

3.7.2 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*.

3.7.3 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*.

GC 3.8 SHOP DRAWINGS

3.8.1 The *Contractor* shall provide *Shop Drawings* as required in the *Contract Documents*.

3.8.2 The *Contractor* shall provide *Shop Drawings* to the *Consultant* to review in accordance with an agreed schedule, or in the absence of an agreed schedule, in orderly sequence and sufficiently in advance so as to cause no delay in the *Work* or in the work of *Other Contractors* or the *Owner*'s own forces.

- 3.8.3 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*.
- 3.8.4 The *Consultant's* review is for conformity to the design concept and for general arrangement only.
- 3.8.5 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.
- 3.8.6 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*.
- 3.8.7 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*.

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 the *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, any unexpended amounts from other cash allowances shall be reallocated, at the *Consultant's* direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the *Contract Price* for overhead and profit. Only where the actual cost of the *Work* under all cash allowances exceeds the total amount of all cash allowances shall the *Contractor* be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the *Contract Documents*.
- 4.1.5 The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the *Contract Price* by *Change Order* without any adjustment for the *Contractor's* overhead and profit on such amount.
- 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 items called for under cash allowances must be ordered 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 fulfil the *Owner's* obligations under the *Contract* during the performance of the *Contract*.

GC 5.2 APPLICATIONS FOR PAYMENT

- 5.2.1 Applications for payment on account as provided in Article A-5 of the Agreement – PAYMENT shall be submitted monthly to the *Owner* and the *Consultant* simultaneously 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 as specified in the *Contract* and supported by such evidence as the *Consultant* may reasonably require.
- 5.2.6 Applications for payment shall be based on the schedule of values accepted by the *Consultant* and shall comply with the provisions of *Payment Legislation*.
- 5.2.7 Each application for payment shall include evidence of compliance with workers' compensation legislation at the *Place of the Work* and after the first payment, a declaration by the *Contractor* as to the distribution made of the amounts previously received using document CCDC 9A 'Statutory Declaration'.
- 5.2.8 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 PAYMENT

- 5.3.1 After receipt by the *Consultant* and the *Owner* of an application for payment submitted by the *Contractor* in accordance with GC 5.2 – APPLICATIONS FOR PAYMENT:
 - .1 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* certifies a different amount, or rejects the application or part thereof, the *Owner* shall promptly issue a written notice to the *Contractor* giving reasons for the revision or rejection, such written notice to be in compliance with *Payment Legislation*.
 - .2 The *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement – PAYMENT on or before 28 calendar days after the receipt by the *Owner* and the *Consultant* of the application for payment, and in any event, in compliance with *Payment Legislation*.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

- 5.4.1 The *Consultant* will review the *Work* to certify or verify the validity of the application for *Substantial Performance of the Work* and will promptly, and in any event, no later than 20 calendar days after receipt of the *Contractors* 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*.
- 5.4.2 Where the holdback amount required by the applicable lien legislation has not been placed in a separate lien holdback account, the *Owner* shall, no later than 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*.
- 5.4.3 Subject to the requirements of any *Payment Legislation*, all holdback amount prescribed by the applicable lien legislation for the *Work* shall become due and payable to the *Contractor* no later than 10 *Working Days* following the expiration of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*.
- 5.4.4 The *Contractor* shall submit an application for payment of the lien holdback amount in accordance with GC 5.3 – PAYMENT.
- 5.4.5 Where legislation permits progressive release of the holdback for a portion of the *Work* and the *Consultant* has certified or verified that the part of the *Work* has been performed prior to *Substantial Performance of the Work*, the *Owner* hereby agrees to release, and shall release, such portion to the *Contractor* in accordance with such legislation.

- 5.4.6 Notwithstanding any progressive release of the holdback, the *Contractor* shall ensure that such parts of the *Work* 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 the holdback was released.

GC 5.5 FINAL PAYMENT

- 5.5.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall submit an application for final payment.
- 5.5.2 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 when the *Consultant* finds the *Contractor's* application for final payment valid, the *Consultant* will promptly issue a final certificate for payment to the *Owner*, with a copy to the *Contractor*.
- 5.5.3 If the *Consultant* rejects the application or part thereof, the *Owner* will promptly issue a written notice to the *Contractor* giving reasons for the revision or rejection, such written notice to be in compliance with *Payment Legislation*.
- 5.5.4 Subject to the provision of paragraph 10.4.1 of GC 10.4 – WORKERS' COMPENSATION, and any 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 and in any event, in compliance with *Payment Legislation*.

GC 5.6 DEFERRED WORK

- 5.6.1 If because of climatic or other conditions reasonably beyond the control of the *Contractor*, or if the *Owner* and the *Contractor* agree that, there are items of work that must be deferred, 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 deferred *Work*.

GC 5.7 NON-CONFORMING WORK

- 5.7.1 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 to the *Consultant*, in a form that can be reasonably evaluated, 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 the *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 applications 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 in as much as it contributes directly to the implementation of the *Change Directive*:

Labour

- 1 rates that are listed in the schedule or as agreed by the *Owner* and the *Contractor* including wages, benefits, compensation, contributions, assessments, or taxes incurred for such items as employment insurance, provincial or territorial health insurance, workers' compensation, and Canada or Quebec Pension Plan for:
 - (1) trade labour in the direct employ of the *Contractor*;
 - (2) the *Contractor*'s personnel when stationed at the field office;
 - (3) the *Contractor*'s personnel engaged at shops or on the road, in expediting the production or transportation of materials or equipment; and
 - (4) the *Contractor*'s office personnel engaged in a technical capacity, or other personnel identified in Article A-3 of the Agreement – CONTRACT DOCUMENTS for the time spent in the performance of the *Work*;

Products, Construction Equipment and Temporary Work

- 2 cost of all *Products* including cost of transportation thereof;
- 3 in the absence of agreed rates, cost less salvage value of *Construction Equipment*, *Temporary Work* and tools, exclusive of hand tools under \$1,000 owned by the *Contractor*;
- 4 rental cost of *Construction Equipment*, *Temporary Work* and tools, exclusive of hand tools under \$1,000;
- 5 cost of all equipment and services required for the *Contractor*'s field office;

Subcontract

- 6 subcontract amounts of Subcontractor with pricing mechanism approved by the *Owner*;

Others

- 7 travel and subsistence expenses of the *Contractor*'s personnel described in paragraph 6.3.7.1;
- 8 deposits lost provided that they are not caused by negligent acts or omissions of the *Contractor*;
- 9 cost of quality assurance such as independent inspection and testing services;
- 10 charges levied by authorities having jurisdiction at the *Place of the Work*;
- 11 royalties, patent license 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;
- 12 premium for all contract securities and insurance for which the *Contractor* is required, by the *Contract Documents*, to provide, maintain and pay in relation to the performance of the *Work*;
- 13 losses and expenses sustained by the *Contractor* for matters which are the subject of insurance under the policies prescribed in GC 11.1 – INSURANCE when such losses and expenses are not recoverable because the amounts are in excess of collectible amounts or within the deductible amounts;
- 14 taxes and duties, other than *Value Added Taxes*, income, capital, or property taxes, relating to the *Work* for which the *Contractor* is liable;
- 15 charges for voice and data communications, courier services, expressage, transmittal and reproduction of documents, and petty cash items;
- 16 cost for removal and disposal of waste products and debris;
- 17 legal costs, incurred by the *Contractor*, in relation to the performance of the *Work* provided that they are not:
 - (1) relating to a dispute between the *Owner* and the *Contractor* unless such costs are part of a settlement or awarded by arbitration or court,
 - (2) the result of the negligent acts or omissions of the *Contractor*, or
 - (3) the result of a breach of this *Contract* by the *Contractor*;
- 18 cost of auditing when requested by the *Owner*; and
- 19 cost of *Project* specific information technology in accordance with the method determined by the parties.

- 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* performance of the *Work* attributable to the *Change Directive* 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.
- 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 a finding.
- 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* and 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 *Owner*, through the *Consultant*, shall 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 promptly inform 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 the *Owner*, the *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, resulting in the failure of the *Contractor* to attain *Ready-for-Takeover* by the date stipulated in Article A-1 of the Agreement – THE WORK, 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*, the *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 2.2.12 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 and the *Consultant* will make a finding upon such claim.

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 perform 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* which provides the detail of such neglect to perform the *Work* properly or such failure to comply with the requirements of the *Contract* to a substantial degree, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, give the *Contractor Notice in Writing*, containing particulars of the default including references to applicable provisions of the *Contract*, 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,
- .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 by giving *Notice in Writing*:
- .1 correct such default and deduct the cost thereof from any payment then or thereafter due the *Contractor* for the *Work* 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,
 - .2 withhold further payment to the *Contractor* until a final certificate for payment is issued,
 - .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 in force 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*,
 - .2 the *Consultant* fails to issue a certificate as provided in Part 5 of the General Conditions – PAYMENT,
 - .3 the *Owner* fails to pay the *Contractor* when due the amounts certified by the *Consultant* or awarded by adjudication, arbitration or court, or
 - .4 the *Owner* fails to comply with the requirements of the *Contract* to a substantial degree and the *Consultant*, except for GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER, gives a written statement to the *Owner* and the *Contractor* that provides detail of such failure to comply with the requirements of the *Contract* to a substantial degree.
- 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* by giving a *Notice in Writing* to the *Owner* 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 8.3.3 to 8.3.8 of GC 8.3 – NEGOTIATION, MEDIATION AND ARBITRATION, and in GC 8.4 – 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 ADJUDICATION

- 8.2.1 Nothing in this *Contract* shall be deemed to affect the rights of the parties to resolve any dispute by adjudication as may be prescribed by applicable legislation.

GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION

- 8.3.1 In accordance with the rules for mediation as provided in CCDC 40 ‘Rules for Mediation and Arbitration of Construction Industry Disputes’ 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.
- 8.3.2 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*.
- 8.3.3 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.
- 8.3.4 After a period of 10 *Working Days* following receipt of a responding party’s *Notice in Writing* of reply under paragraph 8.3.2, 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 as provided in CCDC 40 in effect at the time of bid closing.
- 8.3.5 If the dispute has not been resolved at the mediation or within such further period as is agreed by the parties, the Project Mediator will terminate the mediated negotiations by giving *Notice in Writing* to the *Owner*, the *Contractor* and the *Consultant*.
- 8.3.6 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 8.3.5, either party may refer the dispute to be finally resolved by arbitration under the rules of arbitration 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*.
- 8.3.7 On expiration of the 10 *Working Days*, the arbitration agreement under paragraph 8.3.6 is not binding on the parties and, if a *Notice in Writing* is not given under paragraph 8.3.6 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.
- 8.3.8 If neither party, by *Notice in Writing*, given within 10 *Working Days* of the date of *Notice in Writing* requesting arbitration in paragraph 8.3.6, requires that a dispute be arbitrated immediately, all disputes referred to arbitration as provided in paragraph 8.3.6 shall be:
- .1 held in abeyance until:
 - (1) *Ready-for-Takeover*,
 - (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 8.3.6.

GC 8.4 RETENTION OF RIGHTS

- 8.4.1 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.
- 8.4.2 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 8.3.6 of GC 8.3 – 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*, 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 or omissions in the *Contract Documents*; or
 - .2 acts or omissions by the *Owner*, the *Consultant*, *Other Contractors*, or 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 the *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 substance 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 any toxic or hazardous substance which was 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 substance 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 the *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 the *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 13.1 – INDEMNIFICATION.
- 9.2.8 If the *Owner* and the *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 13.1 – 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 *Owner*, through the *Consultant*, shall 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 The *Contractor* shall be responsible for establishing, initiating, maintaining, and supervising all health and safety precautions and programs in connection with the performance of the *Work* in accordance with the applicable health and safety legislation.
- 9.4.2 The *Owner* and the *Contractor* shall comply with all health and safety precautions and programs established at the *Place of the Work*.
- 9.4.3 The *Owner* and the *Contractor* shall comply with the rules, regulations and practices required by the applicable health and safety legislation.
- 9.4.4 The *Owner* shall cause the *Consultant*, *Other Contractors* and the *Owner's* own forces to comply with all health and safety precautions and programs established by the *Contractor* at the *Place of the Work*.
- 9.4.5 Nothing in this *Contract* shall affect the determination of liability under the applicable health and safety legislation.

GC 9.5 MOULD

- 9.5.1 If the *Contractor* or the *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,
 - .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 the *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 the *Contractor*.
- 9.5.2 If the *Owner* and the *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,
 - .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 9.5.1.3, and
 - .4 indemnify the *Owner* as required by GC 13.1 – INDEMNIFICATION.
- 9.5.3 If the *Owner* and the *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,
 - .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,
 - .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 13.1 – 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 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 issue 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; 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 physical model, plan or design of which was supplied to the *Contractor* as part of the *Contract*.

GC 10.4 WORKERS' COMPENSATION

- 10.4.1 Prior to commencing the *Work*, and again with the *Contractor*'s applications for payment, the *Contractor* shall provide evidence of compliance with workers' compensation legislation at the *Place of the Work*.

PART 11 INSURANCE

GC 11.1 INSURANCE

- 11.1.1 Without restricting the generality of GC 13.1 – INDEMNIFICATION, the *Contractor* shall provide, maintain and pay for the following insurance coverages, the 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 *Ready-for-Takeover*. Liability coverage shall be provided for completed operations hazards from the date of *Ready-for-Takeover*, as set out in the certificate of *Ready-for-Takeover*, on an ongoing basis for a period of 6 years following *Ready-for-Takeover*.
 - .2 Automobile Liability Insurance from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.
 - .3 Unmanned aerial vehicle aircraft, manned aircraft or watercraft Liability Insurance when owned or non-owned manned or unmanned 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 *Ready-for-Takeover*;
 - (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*; and
 - (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 *Ready-for-Takeover*.
 - .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 *Other Contractors*, the *Owner* shall, in accordance with the *Owner's* obligations under the provisions relating to construction by the *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 *Ready-for-Takeover*.
- .8 *Contractors' Pollution Liability Insurance* from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.

- 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 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 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.

PART 12 OWNER TAKEOVER

GC 12.1 READY-FOR-TAKEOVER

- 12.1.1 The prerequisites to attaining *Ready-for-Takeover* of the *Work* are limited to the following:
 - .1 The *Consultant* has certified or verified the *Substantial Performance of the Work*.
 - .2 Evidence of compliance with the requirements for occupancy or occupancy permit as prescribed by the authorities having jurisdiction.
 - .3 Final cleaning and waste removal at the time of applying for *Ready-for-Takeover*, as required by the *Contract Documents*.
 - .4 The delivery to the *Owner* of such operations and maintenance documents reasonably necessary for immediate operation and maintenance, as required by the *Contract Documents*.
 - .5 Make available a copy of the as-built drawings completed to date on site.
 - .6 Startup, testing required for immediate occupancy, as required by the *Contract Documents*.
 - .7 Ability to secure access to the *Work* has been provided to the *Owner*, if required by the *Contract Documents*.
 - .8 Demonstration and training, as required by the *Contract Documents*, is scheduled by the *Contractor* acting reasonably.
- 12.1.2 If any prerequisites set forth in paragraphs 12.1.1.3 to 12.1.1.6 must be deferred because of conditions reasonably beyond the control of the *Contractor*, or by agreement between the *Owner* and the *Contractor* to do so, *Ready-for-Takeover* shall not be delayed.
- 12.1.3 When the *Contractor* considers that the *Work* is *Ready-for-Takeover*, the *Contractor* shall deliver to the *Consultant* and to the *Owner* a comprehensive list of items to be completed or corrected, together with a written application for *Ready-for-Takeover* for review. Failure to include an item on the list does not alter the responsibility of the *Contractor* to complete the *Contract*.
- 12.1.4 The *Consultant* will review the *Work* to verify the validity of the application and will promptly, and in any event, no later than 10 calendar days after receipt of the *Contractor's* list and application:

- 12.1.5 Immediately following the confirmation of the date of *Ready-for-Takeover*, the *Contractor*, in consultation with the *Consultant*, shall establish a reasonable date for finishing the *Work*.
- 12.1.6 The provision of GC 12.1 – READY-FOR-TAKEOVER shall be subject to GC 12.2 – EARLY OCCUPANCY BY THE OWNER.

GC 12.2 EARLY OCCUPANCY BY THE OWNER

- 12.2.1 The *Owner* may take occupancy of a part or the entirety of the *Work* before *Ready-for-Takeover* has been attained only as agreed by the *Contractor* which agreement shall not be unreasonably withheld.
- 12.2.2 The *Owner* shall not occupy a part or the entirety of the *Work* without prior approval by authorities having jurisdiction.
- 12.2.3 If the *Owner* takes occupancy of a part of the *Work* before *Ready-for-Takeover* has been attained:
- .1 The part of the *Work* which is occupied shall be deemed to have been taken over by the *Owner* as from the date on which it is occupied.
 - .2 The *Contractor* shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the *Owner*.
 - .3 The warranty period specified in paragraph 12.3.1 of GC 12.3 – WARRANTY for that part of the *Work* shall start from the date on which it is occupied.
- 12.2.4 If the *Owner* takes occupancy of the entirety of the *Work* before all the prerequisites are met as described in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER, the *Work* shall, subject to the requirements of the applicable lien legislation, be deemed to achieve *Ready-for-Takeover*. This shall not relieve the *Contractor*'s responsibility to complete the *Work* in a timely manner.

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 when *Ready-for-Takeover* has been attained.
- 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.

PART 13 INDEMNIFICATION AND WAIVER

GC 13.1 INDEMNIFICATION

- 13.1.1 Without restricting the parties' obligation to indemnify respecting toxic and hazardous substances, patent fees and defect in title claims all as described in paragraphs 13.1.4 and 13.1.5, 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 negligent 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 *Ready-for-Takeover* date 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*.
- 13.1.2 The obligation of either party to indemnify as set forth in paragraph 13.1.1 shall be limited as follows:

- 13.1.2 The obligation of either party to indemnify as set forth in paragraph 13.1.1 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 minimum liability insurance limit for one occurrence, of the applicable insurance policy, 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 indemnification by a party against the other with respect to losses suffered by them, such obligation shall be restricted to direct loss and damage, and neither party shall have any liability to the other for indirect, consequential, punitive or exemplary damages.
 - .4 In respect to indemnification respecting claims by third parties, the obligation to indemnify is without limit.
- 13.1.3 The obligation of either party to indemnify the other as set forth in paragraphs 13.1.1 and 13.1.2 shall be inclusive of interest and all legal costs.
- 13.1.4 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.
- 13.1.5 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*.
- 13.1.6 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 become known; and
 - .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 13.2 WAIVER OF CLAIMS

- 13.2.1 Subject to any lien legislation applicable to 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* under the *Contract*, 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 *Ready-for-Takeover* date, except as follows:
- .1 claims arising prior to or on the *Ready-for-Takeover* date for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* no later than 5 calendar days before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work* or 20 calendar days following the *Ready-for-Takeover* date, whichever is later;
 - .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 respecting toxic and hazardous substances, patent fees and defect in title matters for which a right of indemnity could be asserted by the *Contractor* pursuant to the provisions of paragraphs 13.1.4 or 13.1.5 of GC 13.1 – INDEMNIFICATION; and
 - .4 claims resulting from acts or omissions which occur after the *Ready-for-Takeover* date.
- 13.2.2 The *Contractor* waives and releases the *Owner* from all claims resulting from acts or omissions which occurred after the *Ready-for-Takeover* date except for:
- .1 indemnification respecting third party claims, and claims respecting toxic and hazardous substances, patent fees and defect in title matters, all as referred in paragraphs 13.2.1.2 and 13.2.1.3; and
 - .2 claims for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* within 395 calendar days following the *Ready-for-Takeover* date.
- 13.2.3 Subject to any lien legislation applicable to 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* under the *Contract*, 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 *Ready-for-Takeover* date, except as follows:
- .1 claims arising prior to or on the *Ready-for-Takeover* date for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* no later than 20 calendar days following the *Ready-for-Takeover* date;

- .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 respecting toxic and hazardous substances for which a right of indemnity could be asserted by the *Owner* against the *Contractor* pursuant to the provisions of paragraph 13.1.4 of GC 13.1 – 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 *Ready-for-Takeover* date.
- 13.2.4 Respecting claims arising upon substantial defects and deficiencies in the *Work*, as referenced in paragraph 13.2.3.4, and notwithstanding paragraph 13.2.3.5, the *Owner* waives and releases the *Contractor* from all claims 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 *Ready-for-Takeover* date, provided that 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, the time within which any such claim may be brought shall be such shorter period as may be prescribed by any limitation statute of the Province or Territory of the *Place of the Work*.
- 13.2.5 The *Owner* waives and releases the *Contractor* from all claims arising from acts or omissions which occur after the *Ready-for-Takeover* date, except for:
- .1 indemnification for claims advanced against the *Owner* by third parties, as referenced in paragraph 13.2.3.2;
 - .2 claims respecting toxic and hazardous substances for which a right of indemnity could be asserted by the *Owner* against the *Contractor*, as referenced in paragraph 13.2.3.3;
 - .3 claims arising under GC 12.3 – WARRANTY; and
 - .4 claims for which *Notice in Writing* has been received by the *Contractor* from the *Owner* within 395 calendar days following the *Ready-for-Takeover* date.
- 13.2.6 "Notice in Writing of claim" as provided for in GC 13.2 – WAIVER OF CLAIMS to preserve a claim or right of action which would otherwise, by the provisions of GC 13.2 – WAIVER OF CLAIMS, be deemed to be waived, must include the following:
- .1 a clear and unequivocal statement of an 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.
- 13.2.7 A claim for lien asserted under the lien legislation prevailing at the *Place of the Work* shall qualify as notice of claim for the purposes of this *Contract*.
- 13.2.8 The party giving the *Notice in Writing* of claim as provided for in GC 13.2 – WAIVER OF CLAIMS shall submit within a reasonable time a detailed account of the amount claimed.
- 13.2.9 Where the event or series of events giving rise to a claim made under paragraphs 13.2.1 or 13.2.3 has a continuing effect, the detailed account submitted under paragraph 13.2.8 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 such claim 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.
- 13.2.10 Nothing in GC 13.2 – WAIVER OF CLAIMS shall be deemed to affect the rights of the parties under any lien legislation or limitations legislation prevailing at the *Place of the Work*.

Part 1 General

1.1 INTENT

- .1 These amendments amend the Agreement between *Owner* and *Contractor* forming part of the CCDC 2 – Stipulated Price Contract as indicated below. Provisions not amended remain in full force and effect.

1.2 AMENDMENTS TO AGREEMENT

- .1 REVISE article A-3, paragraph 3.1 to read as follows:
 - .1 **3.1** The following are the Contract Documents referred to in Article A-1 of the Agreement – THE WORK:
 - .1 Agreement between the Owner and the Contractor (for information only)
 - .2 Definitions
 - .1 00 71 50 – Amendments to Definitions
 - .3 The General Conditions of the Stipulated Price Contract
 - .1 00 73 00 – Supplementary Conditions
 - .4 Project Specifications as listed in Section 00 01 00 – Table of Contents
 - .5 Drawings list as listed in Section 00 01 15 – List of Drawings
 - .6 All Addenda issued during bidding period
 - .2 REVISE article A-5, clause 5.1.2 to read as follows:
 - .1 **5.1.2** 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 in accordance with the NB Construction Remedies Act, and
 - .3 REVISE article A-5, paragraphs 5.2.1 (1) and 5.2.1 (2) to read as follows:
 - .1 **5.3.1** (1) 1% per annum above the prime rate for the first 60 days.
(2) 2% per annum above the prime rate after the first 60 days.
 - .4 ADD article A-5, paragraph 5.1.4 to read as follows:
 - .1 **5.1.4** Holdback and Release of Holdback to be completed as described in Section 01 29 00 – Payment Procedures, which supersedes and supplements this Article.

Products

1.3 NOT USED

- .1 Not Used.

Part 2 Execution

2.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 These amendments amend the Definitions forming part of the CCDC 2 – Stipulated Price Contract as indicated below. Provisions not amended remain in full force and effect.

1.2 AMENDMENTS TO DEFINITIONS

- .1 ADD Definition of *Contemplated Change Order* to read as follows:

.1 Contemplated Change Order

A *Contemplated Change Order* is a written request for pricing information for a change to the *Contract Documents*. If change is acceptable, a signed *Change Order* will be issued.

- .2 REVISE Definition of *Consultant* to read as follows:

.1 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 practice in the province or territory of the *Place of the Work*. The term *Consultant* means the *Consultant* or the *Consultant's* authorized representative. All references to Engineer, Architect, Departmental Representative, DCC Representative, or any other wording meaning an agent of the *Owner* shall be read as *Consultant*.

- .3 REVISE Definition of *Substantial Performance of the Work* to read as follows:

.1 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*. The following conditions must be met to achieve *Substantial Performance of the Work*:

- .1 the work has passed any final tests required under the *Contract*;
- .2 the *Contractor* has given a written undertaking to complete any outstanding work or correct any defects expeditiously;
- .3 the Operation and Maintenance Manuals, if required in the *Contract*, have been received and accepted by the *Consultant*, and all necessary commissioning has been successfully completed; and
- .4 if there is a known defect, or correction required, at a cost of not more than
 - .1 3 % of the first \$250,000 of the *Contract Price*.
 - .2 2 % of the next \$250,000 of the *Contract Price*, and
 - .3 1 % of the balance of the *Contract Price*.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 These Supplementary Conditions amend the General Conditions (GC) of the CCDC 2 – Stipulated Price Contract as indicated below. Provisions not amended remain in full force and effect.

1.2 AMENDMENTS TO GENERAL CONDITIONS

.1 PART 5 PAYMENT

- .1 REVISE GC 5.3, paragraph 5.3.1 to read as follows:

- .1 **5.3.1.2** the Owner shall make payment to the Contractor on account as provided in Article A-5 of the Agreement - PAYMENT on or before [28] calendar days after the later of:
- a) receipt by the Consultant of the application for payment, or
 - b) the last day of the monthly payment period for which the application for payment is made.

- .2 DELETE GC 5.2.7 in its entirety and replace with the following:

- .1 **5.2.7.1** submit a statutory declaration (in a form satisfactory to the Owner) 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.

- .2 **5.2.7.2** submit a Clearance Certificate from WorkSafe NB

- .3 ADD new clauses to GC 5.4 as follows:

- .1 **5.4.7** The holdback amount authorized by the certificate for payment of the holdback amount is due and payable on the calendar day following the expiration of the holdback period stipulated in the NB Construction Remedies Act.

- .2 **5.5.8** The Owner may retain out of the holdback amount any sums required by the NB Construction Remedies Act as permitted by the Act.

- .3 **5.5.9** The Owner may retain from the Contract Price the amounts required as a Completion Retention and a Deficiency Retention. The Completion Retention and a Deficiency Retention are subject to a further Construction Remedies Act Holdback in the amount of ten percent (10%) of monies due to the Contractor for a period sixty-one (61) days after the Certificate of Final Completion has been issued.

- .4 **5.5.10** Where the Contractor does not provide a Statutory Declaration or does not complete the Work as directed by or to the satisfaction of the Consultant, the Owner may withhold payment of the monies which

- .5 would otherwise have become due, and during this time, the Owner shall not be required to pay interest.
- .6 **5.5.11** The Owner may retain additional amounts, under the contract, for any known claims, unpaid amounts due to subcontractors, labourers or suppliers, defective workmanship, equipment, materials, penalties and liquidated damages.”
- .7 **5.5.12** The Contractor shall, in the event that he fails to complete the Work on the day fixed in the Contract for completion, or on the day to which the time for completion may be extended by the Engineer, forfeit and pay to the Owner the sum on one thousand dollars (\$1,000) for each day of delay as liquidated damages and not as a penalty. The payment recognizes both, the extra cost to the Owner of the continued observation of the Works by the Engineer, and/or the loss of revenue or additional cost incurred by the Owner by virtue of the delay. The Owner may deduct the amount of such Liquidated Damages from any monies payable to the Contractor under the Contract.

.2 PART 11 INSURANCE AND CONTRACT SECURITY

- .1 DELETE GC 11.1, paragraph 11.1.1.8.
- .2 ADD GC 11.1, paragraph 11.1.1.8, 11.1.1.9 and 11.1.1.10 as follows:
 - .1 **11.1.1.8** *Contractor’s* Pollution Liability insurance from the date of commencement of the Work until one (1) year after the date of *Substantial Performance of the Work*.
 - .2 **11.1.1.9** Unmanned aerial vehicle liability insurance with respect to owned or non-owned aircraft (if used directly or indirectly in the performance of the *Work*), shall have limits of not less than \$5,000,000 per occurrence or accident for bodily injury, death and damage to property or such amounts as required by any applicable law or regulation.
 - .3 **11.1.1.10** *Contractor’s* Commercial General Liability and Umbrella Liability insurance shall not contain an exclusion for Explosion, Collapse and Underpinning.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SURETY BONDS

- .1 Provide security for performance of the *Contract* in the form of a **Performance Bond** for 50 % of the *Contract Price including Value Added Taxes*.
- .2 Provide security for payment of labour and material provided in the performance of the *Work* in the form of a **Labour and Material Payment Bond** for 50 % of the *Contract Price including Value Added Taxes*.
- .3 Unless specified elsewhere within the Bid Documents, the Bonds shall be in the form prescribed by the regulations under the *New Brunswick Construction Remedies Act (NBCRA)*. The Bonds shall be issued and be compliant with the requirements of the *NBCRA* whether the value of the *Contract* is less than the amount prescribed pursuant to sections 83(1) and 83(2) and 84(1) of that *Act*. Where permitted pursuant to the *NBCRA* and where specifically allowed and called for in the Bid Documents as being permitted, the *Consultant* may allow alternate forms of security.
- .4 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*.
- .5 Bonds shall be issued in the name of the *Owner* and shall specifically name this *Contract*. The Bonds shall be signed, sealed, and dated by both the *Contractor* and the surety company.
- .6 Submit Bonds to *Owner* within 5 *Working Days* after *Contract* award.
- .7 The Bonds will be held by the *Owner* as security for the due performance of the *Work* and shall be in effect until the *Consultant* issues the Certificate of Final Acceptance.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 WORK OF THE PROJECT

.1 *Work of the Project*, of which *Work of this Contract* is a part, comprises the following:

1. Aeration System Replacement

- Remove and dispose of existing aeration system, and aeration piping.
- Replace the existing aeration system with a **Floating Lateral Fine Bubble Diffuser System**, providing higher efficiency in BOD and TSS removal, environmental friendliness, and ease of maintenance.
- Install shallow-buried main headers and floating laterals, enabling maintenance without draining the lagoon.

2. Sludge Removal

- Remove and dispose of existing sludge in the lagoon, prior to the removal of the existing system.

3. Blowers Upgrade

- Remove and dispose of existing blowers, mechanical, and electrical.
- Install new Blowers for enhanced efficiency, energy savings, and reduced operational costs.

4. Lagoon Modifications

- Remove and dispose of existing baffle.
- Modify Cell No. 1 into a "complete mix" aerated cell and Cell No. 2 into a "partial mix" cell with a settling zone to improve effluent quality.
- Install a floating baffle curtain to optimize flow and treatment efficiency.
- Install a safety rope system around the lagoon perimeter for additional security, considering the synthetic liner.

5. UV Building

- Construct a new UV Building, complete with UV system.

6. UV Building By-pass

- Install new By-pass Manhole for the new UV building.

7. SCADA System

- Install SCADA system for the new UV building.

1.2 WORK OF THIS CONTRACT

- .1 The *Work* to be done under this Contract will consist of the supplying of all materials, labour, supervision, construction plan, equipment, etc., necessary for the completion of the *Work* as shown on the drawings and as described in these Specifications.
- .2 The foregoing will not be construed as limiting, restricting, or modifying any general or specific requirements as set forth in any part of the Contract documents. The work includes all work subsidiary and incidental thereto required for a complete and functional installation.
- .3 Location: PID 65040297 - 278 MAIN ST, Tobique Indian Reserve No. 20, NB

1.3 DIVISION OF WORK

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

1.4 SPECIFICATIONS LANGUAGE AND STYLE

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", " Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use".

1.5 DOCUMENTS AT THE SITE

- .1 Keep the following documents at *Place of the Work*, stored securely and in good order and available to *Owner* and *Consultant* in hard copy and/or electronic form as directed by the *Consultant*:
 - .1 Current Contract Documents, including Drawings, Specifications and addenda.
 - .2 Change Orders, Change Directives, and Supplementary Instructions.
 - .3 Reviewed Shop Drawings, Product data and samples.
 - .4 Field test reports and records.
 - .5 Construction progress schedule.
 - .6 Meeting minutes.
 - .7 Manufacturer's certifications.
 - .8 Permits, inspection certificates, and other documents required by authorities having jurisdiction.
 - .9 Current record drawings.
 - .10 Material Safety Data Sheets (MSDS) for all controlled Products.

1.6 CONTRACTOR'S USE OF PREMISES

- .1 Except as otherwise specified, *Contractor* has unrestricted use of *Place of the Work* from time of *Contract* award until *Substantial Performance of the Work*.
- .2 Confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and all other construction operations to limits required by laws, ordinances, permits, and *Contract Documents*, whichever is most restrictive. Do not unreasonably encumber *Place of the Work*.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 This section defines allowable disruptions to existing operations and provides additional description of operations that may assist the *Contractor* in preparing his program of work. This section is not meant to be an exhaustive list of disruptions but to highlight those restrictions which are known.

1.2 WORK SEQUENCE

- .1 The following sequence of work is intended for information purposes only to achieve the constraints described in the *Contract Documents*. The *Contractor* shall be responsible to develop their own proposed work sequence for review and approval by the *Consultant*.
 - .1 Step 1: Mobilization;
 - .2 Step 2: Installation of erosion control structures;
 - .3 Step 3: Sludge removal;
 - .4 Step 4: Existing equipment decommissioning & removal including but not limited to the following:
 - .1 Removal and disposal of abandoned Chlorination Building;
 - .2 Removal and disposal of blowers c/w electrical; and
 - .3 Removal and disposal of aeration system and baffle.
 - .5 Step 5: Installation of new blowers, aeration system, and baffles;
 - .6 Step 6: Excavation and installation of UV Building By-pass manhole;
 - .7 Step 7: Construction of UV Building and UV System;
- .2 Neither the work sequence described above, nor the approval of a work sequence prepared by the *Contractor* shall relieve the *Contractor* from overall responsibility for coordinating the *Work* in accordance with the *Contract Documents*.
- .3 *Contractor* shall maintain the operation of the system at all times to prevent the discharge of untreated effluent. Work shall be scheduled and executed in a manner that ensures continuous system functionality, with no interruption that could lead to untreated discharge.

1.3 COMPLETION DATE

- .1 *Substantial Performance of the Work* shall be obtained within the timelines specified in the Bid Form.
- .2 The *Contractor* is to provide and schedule sufficient crews, plant, etc. to ensure these completion requirements are met. If the *Contractor's* original schedule is affected by weather or other factors, he shall make every reasonable effort to provide additional personnel and/or equipment as necessary to ensure this completion date is met.
- .3 If the *Contractor* wishes to extend the prescribed time for completion of the *Work* because of delays occasioned by extra work, epidemic, pandemic, strikes, lockouts, fires, insurrection, acts of God, or delay in delivery of equipment, the *Contractor* shall give

notice in writing to the *Consultant* within ten (10) *Working Days* after any such delay or other event listed above has first arisen, stating the reason for the request and, in such an event, the *Consultant* may, in their absolute discretion, determine what extension of time, if any, will be allowed.

- .4 The *Contractor* shall, in the event that he fails to complete the *Work* on the day fixed in the *Contract* for completion, or on the day to which the time for completion may be extended by the *Consultant*, forfeit and pay to the *Owner* the sum of one thousand dollars (\$1,000) for each day of delay as Liquidated Damages and not as a penalty. The payment recognizes both, the extra cost to the *Owner* of the continued observation of the *Work* by the *Consultant*, and/or the loss of revenue or additional cost incurred by the *Owner* by virtue of the delay. The *Owner* may deduct the amount of such Liquidated Damages from any monies payable to the *Contractor* under the *Contract* through the right of set-off.

1.4 MAINTENANCE OF SERVICE

- .1 The *Contractor* is to advise the *Consultant* at least 48 hours in advance of any planned service disruption.

1.5 RESTRICTIONS ON USE OF PREMISES

- .1 Limit use of premises for *Work*, for storage, and for access.
- .2 Coordinate use of premises under direction of *Consultant*.
- .3 The *Work* is on or immediately adjacent to public rights-of-way and *Work* must be limited to within identified limits including easements. Any damage or disturbance caused by the *Contractor* outside these limits shall be reinstated at his cost and to the satisfaction of the *Consultant*.
- .4 The site shall be kept secure by the *Contractor* throughout the course of the *Work*. When the *Contractor* is not on site, the site fencing shall be securely closed or site security provided to protect the safety of the public.
- .5 It is the *Contractor's* responsibility to examine the site and determine any other restrictions which may affect the *Work*, as no claim will be entertained for any additional costs caused by site conditions or restrictions.
- .6 Access to the work area, including the construction and maintenance of an access road if required, shall be the responsibility of the *Contractor*. The *Contractor* shall acquire written permission of owners to operate on or use all private property outside easements. Furthermore, at no time will the *Contractor* be allowed to use any private roads unless a written confirmation from the owner of such roads has been provided to the *Consultant* clearly stating that the *Owner* and their *Consultant* are in no way responsible for the upkeep of this road during or after construction. A copy of this signed agreement shall be provided to the *Consultant* prior to the use of any private properties. This will be the full and complete responsibility of the *Contractor*.
- .7 Verbal permissions for access of private lands will not be acceptable.

1.6 TRUCK ROUTES

- .1 All heavy equipment, including trucks hauling imported material or excavated material or empty, shall proceed to and from the work site by taking the shortest route to and from

the nearest truck route and then the shortest truck route to and from the origins and destination of the required trip. Truck routes shall be as defined by the New Brunswick Department of Transportation or by Municipal ordinance. For any projects where heavy equipment movement is required on streets not identified as truck routes, it shall be the *Contractor's* responsibility to arrange for permission to use such streets before commencing the *Work*.

1.7 BLASTING

- .1 Blasting is not permitted on this *Contract*.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

General

1.1 DEFINITION

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

1.2 SUBSTITUTION PROCEDURES

- .1 *Contractor* may propose a Substitution wherever a *Product* or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.
- .2 *Contractor* may propose a Substitution wherever a *Product* or manufacturer is specified by proprietary name(s) and accompanied by language such as "or equal", "or approved equal", "or approved equivalent", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without *Consultant's* prior acceptance in writing. Do not order or install any Substitution without a *Supplemental Instruction* or *Change Order*.
- .3 Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements for Proposed Substitutions, *Consultant* will promptly review and accept or reject the proposed Substitution.
- .4 *Consultant* may accept a Substitution if satisfied that:
 - .1 the proposed substitute *Product* is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations as the specified *Product*,
 - .2 the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and
 - .3 the Substitution provides a benefit to *Owner*.
- .5 If *Contractor* fails to order a specified *Product* or order a *Product* by a specified manufacturer in adequate time to meet *Contractor's* construction schedule, *Consultant* will not consider that a valid reason to accept a Substitution.
- .6 If *Consultant* accepts a Substitution and subject to *Owner's* agreement, the change in the *Work* will be documented in the form of either a *Supplemental Instruction* or *Change Order* as specified in Section 01 26 00 – Contract Modification Procedures.
- .7 If a Substitution is accepted in the form of a *Supplemental Instruction* or *Change Order*, *Contractor* shall not revert to an originally specified *Product* or manufacturer without *Consultant's* prior written acceptance.

1.3 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

- .1 Include with each proposed Substitution the following information:

- .1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.
- .2 Reason(s) for proposing the Substitution.
- .3 A statement verifying that the Substitution will not affect the *Contract Price* and *Contract Time* or, if applicable, the amount and extent of a proposed increase or decrease in *Contract Price* and *Contract Time* on account of the Substitution.
- .4 A statement verifying that the Substitution will not affect the performance or warranty of other parts of the *Work*.
- .5 Manufacturer's *Product* literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.
- .6 *Product* samples as applicable.
- .7 A summarized comparison of the physical properties and performance characteristics of the specified *Product* and the Substitution, with any significant variations clearly highlighted.
- .8 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.
- .9 If applicable, estimated life cycle cost savings resulting from the Substitution.
- .10 Details of other projects and applications where the Substitution has been used.
- .11 Identification of any consequential changes in the *Work* to accommodate the Substitution and any consequential effects on the performance of the *Work* as a whole. A later claim for an increase to the *Contract Price* or *Contract Time* for other changes in the *Work* attributable to the Substitution will not be considered.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SCHEDULE OF LABOUR RATES

- .1 Prior to the first application for payment, submit for the *Consultant's* review a schedule of labour rates for all trades and classifications of trades, such as journeymen, apprentices, and foremen that will be employed in the *Work*. Provide a breakdown of payroll burden component of labour rates.
- .2 Labour rates shall reflect the salaries, wages, and benefits paid to personnel in the direct employ of the *Contractor*, *Subcontractors*, and sub-Subcontractors, stated as hourly rates, that will be used when:
 - .1 preparing price quotations for *Change Orders*, and
 - .2 determining the cost of work attributable to *Change Directives*.
- .3 Labour rates stated in the schedule of labour rates shall be consistent with rates that will actually be paid, and payroll burden costs that will actually be incurred, in the normal performance of the *Work*, during regular working hours. Labour rates shall not include any additional overhead and profit component.
- .4 Where collective agreements apply, the labour rates shall not exceed those established by collective agreement.
- .5 Obtain the *Owner's* written acceptance of the schedule of labour rates before submitting the first *Change Order* quotation.
- .6 Accepted schedule of labour rates will be used solely for evaluating *Change Order* quotations and cost of performing work attributable to *Change Directives*.
- .7 The *Contractor* may request amendments to the accepted schedule of labour rates if changes in the labour rates that will actually be paid, or payroll burden cost that will actually be incurred, in the normal performance of the *Work* can be demonstrated. Obtain the *Owner's* written acceptance of such changes.

1.2 SCHEDULE OF EQUIPMENT RATES

- .1 Prior to the first application for payment, submit for the *Consultant's* review a schedule of equipment rates for *Contractor* owned *Construction Equipment*.
- .2 Equipment rates shall reflect the rates that will be used when:
 - .1 preparing price quotations for *Change Orders*, and
 - .2 determining the cost of work attributable to *Change Directives*.
- .3 Equipment rates stated in the schedule shall be consistent with local equipment rental market rates and shall not include any additional overhead and profit component.
- .4 Obtain the *Owner's* written acceptance of the schedule of equipment rates before submitting the first *Change Order* quotation.
- .5 Accepted schedule of equipment rates will be used solely for evaluating *Change Order* quotations and cost of performing work attributable to *Change Directives*.

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

1.3 VALUATION OF CHANGES BASED ON AGREED UNIT PRICES

- .1 The *Consultant* may, at the outset of the *Contract* or at any other time, request the *Contractor* to submit unit prices anticipated to be required in valuing changes in the *Work*.
- .2 The *Contractor* shall submit such unit prices promptly upon request.
- .3 The unit prices shall be valid for a specified duration.
- .4 The unit prices shall exclude all fees for overhead and profit and shall be subject to the percentage fees specified in this Section under the article titled Fees for Overhead and Profit – Change Orders.
- .5 The *Consultant* will evaluate the *Contractor's* quoted unit prices and, if accepted by the *Owner* in writing, the agreed unit prices shall be used to value subsequent proposed changes in the *Work* wherever they are applicable.

1.4 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE ORDERS

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

1.5 FEES FOR OVERHEAD AND PROFIT – CHANGE ORDERS

- .1 Where the *Contractor's* price quotation for a *Change Order* results in a net increase to the *Contract Price*, the *Contractor's* entitlement to a fee for overhead and profit in the quotation shall be as follows, as applicable:
 - .1 For work to be performed by the *Contractor's* own forces, 10 % of the *Contractor's* price quotation before the *Contractor's* fee is applied.
 - .2 For work to be performed by a *Subcontractor*, 5 % of the *Subcontractor's* price quotation including the *Subcontractor's* fee.
- .2 Where a *Subcontractor's* price quotation for a *Change Order* results in a net increase to the *Subcontractor's* contract price, the *Subcontractor's* entitlement to a fee for overhead and profit in the quotation shall be as follows, as applicable:
 - .1 For work to be performed by the *Subcontractor's* own forces, 10 % of the *Subcontractor's* price quotation before the *Subcontractor's* fee is applied.
 - .2 For work to be performed by a sub-*Subcontractor*, 5 % of the sub-*Subcontractor's* price quotation including the sub-*Subcontractor's* fee.
- .3 Where the *Contractor's* or a *Subcontractor's* price quotation for a *Change Order* results in a net decrease in price before adjustment for fees for overhead and profit, such a price quotation shall be for the net decrease without any adjustment for fees for overhead and profit.

1.6 CHANGE DIRECTIVE PROCEDURES

- .1 If a *Change Directive* is issued for a change in the *Work* for which a proposed change was previously issued, but no *Change Order* has yet been signed, the *Change Directive* shall cancel the proposed change and any *Contractor* quotations related to that change in the *Work*.
- .2 When proceeding with a change in the *Work* under a *Change Directive*, keep accurate records of daily time sheets for labour and *Construction Equipment*, and invoices for *Product* and *Construction Equipment* costs. Submit such records to the *Consultant* daily until the *Change Order* superseding the *Change Directive* is issued.

1.7 FEES FOR OVERHEAD AND PROFIT – CHANGE DIRECTIVES

- .1 The *Contractor*'s entitlement to a fee for overhead and profit on the *Contractor*'s expenditures and savings attributable to a *Change Directive* shall be as follows, as applicable:
 - .1 For work performed by the *Contractor*'s own forces, 10 % of the *Contractor*'s net increase in costs.
 - .2 For work performed by a *Subcontractor*, 5 % of the sum of the *Subcontractor*'s net increase in costs plus the *Subcontractor*'s fee.
- .2 A *Subcontractor*'s entitlement to a fee for overhead and profit on the *Subcontractor*'s expenditures and savings attributable to a *Change Directive* shall be as follows, as applicable:
 - .1 For work performed by the *Subcontractor*'s own forces, 10 % of the *Subcontractor*'s net increase in costs.
 - .2 For work performed by a sub-*Subcontractor*, 5 % of the sum of the sub-*Subcontractor*'s net increase in costs plus the sub-*Subcontractor*'s fee.
- .3 Where a *Change Directive* results in net savings on account of work not required to be performed and a net decrease in the *Contractor*'s or *Subcontractor*'s cost, the net savings to the *Contractor* or *Subcontractor* shall be calculated without any adjustment for fees for overhead and profit.
- .4 When a *Change Directive* is ultimately recorded as a *Change Order*, there shall be no additional entitlement to fees for overhead and profit beyond those specified in this article.

1.8 SUPPLEMENTAL INSTRUCTIONS

- .1 The *Consultant* may issue *Supplemental Instructions* to provide clarifications to the *Contract Documents*, provide additional information, or make minor variations in the *Work* not involving adjustment in the *Contract Price* or *Contract Time*.
- .2 If the *Contractor* considers a *Supplemental Instruction* to require an adjustment in *Contract Price* or *Contract Time*, the *Contractor* shall promptly notify the *Consultant* and the *Owner* in writing and shall not proceed with any work related to the *Supplemental Instruction* pending receipt of a *Change Order*, a *Change Directive*, or, in accordance with the dispute resolution provisions of the General Conditions of *Contract*, a Notice in Writing of a dispute and instructions to proceed.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SCHEDULE OF VALUES

- .1 Prior to the first application for payment, submit for *Consultant's* review an initial schedule of values. Modify the initial schedule of values if and as requested by *Consultant*. Obtain *Consultant's* written acceptance of the initial schedule of values prior to the first application for payment.
- .2 Provide the schedule of values in an approved format that provides for inclusion of the following information:
 - .1 Identifying information including title and location of the *Work*, name of *Contractor*, number and date of application for payment, and period covered by the application for payment.
 - .2 A work breakdown structure that is sufficiently detailed and comprehensive to facilitate *Consultant's* evaluation of applications for payment at an appropriate level of detail.
 - .3 Provisions for approved *Change Orders* that the breakdown amounts indicated in the schedule of values aggregate to the current total *Contract Price*. Also provide for indicating the estimated value of *Change Directives* within the schedule of values, separately from the current total *Contract Price*.
- .3 Together with the first and all subsequent applications for payment, submit updated versions of the schedule of values to indicate the values, to the date of application for payment, of *Work* performed and *Products* delivered to *Place of the Work*.
- .4 For each item in the work breakdown structure, provide as a minimum the following information, under headings as indicated:
 - .1 Breakdown Amount: A dollar amount, including an appropriate pro rata portion of *Contractor's* overhead and profit.
 - .2 Performed to Date: The value of *Work* performed and *Products* delivered to *Place of the Work* up to the date of the application for payment, stated as a percentage of the *Contract Price* and in dollars.
 - .3 Previously Performed: The value of *Work* performed and *Products* delivered to the *Place of the Work* for which payment has been previously certified, stated in dollars.
 - .4 Current Period: The value of *Work* performed and *Products* delivered to *Place of the Work* for which *Contractor* is currently applying for payment, stated in dollars.
 - .5 Balance to Complete: The value of *Work* not yet performed and *Products* not yet delivered to *Place of the Work*, stated in dollars.

1.2 WORKERS' COMPENSATION CLEARANCE

- .1 With each application for payment, submit a Clearance Certificate or proof of good standing from provincial workers' compensation authority as evidence of compliance with workers' compensation legislation at the *Place of the Work*.

1.3 STATUTORY DECLARATIONS

- .1 Submit a statutory declaration of progress payment distribution by *Contractor*, in a form acceptable to the *Owner*, with each application for payment except the first.
 - .1 Where the *Owner* does not have a preferred format, use of the following document is recommended: CCDC 9A – *Statutory Declaration of Progress Payment Distribution by Contractor*.

1.4 PAYMENT FOR PRODUCTS STORED OFF SITE

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

1.5 HOLDBACK AND RETENTION FUNDS

- .1 *New Brunswick Construction Remedies Act (NBCRA)* Holdback:
 - .1 The *Consultant* shall retain money in the amount of ten percent (10 %) as a Holdback in accordance with the *NBCRA*, and amendments thereto.
- .2 Retention Funds:
 - .1 The *Consultant* may retain from the *Contract Price* the amounts required as a Completion Retention and a Deficiency Retention.
 - .1 Completion Retention:
 - .1 When the *Work*, in the opinion of the *Consultant*, is ready for use or is being used for the purposes intended, but the *Contractor* is unable to complete the remaining *Work* within the agreed schedule, the *Consultant* may retain a Completion Retention amount in the value of the remaining *Work*.
 - .2 This Completion Retention shall be subject to a Holdback under the *NBCRA*.
 - .3 See Section 01 77 00 - Closeout Procedures for more information.
 - .2 Deficiency Retention:
 - .1 The amount deducted from the *Contract Price* for the purpose of ensuring the completion of a deficiency in the *Work* (as identified through an inspection) shall be referred to as the Deficiency Retention.
 - .2 The *Consultant* may retain sufficient funds to allow the proper completion of the *Work* by others, including the use of the *Owner*'s own forces or another *Contractor*.
 - .3 The amount retained shall be no less than an amount equal to twice the *Consultant*'s estimate of the cost of remedying the

Deficiency. The amount shall be retained until the Deficiency is remedied to the satisfaction of the *Consultant*.

- .4 This Deficiency Retention shall be subject to a Holdback under the *NBCRA*.
- .3 The *Owner* may retain additional amounts, under the *Contract*, for any known claims, unpaid amounts due to *Subcontractors*, labourers or *Suppliers*, defective workmanship, equipment, materials, penalties and Liquidated Damages.

1.6 RELEASE OF HOLDBACK AND RETENTION FUNDS

- .1 *New Brunswick Construction Remedies Act (NBCRA)* Holdback:
 - .1 The *Owner* shall, upon receipt of the following documents, release the Holdback sixty-one (61) days after the date of *Substantial Performance of the Work* in accordance with the *NBCRA*.
 - .1 A Statutory Declaration (in a form acceptable to the *Consultant*) to the effect that:
 - .1 all persons who have been employed upon the *Work* or who have furnished equipment and materials for the *Work* have been fully paid except for statutory holdbacks properly retained,
 - .2 Form 7 of the *NBCRA* was posted in the manner and within the time required by the *NBCRA*; and,
 - .3 The *Contractor* is not aware of any claim for Lien made with respect to the public *Owner's* holdback as contemplated by the *NBCRA*.
 - .2 A Clearance Certificate or proof of good standing from provincial workers' compensation authority as evidence of compliance with workers' compensation legislation at the *Place of the Work*; and,
 - .3 A letter from the *Contractor* releasing the *Owner* from any further claims with respect to this *Contract* (except for this *Progress Claim* and any statutory holdbacks properly retained).
 - .2 Completion Retention:
 - .1 The *Owner* shall, upon issuance of the Certificate of Final Completion, release all amounts retained as the Completion Retention, less twice the value of any remaining deficiencies and the *NBCRA* Holdback (10 % of monies due to the *Contractor*).
 - .2 The *NBCRA* Holdback on Completion Retention shall be released sixty-one (61) days after the Certificate of Final Completion has been issued.
 - .3 Deficiency Retention
 - .1 The *Owner* shall, upon issuance of the Certificate of Final Completion, release all amounts retained as the Deficiency Retention, less twice the value of any remaining deficiencies and the *NBCRA* Holdback (10% of monies due to the *Contractor*).
 - .2 The *NBCRA* Holdback on Deficiency Retention shall be released sixty-one (61) days after the Certificate of Final Completion has been issued.

- .4 Where the *Contractor* does not provide a *Statutory Declaration* or does not complete the *Work* as directed by or to the satisfaction of the *Consultant*, the *Consultant* or *Owner* may withhold payment of the monies which would otherwise have become due, and during this time, the *Consultant* or *Owner* shall not be required to pay interest.
- .5 It is the responsibility of the *Contractor* to request, in writing to the *Consultant*, release of any *NBCRA* Holdback or Retention amounts as described in this section.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 CONSTRUCTION START-UP MEETING

- .1 Promptly after *Contract* award, *Contractor* will establish the time and location of a construction start-up meeting to review and discuss administrative procedures and responsibilities. *Contractor* will notify *Consultant and the Owner* at least 5 *Working Days* before the meeting.
- .2 Senior *Owner* , *Consultant*, and *Contractor*, including *Contractor*'s project manager and site superintendent, and major *Subcontractors*, shall be in attendance.
- .3 *Contractor*'s representative will chair the meeting and record and distribute the minutes.
- .4 Agenda will include following at a minimum (where relevant) and others as appropriate:
 - .1 Appointment of official *Owner* , *Contractor*, *Subcontractors*, *Consultant*, and Subconsultants.
 - .2 Project communications.
 - .3 *Contract Documents* for construction purposes.
 - .4 Documents at the site and construction progress documentation.
 - .5 *Contractor*'s use of premises.
 - .6 Owner-supplied *Products*.
 - .7 Work restrictions.
 - .8 Substitution procedures.
 - .9 Contract modification procedures.
 - .10 Payment procedures.
 - .11 Construction progress meetings.
 - .12 Construction progress schedule, including long lead time items.
 - .13 Submittals schedule and procedures.
 - .14 Health and Safety requirements.
 - .15 Environmental procedures.
 - .16 Quality requirements, including testing and inspection procedures.
 - .17 *Contractor*'s mobilization.
 - .18 Temporary utilities.
 - .19 Existing utility services.
 - .20 Construction facilities.
 - .21 Temporary barriers and enclosures.
 - .22 Temporary controls.
 - .23 Field engineering and layout of work.
 - .24 Site safety.
 - .25 Site security.
 - .26 Cleaning and waste management.

- .27 Closeout procedures and submittals.
- .28 As-built (during construction progress) and Record (after project completion) drawings.
- .29 Take-over procedures, acceptance, warranties.
- .30 Monthly progress claims, administrative procedures, photographs, holdback and retention amounts.
- .31 Appointment of inspection and testing agencies or firms.
- .32 Insurances, transcript of policies.
- .33 Other items.

1.2 CONSTRUCTION PROGRESS MEETINGS

- .1 Schedule regular bi-weekly virtual construction progress meetings for the duration of the *Work*. *Contractor* will prepare meeting agendas, chair the meetings, and record and distribute the meeting minutes.
- .2 *Contractor* will arrange for and provide physical space for meetings.
- .3 *Contractor* will record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.
- .4 *Contractor* will distribute copies of minutes, within three (3) *Working Days* after each meeting, to meeting attendees and any affected parties who may not be in attendance.
- .5 The *Contractor* shall ensure that *Subcontractors* attend as and when appropriate to the progress of the *Work*.
- .6 Agenda for each meeting shall include the following, as a minimum:
 - .1 Work progress since previous meeting.
 - .2 Field observations, including any problems, difficulties, or concerns.
 - .3 Construction progress schedule.
 - .4 Submittals schedule.
 - .5 Proposed changes in the *Work*.
 - .6 Requests for information.
 - .7 Site safety issues.
 - .8 Environmental site controls.
 - .9 Other business.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section specifies *Contractor's* responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.
- .2 The purpose of submitting progress schedules is to:
 - .1 inform *Owner* and *Consultant* of actual progress versus planned progress, and
 - .2 provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.

1.2 CONSTRUCTION PROGRESS SCHEDULE

- .1 Format and content:
 - .1 Prepare schedule in the form of a Critical Path Method (CPM) Gantt chart using appropriate scheduling software.
 - .2 Provide a work breakdown structure identifying key activities, work packages, and major milestones, including long delivery *Products*, inspection and testing activities, key decisions required from *Owner*, and similar items, at a sufficient level of detail to effectively manage construction progress.
 - .3 Indicate milestone dates for *Substantial Performance of the Work* and for the following additional milestones:
 - .1 Mobilization and Demobilization;
 - .2 Sludge removal;
 - .3 UV Building By-Pass Manhole;
 - .4 UV Building;
 - .5 Blowers Building upgrades;
 - .6 Lagoon Upgrades including removals;
 - .7 SCADA system;
 - .8 Reinstatement;
 - .9 Other milestones/dates as directed by *Consultant*.
- .2 Submission:
 - .1 Submit initial schedule to *Owner* and *Consultant* within 7 *Working Days* after *Contract* award.
 - .2 Submit schedule via electronic format acceptable to the *Consultant*.
 - .3 *Consultant* will review format and content of initial schedule and request necessary changes, if any, within 5 *Working Days* after receipt.
 - .4 If changes are required, resubmit finalized initial schedule within 5 *Working Days* after return of review copy.
 - .5 Submit updated progress schedule with Applications for Progress Payment to *Owner* and *Consultant*, indicating actual and projected start and finish dates with

report date line and progress. Include information on changes (slippage) since the previously submitted schedule.

1.3 SUBMITTALS SCHEDULE

- .1 Format and content:
 - .1 Prepare schedule identifying all required *Shop Drawings*, *Product* data, and sample submissions, including samples required for testing.
 - .2 Prepare schedule in electronic format.
 - .3 Provide a separate line for each required submittal, organized by *Specifications* divisions, section names and numbers, and further broken down by individual *Products* and systems as required.
 - .4 For each required submittal, show planned earliest date for return of reviewed submittal by *Consultant* and latest date for return of reviewed submittal without causing delay.
 - .5 Allow time in schedule for resubmission of submittals, should resubmission be necessary. Failure to submit in ample time for *Consultant*'s review is not considered sufficient reason for extension of *Contract Time* and no claim for extension by reason of such default will be allowed.
- .2 Submission:
 - .1 Submit initial schedule to *Consultant* within 15 *Working Days* after *Contract* award.
 - .2 Submit schedule electronically in a format acceptable to the *Consultant*.
 - .3 *Consultant* will review format and content of initial schedule and request necessary changes, if any, within 10 *Working Days* after receipt.
 - .4 If changes are required, resubmit finalized schedule within 5 *Working Days* after return of review copy.
 - .5 Submit updated submittals schedule at each Project Meeting and as requested by the *Consultant*.

1.4 SCHEDULE MANAGEMENT

- .1 A schedule submitted as specified and accepted by *Consultant* shall become the baseline schedule and shall be used as the baseline for updates.
- .2 At each regular progress meeting, review and discuss current construction progress and submittals schedules with *Consultant*, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path.
- .3 Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

1.5 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS AND SPECIFICATIONS

- .1 After award of *Contract*, obtain from *Consultant*:

- .1 Two sets of black line on white opaque print *Construction Drawings* and *Specifications*, including digital copies, for the purpose of creating as-built drawings and specifications.
 - .1 On one set, use felt tip marking pens for recording information primarily in **red** ink, and accurately and neatly record changes and deviations from *Contract Documents* caused by site conditions and changes ordered by *Consultant* on these as-built drawings for later inclusion in Project Manual. Maintain separate colours of ink to record information for each major system if required.
 - .2 Maintain as-built drawings and specifications in clean, dry and legible condition.
 - .3 Prior to submission of as-built drawings and specifications to *Consultant*, neatly transfer information from the working set of drawings to the second set to be included with the Project Manual.
- .2 An electronic copy of the *Construction Drawings* and *Specifications*, for the purpose of creating as-built documents.
 - .1 Accurately and neatly record changes and deviations from *Contract Documents* caused by site conditions and changes ordered by *Consultant* on these as-built drawings and specifications electronically for later inclusion in Project Manual. Maintain separate colours of lines to record information for each major system if required.
- .2 Clearly label each drawing as “AS-BUILT DRAWING”. Maintain in new condition and make available for inspection by *Consultant* on site, and at all job meetings.
- .3 Record information concurrently with construction progress. Do not conceal *Work* until required information is recorded.
- .4 *Contract Drawings* and *Shop Drawings*: mark each item to record actual construction, including:
 - .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .2 Record locations of concealed components of mechanical and electrical services.
 - .3 Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
 - .4 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
 - .5 Field changes of dimension and detail.
 - .6 Changes made by *Change Orders*, field orders, site instructions and *Supplemental Instructions*.
 - .7 References to related *Shop Drawings* and modifications, where *Shop Drawings* show more detail.
- .5 *Contract Specifications*: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by addenda and *Change Orders*.

- .6 Other documents: maintain manufacturer's certifications, inspection certifications, and field test records, as required by individual specifications sections.
- .7 Do not use as-built drawings for construction purposes.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 *Shop Drawings* are to be submitted as per the General Conditions of the *Contract*. In the case of a conflict between the *Contract* and this section, the Provisions of the *Contract* shall take precedence.
- .2 Submit specified submittals to *Consultant* for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the *Work*. Failure to submit in ample time is not considered sufficient reason for an extension of *Contract Time* or for *Product* substitutions or other deviations from the *Drawings* and *Specifications*.
- .3 Do not proceed with *Work* affected by a submittal until review is complete.
- .4 Present *Shop Drawings*, *Product* data, and samples in SI metric units. Where items or information is not produced in SI metric units, converted values are acceptable.
- .5 Where *Shop Drawings*, *Product* data or samples submittals show multiple options, clearly mark selected option. General data submitted with no selection if one is required will be returned without being examined and considered rejected.
- .6 Review submittals, provide verified field measurements where applicable, clearly indicate the referenced *Drawing* or *Specification* section number and detail or article number to which the submittal applies, and affix Contractor's review stamp prior to submission to *Consultant*. Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the *Work* and *Contract Documents*.
- .7 Submittals not stamped, signed, dated and identified as to specific project and reference *Drawing* or *Specification* will be returned without being examined and considered rejected.
- .8 Verify field measurements and that affected adjacent work is coordinated.
- .9 Submittals not meeting specified requirements will be returned with comments.
- .10 Reproduction of construction *Drawings* to serve as background for *Shop Drawings* is permitted. If construction *Drawings* are used for this purpose, remove references to *Consultant*.
- .11 Do not propose Substitutions or deviations from *Contract Documents* via *Shop Drawing*, *Product* data and sample submittals.
- .12 For all requests for substitution, please refer to Section 01 25 00 - Substitution Procedures.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "*Shop Drawings*" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by *Contractor* to illustrate details of a portion of *Work*.

- .2 Indicate *Products*, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the *Work*.
- .3 Where *Products* attach or connect to other *Products*, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to *Drawings*, *Specifications* and other already reviewed *Shop Drawings*.
- .4 Accompany submittals with a transmittal information including:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification of each submittal item and quantity, with reference to *Drawing* or *Specification* requiring each item's submittal.
 - .5 Other pertinent data.
- .5 *Shop Drawing* submittals shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 *Subcontractor*.
 - .2 *Supplier*.
 - .3 *Manufacturer*.
 - .4 *Contractor's* stamp, date, and signature of *Contractor's* authorized representative responsible for *Shop Drawing* review, indicating that each *Shop Drawing* has been reviewed for compliance with *Contract Documents* and, where applicable, that field measurements have been verified.
 - .5 Details of appropriate portions of the *Work* as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationships to other parts of the *Work*.
- .6 The specified service for which material or equipment is to be used and *Specification* section which the product is related to, including article number where *Product* is specified. Clearly mark and indicate on first page of each submission. If the submissions do not contain these references, they will be

returned for re-submission until they are submitted correctly. *Owner* will not be responsible for any additional cost related to non-conforming submissions.

- .6 *Product* data submittals shall include material safety data sheets (MSDS) for all controlled *Products*.
- .7 Submit electronic copy of *Shop Drawings* where specified in the technical *Specifications*.
- .8 Submit electronic copy of *Product* data sheets or brochures where specified in the technical *Specifications*.
- .9 Where a submittal includes information not applicable to the *Work*, clearly identify applicable information and strike out non-applicable information
- .10 Supplement standard information to include details applicable to *Project*.
- .11 Allow 5 *Working Days* for *Consultant's* review of each submittal for *Shop Drawings*, *Product* data, and samples. Allow additional *Working Days* where subconsultant or commissioning agent review is required.
- .12 If upon *Consultant's* review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of *Work* may proceed.
- .13 If upon *Consultant's* review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.
- .14 *Consultant's* notations on submittals are intended to ensure compliance with *Contract Documents* and are not intended to constitute a change in the *Work* requiring change to the *Contract Price* or *Contract Time*. If *Contractor* considers any *Consultant's* notation to be a change in the *Work*, promptly notify *Consultant* in writing before proceeding with the *Work*.
- .15 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the *Work* proceeds. When resubmitting, notify *Consultant* in writing of any revisions other than those requested by *Consultant*.
- .16 *Shop Drawings* with engineering content must bear the stamp and signature of the Engineer, licensed to practice in the Province of the *Place of the Work* of the *Project*, responsible for their preparation.
- .17 Submit electronic copies of test reports for requirements requested in *Specification* sections and as requested by *Consultant*.
 - .1 Report must be signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of the date of *Contract* award for the *Project*.
- .18 Submit electronic copies of certificates for requirements requested in *Specification* sections and as requested by *Consultant*.

- .1 Statements must be printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of *Project Contract* complete with project name.
- .19 Submit electronic copies of manufacturer's instructions to indicate special handling criteria, installation details and sequence, repair procedures and any requirements requested in *Specification* sections and as requested by *Consultant*.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .20 Submit electronic copies of Manufacturer's Field Reports for requirements requested in *Specification* sections and as requested by *Consultant*.
- .21 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .22 Submit electronic copies of Operation and Maintenance Data for requirements requested in *Specification* sections and as requested by *Consultant*.
- .23 Shop drawings are to be submitted for all supplied items and other items which may be required by the *Contract Documents*.
- .24 If any *Product* is installed prior to approval, the removal cost and any related cost is not covered by the *Owner*.
- .25 Delay claims and any related costs will not be paid for non-conforming submissions.
- .26 Payments may be held back until proper submission is provided.
- .27 The review of *Shop Drawings* is for sole purpose of ascertaining conformance with general concept. This review shall not mean approval of detail design inherent in *Shop Drawings*, responsibility for which shall remain with *Contractor* submitting same, and such review shall not relieve *Contractor* of responsibility for errors or omissions in *Shop Drawings* or of responsibility for meeting all requirements of construction and *Contract Documents*. Without restricting generality of foregoing, *Contractor* is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of *Work* of all sub-trades.

1.3 SAMPLES

- .1 Submit samples for *Consultant's* review in duplicate where specified in the technical *Specifications*. Label samples as to origin, *Project* name, and intended use, including *Specification* section number and article number where *Product* is specified.
- .2 Deliver samples prepaid to *Consultant's* business address.
- .3 Notify *Consultant* in writing of any deviations in samples from requirements of *Contract Documents*.
- .4 Where a required colour, pattern or texture has not been specified, submit full range of available *Products* meeting other specified requirements.

- .5 *Consultant* selection from samples is not intended to change the *Contract Price* or *Contract Time*. If a selection would affect the *Contract Price* or *Contract Time*, notify *Consultant* in writing prior to proceeding with the *Work*.
- .6 Resubmit samples as required by *Consultant* to comply with *Contract Documents*.
- .7 Reviewed and accepted samples will establish the standard against which installed *Work* will be reviewed.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Province of New Brunswick
 - .1 Occupational Health and Safety Act, S.N.B. - Latest revision.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within *7 Working Days* after date of *Contract* award and prior to commencement of *Work*. Health and Safety Plan must include:
 - .1 Results of site-specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation
 - .3 Identify responsible persons.
 - .4 Provide emergency contact names and numbers.
 - .5 Include a copy of the *Contractor's* safety manual if available.
 - .6 Site-specific safe work procedures.
 - .7 Site-specific safety orientation program.
 - .8 Weekly safety meetings.
 - .9 Environmental response plan.
- .3 Submit 3 copies of *Contractor's* authorized representative's work site health and safety inspection reports to *Consultant*.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets.
- .7 *Consultant* will review *Contractor's* site-specific Health and Safety Plan and provide comments to *Contractor* within *4 Working Days* after receipt of plan. Revise plan as appropriate and resubmit plan to *Consultant* within *4 Working Days* after receipt of comments from *Consultant*.
- .8 *Consultant's* review of *Contractor's* final Health and Safety plan should not be construed as approval and does not reduce the *Contractor's* overall responsibility for construction Health and Safety.

1.3 SAFETY ASSESSMENT

- .1 Perform site-specific safety hazard assessment related to *Project*.

1.4 MEETINGS

- .1 Schedule and administer Health and Safety meeting with *Consultant* prior to commencement of *Work*.

1.5 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan for this Project based on hazard assessment prior to beginning site *Work* and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address *Project Specifications*.
- .2 *Consultant* may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.
- .3 Before starting the work, inform WorkSafeNB. WorkSafeNB is responsible for overseeing the application of the province's Occupational Health and Safety Act, the Workers Compensation Act and the Workplace Health, Safety and Compensation Commission Act. All work will be done in compliance with the Occupational Health and Safety Act, Regulations 91-191 and 88-221.
- .4 All *Work* will be performed in a safe and efficient manner to the complete satisfaction of both the *Consultant* and the Safety Inspector.

1.6 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of *Work*.
- .2 Comply with and enforce compliance by employees with safety requirements of *Contract Documents*, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act, General Regulation, N.B. Reg. 91-191.

1.8 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of *Work*, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of the Province having jurisdiction and advise *Consultant* verbally and in writing.

1.9 POSTING OF DOCUMENTS

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

1.10 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by *Consultant*.
- .2 Provide *Consultant* with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 *Consultant* may stop *Work* if non-compliance of health and safety regulations is not corrected.

1.11 DISCIPLINARY ACTIONS

- .1 Upon any breach of the safety procedures contained in the site-specific Health and Safety Plan (including the failure to wear proper personal protective equipment (PPE), improper signage or unsafe trenches), the following disciplinary actions will be administered in the case of *Contractor's* personnel's actions on the construction site:
 - .1 1st instance: Verbal warning by Inspector or *Consultant*.
 - .2 2nd instance: Written warning violation report by *Consultant*, and notification of WorkSafeNB
 - .3 3rd instance: Removal of *Contractor's* employee and/or Foreman from site by the *Consultant* in writing, and notification of WorkSafeNB
- .2 All notices will be explained to the Foreman and *Contractor's* employee by the Inspector/*Consultant* regarding violation. Copies will be distributed to the Foreman. **Verbal warnings will be documented.**
- .3 The removal from the site of the *Contractor's* employees and/or Forman for safety violations shall not justify schedule adjustments. The *Contractor* shall be required to immediately replace this individual with an individual of equal or greater experience and qualifications, to be approved by the *Consultant*.

1.12 BLASTING

- .1 Blasting or other use of explosives is not permitted.

1.13 WORK STOPPAGE

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 BLOCKAGE OF ROADWAYS

- .1 Advise Fire Chief of any work that would impede fire apparatus response. This includes violation of minimum overhead clearance, as prescribed by Fire Chief, erecting of barricades and the digging of trenches.
- .2 Do not block fire exits without prior approval by Fire Marshall and *Consultant*. Provide new temporary fire exits and safe path of travel to secure area as required to maintain safety of building occupants. These exits shall conform to article 8.2.1.2 of the National Building Code of Canada (current version adopted by the province of New Brunswick).

1.2 RUBBISH AND WASTE MATERIALS

- .1 Rubbish and waste materials are to be kept to a minimum.
- .2 The burning of rubbish is prohibited.
- .3 Removal:
 - .1 Remove all rubbish from the work site at the end of the work day or shift or as directed.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in an approved receptacles and remove in accordance with this Section.

1.3 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 The handling, storage and use of flammable and combustible liquids are to be governed by the current National Fire Code of Canada.
- .2 Flammable and combustible liquids such as gasoline, kerosene and naphtha will be kept for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing the Underwriter's Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes, requires the permission of the Fire Chief.
- .3 Transfer of flammable and combustible liquids is prohibited within buildings or jetties.
- .4 Transfer of flammable and combustible liquids will not be carried out in the vicinity of open flames or any type of heat-producing devices.
- .5 Flammable liquids having a flash point below 38°C such as naphtha or gasoline will not be used as solvents or cleaning agents.
- .6 Flammable and combustible waste liquids, for disposal, will be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum and the Fire Department is to be notified when disposal is required.

1.4 HAZARDOUS SUBSTANCES

- .1 Work entailing the use of toxic or hazardous materials, chemicals and/or explosives, otherwise creates a hazard to life, safety or health, will be in accordance with the National Fire Code of Canada.
- .2 Notify Fire Chief of work involving welding, burning or the use of blow torches and salamanders, in buildings or facilities.
- .3 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers, equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with the level of protection necessary for Fire Watch is at the discretion of the Fire Chief. *Contractor* is responsible for providing fire watch service for work on a scale established and in conjunction with the Fire Chief at the pre-work conference.
- .4 Where flammable liquids, such as lacquers or urethanes are to be used, proper ventilation is to be assured and all sources of ignition are to be eliminated. The Fire Chief is to be informed prior to and at the cessation of such work.

1.5 QUESTIONS AND/OR CLARIFICATION

- .1 Direct any questions or clarification on Fire Safety in addition to above requirements to Fire Chief.

1.6 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as called by Fire Chief, necessary to protect the *Work* in progress and the *Contractor's* physical plant on site.
- .2 Fire extinguishers specified in other sections of this specification are in addition to those required by Fire Chief.
- .3 Know the location of the fire extinguishers and know how to use them properly.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all materials, labour and equipment necessary for Environmental Protection on all work sites as required and herein specified.
- .2 Silt fence and erosion/environmental control structures may be required to remain in place and be maintained under this Contract for up to two (2) years as directed by the Engineer.
- .3 Any spillage of sludge during the transport/disposal process is to be cleaned up by the *Contractor*.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures
- .2 Section 01 35 43 – Environmental Procedures
- .3 Section 33 00 01 – Sludge Removal and Dewatering
- .4 Section 31 23 33.01 – Excavation, Trenching and Backfilling

1.3 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
 - .1 Canadian Construction Documents Committee (CCDC)
 - .2 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.
 - .2 EPA General Construction Permit (GCP) 2012.
 - .3 ASTM International
 - .1 ASTM D98, Standard Specification for Calcium Chloride
 - .4 Province of New Brunswick
 - .1 *Clean Environment Act*

1.4 APPROVALS

- .1 Exposed materials resulting from cut and fill operations shall be stabilized against erosion as soon as possible to reduce siltation of the adjacent watercourses. All required sediment control fence and erosion control structures shall be placed by the Contractor prior to the start of any construction work on site.
- .2 Carry out the Work in compliance with the various Federal, Provincial and Municipal Acts, Regulations, and Policies involving protection of the environment, and any approvals or permits issued.

1.5 FIRES

- .1 Fires and burning of rubbish on site are not permitted.

1.6 DRAINAGE

- .1 The erosion and sedimentation control plan shall be the responsibility of the Contractor to adequately protect downstream environments from sediment-laden runoff. It is the Contractor's responsibility to implement measures and controls to ensure Federal, Provincial and Municipal requirements for erosion and sediment control are met.
- .2 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .3 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.7 WORK ADJACENT TO WATERWAYS

- .1 Take all precautions necessary as determined by the appropriate regulating authorities for protection of watercourses affected directly or indirectly by work in the contract.
- .2 Protect natural watercourses in accordance with the New Brunswick *Clean Environment Act*.
 - .1 The Contractor will ensure that no equipment, material, or substance that could cause pollution will be allowed to enter watercourses. The Contractor will be responsible for all costs and/or penalties related to the clean-up and removal of any pollution which does occur, at no cost to the City.
- .3 Construction Equipment to be operated on land only.
- .4 Contractor shall not use waterway beds for borrow material.
- .5 Waterways to be kept free of excavated fill, waste material, debris, or substance that could cause pollution. Assume responsibility for all costs and/or penalties related to the clean-up and removal of any pollution which does occur, at no cost to the City.
- .6 Design and construct temporary crossings to minimize erosion to waterways.
- .7 Do not skid logs or construction materials across waterways.
- .8 Avoid indicated spawning beds when constructing temporary crossings of waterways.

- .9 Blasting is not permitted.

1.8 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.9 NOTIFICATION

- .1 The Engineer will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform the Engineer of proposed corrective action and take such action for approval by the Engineer.
 - .1 Take action only after receipt of written approval by the Engineer.
- .3 The Engineer will issue stop order of Work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 DUST CONTROL

- .1 Water:
 - .1 Apply water several times daily as required and at the direction of the Engineer.
 - .2 Apply water using equipment capable of applying the water at a uniform and evenly distributed rate in amounts as required and/or as directed.
- .2 Calcium Chloride: not to be applied as part of this project.

3.2 SILT FENCE AND EROSION CONTROL

- .1 Install sediment control fence and erosion control structures as per manufacturer's instructions prior to the start of any construction work on site, as indicated on the

Drawings and as directed by the Engineer. Sediment control fences and erosion control devices are to be installed as per the Contractor's sediment and erosion control plan.

- .2 The sediment control fence and erosion control structures shall remain effectively on site for the period prior to any grubbing, stripping or excavation until Work is completed and all exposed surfaces have a dense growth that will control silt run-off. They are not to be removed until authorized by the Engineer.
- .3 Install additional sediment control fence when required by specific activities such as stockpiling of materials for reuse in the Work in order to control silt runoff from these areas that may reach ditching that drains to adjacent watercourses.
- .4 In areas of potential runoff where construction activity may cause the drainage runoff to transport sediment(s), ensure that sediment control fences or erosion control structures are properly located for effective runoff control.
- .5 Acceptably dispose of sediment removed from the fences or erosion control structures off the site.
- .6 Maintain sediment control fence and erosion control structures until they are authorized to be removed. This includes but is not limited to replacement of torn or damaged sections, replacement of broken supports, reattachment of fabric to supports, re-anchoring of washed-out fabric, replacement of washed-out or broken bales, and cleaning out of accumulated silt that reduces the effectiveness of any of these structures.
- .7 When the sediment control fence and erosion control devices have been authorized for removal, promptly remove them from the site and reinstate the surfaces and ditches to the Engineer's satisfaction.
- .8 Ensure that any water running off any exposed soils created as a result of the *Project*, or pumped from any excavation to a watercourse, or a ditch leading to a watercourse, is pumped to a settling pond or filtered through a vegetated area or through a sediment control system.

3.3 CLEANING

- .1 Do not bury rubbish and waste materials on site.
- .2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .3 Waste Management: separate waste materials for recycling in accordance with local jurisdiction solid waste disposal procedures.
 - .1 Remove any sludge spillage material and dispose at appropriate facility.
 - .2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 “Reference standards” means consensus standards, trade association standards, guides, and other publications expressly referenced in *Contract Documents*.
- .2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However, if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.
- .3 Reference standards establish minimum requirements. If *Contract Documents* call for requirements that differ from a referenced standard, the more stringent requirements shall govern.
- .4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to *Consultant* for clarification.
- .5 Within the *Specifications*, reference may be made to the following standards writing, testing, or certification organizations by their acronyms or initialisms:

AA	Aluminum Association
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWMAC	Architectural Woodwork Manufacturers Association of Canada
AWPA	American Wire Producers Association
CaGBC	Canadian Green Building Council
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CPCI	Canadian Prestressed Concrete Institute
CSA	Canadian Standards Association
CSSBI	Canadian Sheet Steel Building Institute
CWB	Canadian Welding Bureau
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers

IGMAC	Insulating Glass Manufacturers Association of Canada
LEED	Leadership in Energy and Environmental Design
MPP	Master Painters Institute
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NAAMM	National Association of Architectural Metal Manufacturers
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
SSPC	The Society for Protective Coatings
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters' Laboratories of Canada

1.2 RESPONSIBILITY FOR QUALITY CONTROL AND MATERIALS TESTING

- .1 The *Owner* will retain the services of an approved Geotechnical Consultant to perform regular quality inspections and material testing.
- .2 Retain and pay for inspection and testing that is for *Contractor's* own quality control or is required by regulatory requirements.

1.3 INDEPENDENT INSPECTION AND TESTING AGENCIES

- .1 Employment of inspection and testing agencies by *Contractor* or *Owner* does not relieve *Contractor* from responsibility to perform the *Work* in accordance with *Contract Documents*.
- .2 Allow and arrange for inspection and testing agencies to have access to the *Work*, including access to off-site manufacturing and fabrication plants.
- .3 For inspection and testing required by *Contract Documents* or by authorities having jurisdiction, provide *Consultant* and inspection and testing agencies with timely notification in advance of required inspection and testing.
- .4 Submit test samples required for testing as indicated in the *Contract Documents*.
- .5 Provide labour, *Construction Equipment*, and temporary facilities to obtain and handle test samples on site.

1.4 INSPECTION AND TESTING AGENCY REPORTS

- .1 For inspection and testing required by *Contract Documents* or by regulatory requirements, and performed by *Contractor* retained inspection and testing agencies, submit to *Consultant* (and *Owner* as directed) copies of reports. Submit within three (3) days after completion of inspection and testing.

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 CONSTRUCTION FACILITIES - GENERAL

- .1 Provide temporary construction facilities as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.
- .2 Maintain temporary construction facilities in good condition for the duration of the *Work*.
- .3 Remove temporary construction facilities from *Place of the Work* when no longer required.
- .4 The construction parking, vehicular access, sanitary facilities and fire protection will not be measured separately for payment but shall be considered incidental to the *Contract* unless otherwise noted.

1.2 CONSTRUCTION PARKING

- .1 Limited parking is available at the *Place of the Work*. Off-site parking or excessive use of *Owner*-occupied spaces shall be approved by *Owner*.

1.3 VEHICULAR ACCESS

- .1 Provide and maintain adequate access to *Place of the Work*.
- .2 Build and maintain temporary access roads as required or where indicated on *Drawings*.
- .3 Existing roads at *Place of the Work* may be used for access to *Place of the Work*, provided *Contractor* assumes responsibility for any damage caused by construction traffic, and prevents or promptly cleans up any mud tracking or material spillage.
- .4 Access to the work area, including the construction and maintenance of an access road if required, shall be the responsibility of the *Contractor*.
- .5 The *Contractor* shall acquire written permission of *Owner* to operate on or use all private property outside easements. Furthermore, at no time will the *Contractor* be allowed to use any private roads unless a written confirmation from the *Owner* of such roads has been provided to the *Consultant* clearly stating that the *Owner* and their *Consultant* are in no way responsible for the upkeep of this road during or after construction. A copy of this signed agreement shall be provided to the *Consultant* prior to the use of any private properties. This will be the full and complete responsibility of the *Contractor*.
- .6 Verbal permissions for access of private lands will not be acceptable. Written confirmation to be provided to *Consultant* prior to start of works.

1.4 SANITARY FACILITIES

- .1 Provide sanitary facilities for workers.
- .2 Do not use permanent washroom facilities during construction.
- .3 Keep sanitary facilities clean and fully stocked with the necessary supplies.

1.5 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection systems and equipment during construction.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 BARRIERS AND ENCLOSURES - GENERAL

- .1 Provide temporary barriers and enclosures necessary to protect the public and to secure *Place of the Work* during performance of the *Work*.
- .2 Comply with applicable regulatory requirements.
- .3 Maintain temporary barriers and enclosures in good condition for the duration of the *Work*.
- .4 Remove temporary barriers and enclosures from *Place of the Work* when no longer required.

1.2 FENCING

- .1 Erect temporary security and safety site fencing of type and height determined by *Contractor*, subject to applicable regulatory requirements.

1.3 EMERGENCY RESPONSE ACCESS

- .1 Maintain access routes, including overhead clearances, for use by emergency response vehicles.

1.4 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to *Work*.

1.5 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform *Work* and protect public.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 TEMPORARY CONTROLS - GENERAL

- .1 Provide temporary controls as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.
- .2 Maintain temporary controls in good condition for the duration of the *Work*.
- .3 Remove temporary controls and *Construction Equipment* used to provide temporary controls from *Place of the Work* when no longer required.
- .4 Temporary controls will not be measured separately for payment but shall be considered incidental to the contract unless otherwise noted.
- .5 *Consultant* will notify *Contractor* in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of *Contractor's* Environmental Protection plan.
 - .1 *Contractor*: after receipt of such notice, submit proposed corrective action to *Consultant*.
 - .2 *Consultant* will issue stop order of *Work* until satisfactory corrective action has been taken.
 - .3 No time extensions granted or equitable adjustments allowed to *Contractor* for such suspensions.

1.2 PLANT PROTECTION

- .1 Protect trees and other plant material designated to remain on site and on adjacent properties where indicated on *Drawings*.
- .2 Protect trees and shrubs susceptible to damage during construction by encasing with protective wood framework from grade to height of two (2) metres minimum or more as required.
- .3 For trees designated to remain, protect roots inside dripline from disturbance or damage during excavation and grading. Avoid traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas as indicated by *Consultant*.

1.3 DUST AND PARTICULATE CONTROL

- .1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.
- .2 Execute *Work* by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.
- .3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.

- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- .5 Use appropriate covers on trucks hauling fine, dusty, or loose materials.

1.4 DEWATERING

- .1 Provide temporary drainage and pumping as necessary to dewater excavations, trenches, foundations, and other parts of the *Work*. Maintain such areas free of water arising from groundwater or surface runoff, as required to keep them stable, dry, and protected from damage due to flooding.
- .2 Maintain standby equipment necessary to ensure continuous operation of dewatering system.
- .3 Do not pump water containing suspended materials or other harmful substances into waterways, sewers or surface drainage systems. Treat or dispose of such water in accordance with applicable regulatory requirements.

1.5 SITE DRAINAGE

- .1 Maintain grades to ensure proper site drainage.
- .2 Prevent surface water runoff from leaving the site except as otherwise indicated and considered in the overall Erosion and Sedimentation control plan for the site.
- .3 Prevent precipitation from infiltrating or from directly running off stockpiled materials, where precipitation could either degrade the stockpiled material or where runoff from the stockpiled material could contain environmentally damaging substances. In these cases, cover such stockpiled materials with an impermeable liner during periods of work stoppage including at end of each *Working Day*.
- .4 Control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas as required to prevent erosion and sedimentation.
- .5 Control surface drainage by ensuring that gutters are kept open and water is not directed across or over pavements or sidewalks, except through pipes or properly constructed troughs. Ensure that runoff from unfinished areas is intercepted and diverted to suitable outlets.

1.6 EROSION AND SEDIMENT CONTROL

- .1 This Article is meant to be complimentary to Section 01 35 43 - Environmental Procedures. Where there are conflicts between that Section and this one, the stricter requirements shall apply.
- .2 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and watercourses, and repair damage caused by soil erosion and sedimentation.

- .3 Provide and maintain appropriate temporary measures such as silt fences, straw bales, ditches, geotextiles, drains, berms, terracing, rip-rap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other measures that may be required to prevent erosion and migration of silt, mud, sediment, and other debris.
- .4 Do not disturb existing embankments or embankment protection.
- .5 Periodically inspect erosion and sediment control measures to detect evidence of erosion and sedimentation. Promptly take corrective measures when necessary.
- .6 If soil and debris from site accumulate in ditches or other low areas, remove accumulation and restore area to original condition.

1.7 POLLUTION CONTROL

- .1 Fires and burning of rubbish on site are not permitted.
- .2 Take measures to prevent contamination of soil, water, and atmosphere through uncontrolled discharge of noxious or toxic substances and other pollutants, potentially causing environmental damage.
- .3 Be prepared, by maintaining appropriate materials, equipment, and trained personnel on site, to intercept, clean up, and dispose of spills or releases that may occur.
- .4 Promptly report spills and releases that may occur to:
 - .1 authority having jurisdiction,
 - .2 person causing or having control of pollution source, if known, and
 - .3 *Departmental Representative and Consultant.*
- .5 Contact manufacturer of pollutant, if known and applicable, to obtain material safety data sheets (MSDS) and ascertain hazards involved and precautions and measures required in cleanup or mitigating actions.
- .6 Take immediate action to contain and mitigate harmful effects of the spill or release.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Provide *Products* that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by *Consultant*, furnish evidence as to type, source and quality of *Products* provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent while meeting required levels of quality and performance. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of *Work*.
- .3 Defective *Products*, whenever identified prior to completion of *Work*, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility but is precaution against oversight or error. Remove and replace defective *Products* at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or suitability of *Products*, decision rests strictly with *Consultant* based upon requirements of *Contract Documents*.
- .5 Unless otherwise specified, maintain uniformity of manufacture for like items throughout.
- .6 Permanent manufacturer's markings, labels, trademarks, and nameplates on *Products* are not acceptable in prominent locations, except where required by regulatory requirements or for operating instructions, or when located in mechanical or electrical rooms.

1.2 PRODUCT OPTIONS

- .1 Subject to the provisions of Section 01 25 00 - Substitution Procedures:
 - .1 Wherever a *Product* or manufacturer is specified by a single proprietary name, provide the named *Product* only.
 - .2 Wherever more than one *Product* or manufacturer is specified by proprietary name for a single application, provide any one of the named *Products*.
- .2 Wherever a *Product* is specified by reference to a standard only, provide any *Product* that meets or exceeds the specified standard. As part of the *Shop Drawing* submittal to the *Consultant*, submit information verifying that the proposed *Product* meets or exceeds the specified standard.
- .3 Wherever a *Product* is specified by descriptive or performance requirements only, provide any *Product* that meets or exceeds the specified requirements. As part of the *Shop Drawing* submittal to the *Consultant*, submit information verifying that the proposed *Product* meets or exceeds the specified requirements.

1.3 PRODUCT AVAILABILITY AND DELIVERY TIMES

- .1 Promptly upon *Contract* award and periodically during construction, review and confirm *Product* availability and delivery times. Order *Products* in sufficient time to meet the construction progress schedule and the *Contract Time*.

- .2 If a specified *Product* is no longer available, promptly notify *Consultant*. *Consultant* will take action as required.
- .3 If delivery delays are foreseeable, for any reason, promptly notify *Consultant*.
 - .1 If a delivery delay is beyond *Contractor*'s control, *Consultant* will provide direction.
 - .2 If a delivery delay is caused by something that was or is within *Contractor*'s control, *Contractor* shall propose actions to maintain the construction progress schedule for *Consultant*'s review and acceptance.

1.4 STORAGE, HANDLING, AND PROTECTION

- .1 Store, handle, and protect *Products* during transportation to *Place of the Work* and before, during, and after installation in a manner to prevent damage, adulteration, deterioration and soiling.
- .2 Comply with manufacturer's instructions for storage, handling and protection.
- .3 Store packaged or bundled *Products* in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in *Work*.
- .4 Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of material safety data sheets (MSDS).
- .5 Store *Products* subject to damage from weather in weatherproof enclosures.
- .6 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.
- .7 Store sheet *Products* on flat, solid, supports and keep clear of ground. Slope to shed moisture.
- .8 Remove and replace damaged *Products*.
- .9 Store cementitious products clear of earth or concrete floors, and away from walls or wet/damp areas.
- .10 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .11 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .12 Touch-up damaged factory finished surfaces to *Consultant*'s satisfaction. Use touch-up materials to match original. Do not paint over name plates.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Except where otherwise specified in technical *Specifications* or otherwise indicated on *Drawings*, comply with requirements of this Section.

1.2 MANUFACTURER'S INSTRUCTIONS

- .1 Install, erect, or apply *Products* in strict accordance with manufacturer's instructions.
- .2 Notify *Consultant*, in writing, of conflicts between *Contract Documents* and manufacturer's instructions where, in *Contractor's* opinion, conformance with *Contract Documents* instead of the manufacturer's instructions may be detrimental to the *Work* or may jeopardize the manufacturer's warranty.
- .3 Do not rely on labels or enclosures provided with *Products*. Obtain written instructions directly from manufacturers.
- .4 Provide manufacturer's representatives with access to the *Work* at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.3 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

- .1 Adequately protect parts of the *Work* completed and in progress from any kind of damage.
- .2 Promptly remove, replace, clean, or repair, as directed by *Consultant*, work damaged as a result of inadequate protection.
- .3 Do not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety or integrity of the *Work*.

1.4 REMEDIAL WORK

- .1 Notify *Consultant* of, and perform remedial work required to repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

1.5 EXCESS AND/OR UNSUITABLE MATERIALS

- .1 Unless a disposal site is designated, all excess materials found upon or excavated from the site shall become the property of the *Contractor* and shall be disposed of in accordance with all federal, provincial and municipal regulations and requirements, including acquisitions of permits, etc. The excess and/or unsuitable materials shall remain in the custody of the *Contractor* until delivery at the designated place.
- .2 All related costs shall be incidental to the work. The *Contractor* must indicate by letter, prior to start of *Contract*, where excess materials will be disposed of and provide written documentation showing that the *Owner* of the disposal site has granted approval, and that all environmental approvals, and any other required permits as may be necessary from the applicable regulatory agencies have been obtained. The *Contractor* shall be responsible

to identify, install, and maintain all required environmental protection measures at the disposal site, and shall follow any instructions received from the regulatory agencies having jurisdiction.

- .3 When insufficient space is available to allow placing of excavated materials on the right-of-way, the *Contractor* shall load, haul and stockpile such excavated materials at an off-site location arranged for by, and at the sole expense of the *Contractor*. When all excavation work is complete, the *Contractor* shall, at his own expense, bring back as much acceptable material as may be required to properly refill all excavations or trenches, or for general backfilling purposes.

1.6 SPECIAL EXCAVATION

- .1 The *Contractor* shall carry out special excavation required for the construction of the *Work* when ordered by the *Consultant*. The *Work* shall include the digging of test pits to determine the location or elevation of pipes, sewers, conduits, structures, or other objects or to ascertain underground conditions. Compensation for such exploratory work shall be negotiated or paid for under force account. This does not include “daylighting” of existing pipes to be connected to or other utilities which could be affected by this *Contract*, which is incidental to the *Work*.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REGULATORY REQUIREMENTS

- .1 Comply with applicable regulatory requirements when disposing of waste materials.
- .2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

- .1 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .2 Prevent cross-contamination during the cleaning process.
- .3 Notify the *Consultant* of the need for cleaning caused by *Owner* or other contractors.

1.3 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

- .1 Maintain the *Work* in a tidy and safe condition, free from accumulation of waste materials and construction debris.
- .2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables.
- .3 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each *Working Day*. Collect packaging materials for recycling or reuse.
- .4 Remove waste materials and recyclables from *Place of the Work* at regular intervals.
- .5 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.
- .6 Where public walkways are to be maintained through the *Place of the Work*, clear snow and ice from those public sidewalks as required to comply with applicable municipal regulatory requirements.

1.4 FINAL CLEANING

- .1 Remove from *Place of the Work* surplus *Products*, waste materials, recyclables, *Temporary Work*, and *Construction Equipment* not required to perform any remaining work.
- .2 Remove stains, spots, marks, and dirt from finished surfaces.
- .3 Remove stains, spots, marks, and dirt from exterior facades.
- .4 Use leaf blowers to clean landscaped surfaces.
- .5 Second thorough cleaning shall be allowed for after all deficiencies have been completed and signed-off. Site shall be cleaned to an acceptable condition as determined and accepted by *Consultant*.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.
- .2 Do not burn or bury waste materials at *Place of the Work*.
- .3 Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from *Place of the Work*, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.
- .4 Cover or wet down dry waste materials to prevent blowing dust and debris.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Government of New Brunswick, Canada
 - .1 *Construction Remedies Act* and its *Regulations*.

1.2 SUBSTANTIAL PERFORMANCE OF THE WORK

- .1 The prerequisites to, and the procedures for, attaining *Substantial Performance of the Work*, or similar such milestone as provided for in the lien legislation applicable to the *Place of the Work*, shall be:

- .1 independent of those for attaining *Ready-for-Takeover* of the *Work* where applicable in the General Requirements, and
- .2 in accordance with the lien legislation applicable to the *Place of the Work*.

- .2 In New Brunswick, *Substantial Performance* is defined in the provincial *Construction Remedies Act* and will be achieved when:

- .1 The *Work* is ready for use or is being used for the purpose intended and is so certified by the *Consultant*;
- .2 The *Work* has passed any final tests required by the *Contract Documents*;
- .3 The *Contractor* has given a written undertaking to complete any outstanding work expeditiously;
- .4 All project closeout documentation, commissioning and training has been received and/or accepted by the *Consultant*; and
- .5 If there is a known defect, or correction required, at a cost of not more than
 - .1 3 % of the first \$250,000 of the *Contract Price*,
 - .2 2 % of the next \$250,000 of the *Contract Price*, and
 - .3 1 % of the balance of the *Contract Price*.

1.3 INSPECTIONS

- .1 The *Contractor* shall make a request to the *Consultant*, in writing, at least ten (10) *Working Days* prior to the requested inspection date.
 - .1 *Contractor's Inspection*: *Contractor* and all *Subcontractors* shall conduct an inspection of the *Work*, identify deficiencies and defects; repair as required to conform to *Contract Documents*. Notify *Consultant* in writing of satisfactory completion of *Contractor's Inspection* and that corrections have been made. The *Contractor* may then request the *Consultant* to perform a *Substantial Performance Inspection*.
 - .2 *Substantial Performance Inspection*: The *Contractor*, when they believe the requirements described in the Definition of *Substantial Performance* have been achieved, may request a *Substantial Performance Inspection*. The *Consultant*, *Contractor* and *Owner* will perform an inspection of the *Work* to identify obvious defects or deficiencies. *Contractor* shall correct the deficiencies within a time

period agreeable to *Contractor* and *Consultant*. A *Certificate of Substantial Performance* may be issued. After all deficiencies are completed, the *Contractor* may call for a *Final Completion* inspection.

- .3 *Final Completion Inspection*: Once all defects or deficiencies have been addressed, the *Contractor* shall notify the *Consultant* in writing and request a *Final Completion* Inspection. If the *Consultant* is satisfied that all requirements of the *Contract* have been performed, a *Certificate of Final Completion* will be issued.
- .4 *Final Acceptance Inspection*: Eleven (11) months after the date declared in the *Certificate of Substantial Performance* and the completion of all deficiencies, the *Contractor* shall advise in writing that the *Work* is fully completed and is ready for *Final Acceptance* Inspection. Within ten (10) *Working Days* following receipt of this letter, the *Consultant* shall make arrangements for this final inspection of the *Work* with appropriate *Owner's* staff and the *Contractor*.
- .5 *Additional Inspections*: If the *Consultant* does not find the *Work* to be sufficiently complete to warrant a requested inspection (*Substantial Performance* or *Final Completion*) and the *Substantial Performance/Final Completion* certificate is not issued, the costs associated with extra inspections shall be borne by the *Contractor*.

1.4 CERTIFICATES

- .1 Role of Inspections
 - .1 Prior to making a request for Certificates under this section, the *Contractor* shall schedule the appropriate inspection as described in INSPECTIONS above.
 - .2 These inspections shall form the basis for determining the value of defects or deficiencies. Deficiency values determined through this process will be used to confirm adherence to the limits (% of *Contract Price*) for any Certificate issuance as described in the *New Brunswick Construction Remedies Act (NBCRA)*.
- .2 Certificate of *Substantial Performance*
 - .1 The *Contractor*, when they believe the requirements described in the Definition of *Substantial Performance* have been achieved, may make a request in writing to the *Consultant* for a *Certificate of Substantial Performance* in accordance with the *NBCRA*.
 - .2 The *Consultant* will review the request and respond in accordance with the *NBCRA*.
 - .3 If the *Consultant* is satisfied that the *Work* has been *Substantially Performed*, they will issue a Certificate and *Form 7* pursuant to the *NBCRA*.
 - .4 The *Contractor* shall post *Form 7*, in accordance with the *NBCRA*.
- .3 Certificate of *Final Completion*
 - .1 Requirements for *Final Completion*
 - .1 Final measurements and/or quantities have been approved and accepted in writing by both the *Consultant* and the *Contractor*;

- .2 The *Contractor* has, in writing, released the *Owner* for any further claims with respect to the *Contract*;
 - .3 The value of defects or deficiencies does not exceed one percent (1%) of the *Contract Price* in accordance with the *NBCRA*.
 - .2 Once these requirements have been met, the *Contractor* may make a request in writing to the *Consultant* for a Certificate of *Final Completion*.
- .4 Certificate of *Final Acceptance*
 - .1 Requirements for *Final Acceptance*
 - .1 Warranty and Maintenance period has expired;
 - .2 *Consultant* is satisfied the *Contractor* has fulfilled all the requirements of the *Contract*.
 - .2 Once these requirements have been met the *Contractor* may make a request in writing to the *Consultant* for a Certificate of *Final Acceptance*.

1.5 COMPLETION RETENTION

- .1 When the *Work*, in the opinion of the *Consultant*, is ready for use or is being used for the purposes intended, but the *Contractor* is unable to complete the remaining *Work* within the agreed schedule, the *Consultant* may, in its sole discretion, allow the *Contractor* to revise the schedule to complete a portion of the *Work* expeditiously and within the revised schedule.
- .2 The value of the incomplete and remaining *Work* may be deducted from the *Contract Price* in determining *Substantial Performance of the Work* in accordance with the *NBCRA*.
- .3 The *Contractor* is in no way relieved of their duty to complete the remaining *Work*.
- .4 The value of the incomplete and remaining *Work*, as established at the discretion of the *Consultant*, shall be referred to as the "Completion Retention" and will be subject to holdback in accordance with the *NBCRA*. For further detail, see Section 01 29 00 - Payment Procedures, Article entitled HOLDBACK AND RETENTION FUNDS.

1.6 PREREQUISITES TO FINAL PAYMENT

- .1 After *Substantial Performance of the Work* and before submitting an application for final payment in accordance with the General Conditions of *Contract*:
 - .1 Correct or complete all remaining defective, deficient, and incomplete *Work*.
 - .2 Remove from the *Place of the Work* all remaining surplus *Products*, *Construction Equipment*, and *Temporary Work*.
 - .3 Perform final cleaning and waste removal necessitated by the *Contractor's* work performed as specified in Section 01 74 00 - Cleaning and Waste Management.

1.7 FINAL CLEANING

- .1 Prior to requesting final payment, complete final cleaning as described in Section 01 74 00 - Cleaning and Waste Management.

1.8 CLOSEOUT DOCUMENTATION

- .1 Provide required closeout documentation as described in Section 01 78 00 - Closeout Submittals.

1.9 WARRANTY AND MAINTENANCE PERIOD

- .1 Pre-warranty Meeting :
 - .1 Convene meeting one week prior to *Contract* completion with *Contractor's* representative and *Consultant* in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify *Project* requirements.
 - .2 Review installation instructions and warranty requirements.
 - .2 *Consultant* to establish communication procedures to:
 - .1 Notify of construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
 - .3 Provide contact information for bonded and licensed company for warranty work action: name, telephone number and address of company authorized for construction warranty work action.
 - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.
- .2 The Warranty and Maintenance period shall commence on the date of *Substantial Performance* and end exactly twelve (12) months later.
 - .1 However, a number of supplied items may be subject to an extended warranty (as noted in the *Specifications*). The *Contractor* shall ensure that *Suppliers* are aware of the specific warranty requirements that apply under this *Contract*.
- .3 Refer to Section 01 78 00 - Closeout Submittals for additional Warranty documentation requirements.
- .4 Response to Defect, Fault or Deficiency identified prior to or during the Maintenance Period.
 - .1 The *Contractor*, at their own expense, shall be responsible to inspect, audit and maintain the *Work* and remedy any defects or deficiencies discovered or appearing in the *Work* from the first day of construction through the Date of Final Acceptance, to the *Consultant's* satisfaction.
 - .2 The *Contractor* further agrees to correct or pay for any damages to other work resulting from the said defects and/or the correction thereof, including all work incidental thereto.
 - .3 Deficiencies of a non-emergency nature must be repaired within five (5) *Working Days* of observation or after receipt of instructions in writing to do so.
 - .4 Deficiencies of an urgent or emergency nature must be repaired immediately upon observation or upon receipt of notification from the *Consultant*. Every effort possible must be made by the *Contractor* to repair such deficiencies immediately.

- .5 The failure to make necessary repairs or corrections due to lack of equipment, material, labour or any reasons whatsoever will result in the *Owner* causing the work to be done at the expense of the *Contractor*.
- .6 All costs and expenses incurred in correcting any defects which appear prior to and during the warranty and maintenance period, whether performed by the *Contractor*, his representative, or the *Owner* or his representative, shall be borne by the *Contractor*. The *Contractor* shall, in addition, be liable to the *Owner* for all expenses, losses, or damage incurred by the *Owner* as a result of any faulty materials and defective workmanship, or as a result of the *Contractor*'s failure to correct any defects as observed or as notified, including but not restricted to all extra engineering costs, inspection and testing of the *Work*, and all work incidental thereto.
- .7 The *Contractor*'s failure to resolve the defects or deficiencies shall permit access to the *Contractor*'s Performance Bond by the *Owner* to resolve such defects or deficiencies.
- .5 Neither the Certificate of *Substantial Performance*, the Certificate of *Final Acceptance*, nor any payment made thereunder by the *Owner* shall relieve the *Contractor* of his responsibilities for faulty materials or defective workmanship. Notwithstanding the provisions of this Article, if any statute in force in the jurisdiction where the *Product* was manufactured, or if manufacturer's warranty extends the liability for faulty products or workmanship beyond the scope of this *Contract*, then the provisions of such statute or manufacturer's warranty shall apply.

1.10 LIENS

- .1 Notice of Liens
 - .1 If the *Contractor* files a lien pursuant to the *New Brunswick Construction Remedies Act*, the *Contractor* is required to properly serve the *Owner*. In addition, the *Contractor* is required to simultaneously provide notice to the *Consultant* and the *Owner* by electronic means with a request to acknowledge receipt. In the event the *Owner* or the *Consultant* does not acknowledge receipt, notice shall be provided by personal service at the office of the *Owner* and the office of the *Consultant*.
- .2 Commencement of Lien and Warranty Periods: date of *Substantial Performance* to be date for commencement of warranty period and commencement of lien period, unless required otherwise by lien statute of *Place of the Work*.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 32 00 - Construction Progress Documentation.
 - .1 Refer to the above section for as-built and records documentation requirements.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 77 00 - Closeout Procedures.

1.2 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

- .1 Provide spare parts, extra stock and maintenance materials, and special tools:
 - .1 of same quality and manufacture as products provided in *Work*;
 - .2 in quantities specified in individual technical *Specifications* sections.
- .2 Provide items new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed *Products*.
- .3 For special tools, provide items with tags identifying their function and associated *Product* and equipment.
- .4 Deliver to site in the location as directed by *Owner* at *Place of the Work*. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.
- .5 Receive and catalogue items.
 - .1 Submit inventory listing organized by *Specifications* section to *Consultant*.
 - .2 Include approved listing in Project Manual.
- .6 Obtain receipt for delivered products and submit prior to final payment.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, extra stock and maintenance materials, and special tools in a manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by *Consultant*.

1.4 PROJECT MANUAL ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide evidence, if requested, for type, source and quality of products supplied.
- .3 Prepare a comprehensive Project Manual, in English, using personnel qualified and experienced for this task.

- .4 Four (4) weeks prior to *Substantial Performance of the Work* and no later than two (2) weeks prior to the completion of the *Work*, or as directed by the *Consultant*, submit one (1) initial copy of the draft Project Manual electronically, in PDF format, for *Consultant's* review. Any other format for submission must be agreed to with the *Consultant*.
- .5 Submitted copy of manual will be returned with *Consultant's* comments. Revise content of documents as required and resubmit revised draft for verification. If required, repeat this process until *Consultant* accepts the draft manual in writing.
- .6 Prior to *Substantial Performance of the Work*, submit complete sets of the final version of Project Manual to *Consultant* (all volumes, incorporating all of the *Consultant's* comments):
 - .1 One (1) printed hard copy and one (1) PDF copy on USB drive or other electronic media approved by *Owner*.
 - .2 The Project Manual (operation and maintenance documentation) is considered to have a value of \$2,500. If the Holdback release payment is issued in advance of receiving the finalized and approved closeout submittals, this value will be withheld in the form of a Deficiency Retention.

1.5 PROJECT MANUAL AND RECORD DOCUMENTS

- .1 Assemble and organize data in the form of an instructional manual (in several sections/volumes if necessary), and identify it with the typed title '**Project Manual and Record Documents**' (and the section/volume number if used).
 - .1 Binders: durable vinyl, hard covered, plastic jacketed, 3 hole 'D' ring binders, for loose leaf sized 219 x 279 mm (letter size), with spine and face pockets. Binders to be of thickness to adequately contain all necessary information.
 - .1 When multiple binders are used, correlate data into related consistent groupings.
 - .2 Identify each binder with a title sheet on cover and identification on spine.
 - .3 Within each binder, number pages consecutively.
 - .4 Mark each section with labelled cover tabs/dividers.
 - .2 Cover page of each section/volume:
 - .1 Section/volume number, title or identification of main subject matter of contents.
 - .2 List the *Contract/Project's* title, number, and location.
 - .3 Date of submission, version number or name (for example, draft or final), and name of person submitting.
 - .3 Contact information page:
 - .1 Addresses, and telephone numbers of *Contract's Consultant*, subconsultants, *Contractor* and *Subcontractors* with name of responsible parties.
 - .4 Tables of contents:

- .1 Create main Project Manual table of contents listing all sections/volumes of the Project Manual and Record Documents and their content sections' titles, and include it with each binder, if more than one binder is used.
 - .1 Sections/Volumes should be 4 main categories:
 - .1 Operation and Maintenance Manual
 - .2 Shop Drawings Binder
 - .3 Project Construction Record Drawings and Specifications
 - .4 Warranties and Bonds
 - .2 Create a specific table of contents for each section/volume's included data.
 - .1 Contents arranged following the sequence of specification section numbers and/or schedule of products and systems.
- .5 Include a schedule of products and systems. Arrange contents following this schedule, by system, under section numbers and sequence of each section/volume's table of contents.
- .6 Shop Drawings:
 - .1 Supply one complete set of final reviewed shop drawings for all items ordered during the course of the *Work*, indicating corrections and changes made during fabrication and installation.
 - .2 Provide with reinforced punched binder tab.
 - .3 Bind in with text; fold larger drawings to size of text pages.
 - .4 Use clear drawings, diagrams or manufacturer's literature.
 - .5 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions as specified in Section 01 40 00 - Quality Requirements.
 - .6 As required, provide 1:1 scaled CAD files in .dwg format via email or other electronic transfer services, or on USB drive.
- .7 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.
- .8 Additional contents requirements as specified in individual technical *Specifications* sections.

1.6 VOLUME 1 - OPERATION AND MAINTENANCE MANUAL

- .1 Supply written operating and maintenance instructions, which shall be sufficiently comprehensive to enable the operator to operate and maintain the equipment supplied. Include following information plus all other data specified.
- .2 *Product*, Equipment and Systems – For each separate *Product*, item of equipment and system, include following data:
 - .1 Provide labelled tabbed fly leaf with typed description of product and major component parts of equipment, including detailed parts lists. When multiple binders are used, correlate data into related consistent groupings with contents identified on cover and spine of each binder.

- .2 List names, addresses and telephone numbers of contractors, subcontractors, manufacturers, suppliers, distributors and installers, including local source of supplies and replacement parts.
 - .3 Organize data in the following order and in a logical sequence:
 - .1 Reviewed/stamped *Shop Drawings* for each product, equipment or system
 - .2 Product data, manufacturer's printed data
 - .3 Operating instructions and procedures
 - .4 Maintenance instructions and procedures
 - .5 Warranty documents specific to products, equipment or systems, including all requirements detailed in the article titled WARRANTIES AND BONDS herein.
 - .4 Mark each sheet to clearly identify specific products, options and component parts, and data applicable to installation on this specific *Project*. Delete or strike out inapplicable information. Supplement with additional information as required.
 - .5 Include typewritten data, manufacturer's printed data, and all information required to supplement product data, incorporating manufacturer's printed operation and maintenance instructions. Neatly type lists and notes providing logical sequence of instructions for each procedure.
 - .6 Give function, normal operation characteristics and limiting conditions.
 - .7 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .8 Information on building products, applied materials, and finishes to include product data, with catalogue number, options selected, size, composition, and colour and texture designations.
 - .9 Manufacturing, design, supplementary drawings to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - .10 Provide information for re-ordering custom manufactured products.
 - .11 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .12 Include installed colour coded wiring diagrams.
 - .13 Include sequence of operation by controls manufacturer.
 - .14 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - .15 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .16 Provide installed control diagrams by controls manufacturer.
 - .17 Provide *Contractor's* coordination drawings, with installed colour coded piping diagrams.
 - .18 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .3 Operating instructions:

- .1 Prepare instructions as a systems manual including, but not limited to the following:
 - .1 Descriptions of, and operating instruction for, each major component of the facility as supplied, including detailed parts lists.
 - .2 A list of major equipment components with complete model and serial number information, and a list of local and head office manufacturer's representatives including telephone and fax numbers.
 - .3 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .4 Include regulation, control, stopping, shutdown, and emergency instructions.
 - .5 Instructions for operation of the equipment in all intended modes of operation. Include summer, winter, and any special operating instructions.
 - .6 All information and instructions concerning the operation and maintenance of all mechanical equipment and controls.
 - .7 Instructions for all adjustments which must be performed at initial start-up of the facility and adjustments which must be performed in the course of preventive maintenance as specified by the manufacturer.
- .4 Operation and maintenance instructions shall be specific to the equipment supplied in accordance with these *Specifications* for this specific *Project*. Instruction manuals applicable to many different configurations, and which require the operator to selectively read portions of the instructions, shall not be acceptable.
- .5 Maintenance instructions:
 - .1 Maintenance Requirements: include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .2 For all systems, procedures shall include items such as, but not limited to:
 - .1 servicing and cleaning schedules;
 - .2 lubrication schedules and list of lubricants required;
 - .3 filters replacement or maintenance;
 - .4 overhaul and adjustment schedules.
 - .3 For finished surfaces and materials: copy of hardware and paint schedules and description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate name plate information such as make, model, size, capacity and serial number.
 - .4 For all surfaces, moisture-protection and weather-exposed products and materials: include manufacturer's recommendations and instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - .5 Include an outline of requirements for routine and special inspections and for regular maintenance to ensure that ongoing performance of the building envelope will meet the initial building envelope criteria.

1.7 VOLUME 2 - WARRANTIES AND BONDS

- .1 Guarantees, warranties and bonds showing:
 - .1 Name and address of *Project*;
 - .2 Guarantee commencement date (date of *Substantial Performance*);
 - .3 Duration of guarantee;
 - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee;
 - .5 Signature **and seal** of *Contractor*;
- .2 All work and equipment to include a 12-month warranty after the Date of *Substantial Performance* unless otherwise specified in other Sections.
- .3 Develop warranty management plan to contain information relevant to Warranties.
 - .1 Submit warranty management plan 30 calendar days before planned pre-warranty meeting for *Consultant's* approval. See Section 01 77 00 - Closeout Procedures for more information.
 - .2 Warranty management plan to include required actions and documents to assure that *Owner* receives warranties to which they are entitled.
 - .3 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel. Specifically, plan will include:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of *Contractors*, *Subcontractors*, manufacturers or *Suppliers* involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include all items supplied and commissioned.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or *Suppliers*.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include 12-month overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

- .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .4 *Contractor's* plans for attendance at post-construction warranty inspections.
 - .5 Procedure and status of tagging of equipment covered by extended warranties.
 - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .4 Submit to *Consultant* all warranty information made available during construction phase for approval prior to each monthly pay estimate.
- .5 Assemble approved information in binder/volume/section, submit upon acceptance of *Work* and organize as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to table of contents listing.
 - .2 List additional material used in *Project* listed under various Sections, showing name of manufacturer and source of supply.
 - .3 List each warrantor, *Subcontractor*, *Supplier*, and manufacturer, with name, address, and telephone number of responsible principal.
 - .4 Obtain warranties and bonds, executed in duplicate by *Subcontractors*, *Suppliers*, and manufacturers, within ten (10) calendar days after completion of applicable item of *Work*.
 - .5 Verify that documents are in proper form, contain full information, and are notarized.
 - .6 Ensure that warranties are for the correct duration and are in *Owner's* name.
 - .7 Co-execute submittals when required.
 - .8 Retain warranties and bonds until time specified for submittal.
- .6 Except for items put into use with *Owner's* permission, leave date of beginning of time of warranty blank until Date of *Substantial Performance* is determined.
- .7 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .8 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the *Consultant* to proceed with action against *Contractor*.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate operation and maintenance of equipment and systems to *Owner's* personnel two weeks prior to date of substantial completion.
- .2 *Owner*: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation.
 - .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the designated location.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Engineer's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct *Owner's* personnel.

.2 Provide written report that demonstration and instructions have been completed.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

- .1 General requirements relating to commissioning of *Project's* components and systems, specifying general requirements to performance verification of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms:

AFD	Alternate Forms of Delivery, service provider
BMM	Building Management Manual
Cx	Commissioning
EMCS	Energy Monitoring and Control Systems
O M	Operation and Maintenance
PI	Product Information
PV	Performance Verification
TAB	Testing, Adjusting and Balancing

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished *Project*. Cx is performed after systems and integrated systems are completely installed, functional and *Contractor's* Performance Verification responsibilities have been completed and approved. Objectives:
- .1 Verify installed equipment, systems and integrated systems operate in accordance with *Contract Documents* and design criteria and intent.
- .2 Ensure appropriate documentation is compiled into the BMM.
- .3 Effectively train O M staff.
- .2 *Contractor* to assist in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
- .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be operated interactively with each other as intended in accordance with *Contract Documents* and design criteria.
- .2 During these checks, make adjustments to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per *Owner's* requirements or determined by designer. To meet *Project* functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .2 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .3 *Consultant* will issue Certificate of *Substantial Performance* when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by *Consultant*.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required *Consultant*, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by *Contractor*. Above costs to be in form of progress payment reductions as Deficiency Retention or holdback assessments.

1.5 PRE-Cx REVIEW

- .1 Before Construction:
 - .1 Review *Contract Documents*, confirm by writing to *Consultant*.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely the design criteria and intent and special features.
 - .6 Submit complete start-up documentation to *Consultant*.

- .7 Have Cx schedules up-to-date.
- .8 Ensure systems have been cleaned thoroughly.
- .9 Complete TAB procedures on systems, submit TAB reports to *Consultant* for review and approval.
- .10 Ensure "As-Built" system schematics are available.
- .4 Inform *Consultant* in writing of discrepancies and deficiencies on finished *Work*.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this Section and other Sections to *Consultant* before start-up, and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of *Contract*:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to *Consultant* for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to *Consultant* where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by *Consultant*.

1.8 COMMISSIONING DOCUMENTATION

- .1 *Consultant* to review and approve Cx documentation.
- .2 Provide completed and approved Cx documentation to *Consultant*.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 00 - Construction Progress Documentation.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: per Section 01 31 19 - Project Meetings and Section 01 32 00 - Construction Progress Documentation and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, and identify deficiencies relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60 % construction completion stage, per Section 01 32 00 - Construction Progress Documentation, Cx Agent to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of *Contractor* and *Subcontractors*, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until *Project* completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by *Contractor*, who will record and distribute minutes.
- .7 Ensure *Subcontractors* and relevant manufacturer representatives are present at 60 % and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

- .1 *Contractor* assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days of notice prior to commencement.
- .2 *Consultant* to witness of start-up and testing.
- .3 *Contractor's* Cx Agent to be present at tests performed and documented by sub-trades, *Suppliers* and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by *Consultant*.
 - .3 Arrange for *Consultant* to witness tests.
 - .4 Obtain written approval of test results and documentation from *Consultant* before delivery to site.
- .2 Obtain manufacturer's installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with *Consultant*.

- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 Ability to report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 *Post-Substantial Performance* verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from *Consultant* after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by *Consultant*. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by *Consultant*.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by *Consultant*.
 - .3 If evaluation report concludes that major damage has occurred, *Consultant* shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to *Consultant* for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up checklists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit *Consultant* to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer, develop written maintenance program and submit to *Consultant* for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of Certificate of *Substantial Performance*.

1.17 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

- .1 Notify *Consultant* at least 21 calendar days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

- .1 Submit to *Consultant* for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

- .1 *Consultant* to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to *Consultant* within 5 calendar days of test and with Cx report.

1.23 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by *Consultant* in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.24 EXTENT OF VERIFICATION

- .1 Laboratory areas:
 - .1 Provide manpower and instrumentation to verify up to 100 % of reported results.
- .2 Elsewhere:
 - .1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other Sections.
- .3 Number and location to be at discretion of *Consultant*.
- .4 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .5 Review and repeat commissioning of systems if inconsistencies found in more than 20 % of reported results.
- .6 Perform additional commissioning until results are acceptable to *Consultant*.

1.25 REPEAT VERIFICATIONS

- .1 Assume costs incurred by *Consultant* for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive *Consultant's* approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 *Consultant* deems *Contractor's* request for second verification was premature.

1.26 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.27 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of *Consultant*.
- .2 Report problems, faults or defects affecting Cx to *Consultant* in writing. Stop Cx until problems are rectified. Proceed with written approval from *Consultant*.

1.28 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx *Specifications*, complete Cx prior to issuance of Certificate of *Substantial Performance*.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by *Consultant*.

1.29 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.30 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in *Contract*.

1.31 OCCUPANCY

- .1 Co-operate fully with *Consultant* during stages of acceptance and occupancy of facility.

1.32 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under *Contract* for TAB and PV if:
 - .1 Accuracy complies with these *Specifications*.
 - .2 Calibration certificates have been deposited with *Consultant*.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.33 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within $\pm 10\%$ of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within $\pm 2\%$ of recorded values.

1.34 OWNER'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by *Owner* or *Consultant* will not relieve *Contractor* from compliance with specified start-up and testing procedures.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This Section specifies roles and responsibilities of Commissioning and Training.
- .2 Refer to Section 10 81 01 – Supply and Installation of WWTF Aeration System for specific requirements pertaining to the Commissioning for the new aeration system upgrades.

1.2 MEASUREMENT AND PAYMENT

- .1 There shall be no separate payment for Commissioning and Training, but all related costs shall be included in Section 10 81 01 – Supply and Installation of WWTF Aeration System.

1.3 INSTRUCTORS

- .1 Engineer will provide:
 - .1 Descriptions of systems.
 - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

- .1 Training to be detailed and duration to ensure:
 - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
 - .2 Effective on-going inspection, measurements of system performance.
 - .3 Proper preventive maintenance, diagnosis and trouble-shooting.
 - .4 Ability to update documentation.
 - .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
-

- .2 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.
 - .3 Maintenance Manual.
 - .4 Management Manual.
 - .5 TAB and PV Reports.
- .3 Project Manager and Commissioning Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
 - .1 Multimedia (ie Powerpoint) presentations.
 - .2 Manufacturer's training videos.
 - .3 Equipment models.

1.6 SCHEDULING

- .1 Include in Commissioning Schedule time for training.
- .2 Training to be completed prior to acceptance of facility.
- .3 Training to be scheduled for a time convenient to the *Owner* and *Owner's* personnel.

1.7 RESPONSIBILITIES

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
- .2 Engineer will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Engineer.

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

- .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
- .7 Maintenance and servicing.
- .8 Trouble-shooting diagnosis.
- .9 U.V. System operations & Maintenance.
- .10 Interaction among systems during integrated operation.
- .11 Review of O & M documentation.
- .12 Communication training including:
 - .1 Aeration System, including monitoring process performance.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 The work to be performed under this Section consists of the removal of and disposal of all civil, mechanical, architectural/structural, and electrical marked to be removed, including but not limited to the following:
 - .1 Decommissioning and removal of existing chlorination building including all building mechanical and electrical;
 - .2 Removal of abandoned chlorine solution line;
 - .3 Removal of existing aeration system;
 - .4 Removal of existing baffle curtain walls;
 - .5 Removal and disposal of existing fencing;
 - .6 Removal and disposal of existing aeration blowers, concrete pad, existing blower piping, valves, fittings and instrumentation, existing toilet and proper capping of existing plumbing and any other items as shown on Drawings labelled to be removed.
- .2 The Contractor shall receive confirmation from the Consultant to proceed prior to the removal of the blowers and associated equipment.
- .3 Various existing features are to be protected during construction as shown on the Drawings. The Contractor shall protect all such features throughout the course of the work. This includes but is not limited to, lagoon synthetic liner, outlet chambers, various electrical and mechanical components in the Blower building, piping through building slab, building, the door, etc. Protection of existing features will not be measured for payment but is considered incidental to the work.

1.2 RELATED REQUIREMENTS

- .1 01 29 00 – PAYMENT PROCEDURES.
- .2 Refer to detailed drawings for specific requirements for removals.

1.1 REFERENCES

- .1 Reference Standards:
 - .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .2 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

1.2 SITE CONDITIONS

- .1 Site Environmental Requirements.
 - .1 Perform work in accordance with Section 01 35 43 - Environmental Procedures.

- .2 Ensure that removals work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .3 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout the project.
- .4 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities.
- .6 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .2 Existing Conditions.
 - .1 Remove contaminated or hazardous materials from site as directed by the Consultant, prior to start of demolition Work, and dispose of at designated disposal facilities in safe manner in accordance with applicable regulatory requirements.

Part 2 Products

2.1 Not Used

- .1 Not Used.

Part 3 Execution

3.1 PREPARATION

- .1 Inspect site with Consultant and verify extent and location of items designated for removal, disposal, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Contact proper utility companies in order to coordinate the demolition of the building

3.2 REMOVAL OF HAZARDOUS WASTES

- .1 Remove contaminated or dangerous materials defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.

3.3 REMOVAL OPERATIONS

- .1 Remove items as indicated in an orderly fashion and in accordance with the proper authorities.
- .2 Do not disturb items designated to remain in place.
- .3 Refer to drawings for items to be removed.
- .4 Disposal of Material:

- .1 Dispose of materials not designated for salvage or reuse on site.
- .2 Return the existing generator to the Departmental Representative.

3.4 RESTORATION

- .1 Restore areas and existing works outside areas of demolition match condition of adjacent, undisturbed areas.
- .2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
 - .3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

3.6 PROTECTION

- .1 Repair damage to adjacent materials or property caused by selective site demolition.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 07 92 00 - Joint Sealants

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA A23.1/A23.2 -19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
 - .2 CAN/CSA O86-19, Engineering Design in Wood
 - .3 CSA O121-17, Douglas Fir Plywood
 - .4 CSA O141-05 (R2014), Softwood Lumber
 - .5 CSA O151-17, Canadian Softwood Plywood
 - .6 CSA O153-19, Poplar Plywood.
 - .7 CSA O325.0-16, Construction Sheathing
 - .8 CSA O437 Series-93(R2011), Standards for OSB and Waferboard
 - .9 CSA S269.1-16, Falsework and Formwork

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: convene preinstallation meeting one week before beginning concrete works.
 - .1 Ensure key personnel are in attendance.
 - .1 Verify Project requirements.

1.4 SHOP DRAWINGS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit shop drawings for formwork and falsework.
 - .1 Submit drawings stamped and signed by a qualified Professional Engineer registered or licensed in the Province of New Brunswick.
 - .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework and formwork drawings.
 - .3 Indicate sequence of erection and removal of formwork/falsework.
 - .4 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

- .5 A copy of the formwork drawings shall be kept at the Contractor's work area while temporary supporting structures are under construction or use.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: In accordance with Section 01 40 00 - Quality Requirements.
- .2 Retain a Professional Engineer registered or licensed in the Province of New Brunswick with experience in formwork and falsework design of comparable complexity and scope, to perform following services as part of Work of this Section:
 - .1 Design of formwork and falsework:
 - .2 Review, stamp, and sign fabrication and erection Shop Drawings, design calculations and amendments.
 - .3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of Work is in accordance with Contract Documents and reviewed Shop Drawings.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.Store and protect formwork and falsework from damages.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.
 - .2 Place materials defined as hazardous or toxic in designated containers.
 - .3 Divert wood materials from landfill to a recycling facility.
 - .4 Divert plastic materials from landfill to a recycling facility.
 - .5 Divert unused form release material from landfill to an official hazardous material collections site.
- .5 Packaging Waste Management: Remove for reuse as specified in accordance with Section 01 74 00 – Cleaning and Waste Management.

Part 2 Products

2.1 MATERIALS

- .1 Formwork materials:

- .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CAN/CSA O86, CSA O151, CSA O153.
- .2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2 .
- .2 Form ties:
 - .1 For concrete not designated 'Architectural': removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes minimum 25 mm diameter in concrete surface.
 - .2 For Architectural or interior exposed concrete, snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form liner:
 - .1 Plywood: medium density overlay, 19 mm thick.
- .4 Pan forms: free of bends, dents, and residual concrete.
- .5 Form release agent: chemically active release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps, preventing concrete from sticking to forms. Selected product to be non-toxic, biodegradable and low VOC.
- .6 Falsework materials: to CSA S269.1 .
- .7 Sealant: to Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork and ensure dimensions agree with drawings.
- .2 Obtain Consultant's approval for framing openings not indicated on drawings.
- .3 Use of earth forms for footings and walls is not permitted.
- .4 Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2 and as indicated below.
- .5 Formwork and all supporting or bracing members shall be designed such that they will not deflect noticeably under the weight or pressure of the concrete and other loadings incidental to construction. The maximum deflection of facing materials in concrete surfaces exposed to view shall be 1/360 of the span between supporting members.
- .6 When necessary to maintain specified tolerances, the formwork shall be cambered to compensate for anticipated deflections.
- .7 Formwork for exposed concrete must be constructed with watertight joints. To prevent leakage of paste at corners and joints in the forms and against existing concrete, use gaskets or other approved means which will not mar the finished appearance of the concrete. Arrange form ties and plywood panels in a regular pattern. Submit shop drawings showing pattern of forms and form ties.

- .8 A form release agent shall be applied to all forms where the finished concrete surface is to be exposed. The release agent shall be non-staining.
- .9 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .10 Use 20 mm chamfer strips on external corners and/or 20 mm fillets at interior corners and joints of all exposed concrete members unless specified otherwise.
- .11 Form reveals, chases, slots, openings, drips, recesses, expansion, and control joints as indicated.
- .12 Build in anchors, sleeves and other inserts required to accommodate work specified in other sections.
 - .1 Ensure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .13 Clean formwork in accordance with CSA A23.1/A23.2 before placing concrete.
- .14 Inspect forms after each use. Damaged surfaces must be replaced or repaired so that no evidence of the damage is apparent in the finished concrete.

3.2 FORMWORK REMOVAL

- .1 Leave formwork in place for following minimum periods of time after placing concrete:
 - .1 2 day for footings.
 - .2 3 days for walls.
- .2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later.
- .3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Space reshoring in each principal direction at not more than 3000 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.
- .6 Surface tolerances to CSA A23.1/A23.2.

3.3 ALLOWABLE TOLERANCES

- .1 Variations from the plumb: In the lines and surfaces of walls: - 6 mm per 3 metres, but not more than 20 mm.
- .2 Variation from the level of the grades indicated on the drawings: - 6 mm in 3 metres, but not exceed 10 mm.
- .3 Variations in the sizes and locations of sleeves, floor openings and wall openings: Plus or minus 6 mm.
- .4 Variation in the thickness of slabs and walls: Minus - 6 mm; Plus - 12 mm.
- .5 Footings: Variations in dimensions in plan: Minus - 12 mm. Plus - 50 mm. Misplacement or eccentricity: Plus or minus - 30 mm.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 03 35 00 - Concrete Finishing.

1.2 REFERENCE STANDARDS.

- .1 American Concrete Institute (ACI)
 - .1 ACI 315R-18, Guide to Presenting Reinforcing Steel Design Details.
- .2 ASTM International (ASTM)
 - .1 ASTM A 108-18, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 - .2 ASTM A 123/A 123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .3 ASTM A 143/A 143M-07(2014), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
 - .4 ASTM A 641/A 641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - .5 ASTM A 1064/A 1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .3 CSA Group (CSA):
 - .1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A283-19, Qualification code for concrete testing laboratories
 - .3 CAN/CSA A23.3-19, Design of Concrete Structures
 - .4 CSA G30.18-09(R2019), Carbon Steel Bars for Concrete Reinforcement.
 - .5 CSA G40.20/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
- .4 Reinforcing Steel Institute of Canada (RSIC):
 - .1 RSIC-2020, Reinforcing Steel Manual of Standard Practice

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Preinstallation Meetings: convene preinstallation meeting one week before beginning concrete works.
 - .1 Ensure key personnel are in attendance.
 - .1 Verify project requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS) in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped with each page stamped and signed by Professional Engineer registered or licensed in the Province of New Brunswick.
 - .1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315R-18.
 - .2 Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacing, locations of reinforcement and mechanical splices if approved by Consultant, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacing and locations of chairs, spacers and hangers.
 - .3 Detail lap lengths and bar development lengths to CAN/CSA A23.3, unless otherwise indicated.
 - .1 Provide type B tension lap splices unless otherwise indicated.
 - .4 Indicate position and size of openings in slabs and walls. Coordinate with trades requiring openings.
- .4 Quality Assurance Submittals:
 - .1 Submit in accordance with Section 01 40 00 - Quality Requirements and Section 01 33 00 - Submittal Procedures.
 - .2 Mill Test Report: Upon request, submit to Consultant certified copy of mill test report of reinforcing steel, 4 weeks before beginning reinforcing work.

- .3 Upon request submit in writing to Consultant proposed source of reinforcement material.
- .4 Upon request submit to Consultant epoxy coating applicator certificates identified in Quality Assurance.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Store and manage hazardous materials in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .4 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 Reinforcing steel shall be off-loaded from the truck directly onto purpose made storage racks and covered with tarp.
 - .3 Clean reinforcing steel of excess rust and previously deposited concrete prior to placing concrete.
 - .4 Replace defective or damaged materials with new.
- .5 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.
 - .2 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle, transport, store, and install epoxy coated reinforcing steel bars to prevent damage to coating. Prevent bar-to-bar abrasion and excessive sagging. Do not drop or drag bars. Store on suitable non-metallic supports. For lifting use nylon lifting slings, padded slings, or separators.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Consultant.
- .2 Reinforcing Steel: Billet steel, 400W, deformed bars to CSA G30.18 , unless indicated otherwise.
- .3 Cold-drawn annealed steel wire ties: To ASTM A 1064/A 1064M.
- .4 Deformed steel wire for concrete reinforcement: To ASTM A 1064/A 1064M.

- .5 Welded steel wire fabric:
 - .1 Deformed in accordance ASTM A 1064/A 1064M , fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings.
 - .2 Provide in flat sheets only.
- .6 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2, Non-metallic where within 40 mm of exposed concrete surfaces or to suit specific cover requirements.
- .7 Tie wire: 1.5 mm diameter annealed wire.
- .8 Mechanical splices: subject to approval of Consultant.
- .9 Plain Round Bars: To CSA G40.20/G40.21.
- .10 Post-Installed Rebar:
 - .1 Adhesive: Injectable, two-part epoxy suitable for use in cracked and uncracked Concrete. Acceptable products:
 - .1 HIT-HY 200-R V3. Adhesive by HILTI
 - .2 Alternate materials: Approved by addendum in accordance with 00 21 1 3 Instructions to Bidders.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Consultant's written 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.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 2 weeks prior to commencing reinforcing work.
- .2 Upon request, inform Consultant of proposed source of materials to be supplied.

Part 3 Execution

3.1 SITE BENDING

- .1 Do not site bend or site weld reinforcement except where indicated or authorized by Consultant.

- .2 When site bending authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.
- .2 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1/A23.2.
- .3 Install, support and space reinforcement in alignment to position and clearances indicated and secure to supports.
- .4 Unless otherwise indicated, provide the following cover for reinforcing:
 - 75 mm - Where concrete is cast against earth.
 - 50 mm - 20M bars or larger.
 - 50 mm - Slabs-on-grade.
 - 40 mm - 15M bars or smaller.
- .5 Ensure cover to reinforcement is maintained during concrete pour.
- .6 Prior to placing concrete, obtain Consultant's approval, in writing, of reinforcing material and placement. Use of approved chairs to support reinforcement in slabs is mandatory.
- .7 Remove and replace reinforcement which is visibly damaged or cracked.
- .8 Do not cut reinforcement, either before or after concrete is placed, to permit incorporation of other work.
- .9 Do not relocate reinforcement without approval from Consultant.
- .10 Clean reinforcement before placing concrete.
- .11 All wall dowels shall be set in forms prior to placing concrete and held in place by approved means so that each dowel is maintained in its correct position. Dowels shall not be inserted in freshly placed concrete.
- .12 The Consultant shall be notified when the reinforcing steel is in place and in sufficient time to permit an inspection of same prior to concrete placement. Minimum 48-hour notification required.
- .13 Use plain round bars as slip dowels in concrete.
 - .1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
 - .2 Apply thick even film of mineral lubricating grease when paint is dry.

- .14 Before placing concrete, obtain Consultant's approval of reinforcing material and placement.

3.3 SITE QUALITY CONTROL

- .1 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 35 00 - Concrete Finishing.
- .5 Section 07 92 00 – Joint Sealants.

1.2 ABBREVIATIONS AND ACRONYMS

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement types:
 - .1 GU, GUb, GUL and GULb - General use cement.
 - .2 MS, MSb and MSLB - Moderate sulphate-resistant cement.
 - .3 MH, MHb, MHL and MSLB - Moderate heat of hydration cement.
 - .4 HE, HEb, HEL and HELb- High early-strength cement.
 - .5 LH, LHb, LHL LHLb - Low heat of hydration cement.
 - .6 HS, HSb and HSLb - High sulphate-resistant cement.
- .2 Fly ash types:
 - .1 F - with CaO content maximum 8%.
 - .2 CI - with CaO content 15 and 20%.
 - .3 CH - with minimum CaO content of 20%.
- .3 Other Supplementary Cementitious Materials (SCM) types:
 - .1 S-GGBFS - Ground, granulated blast-furnace slag.
 - .2 N - Natural pozzolan.
 - .3 SF - Silica fume with minimum silicon dioxide (SiO_2) content of 85%.
 - .4 SFI - Silica fume with silicon dioxide (SiO_2) content between 75% and 85%.
 - .5 GL - Ground glass with maximum total alkali (NaEq) content of 4%.
 - .6 GH - Ground glass with total alkali (NaEq) content between 4% and 13%.

1.3 DEFINITIONS

- .1 Supplementary Cementitious Materials (SCM)s: Materials added to concrete which contribute to the properties of hardened concrete through hydraulic or pozzolanic activity.

- .2 Workability: The term Workability broadly describes the total properties and expectations for concrete delivered to site as follows:
 - .1 Individual tested properties of concrete that account for confined or free flow slump, penetration, compaction, or relative plasticity of various concrete mix designs used for the project.
 - .2 Overall properties involved with mixing, handling, transportation, and placement using vibratory compaction methods without loss of homogeneity of in-place concrete.

1.4 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C 260/C 260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C 309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C 494/C 494M-17, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C 881/C 881M-15, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - .5 ASTM C 1017/C 1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .6 ASTM C C1059/C1059M- 13, Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
 - .7 ASTM D 412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .8 ASTM D 624-2012, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .9 ASTM D 1751-04(2014)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .10 ASTM D 1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-19, Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005),

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: convene preinstallation meeting one week before beginning concrete works.
 - .1 Ensure key personnel are in attend attendance.
 - .1 Verify project requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Site Quality Control Submittals:
 - .1 Submit proposed quality control procedures for Consultant's review.
 - .2 Minimum two (2) weeks prior to starting concrete work, submit proposed quality control procedures for Consultant's approval for following items:
 - .1 Cold and hot weather concreting.
 - .2 Temporary bracing.
 - .3 Chairs and spacers for support of reinforcing.
 - .4 Curing of concrete.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joint forming and filling. (location of control joints)
 - .8 Pour Sequence Plan (location of construction joints)
 - .9 Waterstops
 - .3 Provide testing results for review by Consultant and do not proceed without written approval when deviations from mix design or parameters are found.
 - .4 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in article titled Field Quality Control in Part 3 of this section.
 - .5 Concrete hauling time: provide for review by Consultant deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.7 CONSTRUCTION QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out in accordance with CSA A23.1.

- .2 Testing laboratory will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .3 Non-destructive methods for testing concrete shall be in accordance with CSA A23.2.
- .4 Inspection or testing by Consultant, or Testing Agency designated by Consultant, will not augment, or replace the Contractor's quality control nor relieve him of his contractual responsibilities.

1.8 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
- .2 At least 2 weeks prior to beginning Work, inform Consultant of proposed source of aggregates and provide access for sampling.

1.9 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 40 00 - Quality Requirements.
- .2 Convene pre-installation meeting one week prior to beginning of concrete work.
 - .1 Ensure key personnel, site supervisor, Consultant, speciality contractor - finishing, forming concrete producer, and representative from testing laboratories attend.
 - .2 Verify project requirements.
- .3 Provide Consultant, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .4 Quality Control Plan: provide written report to Consultant verifying compliance that concrete in place meets performance requirements of concrete as established in Part 2 of this section.
- .5 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA A23.1.
- .6 Provide mix designs in compliance with CSA A23.1 to provide concrete quality, yield and strength as specified under 2.4 Mixes. Mix designs to be prepared, stamped and signed by Professional Engineer registered or licensed in the Province of New Brunswick.
- .7 Provide certification that the concrete supplier is certified by the Atlantic Provinces Ready Mixed Concrete Association program or equivalent. This certification is to remain in good standing for the duration of the project and until the warranty period expires.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Modifying maximum time limit without receipt of before written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2 is prohibited.
 - .2 Deviations submitted for review by Consultant.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2 .
- .2 Packaging Waste Management: remove for reuse and return packaging materials in accordance with 01 74 00 – Cleaning and Waste Management:
 - .1 Separate waste materials for reuse and recycling.
 - .2 Divert unused concrete materials from landfill to local quarry facility approved by Consultant.
 - .3 Provide an appropriate area on the job site where concrete trucks can be safely washed.
 - .4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by the Consultant.
 - .5 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
 - .6 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial and National regulations.

1.11 SITE CONDITIONS

- .1 Placing concrete during rain or weather events that could damage concrete is prohibited.
- .2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.
- .3 Cold weather protection to CSA A23.1/ A23.2 and:
 - .1 Maintain protection equipment, in readiness on Site.
 - .2 Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.
 - .3 Placing concrete upon or against surface at temperature below 5°C is prohibited.
- .4 Hot weather protection to CSA A23.1/ A23.2 and:
 - .1 Protect concrete from direct sunlight when ambient temperature above 27°C.

- .2 Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.
- .5 Protect concrete from drying.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in article titled Mixes in Part 2 of this section.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Consultant and provide verification of compliance as described in article titled Quality Assurance in Part 1 of this section.

2.3 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU, Type GUb or as required to meet chloride ion permeability requirements as per CSA A 23.1.
- .2 Blended hydraulic cement: Type GUb to CSA A3001.
- .3 Supplementary cementitious materials: to CSA A3001.
- .4 Water: to CSA A23.1.
- .5 Aggregates:
 - .1 To CSA A23.1/A23.2,
 - .2 Non-reactive,
 - .3 Coarse aggregates to be normal density,
 - .4 Maximum aggregate size to be 20 mm, unless otherwise.
- .6 Admixtures:
 - .1 Air entraining admixture: to ASTM C 260.
 - .2 Chemical admixture: to ASTM C 494 and ASTM C 1017. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Acceptable products:
 - .1 M-Bed standard by Sika Canada Inc.
 - .2 Masterflow 713 Grout by Master Builders Technologies Ltd.

- .3 NS Grout by Euclid Canada Inc.
- .4 Alternate materials: Approved by addendum in accordance with Instructions to Tenderers.
- .8 Curing compound:
 - .1 CSA A23.1/A23.2 white and ASTM C 309, Type 1-chlorinated rubber.
 - .1 Acceptable products:
 - .1 Kurez Vox by Euclid Chemical Company.
 - .2 Sealtight 1220 White Pigmented Curing Compound by W.R. Meadows.
 - .3 Florseal by Sika Canada Inc.
 - .4 Alternate materials: Approved by addendum in accordance with Instructions to Tenderers.
 - .5 Use curing compounds compatible with applied finish on concrete surfaces. Provide written certification that compounds used are compatible.
- .9 Joint Sealer:
 - .1 Pre-moulded Isolation Joint Filler:
 - .1 To be flexible, lightweight, non-staining, polyethylene, and closed cell. It shall be a chemical-resistant, ultraviolet stable, non-absorbent, low density, compressible foam and have the following requirements:
 - .1 Density, to ASTM D1751: 32.04 kg/m³.
 - .2 Compression, to ASTM D3575
 - .3 10% Deflection: 69 kPa maximum.
80% Deflection: 862.49 kPa maximum.
 - .4 Tensile Strength, to ASTM D3575: 379.50 kPa
 - .5 Water Absorption, to ASTM D3575: 0.5% volume maximum.
 - .6 Temperature Stability: -40°C to 71°C.
- .10 Polyethylene film:
 - .1 0.25 mm thickness to CAN/CGSB-51.34.
- .11 Adhesive for dowel and anchor rod anchorage.
 - .1 Injectable, two-part epoxy to ACI 355.4 and ICC-ES AC308 for use in cracked and uncracked concrete.
- .12 Ribbed waterstops: extruded PVC of sizes indicated with shop welded corner and intersecting pieces:
 - .1 Tensile strength: to ASTM D 412 , method A, Die "C". Min 10 MPa
 - .2 Elongation: to ASTM D 412 , method A, Die "C", minimum 275%.
 - .3 Tear resistance: to ASTM D 624 , method A, Die "B". Min. 30kN/m
- .13 Pre-moulded joint fillers:

- .1 Bituminous impregnated fibre board: to ASTM D 1751 .
- .2 Sponge rubber: to ASTM D 1752 , Type I, firm grade.
- .3 Standard cork: to ASTM D 1752 , Type II.
- .14 Dampproof membrane in accordance with Section 07 13 52 Modified Bituminous Sheet Waterproofing.
- .15 Polyethylene underslab vapour barrier, 0.25 mm (10 mil), meeting minimum requirements of ASTM E1745 Class C. Supply with bond tape for joints.
 - .1 Acceptable Products:
 - .1 Vapor Block 10 by Raven Industries.
 - .2 Moistop Ultra 10 by Fortifiber.
 - .3 Alternate Materials: Approved by addendum in accordance with Instructions to Tenderers.
 - .2
- .16 Acrylic adhesive for dowel and anchor rod anchorage: to ASTM C881, Type IV, Grade 3, Class A, B and C.
 - .1 Acceptable products:
 - .1 Sika AnchorFix4 Anchoring Resin as supplied by Action Fasteners.
 - .2 Epcon Acrylic 7 by ITW Ramset/Red Head.
 - .3 HIT HY200 Adhesive System by HILTI.
 - .4 Acrylic-Tie-Anchoring System by Simpson Strong-tie.
 - .5 Alternate materials: Approved by addendum in accordance with Instructions to Tenderers.

2.4 MIXES

- .1 The Contractor shall be responsible for the concrete mix design.
- .2 It shall be the responsibility of the Contractor to ensure that the mixture proportions shall be properly batched, mixed, placed and cured such that the concrete conforms to the specifications.
- .3 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 – Performance method, to give the following quality for concrete as indicated:
 - .1 Provide concrete mix to meet following hard state requirements for:
 - .1 Foundation walls and footings:
 - .1 Type GU cement.
 - .2 Minimum compressive strength at 28 days: 32 MPa.
 - .3 Class of exposure: F-2.
 - .4 Maximum water/cement ratio: 0.45.
 - .5 Nominal maximum size of coarse aggregate: 19 mm.
 - .6 Slump at time and point of discharge: 80 mm - 30 mm.

- .7 Air content: 4 - 7%.
- .8 Admixtures: Consultant's approval before using admixtures.
- .2 Interior Housekeeping Pads and Pipe Supports:
 - .1 Type GU cement.
 - .2 Minimum compressive strength at 28 days: 30 MPa.
 - .3 Class of exposure: N.
 - .4 Maximum water/cement ratio: 0.45.
 - .5 Nominal maximum size of coarse aggregate: 19 mm.
 - .6 Slump at time and point of discharge: 80mm -30mm.
 - .7 Air content: natural
 - .8 Admixtures: Consultant's approval before using admixtures.
- .3 Exterior Slabs
 - .1 Durability and class of exposure: C-1.
 - .2 Compressive strength at 28 days age: 35 MPa minimum.
 - .3 Coarse aggregate size 20 mm maximum.
 - .4 Air content: 4 to 7%.
- .4 Mud-slabs:
 - .1 Compressive strength at 28 days: 15 MPa.
 - .2 Slump: 75 mm.
 - .3 Nominal maximum size of coarse aggregate: 20 mm.
- .4 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .5 Obtain Consultant's approval before using admixtures.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Consultant's written approval before placing concrete.
 - .1 Provide 48 hours minimum notice before placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed except as noted in the contract documents or as directed by the Consultant.
 - .2 Ensure concrete delivery and handling facilitate placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete permitted only after approval of equipment and mix.

- .5 Disturbing reinforcement and inserts during concrete placement is prohibited.
- .6 Before placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains before application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.
- .10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Post-installed rebar not shown on drawings to be authorized by Consultant
 - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy adhesive to anchor and hold dowels in positions as indicated.
- .11 Do not place load upon new concrete until authorized by Consultant.
- .12 Reinforcing steel, embedded parts, and inserts to be secured in position prior to placing concrete.
- .13 Ensure that reinforcement and formwork are thoroughly clean before placing concrete.
- .14 Ensure that foundation bearing materials are free from water and frost. Remove previously frozen bearing materials.
- .15 Keep excavation dry while placing concrete.
- .16 Do not permit vertical free fall of concrete mix to exceed 1500 mm

3.2 INSTALLATION/ APPLICATION

- .1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2 .
- .2 Hot-weather and cold-weather concreting shall be carried out, protected, and cured in accordance with CSA A23.1.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Slabs-on-grade to be moist cured for minimum 7 days.
- .5 Sleeves and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through structure, except where indicated or approved by Consultant.
 - .2 Where approved by Consultant, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.

- .3 Sleeves and openings greater than 100 x 100 mm not indicated shall be reviewed by Consultant.
- .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Consultant before placing concrete.
- .5 Confirm locations and sizes of sleeves and openings shown on drawings. Coordinate work with all trades.
- .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .6 Anchor Rods:
 - .1 Set anchor bolts to templates in coordination with appropriate trade before placing concrete.
 - .2 Epoxy anchor bolts in holes drilled after concrete has set only after receipt of written approval from Consultant.
 - .1 Drilled holes: diameter and depth as recommended by the manufacturer and after reviewed by Consultant.
 - .3 Protect anchor bolt holes from water accumulations, snow, and ice build-ups.
 - .4 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
 - .5 As per Section 05 50 00 Metal Fabrications
- .7 Anchor Rods for Prefabricated Building:
 - .1 To be drilled-in anchors as designed and supplied by prefabricated building supplier.
- .8 Post-Installed Rebar
 - .1 Adhesive: Injectable, two-part epoxy to ACI 355.4 and ICC-ES AC308 for use in cracked and uncracked concrete. Acceptable products:
 - .2 HIT HY200 Adhesive System by HILTI.
 - .3 Alternate materials: Approved by addendum in accordance with Instructions to Tenderers.
- .9 Waterstops:
 - .1 Install waterstops to provide continuous water seal, as per manufacturer's specifications.
 - .2 Do not distort or pierce waterstop in way as to hamper performance.
 - .3 Do not displace reinforcement when installing waterstops.
 - .4 Use equipment to manufacturer's requirements to field splice waterstops.
 - .5 Tie waterstops rigidly in place.
 - .6 Use only straight heat-sealed butt joints in field.
 - .7 Use factory welded corners and intersections unless otherwise approved by Consultant.

- .10 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .11 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by Consultant or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface not damaged.
 - .3 Formed surfaces:
 - .1 Interior wall surfaces to be left exposed in finished work – smooth rubbed finish
 - .4 Slab and floor finishes:
 - .1 As per CSA A23.1/23.2.
 - .2 Concrete floors intended as finished surface: except as specified herein, finish surfaces to produce a smooth, steel troweled surface free from ridges, trowel marks or undulations to a tolerance defined in Table 21, Class A.
 - .3 Float surface with wood or metal floats and power finishing machine and bring surface to true grade.
 - .4 Steel trowel to smooth and even surface.
 - .5 All exposed slab-on-grade concrete surfaces to be continuously cured for initial 7 days after finishing.
 - .6 Refer to Section 03 35 00 - Concrete Finishing, for additional requirements for interior slabs-on-grade to receive epoxy finish.
 - .7 Cure concrete in accordance with CSA A23.1/23.2. If required, use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration of compatibility of compounds used.
 - .8 Provide finish as required by topping manufacturer where bonded topping is specified.
 - .9 Provide swirl-trowelled finish for interior slab unless otherwise indicated or required by topping manufacturer.
 - .10 Provide broom finish for exterior slabs unless otherwise required.
 - .11 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .12 Joint fillers:
 - .1 Provide filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Consultant.
 - .2 When more than one piece required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form joints as indicated.
 - .4 Install joint filler.

- .5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.
- .13 Dampproof membrane:
 - .1 Install dampproof membrane under concrete slabs-on-grade inside building.
 - .2 Lap dampproof membrane minimum 150 mm at joints or as indicated by manufacturer and seal.
 - .3 Seal punctures in dampproof membrane before placing concrete.
 - .4 Use patching material minimum 150 mm larger than puncture or as indicated by manufacturer and seal.

3.3 SAW-CUT CONTROL JOINTS

- .1 Use purpose-made “early entry” concrete saws. To be Soff-Cut, or approved alternate.
- .2 Capability: Employ sufficient number of saws and workers to complete cutting sawed joints before shrinkage produces cracking.
- .3 Start cutting sawed joints as soon as concrete has hardened sufficiently to prevent ravelling or dislodging of aggregates, (approximately 2 to 5 hours and when concrete strength has reached 0.5 MPa).
- .4 Saw-cut pattern to be as shown on reviewed slab-on-grade shop drawings
- .5 Apply joint sealer in saw-cut joints in accordance with sealant manufacturer’s written instructions.

3.4 CONSTRUCTION JOINTS

- .1 Any construction joints not indicated on the drawings to be approved by the Consultant.
- .2 No horizontal construction joints will be permitted in any foundation walls unless noted on the drawings or otherwise approved by the Consultant.
- .3 Unless noted otherwise, construction joints detailed without a key shall have a roughened surface and reinforcing steel shall be continuous through construction joints.

3.5 SURFACE TOLERANCE

- .1 Concrete tolerance in accordance with CSA A23.1/A23.2 and as otherwise indicated on the drawings.

3.6 SITE QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 40 00 - Quality Requirements and submit report as described in article titled Action and Informational Submittals in Part 1 of this section.

- .1 Concrete pours.
- .2 Slump.
- .3 Air content.
- .4 Compressive strength at 7, 14 and 28 days.
- .5 Air and concrete temperature.
- .2 The services of a concrete testing laboratory will be hired and paid for by the Contractor to perform testing of concrete placed during construction.
 - .1 Consultant will receive every report regarding the site and issued by the testing company no later than the Contractor for review to CSA A23.1/A23.2.
 - .2 Ensure testing laboratory certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Consultant.
- .4 Consultant will direct the contractor to take additional test cylinders during cold weather or hot weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2 .
- .6 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.
- .7 Testing Criteria
 - .1 Strength test – procedure:
 - .1 Six cylinders to be taken from each sample.
 - .2 Cylinders will be tested as follows:
 - .1 One at 7 days.
 - .2 One at 14 days.
 - .3 Two at 28 days.
 - .4 Two cylinders to be held and tested at 56 days if tests at 28 days fail.
 - .2 Strength test – frequency:
 - .1 Not less than one test each day concrete is placed.
 - .2 Not less than one test for each 50 cubic metres, or major fraction thereof, placed in one day.
 - .3 Not less than one test for each type of concrete poured.
 - .4 Not less than one test for each concrete element exceeding 2 cubic metres in volume.
 - .3 Slump test:
 - .1 Determined for each strength test sample.
 - .2 Additional slump tests to be taken as good practice dictates.
 - .4 Air content:

- .1 Determined for each strength test sample.
 - .5 Temperature:
 - .1 Determined for each strength test sample.
- .8 Evaluation of tests:
 - .1 Strength test results:
 - .1 Average of 28-day strength of two cylinders from each sample.
 - .1 If one cylinder manifests evidence of improper sampling, molding, handling, curing, or testing, strength of remaining cylinder will be test result.
 - .2 If both cylinders show any of above defects, test will be discarded.
 - .3 If no tests are available for a structure of more than 2 cubic metres, on site, non-destructive tests shall be conducted at no additional cost to the Consultant.
- .9 Acceptance of concrete:
 - .1 Strength level of each type of concrete shall be considered satisfactory if both of the following requirements are met:
 - .1 Average of all sets of three consecutive strength tests equals or exceeds the required specified 28-day compressive strength.
 - .2 No individual strength test falls below the required specified 28-day compressive strength.
 - .2 If tests fail to indicate satisfactory strength level, perform additional tests and/or corrective measures at no additional cost to Consultant.
- .10 Inspection and testing company will take additional test cylinder during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .11 Unsatisfactory results:
 - .1 In case of unsatisfactory results, the Consultant shall have the right to request one or more of the following at no extra cost to the Consultant.
 - .1 Non-destructive testing.
 - .2 Core drilling and testing.
 - .3 Removing and replacing of all defective concrete.
 - .2 Should the strength of concrete already poured, as shown by job cured test cylinders, fall below the required strength at 28 days, or at 7 days test fail to reach a minimum of 75% of 28 days strength, the Consultant shall have the right to require changes in mixing proportions for the remainder of the work so as to attain these strengths. He shall also have the right to require additional curing of these portions of the work represented by test specimens not meeting the herein quoted strength criteria.

- .3 Should such additional curing not produce the required strength, the Consultant shall have the right to require strengthening or replacement of the portions of work in question at no additional cost to the Consultant.
- .4 The Consultant reserves the right to reduce the amount of payment for all concrete which failed to meet the requirements of the drawings and this specification, where the defect is such as to permit leaving the concrete in question in place.
- .12 Rejection:
 - .1 All construction not meeting the required standard of quality and workmanship shall be rejected unless, in the opinion of the Consultant, suitable repair work can be performed within the work schedule. Cost of replacement or repair shall be borne entirely by the Contractor. All remedial work must be carried out to the satisfactory of the Consultant.

3.7 CLEANING

- .1 Clean in accordance with 01 74 00 – Cleaning and Waste Management.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Prepare Construction Waste Management plan in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .2 Divert unused concrete materials from landfill to local facility after receipt of written approval from Consultant.
 - .3 Provide appropriate area on job site where concrete trucks and be safely washed.
 - .4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Consultant.
 - .5 Disposal of unused admixtures and additive materials, concrete, concrete wash water, or cleaning materials and residues into sewer systems, into lakes, streams, onto ground or in other location to pose health or environmental hazard is prohibited.
 - .6 Prevent admixtures and additive materials from entering drinking water supplies or streams.
 - .7 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
 - .8 Dispose of waste in accordance with applicable local, Provincial and National regulations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 01 29 00 – Payment Procedures.
- .2 03 30 00 - Cast-in-place Concrete
- .3 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C 309-11, Liquid Membrane-Forming Compounds for Curing Concrete
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors
- .3 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 If requested, provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 If requested, submit WHMIS Safety Data Sheet (SDS).
 - .3 Include application instructions for concrete floor treatments.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name, and address.

1.5 SITE CONDITIONS

- .1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 m² of floor being treated.

- .2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area: Make work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature: Maintain minimum 10 degrees C ambient temperature for 7 days before installation and minimum 48 hours after completion of work and maintain relative humidity maximum 40 % during same period or as per manufactures instructions, whichever is more stringent.
- .5 Moisture: Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- .6 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 Ventilate area of work as directed by the Consultant by use of portable supply and exhaust fan.
 - .2 Provide continuous ventilation during and after coating application.

Part 2 Products

2.1 EPOXY FINISH

- .1 The building shall have a finished concrete floor to CSA A23.1 and will have two (2) coats of epoxy floor coating.
- .2 Acceptable product: STONKOTE GS4 with anti-slip texture No.2 as manufactured by STONHARD Limited, SIKAFLOOR 261 with 50 mech anti-slip texture as manufactured by SIKA Canada Inc., or approved equal. Floor finish colour to be determined by Consultant.
- .3 Pipe sleeves to be sealed with STONEFLEW CJ4 by STONEHARD Limited, or approved equal.

2.2 MIXES

- .1 Mixing, ratios and application in accordance with manufacturer's instructions.

2.3 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 40 00 - Quality Requirements.
- .2 Submit written declaration components used compatible and not adversely affect finished flooring products and their installation adhesives.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify slab, substrate and site conditions surfaces are ready to receive work and elevations as indicated on shop drawings and recommended by manufacturer's written instructions.

3.2 PREPARATION OF EXISTING SLAB

- .1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- .2 Saw cut control joints to CSA A23.1 , 24 hours maximum after placing of concrete.
- .3 Use strong solvent mechanical stripping to remove chlorinated rubber or existing surface coatings.
- .4 Use protective clothing, eye protection, and respiratory equipment during stripping of chlorinated rubber or existing surface coatings.

3.3 APPLICATION

- .1 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .2 Apply floor treatment in accordance with manufacturer's written instructions.
- .3 Clean overspray. Clean sealant from adjacent surfaces.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

3.5 PROTECTION

- .1 Protect finished installation in accordance with manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 04 05 13 - Masonry Mortaring and Grouting.
- .4 Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .5 Section 04 22 00 - Concrete Unit Masonry.
- .6 Section 07 92 00 - Joint Sealant

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-A165 Series-14, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A371-14, Masonry Construction for Buildings.
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: conduct preinstallation meeting one week before commencing work of this Section to:
 - .1 Verify project requirements, including mock-up requirements.
 - .2 Verify substrate conditions.
 - .3 Coordinate products, installation methods and techniques.
 - .4 Sequence work of related sections.
 - .5 Coordinate with other building subtrades.
 - .6 Review manufacturer's installation instructions.
 - .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
 - .8 Review warranty requirements.
- .2 Comply with manufacturer's written recommendations for sequencing construction operations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.
- .4 Test and Evaluation Reports:
 - .1 Submit certified test reports in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
 - .3 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.
- .5 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 EXTRA MATERIALS

- .1 Submit manufacturer's instructions in accordance with Section 01 78 00 - Closeout Submittals covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect material packages from nicks, scratches, and blemishes.
- .3 Keep materials dry until use except where wetting of bricks is specified.
- .4 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.
- .2 Weather Requirements: to CAN/CSA-A371 and to IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- .3 Cold weather requirements:
 - .1 To CAN/CSA-A371 with following requirements.
 - .1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.
 - .2 Maintain ambient temperature of masonry work and its constituent materials between 5 degrees C and 50 degrees C and protect site from wind-chill.
 - .3 Maintain temperature of masonry above 0 degrees C for minimum of 7 days, after mortar is installed.
 - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.
 - .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.
 - .3 Spray mortar surface at intervals and keep moist for maximum of 3 days after installation.

Part 2 Products

2.1 MATERIALS

- .1 Masonry materials are specified in related Sections.

Part 3 Execution

3.1 INSTALLERS

- .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

- .1 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience.

3.2 EXAMINATION

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Consultant.
- .3 Verification of Conditions:
 - .1 Verify that:
 - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions before installation masonry.
 - .2 Site conditions are acceptable and are ready to receive work.
 - .3 Built-in items are in proper location, and ready for roughing into masonry work.
 - .2 Commencing installation means acceptance of existing substrates.

3.3 PREPARATION

- .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.
- .2 Establish and protect lines, levels, and coursing.
- .3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

- .1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

- .1 Masonry:
 - .1 Remove chipped, cracked, and otherwise damaged units, in accordance with CAN/CSA-A165 and replace with undamaged units.

- .2 Jointing:
 - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
 - .2 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
- .3 Cutting:
 - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
 - .2 Make cuts straight, clean, and free from uneven edges.
- .4 Building-In:
 - .1 Build in items required built into masonry.
 - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
 - .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- .5 Support of loads:
 - .1 Use 25 MPa concrete to Section 03 30 00 - Cast-in-Place Concrete, where concrete fill is used instead of solid units.
 - .2 Use grout to CAN/CSA-A179 where grout is used instead of solid units
 - .3 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm back from faces of units.
- .6 Provision for movement:
 - .1 Leave 3 mm space below shelf angles.
 - .2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements, unless noted otherwise. Do not use wedges.
 - .3 Built masonry to tie in with stabilizers, with provision for vertical movement.
- .7 Loose steel lintels:
 - .1 Install loose steel lintels, where indicated. Center over opening width.
- .8 Control joints:
 - .1 Construct continuous control joints as indicated and spaced no more than 6 meters apart or as indicate on drawings.
- .9 Interface with other work:
 - .1 Cut openings in existing work as indicated.
 - .2 Openings in walls: reviewed by Consultant.
 - .3 Make good existing work. Use materials to match existing.

3.6 SITE TOLERANCES

- .1 Tolerances in notes to CAN/CSA-A371 apply

3.7 SITE QUALITY CONTROL

- .1 Site Tests, Inspection:
 - .1 Perform site inspection and testing in accordance with Section 01 40 00 - Quality Requirements.
 - .2 Notify inspection agency minimum of 48 hours in advance of requirement for tests.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.

3.9 PROTECTION

- .1 Temporary Bracing:
 - .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
 - .2 Bracing reviewed by Consultant.
 - .3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.
- .2 Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.
- .3 Moisture Protection:
 - .1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
 - .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
 - .3 Air Temperature Protection: protect completed masonry as recommended in 1.10, Site Conditions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 04 05 00 - Common Work Results for Masonry.
- .3 Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .4 Section 04 22 00 - Concrete Unit Masonry.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A371-14, Masonry Construction for Buildings.
 - .4 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry mortar and grout and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOCs mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .3 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Reports:

- .1 Submit reports on mortar indicating conformance of mortar to property requirements of CSA A179, component mortar materials to requirements of CSA A179 and test and evaluation reports to CSA A179.
- .2 Submit reports on grout indicating conformance of component grout materials to requirements of CSA A179 and test and evaluation reports to CSA A179
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.
 - .1 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Weather Requirements: to CAN/CSA-A371.

Part 2 Products

2.1 MATERIALS

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cementitious Material: CSA A179.
 - .1 Portland Cement: CSA A3001, Type GU, natural grey colour.
- .3 Mortar Aggregate: CSA A179, fine aggregate.
- .4 Grout Aggregate: CSA-A179, fine aggregate.
- .5 Water: Clean and potable.
- .6 Admixtures: VOC compliant, type required to suit mix design.
- .7 Cleaning Solution: Maximum 25 g/l VOC

2.2 MORTAR MIXES

- .1 Mortar: Use Type S mortar to CSA A179 for all exterior concrete masonry walls and all interior walls. Maximum 250 g/l VOC.
- .2 Mortar Colour: Provide coloured additives for coloured mortar; colour selection by Consultant.

2.3 MORTAR MIXING

- .1 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use
- .2 Maintain sand uniformly damp immediately before mixing process.
- .3 Add mortar colour and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.
- .4 Do not use antifreeze liquids, calcium chloride, frost inhibitors based on calcium chloride, salts or other substances used for lowering the freezing point or accelerating setting time.
- .5 Adding air entraining admixture to mortar mix is prohibited.
- .6 Use a batch type mixer in accordance with CAN/CSA-A179
- .7 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
- .8 Use mortar within 1.5 hours after mixing at temperatures of 25 degrees C or higher, or 2.5 hours at temperatures less than 25 degrees C within period specified by mortar manufacturer.

2.4 GROUT MIXES

- .1 Bond Beams, Lintels and Engineered Masonry: grout mix 20 MPa strength at 28 days; 200-250mm slump; premixed type in accordance with CSA A23.1/A23.2, mixed in accordance with CAN/CSA-A179.

2.5 GROUT MIXING

- .1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 transit mixed
- .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA-A179 grout.
- .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .4 Using calcium chloride or chloride-based admixtures is prohibited.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for masonry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Apply bonding agent to existing substrate.
- .2 Plug clean-out holes with masonry units.
- .3 Brace masonry for wet grout pressure.

3.3 CONSTRUCTION

- .1 Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise.

3.4 MIXING

- .1 Clean mixing boards and mechanical mixing machine between batches.
- .2 Mortar: weaker than units it is binding.

3.5 MORTAR PLACEMENT

- .1 Install mortar to requirements of CAN/CSA-A179 and to manufacturer's instructions.
- .2 Remove excess mortar from grout spaces.

3.6 GROUT PLACEMENT

- .1 Install grout in accordance with manufacturer's instructions.
- .2 Install grout in accordance with CAN/CSA-A179
- .3 Work grout into masonry cores and cavities to eliminate voids.
- .4 Installing grout in lifts greater than 400 mm, without consolidating grout by rodding is prohibited.
- .5 Displacing reinforcement while placing grout is prohibited.

- .6 Grout all bond beam, lintels, lintel supports, and all vertical rebar locations as indicated on drawings.

3.7 FIELD QUALITY CONTROL

- .1 Perform testing in accordance with Section 01 40 00 - Quality Requirements.
- .2 Test mortar and grout mix in accordance with CSA A179.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Remove droppings and splashings using clean sponge and water.
 - .3 Clean masonry with low pressure clean water and soft natural bristle brush.
 - .4 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

3.9 PROTECTION

- .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 04 05 00 - Common Work Results for Masonry.
- .4 Section 04 05 13 - Masonry Mortaring And Grouting.
- .5 Section 04 22 00 - Concrete Unit Masonry.
- .6 Section 05 50 00 – Metal Fabrications.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 36/A 36M-14, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A 167-15, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .4 ASTM A 641/A 641M-(R2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .5 ASTM A 1022 16B, Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement.
 - .6 ASTM E84-2021a - Test Method for Surface Burning Characteristics of Building Materials.
- .2 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A370-14, Connectors for Masonry.
 - .4 CAN/CSA-A371-14, Masonry Construction for Buildings.
 - .5 CSA G40.20/G40.21-2018 - General Requirements for Rolled or Welded Structural Steel/Structural Quality Steel
 - .6 CSA G164-2020 - Hot Dip Galvanizing of Irregularly Shaped Articles
 - .7 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .8 CSA G30.3-M1983 (R1998) - Cold-Drawn Steel Wire for Concrete Reinforcement
 - .9 CSA S304-14(R2015), Design of Masonry Structures.

- .10 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 ULC (Underwriters Laboratories of Canada) - List of Equipment and Materials for:
 - .1 Building Materials.
 - .2 Fire Resistance.
 - .3 Firestop Systems and Components

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for anchorage and reinforcing materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped with each page stamped and signed by Professional Engineer registered or licensed in the Province of New Brunswick.
 - .2 Submit drawings detailing bar bending details, anchorage details lists and placement drawings.
 - .3 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
 - .4 Ensure wall control joint layout is approved by Consultant and in accordance with Section 04 05 00 article 1.4.3.3.

1.4 QUALITY ASSURANCE

- .1 Perform Work in accordance with CSA A371 - Masonry Construction for Buildings and CSA S304.14 - Design of Masonry Structures.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience.
- .3 Convene one (1) week before starting work of this section for pre-installation meeting.

1.5 SITE MEASUREMENTS

- .1 Make site measurements necessary for proper fit of members.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.7 TEMPORARY REQUIREMENTS

- .1 Scaffolding and access to Work:
 - .1 Provide scaffolding as required to access the Work and for storage of materials.
 - .2 Comply with local occupational health and safety regulations.
 - .3 Allow access to scaffolding by other trades whose Work is integral or related to the Work of this Section, including but not limited to installation of masonry back-up, air and vapour barrier membrane, cavity wall insulation, and openings.
- .2 Heating and Hoarding: By General Contractor; coordinate installation of temporary utilities and equipment required to maintain specified environmental requirements

Part 2 Products

2.1 MATERIALS

- .1 Steel Wire: CSA G30.3.
- .2 Connectors: to CAN/CSA-A370 and CSA S304.1
- .3 Steel Sections and Plates: CAN/CSA-G40.20/G40.21, Grade 350W.

2.2 REINFORCEMENT

- .1 Refer to Drawings for reinforcement details for interior and exterior walls.
- .2 Horizontal Reinforcement: Single Wythe Joint Reinforcement: CSA A370, continuous ladder type; cold drawn steel wire.
 - .1 Finish:
 - .1 Exterior use: Hot dip galvanized to ASTM A123/A123M after fabrication.
 - .2 Interior Use: Plain mill finish.
 - .2 Load Bearing Walls and Shear Walls
 - .1 Wire Size: 4.76mm Heavy Duty @ every second course (400mm on center)
 - .2 Place joint reinforcement in first and second mortar joints below bond beams.

- .3 Vertical Reinforcement, lintels and bond beams: Bar Reinforcing Steel: CAN/CSA-G40.18, Grade 400W, deformed billet bars, uncoated finish.
 - .1 Place joint reinforcement in first and second mortar joints above and below openings. Extend reinforcement minimum 600 mm past openings.
 - .2 Reinforce stack bonded unit joint corners and intersections with strap anchors 400 mm on centre at corners and intersections, cut inside bar and bend both bars. Bar Anchors: CSA A370, bent steel shape, hot dip galvanized to ASTM A123/A123M after fabrication.
 - .3 Provide 1 -15M vertical full height at the following locations:
 - .1 Unsupported ends of walls.
 - .2 Each corner and at intersections.
 - .3 Each side of door, window or other openings
 - .4 Use class 'B' tension lap splice for all reinforcing bars. Provide reinforcement from foundations to match core fill reinforcement diameter and spacing.
 - .5 Provide wall control joint at locations shown on the Consultant's drawings, maximum spacing to be at 12 m. Reinforce and core fill each side as indicated.
 - .6 Provide 200 mm deep bond beam at bottom of openings, extending 400 mm past edge of opening.
- .4 Rod and Bolt Anchors: CSA A370, formed steel rods, adjustable, hot dip galvanized to ASTM A123/A123M after fabrication, size as indicated
 - .1 Anchor Bolts: 12 mm diameter x 150 mm long with embedded ends bent 50 mm at 90 degrees, exposed ends threaded with washer and nut.

2.3 MASONRY ANCHORS

- .1 Insulation Retainer: Plastic, wedge-type insulation retainer. Provide one for each tie in cavity wall construction, coordinate installation with placement of insulation.
- .2 Connect with screws recommended by manufacturer. Submit sample
- .3 Post-Installed Anchors for support framing, Masonry Walls:
 - .1 Adhesive: Injectable, two-part epoxy suitable for use in cracked and uncracked hollow masonry. Acceptable products:
 - .1 HIT-HY 270 Adhesive Anchor System by HILTI, used with HIT-SC composite sleeves.
 - .2 Alternate materials: Approved by addendum in accordance with Instructions to Tenderers.

2.4 FABRICATION

- .1 Fabricate bar reinforcing in accordance with CSA A23.1/A23.2.
- .2 Fabricate reinforcement, anchors, ties and connectors to CSA A370.

- .3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.
- .4 Upon approval of Consultant, weld reinforcement in accordance with CSA W186
- .5 Ship reinforcement and connectors, clearly identified in accordance with drawings.
- .6 Refer to Structural Drawings for additional masonry connectors and details.

2.5 SOURCE QUALITY CONTROL

- .1 Upon request provide Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis.
- .2 Upon request inform Consultant of proposed source of supplied material.

2.6 ACCESSORIES

- .1 Access Doors: Supplied by Mechanical and Electrical Division; installed by this Section

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for anchorage and reinforcing materials installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 INSTALLATION

- .1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370 , CAN/CSA-A371 , CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise
- .2 Prior to placing, obtain Consultant's approval of placement of reinforcement and connectors.
- .3 Supply and install additional reinforcement to masonry as indicated.
- .4 Secure reinforcing steel in place. Inspect steel connections before grouting.

- .5 Provide cleanout openings at bottom of cores containing reinforcement.
- .6 Fill cells containing reinforcement and anchor bolts solidly with grout.
- .7 Install reinforcement at sides of openings. Refer to Drawings.

3.4 BONDING AND TYING

- .1 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370 and CAN/CSA-A371 and manufacturer's instructions.
 - .1 Install horizontal joint reinforcement 400 mm on centre.
 - .2 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
 - .3 Place joint reinforcement continuous in first and second joint below top of walls.
 - .4 Lap joint reinforcement ends minimum 150 mm.
 - .5 Connect joint corners and intersections with strap anchors 400 mm on centre.

3.5 REINFORCED LINTELS AND BOND BEAMS

- .1 Reinforce masonry beams, masonry lintels and bond beams as indicated on drawings
- .2 Place and grout reinforcement in accordance with CSA S304.1 , CAN/CSA-A371 , and CAN/CSA-A179 or as indicated on drawings.
 - .1 Lap vertical reinforcing bar 650 mm for 15M bar and 850 mm for 20M bar.
 - .2 Centre vertical reinforcing bar in the wall unless noted otherwise.
 - .3 Install vertical reinforcing steel with not less than one bar diameter between bars.
- .3 Support and position reinforcing bars in accordance with CAN/CSA-A371

3.6 SUPPORT OF LOADS

- .1 Grout bond beams as indicated on the drawings.
- .2 Install building paper below voids to be filled with grout; keep paper 25 mm back from face of units.

3.7 GROUTING

- .1 Grout masonry in accordance with CSA S304.1 , CAN/CSA-A371 and CAN/CSA-A179 and as indicated

3.8 ANCHORS

- .1 Supply and install metal anchors in accordance with CAN/CSA-A370 and CAN/CSA-A371 and as indicated.

3.9 MOVEMENT JOINTS

- .1 Reinforcement not continuous across movement joints unless otherwise indicated.

3.10 FIELD BENDING

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.
- .2 When field bending authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars and connectors with cracks or splits.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 04 05 00 - Common Work Results for Masonry.
- .3 Section 04 05 13 - Masonry Mortaring and Grouting.
- .4 Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .5 Section 05 50 00 – Metal Fabrications.
- .6 Section 07 92 00 - Joint Sealant

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units.
 - .2 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
 - .3 CSA S304.1-04(R2010), Design of Masonry Structures.
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020 (NBC).
- .3 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-07(R2010), Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 REGULATORY REQUIREMENTS

- .1 Contractors are required to ensure that the Bricklayer Trade is in accordance with local Apprenticeship and Occupational Certification Acts.
- .2 No person other than a registered apprentice or a person employed during a probationary period shall engage in the bricklayer trade unless they hold a current certificate of qualification or a current special certificate.
- .3 The ratio of apprentices to journeypersons must comply with local Apprenticeship and Trades Qualifications Act's General Regulations.
- .4 When requested by the Consultant, provide proof of compliance with the items noted in this section.

- .5 The masonry contractor is to furnish, at the request of the Consultant, a list of completed projects similar in scope and of equal or more value than this project completed in the last five years.
- .6 Conform to applicable code for fire rated masonry construction

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Design Data:
 - .1 Indicate required mortar strength, masonry unit assembly strength in all planes, supportive test data
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit for each sealant and adhesive product supplied by this Section.

1.5 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 10 - Common Work Results for Masonry.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Perform Work in accordance with CSA A371 - Masonry Construction for Buildings and CSA S304.1 - Design of Masonry Structures.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.
 - .2 Do not use brick tongs to move or handle masonry.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Do not double stack cubes of concrete unit masonry.

- .3 Cover masonry units with non-staining waterproof membrane covering.
- .4 Allow air circulation around units.
- .5 Installation of wet or stained masonry units is prohibited unless required by manufacturer.
- .6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.
- .7 Store and protect concrete unit masonry from nicks, scratches, and blemishes.
- .8 Replace defective or damaged materials with new.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Cold and Hot Weather Requirements: CSA A371 - Masonry Construction for Buildings.

Part 2 Products

2.1 MATERIALS

- .1 Concrete Block Masonry Units (CMU): CSA-A165 Series (CSA-A165.1),
 - .1 Type H/15/A/M.
 - .2 Standard Size: modular 190 mm high x 390 mm long x thickness indicated.
 - .3 Special shapes: Provide purpose made shapes for lintels, beams, bond beams, bullnose, and other shapes as indicated or required.
 - .4 Special Conditions:
 - .1 Provide bullnose units at all interior exposed corners, including openings for aluminum doors and windows.
 - .2 Provide custom bullnosed exterior corners on angled wall assemblies. Fabricate using solid masonry units cut to shape and ground. Provide in stack bond at corners only and maintain running bond for field of walls.
 - .3 Provide bullnose soldier course at base of masonry window openings

2.2 FABRICATION

- .1 Manufacture masonry units to CSA-A371 and CSA-S304.1.

2.3 REINFORCEMENT

- .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.4 LATERAL SUPPORT AND ANCHORAGE

- .1 Angles, Clips, Bracing, Struts, Bent Plates and other welded connections to structural steel assemblies: Supplied by Section 05 50 00 – Metal Fabrications; installed by this Section.

- .2 Loose Steel Anchorage and Reinforcement: Supplied by Section 05 50 00 – Metal Fabrications; installed by this Section.

2.5 CONNECTORS

- .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.6 MORTAR MIXES

- .1 Mortar and mortar mixes in accordance with Section 04 05 13 - Masonry Mortaring and Grouting.

2.7 GROUT MIXES

- .1 Grout and grout mixes in accordance with Section 04 05 13 - Masonry Mortaring and Grouting

2.8 CLEANING COMPOUNDS

- .1 Use low VOC products in compliance with SCAQMD Rule 1168.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.9 TOLERANCES

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:
 - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.
- .2 Tolerances for architectural concrete masonry units in accordance with CAN/CSA-A165.1, supplemented as follows:
 - .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.
 - .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete unit masonry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Protect adjacent finished materials from damage due to masonry work.
- .2 Direct and coordinate placement of metal anchors supplied to other Sections.
- .3 Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- .4 Verify that items built-in under other sections are properly located and sized.

3.3 INSTALLATION

- .1 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .2 Establish lines, levels, and coursing indicated. Protect from displacement.
- .3 Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- .4 Concrete Masonry Units:
 - .1 Bond: Running bond coursing as indicated on Drawings.
 - .2 Vertical Coursing: One unit and one mortar joint to equal 200 mm.
 - .3 Mortar Joints:
 - .1 Exposed Masonry: Concave
 - .2 Concealed Masonry: Strike flush.

3.4 REINFORCEMENT

- .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.5 CONNECTORS

- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.6 MORTAR PLACEMENT

- .1 Place mortar in accordance with Section 04 05 13 - Masonry Mortaring and Grouting.

3.7 GROUT PLACEMENT

- .1 Place grout in accordance with Section 04 05 13 - Masonry Mortaring and Grouting.

3.8 CONTROL AND EXPANSION JOINTS

- .1 Provide continuous control joints as indicated.
- .2 Do not continue horizontal joint reinforcement through control and expansion joints.
- .3 Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's written instructions.
- .4 Form expansion joint as detailed.

3.9 BUILT-IN WORK

- .1 As work progresses, install built-in metal door and glazed frames, access doors supplied by Division 08 and Mechanical and Electrical trades, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
- .2 Install built-in items plumb and level.
- .3 Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

3.10 TOLERANCES

- .1 Tolerances for unit masonry as recommended in CSA A371.

3.11 CUTTING AND FITTING

- .1 Cut neatly for electrical switches, outlet boxes and other recessed or built-in objects. Coordinate with other sections of work to provide correct size, shape, and location.
- .2 Make cuts straight, clean and free of uneven edges.
- .3 Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CONSTRUCTION

- .1 Cull out masonry units, in accordance with CAN/CSA-A165 and approved range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.

- .2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .3 Construct masonry walls using running bond unless otherwise noted.
- .4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .6 Install movement joints and keep free of mortar where indicated.
- .7 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .8 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .9 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .10 Tamp units firmly into place.
- .11 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .12 Tool exposed joints concave; strike concealed joints flush.
- .13 After mortar has achieved initial set up, tool joints.
- .14 Do not interrupt bond below or above openings.

3.13 FIELD QUALITY CONTROL

- .1 Inspect and test all engineered masonry work

3.14 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Standard Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
 - .3 Architectural Concrete Unit Masonry:

- .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .4 Prefaced Concrete Unit Masonry:
 - .1 Clean masonry as work progresses using soft, clean cloths, within few minutes after laying. Upon completion, when mortar has set so that it will not be damaged by cleaning, clean with soft sponge or clean cloths, brush, and clean water. Polish with soft, clean cloths.
- .5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.15 PROTECTION

- .1 Brace and protect concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 10 00 - Concrete Forming and Accessories
- .3 Section 03 20 00 - Concrete Reinforcing
- .4 Section 03 30 00 - Cast-in-place Concrete
- .5 Section 04 05 00 – Common Work Results For Masonry
- .6 Section 06 10 00 - Rough Carpentry
- .7 Section 06 17 53 - Shop-Fabricated Wood Trusses

1.2 DEFINITIONS

- .1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 CSA Group (CSA)
 - .1 CSA G40.20-13 /G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16-14, Design of Steel Structures.
 - .4 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding)

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 If requested, submit WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

- .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by Professional Engineer registered or licensed in the Province of New Brunswick, Canada.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
 - .3 Steel connections design:
 - .1 H.T. bolts shall conform to ASTM specifications A325 M for high strength bolts with suitable nuts and washers.
 - .2 Shop connections shall be 75 mm diameter H.T. bolts (bearing type) or welds.
 - .3 Field connections shall be 75 mm diameter H.T. bolts (bearing type) unless shown on drawings.
 - .4 Connections shall be designated for 50% of the total maximum uniformly distributed load which the section is capable of resisting (fully laterally supported) or for forces indicated, whichever is greater.
 - .5 Field welded connections shall be used only when approved by the engineer for each case.
 - .6 A minimum of two bolts per connection shall be used for angle framing.

1.5 QUALITY ASSURANCE

- .1 Test Reports: when requested submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.
- .2 Steel pipe: to ASTM A 53/A 53M standard weight galvanized finish unless otherwise noted.

- .3 Metal Bar Grating: to ANSI/NAAMM MBG 531, Type 30-102M (19-4)- minimum or for the loads indicated on drawings, carbon steel, fully welded, bearing bars and twisted cross bars sized to suit design requirements, hot dipped galvanized finish.
- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series
- .6 Bolts, Nuts, and Washers: ASTM A307 galvanized to CSA G164 for galvanized components.
- .7 Anchor and threaded rods: CSA G40.21 300W, Galvanized, ASTM F1554, Grade 36
- .8 Touch-Up Primer for Galvanized Surfaces: Zinc rich (ZRC) cold galvanizing compound, premixed, UL labelled, liquid organic zinc compound, containing minimum 92% metallic zinc by weight in the dried film, solids content between 65% and 69% by weight.
- .9 Grout: non-shrink, non-metallic, flowable, 20 MPa at 24 hours.
- .10 Stainless steel tubing: to ASTM A269, Type 302. seamless welded with AISI No. 4 finish.

2.2 METAL STAIR ASSEMBLY AND LANDINGS

- .1 Detail and fabricate stairs to the National Association of Architectural Metal Manufacturers, (NAAMM), Metal Stair Manual, Fifth Edition (1992).
- .2 Materials, connection design, fabrication, erection and workmanship shall be to CSA S16.
- .3 Fabricate stairs with open riser, steel grating tread construction.
- .4 Grind or file exposed welds and steel sections smooth.
- .5 Shop fabricate stairs in sections as large and complete as practicable.
- .6 Close ends of stringers where exposed.
- .7 Finished product to be square. Maximum allowable difference on diagonal grating panel dimensions to be 3 mm.
- .8 Accurately form connections with exposed faces flush; mitres and joints tight. Make risers of equal height.
- .9 All stair and landing steel components and fasteners to be hot-dip galvanized after fabrication, (minimum zinc protection to be 610 g/m²).
- .10 Grating for stair landing to be welded steel grating to NAAMM Standards with 32 mm by 4.8 mm thick bearing bars at 30 mm centres. To be serrated for stair landing only. Hot-dipped galvanized.
 - .1 Bearing bars to span short direction of landing and trench and as indicated.
 - .2 Grating on landing to be fastened to edge support framing with saddle clips and c-clamps with 8 mm diameter bolts.
 - .3 Unfactored loading:
 - .1 Live Load = 4.8 kPa

- .2 Dead Load = 1.5kPa + self weight
- .11 Stair treads to be of size indicated, consisting of welded steel serrated grating with checker plate nosing. Construct to NAAMM Standards with 32 mm deep x 4.8 mm thick bearing bars. Treads to be complete with standard end plates. Treads to be fastened to channel stringers by bolting
 - .1 Unfactored loading:
 - .1 Live Load = 4.8 kPa
 - .2 Dead Load = 1.5kPa + self weight

2.3 HANDRAIL

- .1 Construct handrails from steel pipe and HSS sections as indicated.
- .2 Steel pipe: diameter as shown, formed to shapes and sized as indicated.
- .3 Fabricate pipe handrail for stairs and landing using pipe to ASTM A53.
 - .1 Size and weight to be as indicated on drawings.
 - .2 Fabricate handrail to NAAMM Standards.
 - .3 Joint quality to be to NOMMA – Type 2.
 - .4 Galvanize assembly to ASTM A123/A123M (minimum 610 g/m²). Touch up all scratched and damaged galvanized steel.
 - .5 Provide adequate drainage at low points of all rails. Indicate drain hole locations on shop drawings for review by Consultant.

2.4 STRUCTURAL STEEL ITEMS

- .1 The Contractor must review all architectural drawings and supply and install all structural steels, anchor bolts, etc, required and detailed on drawings.
- .2 Supply and install all steel brackets, supports, steel plates and expansion anchors and all other attachments as indicated on architectural and structural drawings. Drill for countersunk screws and anchor bolts.
- .3 Galvanize finish for exterior, prime paint for interior, unless noted otherwise.

2.5 MISCELLANEOUS COLUMNS, ANGLES, CHANNELS AND SHAPES

- .1 Provide structural and non-structural components indicated, including but not limited:
 - .2 Columns and bases.
 - .3 Jamb support angles and channels.
 - .4 Angle support.
 - .5 Beam and channel assembly.
 - .6 Fabricate as indicated.
 - .7 Interior Finish: Shop prime paint and field finish paint to Section 09 91 00 - Painting.

2.6 MISCELLANEOUS FRAMING FOR OPENINGS INCLUDING BUT NOT LIMITED TO ROOF AND WALL ASSEMBLIES

- .1 Refer to Drawings for details.
- .2 Provide angle and channel reinforcement as directed by Consultant to openings in roof and wall assemblies for penetration of ductwork, piping and equipment.
- .3 Welding to structural steel to be performed by Licensed Welders certified to CSA W47.1.

2.7 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof oval headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.
- .5 Continuously seal joined members by continuous welds.
- .6 Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- .7 Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- .8 Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.8 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164

2.9 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of bituminous paint:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete.
 - .3 Wood.

2.10 SHOP PAINTING

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

- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Paint when temperature minimum 7 degrees C.
- .3 Clean surfaces to be field welded; do not paint.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions remedied.

3.2 ERECTION - GENERAL

- .1 Do welding work in accordance with CSA W59 unless specified otherwise
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA S16 or Weld field connection.
- .7 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 06 17 53 – Shop-Fabricated Wood Trusses.

1.2 REFERENCE STANDARDS

- .1 ASME International (ASME):
 - .1 ASME B18.6.1- 1981, Wood Screws Inch Series
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/NPA A208.1-1999, Particleboard, Mat Formed Wood.
 - .2 American Society for Testing and Materials International (ASTM)
 - .3 ASTM A653/A653M-05a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM C1325, Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units
 - .5 ASTM C578-05a, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - .6 ASTM C1289-05a, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - .7 ASTM D1761-88(2000), Standard Test Methods for Mechanical Fasteners in Wood.
 - .8 ASTM D5055-05, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .9 ASTM D5456-05a, Standard Specification for Evaluation of Structural Composite Lumber Products.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package for New Construction and Major Renovations.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-M87, Hardboard.
 - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
 - .3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .4 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA A123.2-03, Asphalt Coated Roofing Sheets.
 - .2 CAN/CSA-A247-M86, Insulating Fiberboard.

- .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .4 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .5 CSA O112 Series-M1977(R2006), CSA Standards for Wood Adhesives.
- .6 CSA O121-M1978(R2003), Douglas Fir Plywood.
- .7 CSA O122-06, Structural Glued-Laminated Timber.
- .8 CSA O141-05, Softwood Lumber.
- .9 CSA O151-04, Canadian Softwood Plywood.
- .10 CSA O153-M1980(R2003), Poplar Plywood.
- .11 CAN/CSA-O325.0-92(R2003), Construction Sheathing.
- .12 CSA O437 Series-93(R2006), Standards on OSB and Waferboard.
- .6 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
 - .2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.
 - .3 FSC Accredited Certified Bodies.
- .7 Truss Design and Procedures for Light Metal Connected Wood Trusses, Truss Plate Institute of Canada.
- .8 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S706-97, Mineral Fibre Thermal Insulation for Buildings.
- .10 National Lumber Grades Authority (NLGA):
 - .1 NLGA Standard Grading Rules for Canadian Lumber 2017

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals (to be submitted before starting any work of this Section):
 - .1 Product Data:
 - .1 submit manufacturer's instructions, printed product literature and data sheets for rough carpentry work and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Informational Submittals (to be provided during the course of Work):
 - .1 Material Certificates:

- .1 Submit certificates for machine-graded and finger-jointed dimensional lumber indicating species and grade selected for each use and design values approved by the NLGA.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19 -mm thick plywood on 19 x 38-mm furring around spacing, perimeter and at maximum 305 mm intermediate

1.5 QUALITY ASSURANCE

- .1 Regulatory Approvals: Wood products used for sheathing and framing must clearly indicate on the face or edge the manufacturer of material, standard to which it was produced, grade of material including whether grade is visually graded or machine-stress rated, and exterior use where applicable, in accordance with listed reference standard.
- .2 Lumber Identification: Identified by grade with a stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
- .3 Plywood Identification: Identified by grade mark in accordance with applicable CSA standards.
- .4 Plywood, OSB and Wood-Based Composite Panel Construction Sheathing Identification: Identified by grade mark in accordance with applicable CSA standards.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Protect materials from weather while in transit and on the jobsite.
- .2 Storage and Handling Requirements:
 - .1 Store materials at least 150 mm above the ground on pallets or blocks
 - .2 Cover with protective waterproof sheets allowing for air circulation and ventilation under the covering
 - .3 Protect edges and corners of sheet materials from damage during handling and storage
 - .4 Protect kiln dried and seasoned wood materials under conditions that will not cause an increase to moisture content
 - .5 Stack, lift, brace, cut and notch engineered lumber products in accordance with manufacturer's instructions and recommendations
 - .6 Store separated reusable wood waste convenient to cutting station and work areas

Part 2 Products

2.1 DESCRIPTION

.1 Regulatory Requirements:

- .1 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project, grade-marked by accredited agencies of the Canadian Lumber Standards Accreditation Board, that conform to National Grading Rules published by the National Lumber Grades Authority, and that have the following characteristics:
 - .1 Grading: Machine Grading, Visual Grading, or Both
 - .2 Moisture Content: Kiln Dry, 19% or less
 - .3 Structural Design Properties: Strength and related properties in accordance with CSA O86
 - .4 Sizes: Nominal dressed dimensions described in CSA O141 for surfaced dry conditions and wood species
- .2 Panel Grades: Provide panel products that are grade-marked by agencies recognized by CSA O325 and the National Institute of Standards and Technology, Voluntary Product Standard PS 2 04 Performance Standard for Wood-Based Structural-Use Panels as modified by other listed CSA panel standards.

2.2 PERFORMANCE CRITERIA

- .1 Lumber Grades: Provide lumber products as described in Paragraph 2.1.1.1 in accordance with Regulatory Requirements.
- .2 Panel Grades: Provide panel products as described in Paragraph 2.1.1.2 in accordance with Regulatory Requirements.

2.3 LUMBER MATERIAL

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:
 - .1 CAN/CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Bracing, blocking, bridging, nailing strips, strapping, wall plates, fascia and soffit framing, and miscellaneous framing:
 - .1 No.1/No.2 grade spruce, pine, fir, (SPF), or better.

2.4 PANEL MATERIALS

- .1 Douglas fir plywood (DFP): to CSA O121, standard construction.
- .2 Canadian softwood plywood (CSP): to CSA O151, standard construction.

- .3 Plywood, OSB and wood based composite panels: to CSA O325.
- .4 Roof Sheathing to be CANPLY Exterior Sheathing grade, T&G, to CSA O151 CSP.
- .5 Fiber-mat Reinforced Cementitious panels: to ASTM C1325

2.5 ACCESSORIES

- .1 Nails, spikes and staples: to CSA B111 and ASTM F1667, Galvanized.
- .2 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .4 Joist hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.
- .5 Sill plate gasket: polyethylene foam, minimum thickness 6 mm x full width of sill plate.

2.6 FINISHES

- .1 Galvanizing: to CAN/CSA-G164 ASTM A653, use galvanized fasteners for exterior work interior highly humid areas pressure-preservative treated lumber.

2.7 WOOD PRESERVATIVE

- .1 SCAQMD Rule #1113 - Architectural Coatings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rough carpentry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied .

3.2 PREPARATION

- .1 Treat surfaces of material with wood preservative, before installation, for wood components where indicated on architectural plans.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and 1 minute soak on plywood.

- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

3.3 INSTALLATION

- .1 Comply with requirements of NBCC 2015, 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, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.
- .6 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, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .9 Install sleepers as indicated.
- .10 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .11 Countersink bolts where necessary to provide clearance for other work.
- .12 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.
- .13 Use dust collectors and high-quality respirator masks when cutting or sanding wood panels.
- .14 Install cement board with ends and edges closely abutted, but not forced together.
- .15 Stagger end joints in successive courses

3.4 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.

3.5 ROOF SHEATHING

- .1 Plywood, DFP or CSP sheathing SHG grade, T&G square edge, 16 mm thick.

- .2 OSB, grade O-1 O-2 18 mm thick.
- .3 Construction sheathing product: end use mark 1R.
- .4 The roof system shall act as a structural diaphragm.
 - .1 Fastening: Long dimension of roof sheathing shall be laid horizontally with ends staggered 1220 mm on centre. Unless otherwise indicated, nail all panel edges at supports with 76 mm long common nails, or equal, spaced at maximum 152 mm on centre. Nail spacing at intermediate supports shall not exceed 305 mm.

3.6 GABLE END WALL SHEATHING

- .1 Plywood for wall sheathing shall be min. 12.7 mm thick, exterior grade.
- .2 Unless otherwise indicated, nail pattern for wall sheathing shall be as follows: panel edges shall be nailed at maximum 152 mm centres at all supports. Nail panels at max. 305 mm centres at all intermediate supports. Use 76 mm common nails, or equal.

3.7 ELECTRICAL EQUIPMENT BACKBOARDS

- .1 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 19 x 38 mm furring around spacing, perimeter and at maximum 300 mm intermediate spacing. Paint with code compliant fire retardant paint.

3.8 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of shop-fabricated wood trusses using light-gauge metal connection plates and truss accessories required for a complete structural system with the following components:
 - .1 Roof Trusses
 - .2 Pre-engineered, pre-fabricated connectors and fastenings
 - .3 Accessories, blocking, and other components required for complete installation.
- .2 This Section requires delegated design, engineering analysis and preparation of sealed and signed shop drawings performed by a qualified, supporting Professional Engineer registered or licensed in the province of New Brunswick, Canada who is retained by the truss fabricator responsible for fabrication of wood trusses described in this Section.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 10 00 - Concrete Forming and Accessories
- .3 Section 03 20 00 - Concrete Reinforcing
- .4 Section 03 30 00 - Cast-in-place Concrete
- .5 Section 04 05 00 – Common Work Results For Masonry
- .6 Section 04 05 13 - Masonry Mortaring and Grouting.
- .7 Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .8 Section 04 22 00 - Concrete Unit Masonry
- .9 Section 05 50 00 - Metal Fabrications
- .10 Section 06 10 00 – Rough Carpentry

1.3 DEFINITIONS

- .1 Delegated Design Professional Engineer: The supporting Professional Engineer hired by, engaged by or contracted to truss fabricator for the design of light metal plate connected wood trusses described in this Section. They produce signed and sealed shop drawings, are registered in the province of the Work, they are not the Consultant, and they are responsible for the following:
 - .1 Equal Dimensions: Structural wood products and assemblies indicating equal dimensions on the Drawings shall be calculated to align with in-place structural elements followed by an even division of the space between structural elements.

1.4 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A 653/A 653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM A 780/A 780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
 - .3 ASTM D 7612-15, Standard Practice for Categorizing Wood and Wood-Based Products According to their Fiber Sources
 - .4 ASTM F 1667-18 Standard Specification for Driven Fasteners: Nails, Spikes and Staples
- .2 CSA Group (CSA)
 - .1 CSA B111 74 (R03) Wire Nails, Spikes and Staples
 - .2 CSA O86 Consolidation-19, Engineering Design in Wood.
 - .3 CSA S347-14 (R18), Method of Test for Evaluation of Truss Plates Used in Lumber Joints.
 - .4 CSA W47.1-19, Certification of Companies for Fusion Welding of Steel.
- .3 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2023, FSC Principle and Criteria for Forest Stewardship
- .4 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2022
 - .2 NLGA SPS-1-2017, Fingerjoined Structural Lumber
 - .3 NLGA SPS-2-2024, Machine Graded Lumber
 - .4 NLGA SPS-4-2014, Fingerjoined Machine Graded Lumber
- .5 National Research Council Canada (NRC)
 - .1 National Building Code of Canada (NBC) 2015
 - .2 Canadian Construction Materials Centre (CCMC)-[on-line edition], Registry of Product Evaluations
- .6 Truss Plate Institute of Canada (TPIC)
 - .1 BCSI Canada 2014, Building Component Safety Information Book, Guide to Good Practice for Handling, Installing, Restraining and Bracing of Metal Plate Connected Wood Trusses
 - .2 TPIC - 2019, Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses (Limit States Design).
 - .3 TPIC TB4-2020, Design for Corrosive Environments
- .7 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2015-2019 (extended through December 2021) SFI Forest Management Standard

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate temporary protective measures required by this Section to prevent exposure to weather and other deleterious environmental conditions in accordance with Section 01 35 43 - Environmental Procedures
- .2 Pre-Construction Meeting: Conduct a pre-construction meeting a minimum of two (2) weeks before starting fabrication and/or work of this Section, attended by Contactor, truss fabricator, other affected subcontractors, and Consultant to discuss the following:
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Coordinate with building subcontractors affected by work of this Section.
 - .4 Review truss fabricator's written product handling and installation instruction requirements

1.6 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals (to be provided before starting any work of this Section):
 - .1 Product Data:
 - .1 Submit truss fabricator's installation instructions, special handling criteria, installation sequence, and printed product literature and data sheets describing product characteristics, performance criteria, physical size, finish and limitations of hardware components required for installation.
 - .2 Shop Drawings: Prepare and submit shop drawings in accordance with the Truss Plate Institute of Canada (TPIC) Truss Design Drawing requirements indicating connection details, erection sequence, framing details, and the following:
 - .1 Special Requirements: Identify special structural modifiers (if any) that may be required by local AHJ or as indicated on framing drawings and drawing notes.
 - .2 Wood Truss Drawings: Indicate applicable TPIC Truss Design Procedures and CSA O86 engineering requirements, including the following:
 - .1 Name of truss fabricator and truss plate manufacturer
 - .2 Truss identification number and job name
 - .3 Wood species, sizes, and stress grades of lumber used as truss members
 - .4 Pitch, span, camber, configuration and spacing of trusses
 - .5 Required bearing widths and bearing details
 - .6 Specified loads applicable to:
 - .1 Top chord live load
 - .2 Top chord dead load
 - .3 Bottom chord live load
 - .4 Bottom chord dead load
 - .5 Concentrated loads and their points of application

- .6 Methods for controlling unbalanced loads
- .7 Wind and earthquake loads used for design solution
- .7 Connector types, thicknesses, sizes, locations and design values
- .8 Location, size and fastening of required permanent truss member bracing
- .9 Connection requirements for truss to truss, truss to girder, truss to bearing, and site fabricated splices
- .10 Reaction forces and point load locations, when different than heel locations, indicating points of occurrence and direction
- .11 Locations of the maximum deflection and movements under live load conditions indicated on Drawings
- .12 Allowable lateral horizontal movement of trusses under live load conditions indicated on Drawings
- .13 Design loads for members
- .14 Bearing length for trusses accounting for maximum deflected shape and horizontal slip at bearing ends of each member
- .15 Location of lateral bracing for compression members
- .16 Connection of chord forces to shear walls or moment frames as indicated on drawings.
- .17 Additional information used for confirmation of truss design
- .3 Indicate stress diagram or print out of computer design indicating design load for truss members - include allowable load and stress increase.
- .4 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
- .5 Indicate adjustments to lumber and connector plate design values based on conditions of use (if any).
- .6 Indicate connector plate types, thickness, size and location at each joint, except where symmetrical configurations allow for centreline illustration of joints.
- .7 Indicate connection requirements for truss to bearing, truss or girder ply to ply and site-assembled splices.
- .8 Indicate end connections of trusses to resist uplift and lateral reactions.
- .9 Supporting Professional Engineer registered or licensed in the province of New Brunswick Canada, is required to seal and sign design solutions presented in submitted shop drawings prepared under their supervision.
- .3 Placement Drawings: Submit placement and layout drawings for review by Consultant including the following:
 - .1 Indicate sequence of installation and erection, and temporary bracing requirements.
 - .2 Label truss and girder layouts using the same identification numbers indicated on shop drawings described in Subparagraph 1.6.2.2 above.
 - .3 Indicate partitions being used as bearing walls.
 - .4 Indicate hanger type used for connecting trusses to girder trusses and beams.

- .5 Indicate connection requirements for truss to bearing, truss or girder ply to ply and site-assembled splices when not indicated on shop drawings described in Subparagraph 1.6.2.2 above.
- .3 Informational Submittals: Provide the following submittals concurrently with Action Submittals described above:
 - .1 Qualification Data: Submit concurrently with shop drawings proof of qualifications for truss fabricator and materials proposed for use as described in Article 1.7, Quality Assurance below.
 - .2 Certificates: Submit certificates signed by truss fabricator indicating that Products supplied to the Project meet requirements of TPIC Truss Design Procedures.
 - .3 Delegated Design Submittals: Submit delegated design of shear connections in for design criteria described in Article 2.2 below. Include the following:
 - .1 Design Notes and Data: Submit supporting Professional Engineer's design notes and calculations concurrently with shop drawings. Verifying capacity of members, connectors for related components of the work, and that assemblies meet design requirements described in this Section.
 - .2 Submit concurrently with preliminary shop drawings indicating supporting Professional Engineer's limitation of design responsibilities.
 - .3 Submit concurrently with site report indicating supporting Professional Engineer's assessment that installation is substantially compliant with system design indicated on shop drawings.
 - .4 Source Quality Control Submittals: Submit test reports for shop-fabricated wood trusses signed by supporting Professional Engineer registered or licensed in the province of New Brunswick, or other independent testing agency acceptable to Consultant indicating compliance with specifications for specified performance characteristics and physical properties.
 - .5 Site Quality Control Submissions: Submit truss fabricator's site services reports within three (3) days of review to Consultant.

1.7 QUALITY ASSURANCE

- .1 Qualifications: When requested by Consultant, provide proof of qualifications as described in Article 1.6, Submittals.
 - .1 Truss Fabricators: Obtain shop-fabricated structural wood trusses and accessories from a single fabrication source qualified in accordance with CWTA National Quality Standard that can provide evidence of In-Plant Qualification Program recognized by regional wood truss associations or other proof of manufacturing and design capability acceptable to the Consultant.
 - .2 Truss Plate Manufacturer: Provide evidence that plates used for truss manufacturing are manufactured to meet testing requirements of CSA S347, and are listed in the Registry of Product Evaluations published by Canadian Construction Materials Centre (CCMC), or other proof of manufacturing capability acceptable to the Consultant.
 - .3 Welded Connection Fabricator: Provide welded connections fabricated in a shop certified by CWB to CSA W47.1, Division 1 or 2.1.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver, handle, store and protect materials in accordance with truss fabricator's written instructions, and in accordance with BCSI Canada.
- .2 Storage and Handling Requirements:
 - .1 Provide bearing supports and bracings to prevent bending, warping and overturning of trusses, in accordance with truss fabricator's written instructions and in accordance with BCSI Canada
 - .2 Store and protect materials from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the truss fabricator.
 - .3 Keep materials dry.
 - .4 Store trusses on hard, dry and level surface.
 - .5 Do not store truss lumber in direct contact with ground.
 - .6 Do not expose trusses to prolonged weather exposure.

1.9 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where shop-fabricated wood trusses are indicated to fit between or around other construction. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating shop-fabricated wood trusses without site measurements where site measurements cannot be made without delaying the Work. Coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

Part 2 Products

2.1 DESCRIPTION

- .1 Regulatory Requirements: Fabricate trusses, bracing and bridging in accordance with CSA O86 using truss joint components tested in accordance with CSA S347, and using products bearing accredited stamp with the manufacturer's name and certificate number, grade, CCMC number and quality control agency.
 - .1 Qualification Markings: Apply CWTA Plant Qualification marking or tag or other plant certification agency accredited by the Standards Council of Canada to each truss assembly in a readily visible location.
 - .2 Loading: Design trusses to account for minimum uniform and minimum concentrated loadings stipulated in NBC 2015 commentary applicable to metal plate connected wood trusses.
 - .3 Loading Markings: Apply additional special markings at point load locations other than truss heels on each truss, and on bottom chord of bottom bearing, parallel chord trusses.
- .2 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade marked by accredited agencies of the Canadian

Lumber Standards Accreditation Board and that conform to National Grading Rules published by NLGA.

- .1 Grading: Machine Grading, Visual Grading, or Both
 - .2 Moisture Content: Kiln Dry, 19% or less
 - .3 Structural Design Properties: Strength and related properties in accordance with CSA O86 and NLGA SPS 2
 - .4 Acceptable Alternate Products: Lumber products meeting requirements of the American Lumber Standards Committee designated ALS Program Lumber and that are accepted by the Canadian Lumber Standards Accreditation Board, may be acceptable for the Project when proof of compliance with strength and related properties meeting CSA O86 are submitted before purchasing any structural wood products.
- .3 Finger joined Lumber : Provide machine-graded lumber (MSR) products meeting requirements of NLGA SPS 1 and SPS 4 acceptable to AHJ, meeting stress design requirements indicated in NBC 2015 and that are grade marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to National Grading Rules published by the NLGA.
- .4 Sustainability Characteristics:
- .1 Environmental Product Declaration (EPD): Submit an Industry-wide EPD or Product-specific EPD for each lumber specified. Provide EPD with at least a cradle-to-gate scope identifying the following impact categories:
 - .1 Global Warming Potential (GWP): All GWP information submitted in the form of kgCO₂ eq/kg.
 - .2 Ozone Depletion Potential (ODP): All ODP information submitted in the form of kgCFC-11/kg.
 - .3 Acidification Potential (AP): All AP information submitted in the form of kgSO₂ /kg.
 - .4 Eutrophication Potential (EP): All EP information submitted in the form of kg N/kg.
 - .5 Photochemical Ozone Creation/Smog Formation Potential (SFP): All SFP information submitted in the form of kgO₃ /kg.
 - .2 Certified Wood Sourcing: Wood products (dimensional lumber, plywood, and similar materials) used for the Project must be extracted and sourced from USGBC recognized sustainable forestry certification agencies. Wood products must be responsibly sourced demonstrating compliance to legal extraction methods with proof of chain of custody from one of the following agencies:
 - .1 American Tree Farm System (ATFS)
 - .2 Canadian Standards Association (CSA Group)
 - .3 Forest Stewardship Council (FSC)
 - .4 Programme for the Endorsement of Forest Certification (PEFC)
 - .5 Sustainable Forestry Initiative (SFI)

2.2 DESIGN CRITERIA

- .1 Design Responsibility: Truss fabricator is required to retain a supporting Professional Engineer registered or licensed in the province of New Brunswick Canada, experienced

in the design and detailing of light metal plate connected wood trusses in accordance with TPIC Truss Design Procedures using engineering properties listed in CSA O86 for components described in this Section, and as follows:

- .1 Loads and forces shown on Drawings are factored, unless specifically indicated otherwise.
- .2 Request any loads and forces not shown on Drawings from Consultant, and that are required by the supporting Professional Engineer registered or licensed in the province of New Brunswick Canada, to complete design and detailing of connections.
- .3 The supporting Professional Engineer will provide the following in accordance with governing standards described in this Section:
 - .1 Design of wood truss members for Serviceability Limit States described in TPIC Truss Design Procedures, and as indicated on Drawings.
 - .2 Design and detailing of wood truss members, bracing and bridging based on design loading and spacing indicated on Drawings.
 - .3 Design and detailing of connections not specifically detailed on the Drawings.
 - .4 Details of dimensions to accommodate mechanical services passing through truss members indicated on Drawings.
 - .5 Written confirmation that components are fabricated in accordance to shop drawings submitted for the Consultant's review.
- .2 Structural Performance Requirements: Design shop-fabricated structural wood component connections to allow for building movements without damage or over stressing, connection failures, and imparting undue strain on fasteners and anchors. Also take into account the following structural performance requirements:
 - .1 Dead Loads: Dead loads as indicated on Drawing.
 - .2 Live Loads: Live loads as indicated on Drawings.
 - .3 Roof Loads: Roof loads as indicated on Drawings.
 - .4 Snow Loads: Snow loads as indicated on Drawings.
 - .5 Exterior Wind Loads: Wind loads q_{50} for deflection and for strength, modified by importance factors, building exposure, gust effect factors, and pressure coefficients in accordance with structural commentaries and also accounting for the following:
 - .1 Wind Design Data: Location specific data from the NBC 2015, as indicated on drawings.
 - .6 Live Load Deflection Limit:
 - .1 Live Load = $L/360$.
 - .2 Total Load = $L/240$.
- .3 Design Tolerances: Design trusses with positive camber to allow for calculated deflection under dead and live loads to planar profile along slope or level top chord appropriate to truss type.
- .4 Modifications to Design: Supporting Professional Engineer registered or licensed in the province of New Brunswick is required to account for changes to dimension and bearing capacities inherent with their Products where they are used to establish the Bid Price, while keeping in mind the following:

- .1 Changes to placement of girder trusses and other loadbearing elements indicated on Drawings will not be permitted without before the acceptance from the Consultant.
- .2 Changes that modify design criteria described by the Consultant will not be permitted without before the acceptance from the Consultant.
- .3 No adjustment to contract price will be considered where manufactured or fabricated component sizes must change to account for design loads indicated on Drawings.

2.3 MATERIALS

- .1 Truss Framing: Provide wood materials meeting truss fabricator's design requirements and meeting Structural Performance Requirements listed above, and as follows:
 - .1 Sizes: Lumber sizes as described in TPIC Truss Design Procedures.
 - .2 Grade: Provide No. 2 Grade or better materials.
 - .3 Species Group: Spruce Pine Fir (SPF) or better materials.
 - .4 Acceptable Alternate Products: Consultant will permit use of truss grade structural composite lumber that meets requirements of TPIC Truss Design Procedures
- .2 Truss Plates: Provide truss plates meeting requirements of CSA S347, manufactured from galvanized steel sheet meeting requirements of ASTM A 653/A 653M, having zinc coating designation Z275, and as follows:
 - .1 Grade: Structural steel sheet or high strength, low alloy steel sheet as determined by truss fabricator's supporting Professional Engineer registered or licensed in the province of New Brunswick Canada, based on loads and use conditions identified by Consultant.
 - .2 Truss Anchors and Hangers: Provide truss anchors and hangers meeting requirements of CSA O86, manufactured from galvanized steel sheet meeting requirements of ASTM A 653/A 653M, having zinc coating designation Z275; types and configurations as indicated on drawings and as follows:
 - .1 Roof Truss Tie-Downs: Brackets rated for wind uplift loads indicated above.

2.4 ACCESSORIES

- .1 Wood Framing and Blocking: Provide sawn lumber materials as specified in Section 06 10 00 - Rough Carpentry
- .2 Setting Plates: For setting plates and embedded items supplied in accordance with this Section that are installed in accordance to other Sections, refer to Section 05 50 00 - Metal Fabrications
- .3 Driven Fasteners: Steel nails, spikes, brads, and staples meeting requirements of ASTM F 1667 or CSA B111. Ensure length is sufficient to penetrate connecting solid wood materials.
 - .1 Exterior Work: Hot-dipped galvanized
 - .2 Interior High Humidity Work: Hot-dipped galvanized
 - .3 Interior Work: Electroplated zinc plated, or cadmium plated

2.5 FABRICATION

- .1 Fabricate wood trusses based on the reviewed shop drawings that were created in accordance with TPIC Truss Design Procedures at an accredited truss plant participating in CWTA In-Plant Qualification Program and with the following:
 - .1 Assemble truss members in design configuration required.
 - .2 Assemble truss members using jigs or other means to maintain uniformity and accuracy of assembly with joints closely fitted to meet tolerances listed by TPIC Truss Design Procedures
 - .3 Account for design camber and roof slopes when positioning truss members.

2.6 SOURCE QUALITY CONTROL

- .1 In-Plant Testing and Inspections:
 - .1 Test a minimum of three (3) trusses of each type as described in CWTA In-Plant Qualification Program and submit a report indicating that tested trusses represent trusses used for the Project
 - .2 Indicate any manufacturing and material variances described in Appendix G of TPIC Truss Design Procedures
 - .3 Conduct in plant testing and inspections in accordance with CSA S347
 - .4 Document any follow-up repairs, rework or replacement of trusses for nonconforming materials or variances in workmanship.
 - .5 Supporting Professional Engineer registered or licensed in the province of New Brunswick Canada, will direct all follow up repairs and rework and validate that trusses delivered to the Project meet specified requirements.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Concentrated Load Prevention: Prevent concentrated loads on trusses until required bracing and sheathing is installed; do not permit stacking of sheathing bundles, lumber and other materials on unsheathed trusses.

3.3 ERECTION

- .1 Installation Requirements:

- .1 Erect wood trusses in accordance with reviewed shop drawings, fabricator's written instructions, and in accordance with BCSI Canada
 - .2 Make adequate provisions for handling and erection stresses.
 - .3 Exercise care to prevent out-of-plane bending of trusses.
 - .4 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed.
 - .5 Install permanent bracing, bridging and sheathing in accordance with reviewed shop drawings, before the application of loads to trusses.
 - .6 Do not cut or remove any truss component without written confirmation by Consultant, and supporting Professional Engineer registered or licensed in the province of New Brunswick
- .2 Bracing Requirements:
- .1 Install permanent lateral bracing as indicated on shop drawings, in size and grade described, and fastened at locations shown using number and size of nails described on truss shop drawings.
 - .2 Restrain lateral movement of bracing using permanently installed cross bracing at ends of each truss run and evenly spaced at intervals of six (6) metres or less
 - .3 Restrain top chord of trusses to prevent lateral movement using sheathing or permanent bracing as indicated on shop drawings.
 - .4 Install lateral ties evenly spaced at intervals of three (3) metres or less; with additional permanent lateral bracing as indicated on shop drawings
- .3 Site Modifications: Cutting, notching, or drilling of shop-fabricated wood trusses arising from site conditions that do not meet fabricator's standard details will not be permitted without fabricator's written recommendations, as directed by the Consultant.
- .4 Damaged Components:
- .1 Do not use shop-fabricated wood truss components that exhibit visible damage; damaged components will require replacement with material of same quality and performance as specified Products.
 - .2 Notify Consultant and supporting Professional Engineer immediately of any damage to wood truss components.
 - .3 Supporting Professional Engineer registered or licensed in the province of New Brunswick Canada, will recommend repair or replacement procedures as directed by the Consultant.
 - .4 No work for repair or replacement of damaged components will be permitted without Consultant's written instructions.

3.4 SITE QUALITY CONTROL

- .1 Truss Fabricator's Site Services: Truss fabricator's supporting Professional Engineer registered or licensed in the province of New Brunswick Canada, will review completed construction to verify that installation of wood truss system is in accordance with shop drawings and placement drawings. Other site services include:
 - .1 Review products supplied under this Section and confirmed that wood truss system handling, installation and erection, protection and cleaning of its products is in accordance with fabricator's written instructions

- .2 Truss fabricator's site services and recommendations include product use recommendations and periodic site visits for inspection of product installation in accordance with truss fabricator's instructions.
- .3 Schedule site visits to review work at the following stages:
 - .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 50% and complete
 - .3 after completion of work of this Section, and after cleaning is completed
- .4 Submit written reports in format acceptable to Consultant, to verify compliance of Work with Contract.

3.5 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at the end of each day
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.6 CLOSEOUT ACTIVITIES

- .1 Non-Conforming Work: Consultant will confirm correction and verification procedures with manufacturer and instruct contractor responsible for work of this Section on repair procedures or replacement of non-conforming work.
- .2 Adjusting: Repair damage to adjacent materials caused by installation of materials specified in this Section.
- .3 Repairs:
 - .1 Replace wood trusses that are damaged or do not meet requirements
 - .2 Apply touch-up coating materials to provide minimum dry film thickness recommended by coating system manufacturer
 - .3 Repair damaged galvanized coatings on exposed surfaces with galvanized repair coating in accordance with ASTM A 780/A 780M and truss plate manufacturer's written instructions

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Membrane waterproofing of foundation components.
- .2 Drainage board.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures
- .2 Section 04 05 00 – Common Work for Masonry
- .3 Section 06 10 00 – Rough Carpentry
- .4 Section 06 17 53 – Shop Fabricated Wood Trusses
- .5 Section 07 21 13 – Building Insulation
- .6 Section 07 27 00 – Air Barriers
- .7 Section 07 61 00 – Sheet Metal Roofing
- .8 Section 07 62 00 – Sheet Metal Flashing and Trim
- .9 Section 07 92 00 – Joint Sealant
- .10 Section 08 11 00 – Metal Doors and Frames

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM D1970/D1970M-2021 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - .2 ASTM D4263-83(2018) - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
 - .3 ASTM D5295-2018 - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems
- .2 Canadian General Standards Board (CGSB).
 - .1 CGSB 37-GP-56M - Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data: Submit product data for damproofing waterproofing membranes, drainage board and protection board.
- .3 Samples: Submit 300 mm x 300 mm piece of each type of protection board.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Provide and maintain dry, off-ground weatherproof storage.
- .4 Store rolls of felt and membrane in upright position.
 - .1 Store membrane rolls with salvage edge up.
- .5 Remove only in quantities required for same day use.
- .6 Place plywood runways over completed Work to enable movement of material and other traffic.
- .7 Store sealants at +5 degrees C minimum.
- .8 Store insulation protected from daylight and weather and deleterious materials.
- .9 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.
- .10 Store and manage hazardous materials in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .11 Packaging Waste Management: remove for reuse and return in accordance with Section 01 74 00 – Cleaning and Waste Management

1.6 SITE CONDITIONS

- .1 Ambient Conditions
 - .1 Do not install waterproofing when temperature remains below -18 degrees C for torch application, or -5 degrees C or to manufacturers' recommendations
 - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
 - .3 Install waterproofing on dry substate, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into waterproofing system.

Part 2 Products

2.1 MEMBRANE WATERPROOFING

- .1 Self-Adhered Waterproofing Membrane: SBS modified bituminous waterproofing membrane, reinforced, having a minimum nominal thickness of 1.5 mm and as follows:
 - .1 Acceptable Products:
 - .1 Henry Blueskin WP200.
 - .2 IKO Aquabarrier FP.
 - .3 Soprema Colphene 3000.

2.2 DRAINAGE BOARD

- .1 Foundation Drainage and Protection Board: Composite three-dimensional hollow studded polystyrene core with needle-punched geotextile filter fabric.
 - .1 Acceptable Products:
 - .1 Henry DB6200.
 - .2 Cosella-Dörken Delta-Drain.
 - .3 Grace Hydroduct 220.
 - .4 Soprema Sopradrain 10-G.
 - .2 Termination Bar: Pre-punched extruded aluminum.
 - .3 Sealant: As recommended by membrane manufacturer.

2.3 INSULATION

- .1 Rigid Insulation: Type 4 XPS; refer to Section 07 21 00.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine surfaces and conditions affecting waterproofing and report any detrimental conditions before proceeding with any work of this Section and as follows:
 - .1 Verify that concrete has cured and aged for minimum time recommended by waterproofing manufacturer.
 - .2 Verify that substrate is visibly dry and free of moisture, and that capillarity is below manufacturers' written tolerances.
 - .3 Test concrete surfaces for moisture using manufacturer's required moisture testing methods; installation will represent installer's acceptance of conditions.

3.2 PREPARATION

- .1 Surface Preparation: Clean and prepare substrate in accordance with ASTM D5295 and manufacturer's written recommendations and as follows:
 - .1 Remove grease, oil, bitumen, form release agents, paints, curing compounds, and other penetrating contaminants or film forming coatings from concrete.
 - .2 Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.
- .2 Preparation at Terminations and Penetrations: Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves in accordance with manufacturer's written instructions and as follows:
 - .1 Prime substrates in accordance with waterproofing manufacturer's

written instructions.

- .2 Provide sealant cants around penetrations and inside corners of deck to wall butt joints.
- .3 Joint and Crack Treatment: Prepare, treat, grout, and fill joints and cracks in substrate in accordance with manufacturer's written instructions and as follows:
 - .1 Remove dust and dirt from joints and cracks before coating surfaces.
 - .2 Apply bond breaker between sealant and preparation strip.
 - .3 Prime substrate and apply a single thickness of preparation strip extending minimum 75 mm along each side of joint.
- .4 Install sheet flashing and bond to deck and wall substrates where indicated or as required by waterproofing manufacturer's written instructions; extend sheet flashings onto perpendicular surfaces and other work penetrating substrate.

3.2 PROTECTION BOARD

- .1 Install board over sheet waterproofing membrane and insulation in accordance with manufacturer's written recommendations.
- .2 Secure board to foundations using manufacturers' recommended fasteners and termination bars. Seal joints as required.
- .3 Ensure positive moisture drainage to footing drains.
- .4 At bottom of walls, extend from wall over footing and drainage pipe, if any.
- .5 Coordinate installation prior to backfilling against foundations.

3.3 SCHEDULE

- .1 Seal penetrations through foundation wall with membrane waterproofing to manufacturer's recommendations.
- .2 Terminate edges of membrane with sealant and termination bar as recommended by manufacturer.
- .3 Apply continuous, uniform coating to exterior side of foundation walls enclosing rooms below finished grade. Include exterior portion of interior walls where floors in adjacent rooms are at different elevations.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect during backfill operation. Avoid impact and damage to greatest extent practical.
Backfill in accordance with Section 31 23 33.01
- .3 Repair damage to materials caused by backfill operations. Notify consultant prior to backfill.
- .4 Repair damage to adjacent materials caused by application.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sectio 01 29 00 – Payment Procedures
- .2 Section 04 05 00 – Common Work for Masonry
- .3 Section 06 10 00 – Rough Carpentry
- .4 Section 06 17 53 – Shop Fabricated Wood Trusses
- .5 Section 07 13 52 – Modified Bituminous Sheet Waterproofing
- .6 Section 07 27 00 – Air Barriers
- .7 Section 07 46 13 – Preformed Metal Siding
- .8 Section 07 61 00 – Sheet Metal Roofing
- .9 Section 07 62 00 – Sheet Metal Flashing and Trim
- .10 Section 07 92 00 – Joint Sealant
- .11 Section 08 11 00 – Metal Doors and Frames

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C612-04(2019) - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .2 ASTM C665-2017 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .3 ASTM C1320-2020 - Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
 - .4 ASTM D2369-2020 - Standard Test Method for Volatile Content of Coatings.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701.1-2022 - Standard for Thermal Insulation, Polystyrene Boards.
 - .2 CAN/ULC-S702.1-2021 - Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
 - .3 CAN-ULC-S710.1-2019 - Standard for Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Material Specification.
 - .4 CAN-ULC-S710.2-2011, Standard for Thermal Insulation - Bead-Applied One Component Polyurethane Air Sealant Foam, Part 2.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures for each product specified.

- .2 Samples:
 - .1 Provide samples of all products and accessories in accordance with Section 01 33 00 – Submittal Procedures, for each product specified.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for each product specified.

Part 2 Products

2.1 HIGH DENSITY EXTRUDED POLYSTYRENE RIGID INSULATION

- .1 The exterior face of the building foundation and exterior walls will be lined with a minimum of 75 mm rigid insulation. The insulation will extend to the top of footing, or as otherwise specified by the Consultant.
- .2 The insulation will be placed on the exterior of the perimeter foundation wall prior to backfilling and will have the following minimum characteristics:
 - .1 Compressive strength: 275 kPa (40 psi)
 - .2 Water absorption (% by volume): Max. 0.6%
 - .3 Capillarity: none
 - .4 Flexural strength: 793 kPa (115 psi)
- .3 Acceptable Products:
 - .1 Foamular 400,
 - .2 Styrofoam Highload 40,
 - .3 Sopra-XPS 40,
 - .4 Celfort 300 or approved alternate.

2.2 BLOWN – IN INSULATION

- .1 Glass Fibre Batt: to CAN/ULC-S702
 - .1 Type: 5.
 - .2 Thickness: as indicated.
 - .3 SCS certified recycled content, formaldehyde free or Greenguard certified for indoor air quality.
 - .4 Acceptable manufacturer: Owens Corning; Certainteed; Johns Manville

2.3 FOAM INSULATION

- .1 Expanding Foam: to CAN/ULC-S710.1 single component, low-expanding polyurethane foam. Compatible with rigid insulation.

2.4 ACCESSORIES

- .1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

- .1 Insulation clips for non-adhesive friendly substrate: steel, concrete screw with 25 mm diameter washer, length to suit insulation.
- .2 Insulation adhesive.
 - .1 Adhesive : VOC compliant polyurethane construction adhesive, resistant to freezing; VOC limit 70 g/l when tested in accordance with USEPA Method 24 and ASTM D23569.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 WORKMANSHIP

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75mm from heat emitting devices such as recessed light fixtures.
- .5 Cut and trim insulation neatly to fit spaces.
 - .1 Butt joints tightly, offset vertical joints.
 - .2 Use only insulation boards free from chipped or broken edges.
 - .3 Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by the Architect.

3.3 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.

3.4 RIGID INSULATION INSTALLATION

- .1 Install rigid insulation for foundations and under concrete slabs.
- .2 Apply adhesive to insulation board in accordance with manufacturer's recommendations.
- .3 Cut, fit, stagger and butt joints tight.

- .4 Foam fill voids with foam insulation.
- .5 Coordinate work with placement of vapour retarder.

3.5 EXPANDING FOAM INSULATION INSTALLATION

- .1 Apply in accordance with CAN/ULC S710.2 and manufacturer's written instructions.
- .2 Apply expanding foam to fill irregular voids and cracks and to interface with building envelope.
- .3 Use around doors, windows, louvers, annular spaces around pipes and ducts and other openings or protrusions through walls, floors and roofs.
- .4 Apply to underside of roof drains and between insulation sheets.
- .5 Completely fill concrete block vertical cells where plumbing and heating lines occur to insulate lines.

3.6 BLOWN-IN INSULATION INSTALLATION

- .1 Install foam insulation baffle between every truss where blown insulation will be installed.
- .2 Install in accordance with manufacturer's written instructions and to CIMA Technical Bulletin #2.
- .3 Prevent insulation from blocking ventilation soffits.
- .4 Pneumatic placement machine should be set as recommended by the machine manufacturer.

3.7 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Sheet vapour barrier on warm side of ceilings and underside of slabs.
- .2 Air and water resistive barrier on exterior face of concrete block.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 06 10 00 - Rough Carpentry
- .3 Section 07 21 00 - Building Insulation.
- .4 Section 07 27 00 - Air Barrier
- .5 Section 07 92 00 - Joint Sealants.
- .6 Section 08 71 00 – Door Hardware

1.3 REFERENCES

- .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .2 ASHRAE 90.1
- .3 ASTM E2357; E2556, Type II Compliant – Standard Specification for Vapor Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment.
- .4 Construction.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Provide data indicating material characteristics, performance criteria, and limitations.
- .3 Manufacturer's Installation Instructions: Indicate preparation and installation requirements, techniques.

1.5 SEQUENCING

- .1 Sequence Work to permit installation of materials in conjunction with other retardant materials and seals, and air barrier assemblies.
- .2 Do not install vapour barrier until items penetrating it are in place.

Part 2 Products

2.1 SHEET MATERIALS

- .1 Polyethylene Vapour Barrier: Listed to CAN/CGSB-51.34M, translucent polyethylene film, 6 mil thick.
- .2 Underslab Vapour Barrier: Listed to CAN/CGSB-51.34M, polyolefin-based resin/chemical sheet, 15 mil thick. W.R. Meadows Perminator or approved alternate.
- .3 Air and water-resistive barrier: Dupont Tyvek CommercialWrap D or approved alternate.

2.2 ACCESSORIES

- .1 Seam tape: pressure sensitive type recommended by manufacturer.
- .2 Sealant: Acoustical Sealant, compatible with polystyrene, specified in Section 07 92 00.

Part 3 Execution

3.1 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion.
- .2 Clean and prime substrate surfaces to receive adhesive, primers and sealants in accordance with manufacturers' written instructions.

3.2 POLYETHYLENE VAPOUR RETARDER

- .1 Ceilings:
 - .1 Lap joints minimum 150 mm and seal with butyl sealant.
 - .2 Patch all holes and tears.
 - .3 Place vapour retarder so that it is on the warm side of the insulation.
- .2 Adhere vapour retarder to steel framing and to perimeter using acoustical sealant.
- .3 Extend vapour retarder tight to and seal to full perimeter of adjacent frames and other items interrupting the plane of membrane.
 - .1 Seal in place with acoustical sealant.
- .4 Coordinate vapour retarder and air seal at openings and protrusions with work in other Sections.
- .5 Seal all punctures using 6 mil poly patch, minimum 100 mm larger than area.
 - .1 Apply acoustic sealant around full perimeter of puncture.
 - .2 Apply seam tape around full perimeter of patch.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Management.

- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Building enclosure materials and assemblies.
- .2 Transition materials to connect and seal openings, joints, and junctions between other air seal materials and assemblies.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 04 05 00 – Common Work for Masonry
- .3 Section 06 10 00 – Rough Carpentry
- .4 Section 06 17 53 – Shop Fabricated Wood Trusses
- .5 Section 07 13 52 – Modified Bituminous Sheet Waterproofing
- .6 Section 07 21 13 – Building Insulation
- .7 Section 07 46 23 – Wood Siding
- .8 Section 07 61 00 – Sheet Metal Roofing
- .9 Section 07 62 00 – Sheet Metal Flashing and Trim
- .10 Section 07 92 00 – Joint Sealant
- .11 Section 08 11 00 – Metal Doors and Frames

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM D226-06 - Standard Specification for Asphalt-Saturated Organic Felt Used In Roofing And Waterproofing.
 - .2 ASTM E283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
 - .3 ASTM E 96 - Standard Test Method for Water Transmission of Materials.

1.4 PERFORMANCE REQUIREMENTS

- .1 Provide continuity of air seal materials and assemblies in conjunction with other materials and assemblies.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work of this section with all sections referencing this section.
- .2 Pre-installation Meetings: Convene one (1) week before starting work of this section.

- .3 Sequencing: Sequence work to permit installation of materials in conjunction with related materials and seals.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Provide data indicating material characteristics, performance criteria, and limitations. Include data sheets for membrane, primers, and sealants.

1.7 QUALITY ASSURANCE

- .1 Perform Work in accordance with manufacturer's written instructions and this specification.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 SHEET MATERIALS

- .1 Air Barrier - for use on Exterior Walls with plywood or OSB sheathing:
 - .1 Type: Spunbonded olefin, non-woven, non-perforated to ASTM E1677 Type I,
 - .2 Minimum weight 2.7 oz/sq yd,
 - .3 Air leakage at 75 Pa wind pressure of less than 0.001 cfm/ft²,
 - .4 Water vapour transmission of greater than 28 perms in accordance with ASTM E-96-90, Method B.
 - .5 Acceptable Product:
 - .1 Tyvek Commercial Wrap by DuPont.
 - .2 Blueskin VP 160 by Bakor.
 - .3 Vaproshield IT.
 - .4 Sopraseal Stick.
 - .5 Approved equivalent.
- .2 Air Barrier – for use on Exterior Concrete Masonry Blocks:
- .3 Refer to Specification Section 04 05 00 – Common Work Results For Masonry Air Barrier Membrane, Flashings and Dampproof Membrane.

2.2 ACCESSORIES

- .1 Transition Membrane: AB membrane, field-cut to suit. Alternatively, provide manufacturer's proprietary or recommended tape, high tack adhesive, UV resistant.
- .2 Sealant: Acoustical sealant, VOC compliant, as specified in Section 07 92 00
 - .1 VOC Limit: < 200 g/l when tested in accordance with USEPA Method 24 and ASTM D2369.

- .3 Staples: chisel point galvanized steel 25 mm crown, 1.5 mm thick, length to suit substrate.
- .4 50 mm plastic disk, approved by air barrier manufacturer for securing membrane to substrate.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that surfaces and conditions are ready to accept the Work of this section.

3.2 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion of materials.
- .2 Clean and prime substrate surfaces to receive adhesive and sealants to manufacturer's instructions.

3.3 INSTALLATION

- .1 Install materials in accordance with manufacturer's written instructions.
- .2 Tape seal all joints.
- .3 Seal joints and penetrations through barrier with sealant and fasteners prior to installation of finish material.
- .4 Sheet to be air tight and free from holes, tears and punctures.
- .5 Attach to wood sheathing using fasteners with manufacturer approved 50mm plastic disk.
- .6 Begin at the corner of the building, leaving approximately 150 mm to 305 mm of material extended beyond the corner edge to overlap later.
- .7 The bottom edge of material to extend over the sill plate interface. Secure to the foundation with joint sealer.
- .8 Secure at approximately every 305 mm to 450 mm on vertical centre.
- .9 Unroll directly over openings.
- .10 All openings and penetrations are to be flashed and sealed with transition membrane. Coordinate with louvre, window and door frame installation.
- .11 Repair any tears, breaks, holes and other damage by taping or patching.

3.4 PROTECTION OF FINISHED WORK

- .1 Do not permit adjacent work to damage work of this section.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Requirements for the installation of preformed metal cladding, siding, trims, brake-form flashings and soffits.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 07 62 00 - Sheet Metal Flashing and Trim
- .3 Section 07 92 00 - Joint Sealants.

1.3 REFERENCES

- .1 CSA International
 - .1 CSA-S136 for the design of Cold Formed Steel Structural Members.
- .2 ASTM A653/A653M-23 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 Canadian Sheet Steel Building Institute Standards 20M.
- .4 National Building Code of Canada 2015

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Indicate dimensions, layout, joints, construction details, methods of anchorage and support of cladding systems, horizontal flashing reveals and other details at intersections with dissimilar building materials, drips, caps, enclosures and terminations.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal siding from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 DESIGN REQUIREMENTS

- .1 Design wall system to resist.
 - .1 Wind loads, positive and negative, expected in this geographical region NBCC 2015 climatic data, 10 year probability.
- .2 Deflection of the wall system is not to exceed 1/180th of the span for the wind load based on serviceability limit states.
- .3 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects.
- .4 Design expansion joints to accommodate movement in cladding and between cladding and structure to prevent permanent distortion or damage to the cladding.
- .5 Design wall system to maintain the following erection tolerances:
 - .1 Maximum variation from plane or location shown on shop drawings: 20 mm/10 m (3/4 inch/30 feet).
 - .2 Maximum offset from true alignment between two adjacent members abutting end to end in line: 1 mm (0.04 inches).

1.8 WARRANTY

- .1 Provide a manufacturer's written warranty. Furnish panel manufacturer's written warranty covering failure of factory-applied exterior finish within the warranty period. Warranty period for finish: 40-year Weather XL Coating Warranty after the date of Substantial Completion.

Part 2 Products

2.1 STEEL CLADDING AND COMPONENTS

- .1 Steel Soffit:
 - .1 Prepainted Galvanized Steel Sheet: ASTM A653/A653M, Coating Designation Z275;
 - .2 Solid and perforated, refer to Drawings for locations:
 - .1 Steel Thickness: Minimum 28 gauge.
 - .3 Minimum NFVA 6.2 in² / S.F when perforated.
 - .4 Colour: To be selected by the Consultant after Award of Contract, from a physical sample.
 - .5 Acceptable Profile: Agway V-Rib SoFit Panels, Vicwest Ventilated Steel SoFit or approved equal.
- .2 Steel Siding:
 - .1 Fabricated from commercial grade ASTM A 652M with Z275 zinc coating
 - .2 Vertical, 15 mm deep, rib profile .51 mm (24 Ga) preformed interlocking joints, fastener holes pre-punched.
 - .3 Pattern: 755 mm with intermediate ribs.
 - .4 Finish coating: factory precoated with modified silicone fluorocarbon paint finish, 2 coat system dry paint film thickness of 0.025 mm.
 - .5 Colour: To be selected by the Consultant after Award of Contract, from a physical sample.
 - .6 Back coating: ASTM A 653/A 653M, grade A, ZF075 Z275 coating designation.
 - .7 Gloss: high.
 - .8 Acceptable Profile: Vic West CL7015 or approved alternate.
- .3 Steel fascia facings and exposed trim:
 - .1 Profile: custom and manufacturer's standard as indicated.
 - .2 Finish coating: factory precoated with modified silicone fluorocarbon paint finish, 2 coat system dry paint film thickness of 0.025 mm.
 - .3 Colour: To be selected by the Consultant after Award of Contract, from a physical sample.
 - .4 Gloss: high medium low.
 - .5 Thickness: .51 mm (24 Ga) base metal thickness.
- .4 Ceiling Steel Cladding:
 - .1 Fabricated from Z275 galvanized sheet steel conforming to ASTM A653M Grade 230 having a thickness of 24 gauge.
 - .2 Acceptable product is Vicwest profile CL 815R or similar product.
 - .3 Steel cladding shall be pre-painted with 5000 series, one side. Color to be chosen by the Consultant after the award of the Contract.

- .4 Flashings, trims and closures will be fabricated as indicated on the shop drawings to be provided by Suppliers. Colour of exposed items will match cladding and in concealed areas these items will be galvanized only.
- .5 Sealants in concealed locations will be tape or compound, non-shrinking, non-drying, butyl rubber. In exposed areas sealants will be acrylic co-polymer to CGSB 19GP-5M or one part silicone to CGSB CAN2-19.13.
- .6 Installation of metal cladding and accessories will be in accordance with manufacturer's recommendations and standard practice.

2.2 FASTENERS

- .1 Nails: CSA B111. Screws: ASME B18.6.3. Purpose made aluminum alloy stainless steel, cadmium plated steel.
- .2 Fasteners will be galvanized and pre-finished in same colour as the cladding. Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized; fastener cap same colour as exterior panel. Exposed fasteners same finish as panel system.

2.3 CAULKING

- .1 Sealants in concealed locations will be tape or compound, non-skinning, non-drying, butyl rubber. In exposed areas sealants will be acrylic co-polymer to CGSB 19GP-5M or one part silicone to CGSB CAN2-19.13 to match siding color.

2.4 ACCESSORIES

- .1 Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same colour and gloss as cladding, with fastener holes pre-punched.
- .2 Metal Girts – Galvanized to manufacturer's recommended gauge for installation as detailed.
 - .1 Standard breakshapes including Z-bar, U-bar, and L-Bar as detailed on Drawings.
 - .2 Agway Metals Inc Sub-girts or approved alternate

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 INSTALLATION

- .1 Install cladding in accordance with CGSB 93.5, and manufacturer's written instructions.
- .2 Install continuous starter strips, inside and outside corners, edgings, soffit, drip, cap, sill, intakes, louvres, and window/door opening flashings as indicated.
- .3 Install outside corners, fillers and closure strips with carefully formed and profiled work.
- .4 Install soffit and fascia cladding as indicated.
- .5 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
- .6 Attach components in manner not restricting thermal movement.
- .7 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00 - Joint Sealants.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by preformed metal siding installation.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Materials and installation of metal roofing and accessories.
- .2 Coping, cap, sill, and other flashings.
- .3 Brake-formed flashing at openings for windows, louvres and other openings.
- .4 Brake-formed covers and trim.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 07 21 00 - Building Insulation
- .3 Section 07 26 00 - Vapour Barriers
- .4 Section 07 27 00 - Air Barriers
- .5 Section 07 46 13 - Preformed Metal Siding
- .6 Section 07 62 20 - Sheet Metal Flashing and Trim
- .7 Section 07 92 00 - Joint Sealants
- .8 Section 08 11 00 – Metal Doors and Frames

1.3 INSTALLER QUALIFICATIONS

- .1 Roofing Contractor to be an active member of the Canadian Roofing Contractors Association.
- .2 Roofing Contractor to have a minimum of five years proven satisfactory experience.
- .3 When requested, provide a list of last three comparable jobs including, job name and location, and project manager.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sheet metal roofing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit product data sheets for accessories.
 - .3 Shop Drawings:
 - .1 Submit drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, fascia, metal furring, and related work.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Deliver, handle, store and protect materials in accordance with manufacturer's written instructions.
- .3 Provide and maintain dry, off-ground weatherproof storage.
- .4 Remove only in quantities required for same day use.

1.6 WARRANTY

- .1 Provide the CRCA Standard Form of Warranty guaranteeing workmanship related to the installation of the roofing system will remain leakproof for a period of two (2) years from the date of Substantial Performance.

Part 2 Products

2.1 METAL ROOFING

- .1 Pre-painted Galvanized Steel Sheet: ASTM A653/A653M, Coating Designation Z275.
 - .1 Thickness: 0.61 mm.
- .2 Roofing Profile:
 - .1 15mm deep, rib profile, interlocking side laps, exposed fasteners.
 - .2 Panel Width: 755 mm with intermediate ribs.
- .3 Finish: Silicone-modified polyester to AAMA 2604, 2-coat system having total topside dry film thickness between 0.9 to 1.1 mils.
 - .1 Colour: To be selected by consultant at time of award.
- .4 Acceptable Profile: Vic West CL816R or approved equal.

2.2 ACCESSORIES

- .1 A continuous ridge vent system shall be installed.
 - .1 Acceptable product: As manufactured by Lomanco, or approved equivalent.
 - .2 Colour to match roofing.
- .2 Foam and metal closures to match specified profile.
- .3 SBS modified bitumen self-adhesive high temp membrane to cover entire roof area.

- .1 Width: For all applications under metal roofing, cover entire area;
- .2 Thickness: Minimum 1.0 mm (40 mil);
- .3 Acceptable products: Lastobond Shield HT, Blueskin PE200HT or approved equivalent. Product must be for high temperature applications;
- .4 Edge of roof shall be finished with preainted aluminum fascia and trim;
- .5 Under eaves shall be finished with a vinyl soffit, suitable to provide sufficient ventilation;
- .6 Aluminum drip edge: extruded profile of unplasticized polyvinyl chloride of minimum thickness of 0.8 mm;
- .7 Flashings and Accessories: Formed from same materials as the metal roofing.
- .8 Flashings to be custom fabricated to profiles indicated.
- .9 Fasteners and Cleats: manufacturer's standard, colour-matched to panel, designed to achieve FM I-90 uplift rating.
- .10 Closures: Foam and metal closures to suit profiles indicated, to provide complete watertight barrier.
- .11 Pipe flashing: Premoulded EPDM flexible boot as recommended by roofing manufacturer, to suit pipe penetration outside diameter.
- .12 Sealant: Silicone type, refer to Section 07 92 00. Colour as selected by Consultant.

2.3 FABRICATION

- .1 Fabricate sheet metal roofing components to comply with dimensions, profiles, gauges and details shown on reviewed shop drawings.
- .2 Form components whenever possible prior to delivery to site.
- .3 Provide roof sheet and accessories in longest practical length to minimize field lapping.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sheet metal roofing installation in accordance with manufacturer's written instructions.
 - .1 Inform Engineer of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Installation and preparation: as per manufacturer.

- .2 Install SBS modified bitumen membrane over entire area.
 - .1 Roof to be thoroughly cleaned, free of debris and dry prior to installation.
 - .2 Membrane to be covered within 24 hours.
- .3 Install metal roofing with the profile in the direction of the slope and so that both side edges are at the flat part of the profile.
- .4 Install continuous ridge vent system as per Manufacturer's recommendations.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Remove protective film (if any) from exposed surfaces of copper sheeting promptly upon installation. Strip with care to avoid damage to finishes.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by sheet metal roofing installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Coping, cap, sill, and other flashings.
- .2 Brake-formed flashing at openings for windows, louvres and other openings.
- .3 Brake-formed covers and trim.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 07 13 52 – Modified Bituminous Sheet Waterproofing
- .3 Section 07 26 00 - Vapour Retarder.
- .4 Section 07 27 00 - Air Barrier.
- .5 Section 07 46 13 – Preformed Metal Siding.
- .6 Section 07 62 00 - Sheet Metal Flashing and Trim
- .7 Section 08 11 10 - Metal Doors and Frames.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International).
 - .1 ASTM A653/A653M-23 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.4 SUBMITTALS

- .1 Provide Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.5 QUALIFICATIONS

- .1 Fabricator and Installer: Company specializing in sheet metal flashing work with 5 years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 To be in accordance with section 01 61 00 – Common Product Requirements.
- .2 Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- .3 Prevent contact with materials which may cause discolouration or staining.

Part 2 Products

2.1 PREFINISHED STEEL SHEET

- .1 Pre-painted Galvanized Steel Sheet: ASTM A653/A653M, 24 gauge, zinc coated Z275 galvanized steel sheet.

- .1 Colour: to match adjacent metal cladding.

2.2 PREFINISHED ALUMINUM SHEET

- .1 Finish: factory applied coating to CAN/CGSB 93.1 supplemented and amended as follows:
 - .1 Aluminum Base Sheet, minimum thickness 22 gauge
 - .2 Specular gloss: 30 units +/- units.
 - .3 Outdoor exposure period: 2500 hours.
 - .4 Exposure period for humidity resistance: 5000 hours.

2.3 ACCESSORIES

- .1 Fasteners: DT2000 coated or hot dipped galvanized; Provide plastic covered hex head screw complete with rubber gasket, colour match to sheet metal.
- .2 Exposed Sealant: Silicone, as specified in Section 07 92 00; colour to match sheet metal finish.

2.4 FABRICATION

- .1 Form sections true to shape, accurate in size, square, and free from distortion or defects.
- .2 Fabricate cleats of same material as sheet, minimum 50 mm wide, interlockable with sheet.
- .3 Form pieces in longest possible lengths.
- .4 Fabricate flashings to drain away from building interface. Provide hemmed edge and end dams.
- .5 Hem exposed edges on underside 13 mm; mitre and seam corners.
- .6 Form material with flat lock seams.
- .7 Fabricate vertical faces with bottom edge formed outward 6 mm and hemmed to form drip.
- .8 Fabricate flashings to profiles indicated. Coordinate installation with work of other sections

2.5 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of prefinished metal of aluminum sheet.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details, AAI-Aluminum Sheet Metal Work in Building Construction as detailed.

- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
 - .1 Secure in place and lap joints 100 mm.
- .4 Counter flash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lock forming tight fit over hook strips, as detailed.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglet true and level, and caulk top of reglet with sealant.
- .7 Insert metal flashing into under cap flashing to form weather tight junction.
- .8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .9 Caulk flashing at reglet with sealant.
- .10 Install soffit and fascia cladding as indicated.

3.3 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .2 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Materials, substrate preparation and application for caulking, backing and sealants.
- .2 Text to complete other various Sections containing sealant or caulking specifications.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 10 00 – Concrete Forming And Accessories
- .3 Section 03 20 00 – Concrete Reinforcing
- .4 Section 03 30 00 – Cast-In Place Concrete
- .5 Section 03 35 00 – Concrete Finishing
- .6 Section 04 05 00 – Common Work For Masonry
- .7 Section 04 05 13 - Masonry Mortaring And Grouting
- .8 Section 04 05 19 - Masonry Anchorage And Reinforcing
- .9 Section 04 22 00 – Concrete Unit Masonry
- .10 Section 05 50 00 - Metal Fabrications
- .11 Section 07 13 52 – Modified Bituminous Sheet Waterproofing
- .12 Section 07 21 00 – Building Insulation
- .13 Section 07 27 00 – Air Barriers
- .14 Section 07 46 13 – Preformed Metal Siding
- .15 Section 07 61 00 – Sheet Metal Roofing
- .16 Section 07 62 00 – Sheet Metal Flashing and Trim
- .17 Section 08 11 00 – Metal Doors and Frames
- .18 Section 09 91 99 – Painting
- .19 Division: 20,22 and 23Mechanical.

1.3 DIVISIONS: 26 ELECTRICALREFERENCES

- .1 American Society for Testing of Materials (ASTM).
- .2 ASTM C834-17, Standard Specification for Latex Sealants.
- .3 ASTM C919-22, Standard Practice for Use of Sealants in Acoustical Applications.
- .4 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
- .5 ASTM D2369-04, Standard Test Method for Volatile Content of Coatings.

- .6 ASTM D5893-16(2021), Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and colour availability.
- .3 Submit laboratory tests or data validating product compliance with performance criteria specified.
- .4 Samples: Once selection is made submit two sample ribbons of sealant, illustrating sealant colours for selection. No restrictions.
- .5 Manufacturer's Installation Instructions: Indicate special handling criteria, installation sequence, and cleaning procedures.
- .6 Provide confirmation that the manufacturer has a minimum 5 years experience in producing of material used for work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in Work.
- .7 Provide a list of completed projects by the sub-contractor similar in scope and of equal or more value than this project in the past five (5) consecutive years.
- .8 Provide documented proof for each installer performing the Work of this section has a minimum five (5) years documented experience.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .3 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

- .4 Store products in a location protected from freezing, damage, construction activity, precipitation, and direct sunlight in strict accordance with manufacturer's recommendations.
- .5 Condition products to approximately 16 to 21°C for use in accordance with manufacturer's recommendations.
- .6 Material not protected as noted will be subject to removal from site.
- .7 Material not protected as noted and installed will be subject to removal from site.

1.6 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
 - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

Part 2 Products

2.1 SEALANT MATERIALS

- .1 Acoustical sealant: to ASTM C919, single component, non-hardening, non-skinning, synthetic rubber. Acceptable product: Pecora BA-98, Tremco Acoustical Sealant or approved equal.
- .2 Acrylic latex: to ASTM C 834, single component general purpose siliconized acrylic latex sealant. Acceptable product: BASF Sonolastic Sonolac, GE L100, Master Builders Master Seal NP520, Pecora AC-20 + Silicone, Tremco Tremflex 834 or approved equal.
- .3 Butyl Sealant: to ASTM C1311, single component, solvent release, non-skinning, nonsagging, lack colour; Acceptable Products: Pecora BC-158, Tremco Butyl Sealant or approved equal.
- .4 Epoxy, flexible: Poured flexible 100% solids epoxy joint filler. Acceptable product: BASF Epolith-P, Euclid Dural 340SL, Master Builders Master Seal CR190, Sika Loadflex 2, W.R. Meadows Rezi-Weld Flex or approved equal.

- .5 Polyurethane, self-levelling: to ASTM C 920, Type S, Grade P, Class 25, single component self-levelling polyurethane sealant with plus or minus 25 percent movement capability for horizontal joints. Acceptable product: BASF Sonolastic SL1, Master Builders Master Seal SL1, Pecora Urexpan NR-201, Tremco Vulkem 45, Sika Sikaflex 1C SL or approved equal.
- .6 Silicone, one part: to ASTM C 920, Type S, Grade NS, Class 25, single component neutral cure silicone sealant, plus minus 50% joint movement capability.
- .7 Acceptable product: Dow Corning 795, NUCO Nuflex 319, Pecora 895NST, Tremco Spectrum 2, BASF Omniseal 50 or approved equal.
- .8 Silicone, mildew resistant: to ASTM C 920, single component mildew resistant silicone sealant, +/- 25% movement capability. Acceptable product: Tremco Tremsil 200, Dow Corning 786, NUCO Nuflex 302, Pecora 898NST, BASF Omniplus or approved equal.

2.2 ACCESSORIES

- .1 Primer: Type recommended by the sealant manufacturer and compatible with joint forming materials.
- .2 Joint Cleaner: Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.
- .3 Soft Backer Rod: to ASTM C 1330, non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants. Size required for joint design.
- .4 Closed-Cell Backer Rod: to ASTM C 1330, closed-cell polyethylene rod designed for use with cold-applied joint sealants for on-grade or below-grade applications. Size required for joint design.
- .5 Joint Filler: closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 6 mm. Size required for joint design.
- .6 Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

2.3 SEALANT SELECTION

- .1 The following schedule covers locations requiring sealant whether shown on the drawings or not.
 - .1 All cracks are to be caulked.
 - .1 Locations not included in this schedule shall be caulked at the discretion of the Engineer at no extra cost.
- .2 Perimeters of exterior openings where frames meet exterior of building.
 - .1 Sealant type: Silicone, one part.
- .3 All other exterior applications.
 - .1 Sealant type: Silicone, one part.
- .4 Perimeters of interior door, windows, edges of drywall and other frames and surfaces.
 - .1 Sealant type: Acrylic latex or Silicone, one part.

- .5 Perimeter of plumbing fixtures, countertop backsplash at wall, window sills, FRP panels, ceramic tile.
 - .1 Sealant type: Silicone, mildew resistant.
- .6 Building envelope applications (vapour retarder, vapour barrier, vapour barrier/wall openings and vapour retarder/ wall openings, etc.):
 - .1 Sealant type: Acoustical sealant.
- .7 Interior partitions acoustic applications:
 - .1 Sealant type: Acoustical sealant.
- .8 Interior masonry: walls to floor, wall to steel
 - .1 Sealant type: Silicone, one part.
- .9 Perimeter and annular space around all interior non rated penetrations in floors, walls, ceilings, partitions etc.:
 - .1 Sealant type: Acoustical sealant.
- .10 Perimeter all interior walls, ceilings, partitions etc.
 - .1 Sealant type: Silicone, one part.
- .11 Interior concrete control joints and saw cuts.
 - .1 Sealant type: Epoxy, flexible.
- .12 Perimeter of interior concrete slab. – Radon gas seal.
 - .1 Sealant type: Polyurethane, self-levelling.
- .13 Perimeter all countertops, joints between millwork and walls.
 - .1 Sealant type: Silicone, one part.
- .14 Perimeter all stairs and stringers.
 - .1 Sealant type: Silicone, one part.
- .15 Perimeter of cover plates, access doors and other similar items.
 - .1 Sealant type: Silicone, one part.
- .16 Metal Fabrications; welded and non-welded exposed to view seams:
 - .1 Sealant type: single component pick-resistant moisture curing, aliphatic polyurethane sealant.
 - .1 Acceptable Product: Sonalatic Ultra by BASF
- .17 For locations not included in this schedule, consult with Engineer for proper selection of sealants.

2.4 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written recommendations.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
- .2 Verify that substrate surfaces and joint openings are clean, dry, and free of frost and ready to receive work.
- .3 Verify that joint backing and release tapes are compatible with sealant.

3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

- .1 Remove loose materials and foreign matter which might impair adhesion of sealant.
- .2 Clean, prepare and prime joints in accordance with sealant manufacturer's written instructions.
- .3 Protect elements surrounding the work of this section from damage or disfiguration.

3.4 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.5 APPLICATION

- .1 Install sealant in accordance with sealant manufacturer's written instructions.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .3 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .4 Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.
- .5 Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- .6 Install bond breaker where joint backing is not used.

- .7 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- .8 Apply sealant within recommended application temperature ranges.
- .9 Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .10 Tool joints concave.

3.6 FIELD QUALITY CONTROL

- .1 Joint Sealants: Perform adhesion tests in accordance with manufacturer's written
- .2 instructions.
- .3 Perform test 21 days after installation at a rate of one test every 300 m of installed sealant.
- .4 Remove sealants failing adhesion test, clean substrates, reinstall sealants and perform retesting.
- .5 Maintain test log and submit report to Engineer indicating tests, locations, dates, results, and remedial actions.

3.7 CLEANING

- .1 Clean adjacent soiled surfaces.

3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 04 05 00 - Common Work Results for Masonry.
- .3 Section 06 10 00 – Rough Carpentry
- .4 Section 07 21 00 - Building Insulation.
- .5 Section 07 27 00 - Air Barriers.
- .6 Section 07 92 00 - Joint Sealants.
- .7 Section 08 71 00 – Door Hardware
- .8 Section 09 91 99 – Painting

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-22, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20-04/G40.21-18, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
 - .3 CSA O151-04 - Canadian Softwood Plywood.
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
 - .2 Canadian Steel Door Manufacturers Association (CSDMA), Recommended Dimensional Standards for Commercial Steel Doors and Frames, 2000.
 - .3 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-99, Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701.1-2022 - Standard for Thermal Insulation, Polystyrene Boards.
 - .2 CAN-ULC-S710.1-2019 - Standard for Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Material Specification.
 - .3 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
 - .4 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.
 - .5 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 REGULATORY REQUIREMENTS

- .1 Fire Rated Door and Frame Construction: Labelled and listed to CAN4-S104M.
- .2 Installed Door and Frame Assembly: Conform to NFPA 80 for fire rated class as indicated.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: Indicate door and frame configurations and finishes, location of cut-outs for hardware reinforcement.
- .3 Shop Drawings:
 - .1 Indicate frame elevations, frame section, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.
 - .2 Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing, and finishes.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Perform in accordance with Section 01 61 00: Deliver, store, protect and handle products to site.
- .2 Remove doors and frames from wrappings or coverings upon receipt on site and inspect for damage.
- .3 Store in vertical position, spaced with blocking to permit air circulation between components.
- .4 Store material under waterproof cover on pallets or plank platforms held off ground.
- .5 Clean and touch up scratches or disfigurement caused by shipping or handling with zinc rich primer.
- .6 Material not protected as noted will be subject to removal from site.
- .7 Material not protected as noted and installed will be subject to removal from site.

1.6 COORDINATION

- .1 Coordinate the work with frame opening construction, door, and hardware installation.

- .2 Sequence installation to ensure wire connections are achieved in an orderly and expeditious manner.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers:
 - .1 Fleming Door products
 - .2 Metal Door Limited
 - .3 Métalec Steel Doors and Frames
 - .4 Apex
 - .5 Daybar Industries Limited

2.2 MATERIALS

- .1 Sheet Steel: Galvanized steel to ASTM A653/A653M, commercial grade (CS), Type B:
 - .1 Coating designation Z275 for exterior doors and frames,
 - .2 Coating designation ZF001 for interior doors and frames.
- .2 Reinforcement Channel: To CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.
- .3 Plywood: CSA O151 (CSP), CANPLY Grade SHG; un- sanded, exterior use, thicknesses as indicated; Urea-Formaldehyde free.

2.3 DOOR CORE MATERIALS

- .1 Honeycomb Core: Structural small cell 25.4 mm maximum kraft paper honeycomb, sanded to required thickness.
- .2 Polystyrene Core: Rigid extruded fire retardant, closed cell board, density 16 to 32 kg/m³, thermal values RSI 1.0 minimum, Type 1, in accordance with CAN/ULC-S701.

2.4 ADHESIVES

- .1 Cores and Steel Components: Manufacturer's standard VOC compliant adhesive. Total VOC content of adhesive less than or equal to 250 g/L, less water, when tested to ASTM D2369.
- .2 Lock Seam: Manufacturer's standard VOC compliant sealant. Total VOC content of sealant less than or equal to 250 g/L, less water, when tested to ASTM D2369.
- .3 Construction Adhesive: Low VOC polyurethane construction adhesive, resistant to freezing; VOC Limit: 70 g/l (0.58 lb/gal) when tested in accordance with USEPA Method 24 and ASTM D2369.

2.5 PAINT

- .1 Finish: Field painted in accordance with Section 09 91 99

2.6 ACCESSORIES

- .1 Expanding Foam Sealant: to Section 07 21 00, VOC compliant.
- .2 Joint Sealers: to Section 07 92 00, colour to match adjacent wall finish.
- .3 Door Silencers: Single stud rubber/neoprene.
- .4 Exterior Top Caps: Inverted, continuously welded, weathertight steel channel.
- .5 Frame Thermal Breaks: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
- .6 Glazing Stops: Formed galvanized steel channel, minimum 16 mm high, accurately fitted, butted at corners and fastened to frame sections with counter-sunk tamper proof sheet metal screws.
- .7 Glass: Types as indicated.

2.7 FABRICATION - DOORS

- .1 Interior Doors: Laminated honeycomb core construction.
 - .1 Face sheet thickness: 18 gauge.
 - .2 Honeycomb core: laminated under pressure to face sheets.
- .2 Exterior Doors: Polystyrene insulated and laminated steel stiffened construction.
 - .1 Face sheet thickness: 16 gauge.
 - .2 G-90 Material.
 - .3 Longitudinal Edges: Mechanically interlocked, tack welded.
 - .4 Welded steel top cap.
- .3 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier.
- .4 Reinforce for surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware.
- .5 Top and Bottom Channels: Inverted, recessed, welded steel channels.
 - .1 Channel set with legs facing inside of door to create a flat flush surface with the edge frame, fully welded to prevent water infiltration.
- .6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .7 Attach fire rated label to each fire rated door unit.

2.8 FABRICATION - FRAMES

- .1 Interior Frames: Face sheet thickness: 18 gauge
 - .1 Welded type construction.
- .2 Exterior Frames: Face sheet thickness 14 gauge.
 - .1 Welded type construction,
 - .2 No thermal break,

- .3 G-90 material.
- .3 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier.
- .4 Reinforce frames wider than 1200 mm with roll formed steel channels fitted tightly into frame head, flush with top.
- .5 Prepare frames for silencers.
 - .1 Provide three single silencers for single doors and mullions of double doors on strike side.
 - .2 Provide two silencers on frame head at double doors without mullions.
- .6 Attach fire rated label to each fire rated frame unit.
- .7 Infill Panels: Fabricate infill panels as metal sheet laminated to plywood core using construction adhesive.
 - .1 Caulk perimeter with silicone sealant to Section 07 92 00.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that opening sizes and tolerances are acceptable; check floor area within path of door swing for flatness.
- .2 Verify doors and frames are correct size, swing, rating and opening number.
- .3 Remove temporary shipping spreaders.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.
- .3 Coordinate with wall construction for anchor placement.
- .4 Coordinate installation of glass and glazing.
- .5 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00 - Door Hardware.

3.4 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.

- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowance for deflection to ensure structural loads are not transmitted to frame product.
- .5 Foam fill shim space at perimeter of frame and open back sections to maintain continuity of thermal envelope.
- .6 Maintain continuity of air barrier vapour retarder.

3.5 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Maximum Diagonal Distortion: 3 mm measured with straight edges, crossed corner to corner.
- .3 Adjust operable parts for correct clearances and function.
- .4 Install door silencers and glazing.
- .5 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

3.6 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors with metallic paste filler and sand to a uniform smooth finish.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 08 11 00 - Metal Doors and Frames.

1.2 REFERENCES

- .1 NBCC - National Building Code of Canada Latest, 2015
- .2 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2006, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.3-2001, Exit Devices.
 - .4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
 - .5 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.6-2005, Architectural Door Trim.
 - .7 ANSI/BHMA A156.7-2003, Template Hinge Dimensions.
 - .8 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
 - .9 ANSI/BHMA A156.10-1999, Power Operated Pedestrian Doors.
 - .10 ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
 - .11 ANSI/BHMA A156.13-2005, Mortise Locks and Latches Series 1000.
 - .12 ANSI/BHMA A156.14-2002, Sliding and Folding Door Hardware.
 - .13 ANSI/BHMA A156.15-2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .14 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
 - .15 ANSI/BHMA A156.17-2004, Self-closing Hinges and Pivots.
 - .16 ANSI/BHMA A156.18-2006, Materials and Finishes.
 - .17 ANSI/BHMA A156.19-2002, Power Assist and Low Energy Power - Operated Doors.
 - .18 ANSI/BHMA A156.20-2006, Strap and Tee Hinges and Hasps.
 - .19 ANSI/BHMA A156.21-2006, American National Standards for Thresholds.
 - .20 ANSI/BHMA A156.22-2005, Door Gasketing and Edge Seal Systems.
 - .21 ANSI/BHMA A156.30-2003, American National Standards for High Security Cylinders.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-B651-04.Accessible Design for the Built Environment.
- .4 Canadian Steel Door Manufacturer's Association (CSDMA).

- .1 Standard Hardware Locations in Accordance with the Canadian Steel Door and Frame Association Guidelines.
- .2 Recommended locations for Architectural Hardware for Wood Flush Doors.
- .5 National Fire Protection Agency(NFPA)
 - .1 NBC - National Building Code – Latest Edition
 - .2 NFPA-80 - Standard for Fire Doors and Windows – Latest Edition
 - .3 NFPA101 - Life Safety Code – Latest Edition
 - .4 NFPA-105 - Smoke and Draft Control – Latest Edition

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Upon Consultant request submit samples of door hardware in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Samples will be returned for inclusion into work.
 - .3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .4 After approval samples will be returned for incorporation in Work.
- .4 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Submit detailed hardware list and keying schedule. Hardware Schedule is to be submitted as per DHI vertical format which is in the “Sequence and Format for Hardware Schedules”.
 - .3 Indicate specified hardware including make, model, material, function, size, finish and other pertinent information.
 - .4 Furnish other Sections with templates required for hardware preparation and installation. Issue templates when requested so as not to cause any delays but not before hardware list has received final review by Consultant.
 - .5 Keying Schedule to be in accordance with DHI manual “Keying Systems Names and Nomenclature”. Key schedule is not to hold up the processing of the hardware list.
- .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittal.
- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.5 WARRANTY

- .1 Warranty start date is from substantial completion.
- .2 No liability is to be assumed where damage is due to improper installation, usage or abuse.
- .3 Provide guarantee.
 - .1 Closers 10 years
 - .2 Electronic Closer 2 years
 - .3 Exit Device 3 years
 - .4 Hinges Lifetime of Building
 - .5 All other hardware 1 year

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Meet requirements of National Building Code of Canada and other applicable regulations.
- .3 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .4 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .6 Upon completion of finish hardware installation, hardware supplier shall inspect work and shall certify in writing that all items and their installation are in accord with requirements of Contract Documents and are functioning properly.

1.7 PRODUCT DELIVERY, HANDLING & STORAGE

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 – Common Product Requirements.
 - .2 Package each item of hardware including fastenings, separately or in like groups of hardware, with necessary screws, keys, instructions and installation templates.
 - .3 All items of hardware should be itemized and tagged as per the approved Finish Hardware Schedule.
 - .4 Shortages will not delay installation.

- .5 Items damaged in shipment will be replaced properly with proper material.
- .6 All Hardware shall be handled in a manner to avoid damage, marking and scratching.
- .7 Hardware is to be inventoried on site and confirmed by the Contractor and Hardware Supplier.
- .2 Storage and Protection:
 - .1 Store hardware in locked, clean and dry area.

1.8 MAINTENANCE

- .1 Provide maintenance materials
- .2 Provide three sets of maintenance tools for closers, locks and exit devices as well as a complete set of installation instructions.
- .3 After the building is occupied, arrange for an appointment with the owner to instruct them of proper use, service, adjusting and maintenance of the hardware furnished in this section.
- .4 Extra Material if required.

1.9 INSPECTION

- .1 The hardware supplier shall arrange at least one visit to the job site.
 - .1 Site visit shall take place just prior to building turnover. Co-ordinate with general contractor and Consultant to determine proper time for visit. All hardware shall be checked for proper installation and adjustment. Any errors shall be corrected and adjustments made. Check the key system and furnish a report along with maintenance manuals detailing any errors found.
- .2 Cost of this service will be included as part of this Section and is not covered by any allowance amount.

Part 2 Products

2.1 HARDWARE ITEMS

- .1 Door Hardware – Single Door (Exterior)
 - .1 Door Hardware shall conform to the following schedule or approved equal (hardware per single door)
 - .1 3 ONLY HINGES FBB191 114 x 101 x NRP x C15
 - .2 1 ONLY LOCKSET 7825-OB x C26D
 - .3 1 ONLY DOOR CLOSER EN350-OZ x EN350-B DROP PLATE
 - .4 1 ONLY HOLD OPEN DEVICE 590H x 26D
 - .5 1 ONLY DOOR SWEEP W24S x DOOR WIDTH
 - .6 1 ONLY SET WEATHERSTRIP W49 x SIZE TO SUIT
 - .7 1 ONLY THRESHOLD CT10 x DOOR WIDTH

2.2 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.3 KEYING

- .1 Doors, padlocks and cabinet locks to be keyed alike in groups as directed.
- .2 Provide three (3) sets of keys for every lock in this contract, master keyed to the Owner's standard and key type.
- .3 Keys shall be of nickel silver and shall be furnished by the lock manufacturer.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to Consultant.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Furnish manufacturers' instructions for proper installation of each hardware component.

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 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction locks when directed by Consultant.
 - .1 Install permanent cores and ensure locks operate correctly.

3.3 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.
- .4 All defective or damaged hardware will have to be repaired or replaced at the contractor's expense.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.5 DEMONSTRATION

- .1 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
 - .2 Description, use, handling, and storage of keys.
 - .3 Use, application and storage of wrenches for door closers, locksets and fire exit hardware.
 - .2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.6 PROTECTION

- .1 Protection must be given to all products and finishes until such time as the owner accepts the project.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Material and installation of site applied paint finishes to new interior surfaces, including site painting of shop primed surfaces.

1.2 REFERENCES

- .1 Environmental Protection Agency (EPA)
 - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 Maintenance Repainting Manual - current edition.
- .4 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.

1.3 QUALITY ASSURANCE

- .1 Qualifications: Contractor with minimum of five years proven satisfactory experience.
- .2 Inspection Report:
 - .1 From manufacturer's technical representative that products supplied and installed meet the specification and are installed to specification and manufacturers recommendations and instructions.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Submit product data and instructions for each paint and coating product to be used.
- .3 Provide list of last three comparable jobs including, job name and location, Architect and project manager.
- .4 Provide inspection reports from manufacturer's technical representative.
- .5 Samples: Submit full range colour sample chips to indicate where colour availability is restricted.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading: in accordance with manufacturer's written instructions.
- .2 Remove damaged, opened and rejected materials from site.
- .3 Storage and Protection:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area with temperature range 7°C to 30°C.

1.6 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Provide heating facilities to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .2 Provide continuous ventilation for seven days after completion of application of paint.
 - .3 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- .2 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.

Part 2 Products

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.
 - .1 Under no circumstance shall paint materials be applied without prior review of VOC limits by the Engineer.
 - .2 Provide interior paint products with a VOC range 151 g/L.
 - .3 Provide exterior paint products with a VOC range 201 g/L.
- .4 Colours:

- .1 Consultant will provide Colour Schedule after Contract award.
- .2 Selection of colours from manufacturer's full range of colours at no extra cost.
- .3 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.
- .5 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to site.
 - .2 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
 - .3 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .6 Gloss/sheen ratings:
 - .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	
 - .2 In General Gloss level ratings of painted surfaces shall be:
 - .1 Satin finish in all areas except:
 - .1 Walls: Gloss finish.
 - .2 Metal items: Gloss finish.
 - .3 Final selection will be provided by the Consultant with colour finish schedule at no extra cost.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.
- .3 Review all steel to be painted to ensure that all steel has been ground, sanded, body filled, sealant applied and is ready for painting.

- .1 Do not paint until ready.

3.3 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.4 INTERIOR PAINT AND COATING SYSTEMS

- .1 Interior painting systems to be based on MPI Premium grade unless noted otherwise. The following is list of principal items only. Surfaces not included in this schedule shall be painted at the discretion of the Consultant.
- .2 Concrete horizontal surfaces:
 - .1 INT 3.2L - Waterborne epoxy floor finish; gloss level selected by Consultant.
- .3 Metal Fabrications:
 - .1 INT 5.1B - Water based light industrial finish:
 - .1 One coat metal primer (omit when shop primed),
 - .2 Two finish coats.
- .4 Galvanized Metal: steel doors and frames. Selection to be from one of the following:
 - .1 INT 5.3B - Water based light industrial coating.
 - .1 One coat primer (omit when shop primed),
 - .2 Two finish coats.
 - .2 INT 5.1K - Epoxy-modified latex finish.
 - .1 One coat rust inhibitive primer.
 - .2 Two coats epoxy-modified latex.
- .5 Dressed Lumber: Interior Finish Carpentry and Millwork for Clear and Stained Finish:
 - .1 Shop Finish - INT 6.3K - Polyurethane Varnish Finish:
 - .1 Minimum three coats polyurethane finish (stained when required by Consultant), or alternatively and only when approved by Consultant;
 - .2 Site finish using clear finish (stained when required by Consultant); minimum three coats.
- .6 Dressed Lumber - Painted Finish: Interior finish carpentry, and millwork for painted finish:
 - .1 INT 6.3P - Waterborne light industrial finish:
 - .1 One coat primer (omit when shop primed),
 - .2 Two finish coats.

- .7 Plywood Mounting Boards:
 - .1 INT 6.4P - Pigmented Fire Retardant finish: apply to ULC approved procedures.

3.5 EXTERIOR PAINT COATING SYSTEMS

- .1 Galvanized Metal: fabrications, gates and fences, doors and frames. Selection to be from one of the following:
 - .1 EXT 5.3G - Water based light industrial coating:
 - .1 One coat primer,
 - .2 Two finish coats.
 - .2 EXT 5.3J - Water based light industrial coating (over water-based primer):
 - .1 One coat primer,
 - .2 Two finish coats.

3.6 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking.
 - .1 If damaged, clean and restore surfaces as directed by Engineer-Architect.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
 - .4 Protect passing pedestrians, building occupants and general public in and about the building.
- .2 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements.
- .3 Ensure that the stage plywood floor has been filled, sanded smooth and sealants applied.
- .4 All rust from structural steel, miscellaneous metals, pipes, sprinkler pipes, etc shall be removed by the painter, and primed before painting.
- .5 All structural steel, miscellaneous metals and other items which have factory primer to be re-primed on site by the painter.
- .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

3.7 APPLICATION

- .1 Conform to manufacturer's application instructions unless specified otherwise.
- .2 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied. Two (2) coats to be applied (not including primer).

- .3 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .4 Sand and dust between coats to remove visible defects.
- .5 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .6 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

3.9

Part 1 General

1.1 WORK INCLUDED

- .1 The work included in this section will consist of the supplying of all materials, labour, supervision, construction plant, equipment, etc., necessary for the blower supply and installation, which consist of:
 - .1 Supply and installation of two (2) skid-mounted positive displacement blowers each with an acoustic enclosure;
 - .2 Supply and installation of all related check valves, motors, flexible connections, inlet and outlet filter / silencers for the blower assembly;
 - .3 Supply and installation of an acoustic intake assembly for the blower assembly;
 - .4 Supply of spare parts, operation and maintenance manuals, and start-up assistance.
 - .5 Other related work all as described in these specifications.
- .2 The foregoing will not be construed as limiting, restricting, or modifying any general or specific requirements as set forth in any part of the Contract documents.

1.2 RELATED REQUIREMENTS

- .1 Section 10 81 01 Supply and Installation of WWTP Aeration System.

1.3 GENERAL

- .1 These specifications are for the design, fabrication, delivery, installation and start-up of positive displacement air blowers complete with electric motors including:
 - .1 Two (2) units each comprised of a blower and motor skid mounted as a unit as described herein;
 - .2 Flexible connector and clamp for inlet and outlet connections on each unit supplied;
 - .3 Each unit shall be complete with check valves, isolation valves, and piping;
 - .4 Each unit shall be complete with a high efficiency motor, suitable for use with variable frequency drive controllers (inverter duty);
 - .5 Each unit shall be housed in an acoustic enclosure to limit sound intensity;
 - .6 Each unit shall be complete with an inlet filter silencer as shown on the drawings.
 - .7 Lubricants required for start-up and operation, spare parts, shop drawings, installation manuals;
 - .8 Operating and Maintenance Manuals;
 - .9 Installation inspection, start-up, testing and personnel training assistance by the manufacturer's representative.
 - .1 The Contractor's electrical and mechanical representatives will be required to be present and assist in the start-up of the equipment by the blower manufacturer. This will be for a period of two (2) days.
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- .2 The Blower start-up will only be possible after the level in the Lagoon Cells are returned to design elevations.
- .2 The Contractor shall be responsible for maintaining the units to the manufacturer's requirements until the work is accepted by the Owner.
- .3 The foregoing will not be construed as limiting, restricting, or modifying any general or specific requirements as set forth in any part of the Contract Documents.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Submit shop drawings for review prior to fabrication and in accordance with construction sequence outlined in accordance with Section 01 33 00 – Submittals Procedure.
 - .1 Submit for review detailed shop drawings of all equipment and all material required to complete the project.
 - .2 No material or equipment may be delivered to the job site or installed until the Supplier has in his possession the reviewed shop drawings for the particular material or equipment.
 - .3 Submit not less than the number of sets of shop drawings required to satisfy the following:
 - .1 One PDF sets will be kept by the Engineer following review;
 - .2 Five (5) sets are to be kept by the Supplier for the specific purpose of being included in the Operating and Maintenance Manuals;
 - .3 The number of sets required by the Supplier for his own use.
 - .4 If the Supplier must revise and resubmit shop drawings, promptly re-submit the same number of sets.
 - .5 Submit attached technical questionnaire with Shop Drawings.
 - .6 Shop drawings shall refer not only to drawings, but also any brochures, reports, charts, forms, etc., required for complete review of the equipment of material.
 - .7 Blower shop drawings shall include all components and information necessary for the evaluation of the blower units including but not necessarily limited to: blower dimensions, weight, skid mounting details, performance curves for varying blower speed and discharge pressures, power curves for blower operation, details on inlet and outlet connections, blower noise rating information (with and without acoustic enclosure), etc.
 - .8 Blower motor shop drawings shall include: motor electrical characteristics, power rating, service factor, coupling details with the blower, motor dimensions, weight, location of electrical connections, skid mounting details, etc.
 - .9 Shop drawings shall also be provided for the blower accessories that are to be provided with each unit. This will include detailed information on the blower acoustical enclosure, flexible inlet and outlet discharge connections, acoustical intake louvre and transition duct, check valves, isolation valves, piping, gauges, pressure switches, inlet filter/silencer, discharge silencer, and any other accessories specified herein.

- .10 Submit for review detailed, dimensioned drawings or cuts, showing construction, size, arrangement, operating clearances, mounting or anchoring details, performance characteristics and capacity.
- .11 Submit for review complete assembly and installation drawings, detailed specifications and data covering material used and accessories forming a part of the equipment furnished.
- .12 Each piece of material or equipment proposed shall be a standard catalogue product of an established manufacturer and of quality, finish, and durability equal to that specified.
- .13 Shop Drawings to Include:
 - .1 Package
 - .1 Letter from factory confirming blower package is fully shop assembled and will meet the performance requirements specified herein;
 - .2 Package drawing, showing dimensions and connection sizes and locations;
 - .3 Package weight.
 - .2 Blowers
 - .1 Name of manufacturer;
 - .2 Type and model;
 - .3 Rotative speed;
 - .4 Critical speed of the rotor;
 - .5 Type of bearings, lubrication, and AFBMA L10 Bearing life rating;
 - .6 Connection sizes;
 - .7 Maximum air temperature at discharge flange;
 - .8 Net weight or blower;
 - .9 Net weight of heaviest single component requiring removal for maintenance;
 - .10 Overall dimensions;
 - .11 Complete performance curves showing discharge pressure versus capacity, operating speed, and bhp at minimum and maximum ambient air temperatures and at standard condition. Curves shall indicate performance at various speeds and discharge pressures and shall include the specified minimum airflow and specified maximum airflow at the specified discharge pressure;
 - .12 Shop painting data;
 - .13 Vibration isolator base pads;
 - .14 Estimated maximum noise level measured 1.0 m from the outside of the blower enclosure;
 - .15 Blower/motor skid: bolt-hole locations, overall dimensions, x-y-z co-ordinates for blower inlet and outlet;
 - .16 Heat generation (BTU/hr.) at design operation;

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- .17 Parts list and parts diagram.
 - .3 Motors
 - .1 Name of manufacturer;
 - .2 Type and model;
 - .3 Bearing type and lubrication;
 - .4 Horsepower rating and service factor;
 - .5 Terminal box location;
 - .6 Temperature rise and insulation rating;
 - .7 Full load rotative speed;
 - .8 Net weight;
 - .9 Efficiency at full load, $\frac{3}{4}$ load $\frac{1}{2}$ load, and rated blower;
 - .10 Full load current;
 - .11 Locked rotor current;
 - .12 Overall dimensions;
 - .13 Parts list and parts diagram.
 - .4 Accessories
 - .1 Name of manufacturer;
 - .2 Equipment data.
 - .5 Certified Shop Tests Reports
 - .1 Performance curves;
 - .2 Data;
 - .3 Calculations.
 - .2 Provide installation manuals in accordance with construction sequence outlined in Section 01 78 00 - Closeout Submittals.
 - .1 This Manual is to include:
 - .1 Dimensions and weights of equipment to be installed. Specific information on off-loading equipment required when the equipment is delivered to the site;
 - .2 A checklist of each individual component supplied and identification of the crate/package each is in;
 - .3 Drawings showing equipment configuration, dimensions, location of lifting points, etc;
 - .4 Recommended clearance requirements;
 - .5 Anchor bolt patterns, gasket/pad information, anchor bolt torquing requirements, alignment information;
 - .6 Drawings showing connection/termination point, sizes, etc. for piping, electrical, etc;
 - .7 Electrical characteristics and connection points;
 - .8 Installation sequence and checklist;
 - .9 Specific information on proper maintenance of the equipment between the time it is installed and the time it is brought into normal service;
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- .10 Other information as required to ensure the equipment is safely and properly installed;

1.5 START-UP ASSISTANCE AND TRAINING

- .1 In addition to the Installation Manuals, the supplier shall furnish the necessary skilled technical personnel to check the installation, carry out an evaluation of, and start-up the equipment supplied under this contract.
 - .1 This personnel shall be available on site for not less than two (2) full days of eight (8) hours each for aeration system start-up, including Blowers. Co-ordinate timing with Engineer.
 - .2 The Contractor's electrical and mechanical representatives will also be required to be present and assist in the start-up of the equipment by the blower manufacturer.
 - .3 Provide fourteen (14) calendar days notice of the time when this service will be provided.
- .2 Also during this time on site, the Supplier's personnel shall instruct the Owner or his representative fully on the operation, adjustment, and maintenance of all equipment furnished.
- .3 These two (2) days of on-site assistance and training will not be paid separately, but is considered incidental to the work and is to include all transportation, accommodation, personnel, and related costs including office support.
- .4 **NOTE:** It is intended that the two days of on-site presence for the purpose of start-up and commissioning, and for training of the Owner's personnel, is common to the aeration system and the blower system (as described in Section 10 81 01 Supply and Installation of WWTP Aeration System). In addition, a final inspection of the blowers and aeration system will also be required eleven (11) months after commissioning (as described in Section 10 81 01 Supply and Installation of WWTP Aeration System).
- .5 If additional on-site time is required from the personnel, it must be requested by the Owner in writing and will be paid at the all-inclusive per diem rate provided in the tender. This does not include any time or costs to carry out repairs under the warranty, which is incidental to the contract.
- .6 The Supplier shall not charge for office technical support provided during the warranty period.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 Closeout Submittals.
- .2 Submit for review draft copies of the Operating and Maintenance Manuals in accordance with construction sequence outlined in Article 1.26 of Section 01 00 01 General Requirements. All final copies of these manuals shall be delivered within two (2) calendar weeks of the return of the reviewed draft.
 - .1 Provide three (3) bound and indexed copies of an Operating and Maintenance Manual for the blower assemblies supplied under this contract.

- .2 Submit two (2) hard-copy draft copies of the O & M Manuals to the Engineer for review (Minimum 5 weeks prior to commissioning).
- .3 One (1) copy will be returned to the Supplier with any comments or changes required. Three (3) final copies are then to be submitted to the Engineer.
- .4 Supply written operating and maintenance instructions from the Supplier, which shall be sufficiently comprehensive to enable the operator to operate and maintain the equipment supplied.
- .5 All information in the O & M Manuals shall be clear and legible. Any data sheets with information on multiple models or optional equipment shall be clearly marked to indicate the information which applies to the equipment supplied.
- .6 Assemble all data in a vinyl hard covered, plastic jacketed, 3 hole 'D' ring binder for 215 x 280 mm size paper with spine and face pockets. Binder to be of thickness to adequately contain all necessary information. Number pages consecutively
- .7 Prepare the instructions as a systems manual applicable solely to the equipment supplied by the manufacturer to these specifications, including those devices and equipment supplied by him. Also refer to Section 10 81 01 – Supply and Installation of WWTP Aeration System, Article 1.7.7 – Operation and Maintenance Manuals. The Operation and Maintenance Manual for the Aeration System is to be integrated with the Operation and Maintenance Manual for the Blowers as a single document. The instructions shall include, but not be limited to, the following:
 - .1 Descriptions of, and operating instruction for, each major component of the facility as supplied, including detailed parts lists.
 - .2 Instructions for operation of the equipment in all intended modes of operation.
 - .3 Instructions for all adjustments which must be performed at initial startup of the facility, adjustments which must be performed after the replacement of level control system components, and adjustments which must be performed in the course of preventive maintenance as specified by the Manufacturer.
 - .4 Service instructions for major components not manufactured by the Manufacturers but which are supplied by them in accordance with these Specifications. The incorporation of literature produced by the actual components Manufacturer shall be acceptable.
 - .5 Copies of the reviewed shop drawings for the equipment.
 - .6 A list of major equipment components with complete model and serial number information, and a list of local and head office Manufacturer's representatives including telephone and fax numbers.
 - .7 Operation and maintenance instructions shall be specific to the equipment supplied in accordance with these Specifications. Instruction manuals applicable to many different configurations, and which require the operator to selectively read portions of the instructions, shall not be acceptable.

- .8 Arrange each manual in three sections: General; Equipment; and Operating and Maintenance Procedures.
 - .1 General:
 - .1 Summary of Information Page: project name, equipment description, order number, serial numbers for all components, Manufacturer, Manufacturer's nearest service representative, date prepared (and revised if necessary).
 - .2 Table of Contents.
 - .3 Warranty Information.
 - .4 Listing and Explanation of Abbreviations Used.
 - .2 Equipment:
 - .1 Blowers: shop drawings; certified performance curves identified by serial numbers; parts diagram and parts list; direction of rotation; materials of construction; product specifications, physical characteristics;
 - .2 Electric motors: shop drawings; standard performance data; serial numbers; parts diagram and parts list; physical characteristics;
 - .3 Expansion joints: shop drawings; performance specifications; dimensions;
 - .4 Check valves: shop drawings; performance specifications; dimensions;
 - .5 Filter/silencers: shop drawings; performance specifications; dimensions;
 - .6 Discharge Silencers: shop drawings; performance specifications; dimensions;
 - .7 Inlet Filter Silencer: shop drawings; performance specifications; dimensions.
 - .3 Operating and Maintenance Procedures:
 - .1 Blower and motor units: normal start-up and shut-down procedures; maintenance checklist with maintenance operation and frequency; lubricant list; lubrication points diagrams; recommended spare parts list for minor field repairs; alignment instructions; troubleshooting tips; preventative maintenance inspection and monitoring charts.
 - .2 Filter/silencer units: cartridge element source (manufacturer, model) information; pressure loss and/or time interval for element change.
 - .3 Any other instructions or information the Owner should have for the safe and reliable operation of the equipment.

1.7 WARRANTY AND GUARANTEE REQUIREMENTS

- .1 Full warranty against defects in performance, workmanship and materials on the blowers including all accessories shall be maintained for twenty-four (24) months following the

date of substantial completion (commissioning of the blowers). Warranty documentation to be provided at commissioning.

- .2 Defects which occur or are discovered during this period shall be repaired or replaced by the Manufacturer to the Engineer's satisfaction, at no cost to the Owner. Work under the guarantee/warranty shall include not only replacement of defective parts or materials but also all work incidental thereto. Work required under the Guarantee/Warranty shall be carried out promptly after notification of an issue by the Owner or the Engineer.
- .3 The Guarantee/Warranty Certificate shall be submitted to the Engineer not less than two (2) calendar weeks prior to the date of submission of the draft O & M Manual.
- .4 This Certificate shall clearly identify the following:
 - .1 The Project and Owner being covered by the Guarantee/Warranty.
 - .2 The blower unit manufacturer providing the Guarantee/Warranty, including legal name, address telephone number, and name of authorized representative.
 - .3 The details of coverage of the Guarantee/Warranty stated in accordance with Article 1.8 of this Section.
- .5 The Certificate shall be signed (and witnessed if required) by a representative of the blower unit manufacturer authorized to sign such documents on behalf of the manufacturer, and the manufacturer's corporate seal shall be affixed to this document.
- .6 The original of this Guarantee/Warranty Certificate shall be delivered to the Owner. A copy shall be delivered to the Engineer, and copies shall be included with the O & M Manuals as stated above.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 The equipment and accessories to be supplied under this contract are to be shipped by the supplier to the Wastewater Treatment Plant located in Neqotkuk (Tobique), New Brunswick.
 - .2 Arrangements for delivery and coordination of the equipment are to be made by the successful contractor.
 - .3 All equipment and materials are to be properly packaged, protected and secured to ensure there is no damage or loss.
 - .4 **Notify the Engineer in writing no less than seven (7) working days in advance of shipment of the method, dimensions and weights of each part of each shipment and its anticipated date of arrival at the site.**
 - .5 Label each crate or package to identify its contents and any special handling instructions. The supplier is responsible for the protection of all items until delivered to the site and shall promptly repair and /or replace any damaged items to the satisfaction of the Engineer and at no additional cost, even if any damages or deficiencies are not identified until after delivery.
 - .6 For protection until incorporated into the work, equipment and material may not be unpacked and carefully examined until time of installation.
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- .7 Final acceptance of material will be dependent upon shop test and inspections, field test and inspections, the performance of the materials under operating conditions, and the fulfilment of all guarantees.
- .8 It should be noted that equipment necessary for off-loading at the site **will not be provided** by the owner.
- .9 All equipment (for a complete installation, as described in these Specifications), material, information, etc. required to be provided by the supplier shall be delivered complete to the site. Exact date of delivery will be determined after award of contract and in coordination with the successful Contractor. The only exception shall be provision of installation supervision and start-up assistance which shall be determined by the schedule for construction to be done under a separate contract.
- .10 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .11 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .12 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 AIR BLOWERS

- .1 Skid-mounted blower package: blower, motor, combined inlet filter/ silencer, relief valve, pressure gauge, check valves, isolation valves, spare parts, base gasket/pad, discharge silencer with integral steel base, belts, sheaves, belt guard, safety valve, flexible connections (inlet and outlet), instrumentation, acoustical enclosure and vibration isolators. Provide pressure switch, temperature gauge, temperature switch, and all accessories and appurtenances indicated on the drawings, specified, or otherwise required for a complete, properly operating system.
- .2 General:
 - .1 Equipment to be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and manufacturer's recommendations.
 - .2 Coordinate the blowers with the equipment specified in other sections. The blower unit shall be a current standard product of the blower manufacturer and shall be a packaged type unit, engineered and fully shop assembled by the blower manufacturer. The blower manufacturer shall furnish all accessory items.
 - .3 Approved blower packages:
 - .1 Aerzen Delta GEN-5 GM Blower; Silent Flow Model as manufactured by BOC Edwards-Hibon Inc.
 - .2 Com-paK Plus Package as manufactured by Kaeser Omega Blowers; Model DB.

- .3 Approved equivalent.
- .3 General Equipment Requirements:
 - .1 Power supply to the equipment:
 - .1 Blowers: 575 volts, 60 Hz, 3 Phase.
 - .2 Enclosure fan motors: 120 volt 60 Hz 1 phase.
 - .2 Blower motor: inverter duty suitable for VFD control, designed to operate normally between 50-100% of maximum motor speed.
 - .3 Nameplates: provide nameplate for each blower shall indicating the equipment number.
 - .1 Location of nameplates and method of attachment to be acceptable to the Engineer;
 - .4 Spare parts: each blower shall be provided with a set of spare parts consisting of the following items:
 - .1 Intake air filter elements: 3 sets
 - .2 V-belts: 1 matched set
 - .3 Replacement Oil and/ or Grease: 1 Year Supply
 - .4 One (1) set of any special tools required to operate and/or maintain the equipment supplied.
 - .5 Spare parts to be suitably packaged with labels indicating the contents of each package. Spare parts to be delivered to the Owner as directed.
- .4 Service Conditions:
 - .1 The blowers will be used to supply air to the WWTP aerated lagoon. This facility will be operating continuously, 24 hours/day, 7 days per week, 365 days per year. The equipment will be housed inside a building.
- .5 Performance and Design Requirements:
 - .1 The following design requirements are to be considered as a minimum. The blower supplier has the responsibility to meet the following requirements.
 - .2 It is the responsibility of the aeration system Supplier as part of the aeration system design to identify and select an acceptable blower-motor unit that efficiently provides the volume of air at the required pressure as determined by the Design Brief for this specific project, including all requirements as specified herein. It will be the responsibility of the aeration system supplier to ensure that the blowers can meet or exceed the requirements of the aeration system. This will identify the following performance requirements:
 - .1 Output volume, L/s or scfm at design discharge pressure
 - .2 Motor rated power, HP/kW
 - .3 Pressure differential, kPa/psi
 - .4 Intermittent diffusers purging pressure, kPa/psi
 - .5 Blower unit power consumption in kWh at design operating conditions
 - .3 In the event that the selected aeration system requires additional output volume, output pressure capability, aeration purging pressure or any other requirements

that would result in higher motor horsepower requirements, the Contractor will be responsible for any resulting cost as determined by the Engineer, including any mechanical and electrical modifications required as determined by the Engineer.

- .4 Each blower shall be designed for the following conditions and requirements:
 - .1 Atmospheric pressure: 101 kPa (14.71 psia);
 - .2 Design inlet temperature: 24°C Summer and 0°C in Winter;
 - .3 Design relative humidity: 70%;
 - .4 Gas composition: Air;
 - .5 Gas specific gravity at inlet: 1.0;
 - .6 Maximum blower speed: As recommended by Manufacturer for proper operation;
 - .7 Elevation of installation: + 84.3 m geodetic at finished floor in building;
 - .8 Blower flexibility: able to provide from 50% to 100% of rated capacity without developing transition or heat problems. This will be done by variable frequency drive units provided by others. Motors to be capable of continuous operation with variable frequency drive at 50% output capacity without overheating to be inverter duty suitable for VFD;
 - .9 Maximum steady state operation noise level to meet OSHA standards, and not exceed 75 dB at 1.0 m in any direction (measured with blower and motor operating) with acoustic enclosure at 100% output and not exceed 95 dB at 1.0 m in any direction without acoustic enclosure measured inside the actual building (wood frame with drywall finish);
 - .10 Minimum mechanical efficiency of 75% at 100% output.
- .5 The Blowers shall produce the diffusers purging pressure without entering into the safety factor range.
- .6 Verify the performance of each unit prior to shipment from the factory by testing at various air flow rates from 50% to 110% of rated air flow to develop performance curves which shall be certified and provided to the Owner. The performance curves shall include a power (horsepower or kW) versus air flow rate curve. Each curve shall be developed from not less than five (5) points. These performance/test curves shall be clearly labelled to show the serial number of the unit tested and certified copies provided to the Engineer as soon as available but not less than three 3 weeks prior to delivery of the blowers to the site. Copies shall also be included in the O & M Manuals.
- .6 Positive Displacement Blower
 - .1 Casing: designed to withstand at least twice the specified discharge pressure and shall be reinforced with integrally cast ribs.
 - .1 Provide each casing with tapped and plugged openings for casing and bearing drains and fittings for proper bearing and gear lubrication maintenance.
 - .2 Arrange casing for top inlet and bottom discharge.

- .3 Incorporate a built-in pulsation dampener to reduce air pulsations in the discharge piping by a minimum of 90% and reduce the overall noise level of the package.
- .2 Rotors and Shaft: drop forged in one single piece to ASTM 1043 or equivalent.
 - .1 Rotors: made from high strength ductile iron.
 - .2 Impellers: of the straight, three lobe involute type (unless a rotary lobe blower is selected).
- .3 Timing Gears: carburized and ground steel helical gears located at the drive end to eliminate torsional stress through the shaft. To be enclosed in oil tight housings, splash lubricated.
- .4 Bearings:
 - .1 Each rotor and shaft assembly shall be supported by ball type anti-friction bearings rated for a minimum AFBMA life of 80,000 hours.
 - .2 Provide an additional roller bearing at the drive end designed to handle the V-belt drive stress.
 - .3 Incorporate a minimum of five (5) individual bearing assemblies in each blower.
- .5 Lubrication:
 - .1 Each blower shall be provided with non-wearing, non-contacting piston ring seals designed to prevent lubricant from entering the air stream.
 - .2 Lubrication shall be accomplished via splash type lubrication on both ends of the blower.
 - .3 Provide oil slingers and gear dipping as well as suitable oil level sight glasses.
 - .4 No grease lubrication is allowed.
 - .5 Synthetic oil shall be used to improve bearing life.
- .7 Inlet Filter Silencer
 - .1 Provide an absorptive type inlet filter-silencer in each blower package to reduce noise at frequencies above 500 Hz with an integral resonator.
 - .2 The inlet filter shall be situated inside the inlet silencer, and shall be designed to protect the blower from harmful dirty and foreign matter.
 - .3 The filter element shall be of the dry, washable, synthetic media type, finished carbon steel, all weather housing, ANSI standard 125 lb. bottom flange, 6.35 mm (1/4-inch) FNPT tap to allow installation of gauge to monitor pressure drop, and silencing tubes designed to effectively reduce blower noise.
 - .4 Noise attenuation: not less than 12 dB from 500-8,000 Hz or as required to meet Article 2.1.5 - Performance and Design Requirements.
 - .5 Clean filter pressure drop: not to exceed 1.0 kPa (0.15 psi) at 100% rated flow.
 - .6 Size filter/silencer units properly to suit the design conditions.
 - .7 Effective inlet velocity at the filter housing inlet: maximum 3.05 m/s (600 ft/min).
 - .8 Filter inlets to be on the underside of the housing. Housings shall open to permit the convenient replacement/cleaning of filter elements.

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- .9 Inlet housings shall be complete with bird screen.
 - .8 Discharge Silencer
 - .1 Each blower package shall be provided with a reactive residential type discharge silencer composed of different expansion chambers. The silencer shall be fitted with an integral resonator "sleeve" for maximum noise reduction, as required to meet Article 2.1.5, Performance and Design Requirements. That is, noise within 1.0 m of the outlet of the discharge silencer shall not exceed 75 dBa.
 - .2 The discharge silencer shall be combined in a single assembly with the steel base-plate, which is designed to support the blower and all its appurtenances.
 - .3 Minimum steel thickness of welded carbon steel base: ¼-inch.
 - .4 The steel base/ discharge silencer shall be designed to maintain alignment of the blower and the drive components during operation. No other type of arrangement shall be allowed so as to prevent distortion or misalignment of the whole package.
 - .9 V-Belt Drive
 - .1 Each blower package shall be provided with V-belts and pulleys designed for the blower conditions. Provide a fully automatic belt tensioning system as part of the package. Slide rails shall not be acceptable.
 - .2 Service factor for the belt drive: minimum of 1.5 times over the BHP under maximum load conditions.
 - .3 The belt drive shall be covered by a belt guard in compliance with OSHA regulations.
 - .10 Electric Motor
 - .1 Motors: horizontal, open drip-proof, cast iron frame, induction type, with normal starting torque and low starting current characteristics, suitable for 3 phase, 60 Hertz, 575 volts, electric current. Motors shall not be overloaded at design operating conditions or at any pressure in blower operating range as specified. The motors shall be designed for use with Variable Frequency Drives, to be inverted duty type motors rated for minimum 1,600 Volts.
 - .2 The motor shall be capable of continuously operating at reduced speed of up to 50% of maximum speed without overheating.
 - .3 The motor shall be complete with a perforated belt guard primed with a minimum of 1.5 mils of zinc-based synthetic primer. A finish acrylic enamel coating (minimum 3.0 mils) shall be applied in accordance with Article 2.1.12 - Painting, Colour Definitions of ANSI 253.1; 1967, Safety Colour Code for Marking Physical Hazards.
 - .4 Each motor shall be of cast iron frame construction and shall be of current NEMA design. Rolled steel or aluminum frame motors shall not be acceptable.
 - .5 Motors shall be tested to ASA C50 and conform thereto for insulation resistance and dielectric strength.
 - .6 The capacity shall be sufficient to operate associate driven devices under all conditions of operation and load and without overload, and at least horsepower
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indicated or specified. Each motor shall be selected for quiet operation. Motor specifications shall include:

- .1 Motors shall be CSA approved, ULC listed, SCI type;
 - .2 Motor voltage: 575 V/60 Cycle/3 Phase;
 - .3 Enclosure: open drip proof;
 - .4 Service factor: 1.15;
 - .5 Maximum motor speed at 100% output: 1,800 RPM;
 - .6 Insulation Class F, suitable for continuous duty at 40°C ambient temperature;
 - .7 Motor Rating - as required to properly suit the blower;
 - .8 High efficiency (93% minimum);
 - .9 Manufactured to EEMAC Design B Standards;
 - .10 Frame 405 TS (direct connected to blower);
 - .11 Motors to be equipped with embedded thermistors (one per phase).
- .11 Vibration Isolator Pads
- .1 Vibration isolator base pads shall be provided for each blower as recommended by the manufacturer.
- .12 Painting
- .1 All ferrous metals shall be shop painted. Prior to shop priming, all surfaces shall be sandblasted per SSPC-SP6.
 - .2 The prime coat shall be one coat of universal primer to achieve a minimum dry film thickness of 2-2.5 mils. The application shall be uniform, free of runs, sags and pinholes and in strict compliance with the paint manufacturer's printed instructions. The finish paint of primed surface shall be the factory standard industrial enamel. The minimum dry film thickness for the finish paint shall be 2.0 mils.
 - .3 Blowers and motors shall be standard factory finish colours. The frame shall be painted to match the blower. The supplier shall be responsible for touch-up of any paint damaged during shipment of the equipment.
- .13 Discharge Pressure Relief Valve: spring-loaded type with housing in bronze, suitable for temperature up to 150°C.
- .1 Provide each blower with a pressure relief valve, sized to provide adequate protection for the blower and the motor in case of operation against a closed discharge valve.
 - .2 Valve shall have flanged connection.
 - .3 The relief valve shall be set at the factory at not less than 7 kPa 1 psig above and not more than 35 kPa 5 psig above the maximum design operating discharge pressure.
- .14 Discharge Check Valve: Techoccheck full flanged or wafer type, 125 lb. class, style 5004 CIL, or approved equivalent.
- .1 Provide a discharge check valve for each blower.

- .2 Valve seat materials: designed for temperature up to 1750°C (350°F) and pressure up to 415 kPa (60 psig).
 - .3 Valve body: cast iron with aluminum internals, 316 S.S. springs, teflon sealing member materials.
 - .15 Pressure and Vacuum Gauges
 - .1 Provide each blower with a vacuum restriction gauge on the inlet side and a pressure gauge on the discharge side.
 - .2 Install all gauges with a valve cock between the blower and the gauge to facilitate removal/replacement of the gauge.
 - .3 For the sound enclosure design, supply the vacuum restriction gauge with 62.5 mm (2 ½ inch) dial installed on the sound enclosure wall and visible without opening the sound enclosure.
 - .4 Supply the pressure gauge with 62.5 mm (2 ½ inch) dial, 0-20 psig dial filled with low viscosity glycerin, with a body in stainless steel.
 - .5 For the sound enclosure design, the pressure gauge shall be installed on the outside of the sound enclosure wall.
 - .16 Discharge Temperature Gauge
 - .1 Provide each blower with a discharge temperature gauge. For the sound enclosure design, supply the temperature gauge with bulb and capillary tube with a 4-inch dial installed on the sound enclosure wall.
 - .2 Scale range: 0 to 200°C.
 - .3 Capillary length: sufficient for convenient mounting.
 - .4 Supply a stainless steel well to secure the bulb.
 - .17 Discharge Temperature Switch: Allen Bradley Model 837-A6A complete with Thermowell 837-N1 manual reset, or approved equivalent
 - .1 Provide each blower with a discharge temperature switch to automatically shut the blower down in the event of high temperature. Switch to be remote bulb type with single pole, single throw, 10 ampere switches suitable for 120 volts ac.
 - .2 Housing: NEMA Type 1 housing for indoor installation.
 - .3 Capillary length: sufficient for convenient mounting.
 - .4 Supply a stainless steel well to secure the bulb.
 - .18 Discharge Pressure Switch
 - .1 Install a pressure switch in the discharge piping of each blower.
 - .2 Adjustable range: 0 to 15 psig (0 to 100 kPa), and shall be set lower than the relief valve setting.
 - .3 Each pressure switch shall be field adjustable and shall have a trip point repeatability of better than 1 percent of actual pressure.
 - .4 The contact shall close to shut down the blower, and the rating shall be 10 amperes at 120 volts ac. Each switch shall have a weatherproof NEMA 4 housing.
 - .19 Acoustical Enclosure
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- .1 The blower manufacturer shall provide an engineered acoustical enclosure to minimize the overall noise level. The enclosure shall be made of zinc plated steel sheets with high-density polyurethane noise dampening material. Two removable access doors shall be included, one on each side. The base plate of the noise enclosure shall be made of epoxy-coated steel, and be designed to facilitate lifting with a forklift. The entire blower unit shall be installed on a skid, as part of the acoustic enclosure.
 - .2 An internal high efficiency ventilation system shall be provided and operated by a 120 volt, 1 phase, 60 cycle power supply. A ventilation fan attached to the blower shaft shall not be acceptable. The high efficiency exhaust fan shall be designed to maintain the temperature inside the enclosure at not more than 12oF above the ambient temperature.
 - .3 The acoustical enclosure shall be sandblasted per SSPC-SP6. The prime coat shall be one coat of universal epoxy primer to achieve a minimum dry film thickness of 2-2.5 mils. The application shall be uniform, free of runs, sags and pinholes and in strict compliance with the paint manufacturer's printed instructions.
 - .4 It should be noted that a ventilation fan attached to the blower shaft is acceptable. If a fan operated by 120 V power supply is used, the blower manufacturer shall include a controller to operate the fan when the blower is running and shut down when the blower is stopped. The blower manufacturer shall also include a junction box for electrical connection.
- .20 Acoustical Intake Hood and Transition Duct
- .1 The blower manufacturer shall provide an engineered acoustical intake hood to minimize the overall noise level at the inlet. These hoods shall be supplied loose.
 - .2 The hoods shall be galvanized steel sheet metal connected to the Blower Schedule 10 pipe using a flexible EPDM connector from the welded galvanized steel transition duct as shown on the Drawings.
 - .3 The enclosure shall include an aluminum louvre sized for the application. The louvre shall include a drainable blade and bird screen mesh.
 - .4 The acoustical hood shall include acoustic foam and baffles to reduce noise.
 - .5 Paint hood as specified under Article 2.1.12.
 - .6 Hoods shall be manufactured and supplied to be installed on the wall of a building, with mounting flanges and gaskets.
 - .7 The opening (intake) of the hood shall point downward.
 - .8 Refer to the Drawings for additional details.
 - .9 **Both units (acoustical intake hood and transition duct) are required for each blower unit and will be installed by others.**

Part 3 Execution

3.1 INSTALLATION

- .1 Install according to manufacturer's recommendations.

- .2 The installation shall be inspected for approval by the manufacturer's representative prior to start-up.
- .3 Supplier to provide installation and start-up assistance as noted in Article 1.6 of this Section and in Sections 01 91 13 – General Commissioning (Cx) Requirements and 01 91 41 – Commissioning: Training.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 The work to be done under this Section will consist of the supplying of all materials, labour, supervision, construction plant, equipment, etc., necessary for the completion of the work which consists of:
 - .1 Preparation of a detailed design brief for a fine bubble diffused aeration system to be installed in two (2) lagoon cells at the WWTP, to include determination of air requirements, blower selection, buried distribution header design, and floating laterals with fine bubble submerged diffusers aeration system design to meet the specified wastewater treatment loadings, flows and objectives, and to present the operating concept for the treatment system.
 - .2 Supply and install the blowers required to support this aeration system design (refer to Section 10 81 00 Supply and Installation of Blowers), the aeration system design is to be based on two (2) identical blowers in total, one (1) of which shall operate to provide the air requirements, and one (1) which shall be a “stand-by” unit, but will be included in a rotating operating cycle so that all units are used equally.
 - .3 Supply and install floating lateral piping with submerged fine bubble aeration diffusers system in accordance with the aeration system design including diffuser ballasts, tension assemblies, and all required components and installation hardware for the aerated wastewater treatment plant.
 - .4 Supply and install “free end” self-adjusting lateral tension assembly and anchor posts.
 - .5 Supply of spare parts, Installation Manuals, Operation and Maintenance Manuals, aeration piping/diffuser unit installation, training the Owner’s staff, and installation and start-up assistance.
 - .6 And other related work all as described in these specifications.
- .2 The foregoing will not be construed as limiting, restricting, or modifying any general or specific requirements as set forth in any part of the Contract documents.
- .3 It shall be noted that the bottom of the existing wastewater treatment plant is made of a clay liner with variable bottom elevation and sludge is present, but to be removed as part of this contract. The contractor will be responsible to provide an aeration diffuser system with variable dept. The final depth of each diffuser will be confirmed during the installation of the aeration system.
- .4 As described in these specifications and on the drawings, the aeration system was based on a typical floating lateral system. Any other components required for a complete installation of one of the approved system shall be included in this item, and no extra payment will be made to the Contractor for omissions in the tendered price for floating laterals or any item required for a complete installation of the aeration system, as required by the Manufacturer and as shown on the drawings and in these specifications.

1.2 RELATED REQUIREMENTS

- .1 Sectio 01 29 00 – Payment Procedures
- .2 Section 10 81 00 Supply & Installation of Blowers.
- .3 Section 10 90 00 Air Piping Systems.
- .4 Section 22 20 13 Pressure Piping.

1.3 QUALIFICATIONS AND EXPERIENCE

- .1 The Supplier and Installer shall have experience in the design, manufacturing, supplying, installation and commissioning of fine bubble diffuser aeration systems and flow diversion baffles of the type specified.
- .2 Aeration equipment shall be of proven design and shall be referenced by at least five (5) installations in wastewater treatment lagoons of similar scope (cold climate with more than four (4) months of ice cover conditions), having been in operation for not less than two (2) years. All such systems shall currently be in operation. References of these installations shall be provided with bid submission.
- .3 System installer shall be familiar with and shall have installed a minimum of three (3) of the specified systems within the past ten (10) years and be under the supervision of the Supplier/Manufacturer or Supplier/Manufacturer Certified Installer. A summary-report of the installation procedures and recommended adjustments shall be submitted as part of the O&M Manuals submission.
- .4 Aeration diffusers shall have a documented history of efficient operation, freedom from clogging, excessive backpressures, or structural failure when applied to service conditions similar to those indicated for this project.
- .5 Diffuser membranes shall have a design life span of not less than 10 years before replacement is required. The Owner and/or Engineer reserves the right to reject any bid, which in the opinion of the Engineer does not meet the full qualification as set forth.

1.4 COMMISSIONING AND START-UP ASSISTANCE - AERATION SYSTEM

- .1 In addition to the required on-site Aeration System Manufacturer's representative to be present during the installation of the floating aeration diffuser laterals, the Supplier/Manufacturer shall furnish the necessary skilled technical personnel to start-up and commissioning the aeration system supplied under this contract, including on-site training of the Owner's operators.
- .2 The personnel shall be available on site for not less than two (2) full days of eight (8) hours each for aeration system start-up, including Blowers. The timing of this is to be coordinated with the Engineer. Also, during this time on site, the Supplier's personnel shall instruct the Owner or his representative fully in the operation, adjustment, and maintenance of all equipment furnished.
- .3 The Engineer or Owner will provide the Supplier with a minimum of fourteen (14) calendar day notice of the time when this service is to be provided. It will be scheduled when the installation is completed and the remainder of the Wastewater Treatment Plant is constructed and ready for start-up and the cells have been filled sufficiently for this work to be done.

- .4 The two (2) days of on-site assistance and training will not be paid separately but is considered incidental to the work and is to include all transportation, accommodation, personnel, and related costs including office support services.
- .5 In addition, the Tendered Price shall include two (2) full days of on-site assistance for a complete system verification, re-calibration and adjustment of all components, floating laterals and submerged diffusers, blowers, and general overview of the system maintenance. This work shall be performed eleven (11) months after the date of Substantial Completion and before the end of the first year of the guarantee/warranty period. The inspection is to be done by the Aeration System Manufacturer's skilled technical representative and personnel. In the event that this visit is not required as determined by the Owner or Engineer the Owner will deduct the amount prescribed in the Tender Form from the remaining holdback.
- .6 If additional on-site time is required of these personnel, it must be requested by the Owner in writing and will be paid at the all inclusive per diem rate provided in the tender. This does not include any time or costs to carry out repairs under the guarantee/warranty, which is incidental to the contract.
- .7 The Supplier shall not charge for office technical support provided during the warranty period.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for aeration system and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit complete system shop drawings and design information to Engineer for review prior to fabrication/installation. Submittals required under this Section include:
 - .1 Aeration System Design Brief, including layout drawings
 - .2 Aeration Floating Diffuser Lateral Shop Drawings
 - .3 "Free end" Self-Adjusting Tension Assembly and Anchor Post Shop Drawings
 - .4 Aeration System Operating and Maintenance Manuals
 - .5 Aeration System Guarantee/Warranty Certificate
- .4 The specific minimum requirements for each of these submittals are as follow:
 - .1 Aeration System Design Brief
 - .1 The Design Brief shall be organized in a logical manner with an index identifying each section, plans, attachments, etc. The Brief shall clearly identify the project and Owner for which the design applies.
 - .2 All design factors and assumptions used in the system design shall be clearly identified.
 - .3 The design is to be carried out for summer and winter conditions at the facility.

- .4 Air (oxygen) requirements for each cell shall be identified for summer and winter conditions, to be shown separately for BOD5 reduction, and possible future denitrification. Air requirements shall also show calculations of field transfer rates (FTR) and scfm or L/s requirements for each cell.
- .5 Design treatment efficiency shall be shown for summer and winter conditions and shall show retention time, influent and effluent BOD5, percentage BOD5 removal, influent and effluent TSS, and NH3 removal for each Cell.
- .6 Diffuser design shall be shown, including depth of each cell, depth of installation of each diffuser, number of diffusers in total per cell, diffuser model number(s), number of diffusers on each lateral in each cell, diffuser lateral spacing, delivery air pressure at the diffusers in each cell and any other relevant information.
- .7 The design of the air distribution headers shall be based on the design factors as stated in this Specification. The design of the air distribution headers shall consider all losses from the discharge side of the blowers from piping, fittings, valves, flow meters, etc., both inside the blower building and along the pipe route to each cell in determining the pipe sizes required. (Refer to the attached drawings for information on the proposed piping configuration inside the new Blower Building.)
- .8 The buried air distribution header system, installed by others, shall be 150mm diameter HDPE DR17 pipe, complete with appropriate fitting. Successful Contractor to confirm that installed pipe is acceptable.
- .9 The design of the aeration system shall also identify the manufacturer, model number, performance information, electric power characteristics, etc., of the blowers that will be supplied as part of the scope of the aeration system under this Contract. This Design Brief shall include a section which clearly shows that the blower selection made is appropriate to the requirements of the aeration system performance and oxygen transfer requirements, system pressure losses, etc. The blowers selected shall be as provided under Section 10 81 00 of these Specifications.
- .10 A schedule shall be included to show the time realistically required for the preparation and submission of shop drawings, and for delivery of the various components to the job site.
- .11 The Design Brief shall provide a detailed "operating concept" for the operation of the aeration system at this WWTP facility. This shall include such details as how the aeration system (blowers, diffusers, etc) is to be operated with varying organic and hydraulic loads delivered to the WWTP, and for seasonal variations that affect influent and WWTP operating temperatures.
- .12 Plans are to be included that clearly illustrate the layout and dimensional information of the aeration system, including the air distribution headers and fittings, air diffuser laterals, separation distances, details of the anchoring system required, and any other information required to provide a complete Design Brief.

- .13 Appendices are to be included for any relevant supporting information, such as Clean Water Oxygen Transfer Tests (ASCE certified), design worksheets, material specifications, material quantity summaries, etc. The certified oxygen transfer test curve shall show unit performance over an air flow rate range of at least 4.5 L/s (10 scfm) to 11.25 L/s (25 scfm).
- .14 The Design Brief, calculations and any drawings shall be signed and stamped by a Professional Engineer experienced in this type of work and currently licensed or registered to practice in the Province of New Brunswick. (stamp will be required to cover the total submission, including calculations, design process guaranty, confirmation of influent and effluent parameters, aeration parameters, physical dimensions of each cells all in accordance with theses Specifications, as show on the drawings and incidentals).
- .2 Aeration Floating Lateral Diffuser Shop Drawings
 - .1 These shop drawings are to provide precise details on the aeration floating lateral diffuser units.
 - .2 Aeration floating lateral diffuser shop drawings shall include all components including but not necessarily limited to float tube, diffuser, air feeder tubing, anchor cable and method of connection to the anchors, connection to the air header butterfly valve, aerator ballast, length of lateral between anchors, number of diffusers per lateral, etc.
 - .3 As part of the shop drawing submission for the floating lateral fine bubble aeration system, certified test information from an independent testing facility shall be submitted that confirms each diffuser is capable of transferring a minimum of 0.91 kg O₂/hr in clean water under standard conditions with an air flow of 9.0 L/s (20 scfm) per unit with a liquid depth of 3.0 m. The certified oxygen transfer test curve shall show unit performance over an air flow rate range of at least 4.5 L/s (10 scfm) to 11.25 L/s (25 scfm).
- .3 Free-end Self Adjusting Tension Assembly and Anchor Post Shop Drawings
 - .1 These shop drawings are to provide precise details on the self-adjusting tension assembly and anchor post units.
 - .2 Self-adjusting tension assembly and anchor post shop drawings shall include all components including but not necessarily limited to anchor post diameter and length including bury, concrete base requirements, concrete counterweight, winch details including pulleys and ratchet mechanism, lateral cable connection details, etc. The number of anchor post units being supplied is to be stated.
 - .3 These shop drawings shall provide the installation contractor with all information required for the proper installation of the anchor posts, including the scope of the unit being supplied by the aeration system supplier.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit system operation and maintenance requirements to Engineer prior to system start-up. Include with Operation/Maintenance manuals for the Blowers.
- .3 Submit written copies of the system performance warranty/guarantee to Consultant prior to system start-up. Include with Operation/Maintenance manuals for the Blowers.
- .4 Submit two (2) draft copies of the Operating and Maintenance Manuals to the Engineer no later than five (5) weeks prior to delivery of the complete aeration system.
- .5 One (1) reviewed copy will be returned through the General Contractor, and three (3) final copies shall be prepared incorporating all of the Engineer comments.
- .6 Guarantee/Warranty Certificate for the aeration system: submit to Engineer not less than two (2) calendar weeks prior to the date of submission of the draft O & M Manual.
- .7 Operation and Maintenance Manual – Aeration System (Also refer to Section 10 81 00, Article 1.7.2 - Operation and Maintenance Manual for the Blowers, which is to be integrated with the Operation and Maintenance Manual for the Aeration System, as a single document):
 - .1 Arrange in a hard cover, durable, three-ring binder with pages consecutively numbered.
 - .2 The Supplier shall be responsible for supplying written operating and maintenance instructions, which shall be sufficiently comprehensive to enable the operator to operate and maintain the equipment supplied. This shall include the system operating philosophy.
 - .3 The instructions shall be prepared as a systems manual applicable solely to the equipment supplied by the manufacturer to these specifications and shall include those devices and equipment supplied by him. The instructions shall include, but not be limited to, the following:
 - .1 Descriptions of, and operating instruction for, each major component of the facility as supplied, including detailed parts lists.
 - .2 Instructions for operation of the equipment in all intended modes of operation.
 - .3 Instructions for all adjustments which must be performed at initial startup of the facility, adjustments which must be performed after the replacement of level control system components, and adjustments which must be performed in the course of preventive maintenance as specified by the Manufacturer.
 - .4 Service instructions for major components not manufactured by the Manufacturers but which are supplied by them in accordance with these Specifications. The incorporation of literature produced by the actual components Manufacturer shall be acceptable.
 - .5 Copies of the reviewed shop drawings for the equipment.
 - .6 A list of major equipment components with complete model and serial number information, and a list of local and head office Manufacturer's representatives including telephone and fax numbers.

- .7 Operation and maintenance instructions shall be specific to the equipment supplied in accordance with these Specifications. Instruction manuals applicable to many different configurations, and which require the operator to selectively read portions of the instructions, shall not be acceptable.
- .4 Each manual is to be arranged in three sections: General; Equipment; and Operating and Maintenance Procedures. Each section is to include at least the following information:
 - .1 General
 - .1 Summary of Information Page: project name, equipment description, order number, model and serial numbers, Manufacturer and Manufacturer's nearest service representative including telephone and fax numbers, date prepared (and revised if necessary)
 - .2 Overall description of the system
 - .3 Index for the O & M Manual
 - .4 Warranty Information
 - .5 Listing of Explanation of Abbreviations Used
 - .2 Equipment
 - .1 The complete drawings; performance specifications; dimensions shall be submitted for all equipment related to the aeration system, including but not limited to:
 - .2 Diffuser units;
 - .3 Manifold diffuser fitting;
 - .4 Diffuser mounting;
 - .5 Aeration membrane;
 - .6 Feeder tubing;
 - .7 Other components supplied with aeration system.
 - .3 Operating and Maintenance Procedures
 - .1 Normal start-up and shut-down procedures; maintenance checklist with maintenance operation and frequency; recommended spare parts list for minor field repairs; alignment instructions; troubleshooting tips; preventative maintenance inspection and monitoring charts.
 - .2 Any other instructions or information the Owner should have for the safe and reliable operation of the aeration system.
- .5 All information in the O & M Manuals shall be clear and legible. Any data sheets with information on multiple models or optional equipment shall be clearly marked to indicate the information which applies to the equipment supplied.

1.7 WARRANTY AND GUARANTEE REQUIREMENTS

- .1 Guarantee/Warranty Certificate shall clearly identify the following:
 - .1 The Project and Owner being covered by the Guarantee/Warranty;

- .2 The aeration system manufacturer providing the Guarantee/Warranty, including legal name, address telephone number, and name of authorized representative;
- .3 The details of coverage of the Guarantee/Warranty stated in accordance with this Specification.
- .2 The Certificate shall be signed (and witnessed if required) by a representative of the aeration system manufacturer authorized to sign such documents on behalf of the manufacturer, and the manufacturer's corporate seal shall be affixed to this document.
- .3 The original of this Guarantee/Warranty Certificate shall be delivered to the Owner. A copy shall be delivered to the Engineer and copies shall be included with the O & M Manuals as stated above.
- .4 Header piping and fittings (in water and out of water components):
 - .1 Header piping and fittings shall be warranted to be free from defects in material and workmanship for a period of 60 months from the date of start-up (shipping dates will not be used for warranty calculations).
 - .2 The Supplier/Manufacturers/Contractor shall repair or replace defective parts without charge to the Owner.
 - .3 The aeration Supplier/Manufacturers/Contractor will be responsible for removal (disposal) and reinstallation of any defective parts during the warranty period, and all work and expenses incidental thereto.
- .5 Aeration Diffuser Warranty
 - .1 Aeration diffusers shall be warranted 100% for the first 12 months and be warranted on a 100% down to 52% pro-rated basis (that is, warranty coverage reduces by one percent (1.00%) per month) for the following 48 months. This warranty shall cover not only replacement of defective parts and/or correction of defective work, but also all work and expenses incidental thereto.
 - .2 Product shall be free from defects in material and workmanship from the date of start-up.
 - .3 The cost for removal (disposal) and installation of any diffusers during this warranty period shall be fully born by the Aeration Supplier.
- .6 System Performance Guarantee:
 - .1 Provide a written performance guarantee indicating that minimum average monthly dissolved oxygen levels in the aerated lagoons shall be within original design levels for a period of 60 months from the date of start-up.
 - .2 In the event that the minimum monthly average dissolved oxygen levels are not within design levels for a consecutive period of 90 days or 3 months, the Supplier shall, at his own cost, adjust or modify the aeration equipment to bring the system within the design performance parameters.
 - .3 In the event that the average monthly BOD5 reduction achieved through the cells where this aeration system has been installed does not meet the performance objectives required by these Specifications, the Supplier shall, at his own cost, adjust or modify the aeration equipment to bring the system within the design performance parameters. This action shall apply provided that the moving three-month averages of the influent BOD5 value and the flow rate through the system

do not exceed the influent design BOD5 value and the hydraulic design value as stated in these Specifications by more than ten (10) percent.

- .4 The evaluation of the system's performance shall be based on dissolved oxygen DO values and wastewater samples taken for analysis for BOD5 concentrations by the Owner's operating and maintenance staff.
- .5 The performance guarantee is contingent upon the Owner adhering to the Supplier/Manufacturers operation and maintenance schedule, and that the system has been installed by approved installation personnel and under Manufacturer's direct supervision.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 The equipment and accessories to be supplied under this contract are to be shipped by the supplier to the Wastewater Treatment Plant located in Location, New Brunswick.
- .2 Arrangements for delivery and coordination of the material and equipment are to be made by the successful contractor.
- .3 All equipment and materials are to be properly packaged, protected and secured to ensure there is no damage or loss.
- .4 Notify the Engineer in writing no less than seven (7) working days in advance of shipment of the method, dimensions and weights of each part of each shipment and its anticipated date of arrival at the site.
- .5 Label each crate or package to identify its contents and any special handling instructions. The supplier is responsible for the protection of all items until delivered to the site and shall promptly repair and /or replace any damaged items to the satisfaction of the Engineer and at no additional cost, even if any damages or deficiencies are not identified until after delivery.
- .6 For protection until incorporated into the work, equipment and material may not be unpacked and carefully examined until time of installation.
- .7 Final acceptance of material and equipment will be dependent upon shop tests and inspections, field tests and inspections, the performance of the components under operating conditions, and the fulfilment of all guarantees/warranties.
- .8 It should be noted that equipment necessary for off-loading at the site will not be provided by the owner.
- .9 All equipment (for a complete installation, as described in these Specifications), material, information, etc. required to be provided by the supplier shall be delivered complete to the site. Exact date of delivery will be determined after award of contract. The Contractor of the aeration system contract will be advised of any changes in the delivery schedule requirements. The Contractor of the aeration system contract will not be entitled to any compensation for adjustments in the dates that apply to this Contract.
- .10 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .11 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .12 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 ACCEPTABLE AERATION SYSTEM MANUFACTURER

- .1 The aeration system shall be a “fine bubble type” consisting of floating lateral air distribution system and aeration diffusers. The system, as shown on the drawings and as described in these Specifications is based on the OptAER system as manufactured and installed by Nexom Inc., available from:

Atlantic Purification Systems Ltd. (Attention: Ian Johnston or Hettie Sacre)
10 Ferguson Road
Dartmouth, NS B3A 4M1
(902) 469-2806
- .2 Alternatives will be considered in accordance with Section 01 23 10 Alternatives.
- .3 Components specified herein shall be supplied by one supplier and shall be of the manufacturer’s latest design.
- .4 Indicating the systems named above as being “acceptable” means that they are “generally acceptable”; final acceptance of any system will be subject to submission of complete system information to confirm the details of the system being offered for this project in accordance with the requirements of these Specifications. This shall include the Design Brief, Shop Drawings, Manuals, and any other information required by these Specifications.

2.2 AERATION COMPONENTS REQUIREMENTS

- .1 The installation of the different systems named above may be different from what is shown on the drawings. If there are variations in the installation requirements for the system accepted for installation from those shown on the Drawings, the Contractor/Supplier will be responsible for the complete design, supply and installation of the systems, all in accordance with the manufacturer’s recommendations, these Specifications and drawings and as directed by the Engineer.
- .2 The Owner will not be responsible for any additional parts and components required by different systems not shown on the drawings or described in these Specifications that are essential to each system. No extra payment will be made to the Contractor for additional components required for a complete installation of each system.
- .3 The components and accessories shown on the drawings are to be supplied with each system and to be included in the Tendered Price, and this, even if they are not required by the Manufacturer. This shall include, but not limited to HDPE saddle for sampling/measurement, S.S. cable tie bracket, flange connection for cable, counter weight and adjusting tension assembly.

- .4 The components and accessories shown on the drawings are schematic details for the purpose of illustration only and are not intended to show the total scope of supply.
- .5 Where the Contractor proposes to install the aeration, system supplied under this contract, the Manufacturer must provide at least one (1) representative and must be on site at all times during the installation.
- .6 The Manufacturer (and representative) must provide a detailed report of the installation to Engineer no later than two (2) weeks after the start-up of the system. No extra payment will be made to the Contractor for the inspection and report done by the manufacturer and it shall be considered incidental to the installation of the aeration system.
- .7 All components for the aeration system shall be robust and be of materials and finishes suited for the conditions of installation and operation so as to provide a long service life and minimize maintenance requirements. Various components will be subject to UV exposure, immersion in wastewater, exposure to freeze-thaw conditions including ice, exposure to wind forces, burial in soil, and/or other conditions expected to be encountered at wastewater treatment lagoon systems.

2.3 AERATION SYSTEM DESIGN CRITERIA

- .1 The aeration system design is the sole responsibility of the Supplier/Manufacturer and shall be submitted with the stamp of a Professional Engineer registered to practice in the Province of New Brunswick (stamp will be required to cover the total submission, including calculations, design process guaranty, confirmation of influent and effluent parameters, aeration parameters, physical dimensions of each cells all in accordance with these Specifications, as shown on the drawings and incidentals, all in accordance with these Specifications, and as shown on the drawings). Additional specific requirements for the Design Brief are presented in Article 1.6.4 of these Specifications.
- .2 It is entirely the responsibility of the successful Supplier/Manufacturer to verify all design parameters. No allowance will be made for design errors or omissions that occur due to insufficient site investigation.
- .3 System design must be suitable for the site conditions and meet all applicable standards and guidelines of NBDELG and the CCME regulations.
- .4 The supplied aeration system shall be capable of treating untreated wastewater with the following parameters and treatment shall be effective 12 months per year (effective year round):
 - .1 Influent Parameters:
 - .1 Average Design Flow: 928cu.m./day
 - .2 Total BOD5: 200 mg/L
 - .3 TSS: 200 mg/L
 - .2 Effluent Parameters:
 - .1 Total BOD5: 25 mg/L
 - .2 TSS*: 25 mg/L
 - .3 * TSS 25 mg/L, year round with the following exception: The system will be considered in compliance if excess of TSS occurs during the months of July,

- August, September or October, in accordance with the Wastewater Systems Effluent Regulations.
- .4 Average results of three (3) consecutive months will be considered when determining effluent limit compliance for both BOD5 and TSS based on effluent grab samples (except for effects of algae growth).
- .5 Aeration Design Parameters:
- .1 Alpha = 0.60
- .2 Beta = 0.95
- .3 Theta = 1.024
- .4 Maximum Water Temperature = 16°C
- .5 Minimum Water Temperature = 0.5°C
- .6 Aeration design factors (Alpha, Beta, and Theta): in accordance with these Specifications and shall be confirmed by the Aeration Manufacturer as part of the Design Brief submission.
- .7 The numbers of floating laterals and diffusers shown on the drawings shall be considered a minimum.
- .8 Within the Aerated Cells, Cell No. 1 shall be fully mixed while Cell No. 2 shall be considered partially mixed as shown on the drawings.
- .9 The design of the aeration system is to be based on the wastewater flowing through Lagoons #1 and #2 in series. Dimensions of each cell are to be in accordance with the drawings and confirmed as part of the Design Brief Submission.
- .10 Aeration System Oxygen Requirements
- .1 Aeration system shall provide sufficient oxygen to accommodate loads from:
- .1 BOD5 and CBOD removal
- .2 Denitrification
- .3 Internal sludge digestion
- .2 The average dissolved oxygen content shall be not less than 2.0 mg/l in any part of the aerated lagoons.
- .3 Submit complete design calculations and results of oxygen transfer efficiency tests conducted by an independent laboratory.

2.4 AERATION SYSTEM DESCRIPTION

- .1 Aeration system: fine bubble using low intensity type, to be compatible in every way with the “aerated-facultative” process for the partial mix aerated lagoon.
- .2 The aeration system design for the “partial mix” cells is to create mixing for uniform oxygen dispersion so as to maintain an aerobic biomass treatment system for the progressive reduction of the organic (BOD5) strength of the wastewater through the system, and allow solids settling to reduce suspended solids concentrations.
- .3 Aeration system shall be fully compatible with possible future lagoon based Nitrification and Phosphorus removal upgrades. Components specified herein shall be supplied by one supplier and shall be of the manufacturer’s latest design.

- .4 Aeration system shall transfer a minimum of two (2) kilograms of dissolved oxygen per one (1) kilogram of BOD5 applied at normal operating conditions.
- .5 The system shall have the capability to transfer 2.5 kilograms of oxygen per one (1) kilogram of BOD5 applied to help satisfy intermittent loads.
- .6 The average dissolved oxygen content shall be not less than 2.0 mg/L in any part of the aerated lagoon and in areas where aeration is provided.
- .7 The aeration system concept including the orientation of the laterals in each of the Cells is to be as indicated generally on the Drawings. The aeration system air supply design is to be based on a single air supply header from the blower header to Cells No. 1 and 2. The Drawings are intended to show the concept only, and not to indicate the number of laterals required in each Cell. The number of laterals and diffusers required in each Cell will be as determined by the manufacturer's Design Brief.
- .8 The aeration system shall be able to accommodate lagoon bottom elevation variations without loss in aeration efficiency.

2.5 GENERAL AIR HEADER/LATERAL/FEEDER ARRANGEMENTS

- .1 The air supply system shall generally consist of the blowers which shall provide the required air (oxygen) to the shallow buried main air supply distribution header with floating distribution laterals, as shown generally on the Drawings and as described in these Specifications. The buried air supply header between the blowers and the floating diffuser laterals will be supplied and installed by others, terminating at a butterfly valve connection for each lateral diffuser.
- .2 Although the buried air supply header system between the blowers and the laterals will be supplied and installed by others, it will be supplied in accordance with the overall aeration system design carried out by this Contractor. The design of this air distribution header must be done so as to achieve a cost-effective balance between pressure losses in the system and the cost of the piping; pipe sizes which the Engineer considers excessively large or small will not be acceptable. The design of the air supply header system shall incorporate the following design criteria and operating limits:
 - .1 Design maximum allowable pressure loss through the piping system from the blower to the connection to the lateral piping shall not exceed 0.5 psi (3.45 kPa) at normal operation condition (maximum air flow from 2 blowers running). (excluding static water pressure requirements for the floating laterals and submerged diffusers). The buried air supply header sizing as shown on the Drawings must be verified under this design process, and to confirm the conditions of Article 2.5 can be respected. If changes to the proposed sizing of the buried air supply header are recommended for proper operation of the system, it must be clearly identified in the submission of this Design Brief.
 - .2 Lateral piping shall be connected to the main air supply header with a flanged connection at the butterfly valve as shown on the Drawings.
 - .3 Lateral pipes shall be securely fastened to anchor posts at each end of the lateral to secure them in the proper position. As shown on the Drawings, anchor posts on the butterfly valve ends will be supplied and installed by others but anchor posts at the end of each floating lateral will be supplied and installed under this Contract.

- .4 Each lateral pipe shall have a shutoff butterfly valve at the main header connection.
- .5 Lateral pipes shall be anchored to shore.
- .6 Diffuser connection ports shall be thermally fused onto the lateral piping.
- .7 A feeder hose of a length appropriate to the maximum water depth) shall be connected to the connection port of each diffuser line with stainless steel clamps. The aeration diffuser shall be connected to the opposite end of the feeder hose.
- .3 The main header and lateral system shall ensure that the lagoons do not have to be drained for system installation or maintenance. Each diffuser assembly shall have the capability to be individually adjusted for submergence depth.
- .4 Submerged aeration headers will not be accepted. PVC headers will also not be accepted. The buried air distribution header shall be designed for HDPE of the appropriate class.
- .5 The aeration system shall be installed without de-watering the lagoons. Refer to drawings for configuration of aeration system.

2.6 SYSTEM OPERATION REQUIREMENTS

- .1 Aeration diffuser replacement shall require no more than a crew of two workers.
- .2 Each aeration diffuser shall be individually accessible from the water surface by boat.

2.7 PRODUCTS

- .1 Floating Lateral Pipe:
 - .1 Air floating laterals sizes and types shown on the drawings shall be considered as a minimum. All floating laterals sizes and types shall be confirmed by the Design Brief.
 - .2 HDPE pipe diameters as shown on the drawing are based on IPS size.
 - .3 Air floating lateral pipes (including transition from butterfly valve to floating lines, flexible hose not approved): high density polyethylene (HDPE) DR 17 pressure pipe to ASTM F714 and D3350. Or approved equivalent.
 - .4 Acceptable pipe manufacturer: KWH Sclairpipe (HDPE), Driscoplex or approved equivalent.
- .2 Fittings for HDPE Pipes:
 - .1 Fittings for HDPE pipes: water/air-tight, butt-fused welded to the pipe and made of the same material and by the same Manufacturer of the pipe system as described above.
 - .2 Polyethylene stub end manufactured to match the pipe, with ductile S.S. slip-on flange. Provide saddles, tees, reducers, and other fittings required for the installation shown.
 - .3 HDPE fitting diameters as shown on the drawings are based on IPS size.
 - .4 Installation of fittings (fusion to pipe) to be made by the pipe Manufacturer.
 - .5 Acceptable fitting manufacturer: KWH Sclairpipe, Driscoplex or approved equivalent.
 - .6 Supports: Provide pipe supports and hangers to suit piping system design.

.3 Diffusers:

- .1 Spare diffuser assembly: Provide five (5) complete diffuser assemblies of each type from the floating lateral line to the diffuser. Spare diffusers are not intended to be used during the start up or during the warranty period where additional units must be supplied, if so required, as per Article 1.8 - Warranty and Guarantee Requirements.
- .2 Diffusers shall have a documented history of efficient operation, and freedom from clogging, excessive back pressures, or structural failure when applied to service conditions similar to those indicated for this project. Diffuser membranes shall have a design life span of not less than 12 years before replacement is required.
- .3 Diffusers and feeder tubing must be capable of being operated at double airflow without reducing diffuser life or increasing backpressure beyond the capability of supplied blowers.

.4 Feeder Tubing:

- .1 Feeder Tubing: Flexible PVC material reinforced with spiral polyester yarn; UV and weather resistant.
- .2 Nominal inside diameter: to be confirmed by supplier/manufacturer.
- .3 Nominal outside diameter: to be confirmed by supplier/manufacturer.
- .4 Service temperature range -26oC to 65oC.
- .5 The polyethylene shall conform to the requirements of ASTM D 1248. This specification requires 2% carbon black for ultra-violet stabilization.
- .6 Feeder tubing used as the connection between the aeration tubing and the header pipe shall be SDR11 LDPE (black) Ultra Violet resistant tubing with continuous ballast.

.5 Lateral Anchoring

- .1 Each end of the floating laterals shall be held in place with a stainless steel cable attached to anchor posts. The free end self-adjusting anchor post shall be supplied and installed under this contract. The fixed end anchor posts shall be supplied and installed by others but as required by this aeration system supplier.
- .2 A Self-Adjusting Tension assembly shall be located at the free end of the lateral and shall have the follow characteristics:
 - .1 Adjustment range: ± 0.50 m.
 - .2 Tension assembly to provide a minimum constant tension force on lateral of 125 kg.
 - .3 Equipped with winch for initial adjustments.
 - .4 Constructed of materials that will ensure reliable operation and ease of use under the conditions that will be experienced.
- .3 Anchor Posts:
 - .1 Anchor posts and concrete piers are to be sized as show on the drawings, appropriate to the length of each lateral and anticipated wind and other forces acting on the laterals.

.6 Miscellaneous Components:

- .1 Provide all other miscellaneous process equipment accessories including ratchet winch, stainless steel cable, concrete diffuser ballasts, rope, clamps, pulleys, etc. as required for a complete system (except for the concrete base which will be provided by the installing contractor).

Part 3 Execution

3.1 EXAMINATION

- .1 The aeration system shall be carefully installed to the elevations, lines and grades as shown on accepted Design Brief Drawings and shall be in accordance with these Specifications or as otherwise indicated by the Engineer.
- .2 The floating laterals system supplier shall provide the services of a trained factory service technician to supervise or check the aeration system installation and leveling of the aeration system to ensure a constant air transfer per diffuser, incidental to the work.
- .3 Provide the services of a trained factory service technician to supervise or check the aeration system installation and leveling of the aeration system to ensure a constant air transfer per diffuser, incidental to the work.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all labour, materials and equipment and incidentals necessary for the complete installation and testing of all air piping, butterfly valves and valve access box as shown on the drawings and herein specified. This is the air distribution piping header and fittings from the Blower Building to the air lateral connections of the WWTP Aeration System at the lateral butterfly valve.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures
- .2 Section 05 50 00 Metal Fabrications
- .3 Section 10 81 01 Supply and Installation of WWTP Aeration System
- .4 Section 22 20 13 Pressure Piping
- .5 Section 31 23 33.01 Excavating, Trenching and Backfilling.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM A536, Standard Specification for Ductile Iron Castings.
 - .3 ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
 - .4 ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .2 AWWA
 - .1 AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - .2 AWWA C110, Ductile-Iron and Gray-Iron Fittings.
 - .3 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .4 AWWA C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) through 72 In. (1,800 mm).
 - .5 AWWA C153, Ductile-Iron Compact Fittings.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit detailed shop drawings of all equipment and all material in accordance with Section 01 33 00 - Submittal Procedures.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes, valves and fittings from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Load and unload pipe and accessories by lifting with hoists or skidding to prevent shock and damage.
- .5 Do not drop pipe or drag along ground.
- .6 Pipe handled on skid-ways will not be skidded or rolled against pipe already on the ground.

Part 2 Products

2.1 MATERIALS

- .1 Buried Air Pipes: to be of the size and type shown on the drawings of latest revision.
 - .1 Stainless Steel (S.S.) Schedule 40
 - .2 High density polyethylene (HDPE) DR 17 pressure pipe: to ASTM F714 and D3350.
 - .1 Acceptable pipe manufacturer: KWH Sclairpipe (HDPE) or approved equivalent.
- .2 Buried to Above Ground Pipes
 - .1 To be of the size and type shown on the drawings of latest revision. HDPE pipe diameters as shown on the drawing are based on IPS size.
 - .2 High density polyethylene (HDPE) DR 17 pressure pipe: to ASTM F714 and D3350.
 - .3 Acceptable pipe manufacturer: KWH Sclairpipe (HDPE) or approved equivalent.
- .3 Aeration Blow-Off Connections
 - .1 All aeration blow-off connections including buried to above ground air pipes will be of the size and type as shown on the drawings of latest revision. HDPE pipe diameters as shown on the drawing are based on IPS size.
 - .2 High density polyethylene (HDPE) DR 17 pressure pipe: to ASTM F714 and D3350.
 - .3 Acceptable pipe manufacturer: KWH Sclairpipe (HDPE) or approved equivalent.
- .4 Butterfly Valves for Air Laterals (Above Ground)

- .1 Sized in accordance with drawings and complete with flange end connections with the following specifications:
 - .1 One (1) Piece Body: Ductile Iron to ASTM A536 or Cast Iron to ASTM A126 Class B;
 - .2 Type: Lug Type;
 - .3 Seat Material: EPDM;
 - .4 Disc Material: 316 Stainless Steel;
 - .5 Shaft Material: Stainless Steel 18-8 type 304;
 - .6 Taper pin Disc shall not be pinned to shaft;
 - .7 Key: 316 Stainless Steel;
 - .8 Coating: Fused bonded epoxy coating suitable for exterior application.
 - .9 Nuts and Bolts: Stainless Steel 316;
 - .10 Operator: Leaver Type 304 stainless steel with 10 position S.S. plate;
 - .11 Acceptable Product: Series (31) Bray butterfly valve, Keystone Butterfly Valve Model F222 Lug or approved equivalent.
- .2 One (1) stainless steel support will be installed under each butterfly valve as shown on the drawings.
- .5 Joints and Joint Restraints
 - .1 Joints between HDPE pipe and HDPE fittings: to be made by fusion butt-welding.
 - .2 Drilling and fusion of fittings and piping: to be made on site or at the Manufacturer's factory by the pipe Manufacturer.
 - .3 All HDPE components (pipe and fittings, and fusion operation) are to be done by the same pipe Manufacturer.
- .6 Fittings for HDPE Pipes
 - .1 Fittings to be fused welded to the pipe and be made of the same material and Manufacturer of the pipe system as described in Article 2.1.2 (Buried to Above Ground Pipes).
 - .2 Flange for butterfly valve: made from a two (2) piece system.
 - .1 The two (2) piece system consists of a fused flange and a stainless steel flange (for above and below ground), as manufactured by KWH pipe, or approved equivalent. HDPE fitting diameters as shown on the plan are based on IPS size.
 - .3 Installation of fittings (fusion to pipe): to be made by the pipe Manufacturer.
 - .4 Acceptable fitting Manufacturer: KWH Sclairpipe or approved equivalent.
- .7 Marker Tape
 - .1 Metal marker tape, 50 mm wide, carrying the message "CAUTION – AIR PIPING BURIED".
- .8 Equipment

- .1 Utilize laser beam instrumentation and techniques and approved laser sighting triangle to determine intermediate line and grade for all pipes except where and when the Engineer may allow other methods to be used.
- .2 Provide all necessary labour, materials and equipment for the pressure test, including suitable pump and measuring tank, pressure hoses and connections, plugs, caps, gauges, valves and all other apparatus necessary for filling the main, pumping at the required test pressure, and recording the pressure and leakage losses.
- .3 Supply all labour, water, and facilities required to carry out testing and flushing of air pressure pipes. Water will not be provided by the Owner.

Part 3 Execution

3.1 INSTALLATION OF AIR PIPING

- .1 Air pipes shall be installed according to the types and sizes and in locations as indicated on the drawings.
 - .1 In laying out the air piping system, the Engineer will establish only the locations of air laterals.
 - .2 Lay pipe at a minimum 1.0-meter cover. The Contractor is responsible for locating this line at the connection points.
 - .3 Use approved laser alignment equipment installed in the pipe, just above the pipe, or in the bottom of the manhole to control line and grade while laying pipe.
 - .1 Installation of the laser beam contrary to the aforementioned requires approval of the Engineer.
 - .4 Use approved laser sighting triangle or template in setting each pipe.
- .2 Install air pressure pipes according to recommendations of the pipe Manufacturer and recognized good practice.
- .3 Provide and use proper implements, tools and facilities for safe and efficient execution of the work.
- .4 Carefully lower pipe and fittings into trench in such a manner as to prevent damage to them. Under no circumstances shall pipe or fittings be dropped into trench.
- .5 Thoroughly inspect pipe before and after laying. Immediately remove from the site any defective or damaged pipe and replace with new material.
- .6 Lay pipe in prepared trenches beginning at lowest point with bell of pipe pointing upgrade.
- .7 When pipe laying is not in progress, plug open ends of pipe using a watertight plug.
- .8 Lay pipe true to line and grade with uniform bearing under the full length of the barrel of the pipe.
- .9 Suitably excavate to receive the bell or collar, which shall not bear upon the sub-grade or bedding.

- .10 Remove and re-lay any pipe not in true alignment or showing undue settlement after laying.
- .11 No pipe will be laid on a foundation into which frost has penetrated, or at any time when the Engineer may deem that there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation.
- .12 Keep trenches where pipe laying is in progress dry. Do not lay pipe in water or upon wet bedding.
- .13 Thoroughly clean and protect pipes from dirt and water as the pipes are laid.
- .14 Thoroughly embed and secure pipe in place so as to prevent any movement or disturbance of the pipe before laying next pipe length.
- .15 Do not walk on or work over the pipes after they have been laid until there is at least 300 mm of cover over them, except as necessary in refilling the trench and compacting the bedding material.
- .16 Make mechanical joint connections and tighten and torque bolts in accordance with the manufacturer's instructions and recognized good practice.
- .17 Provide joint restraints for all tees and bends on air pressure pipes.
- .18 Install marker tape 600 mm above the top of the air main header pipe.

3.2 INSTALLATION OF MAIN HEADER BUTTERFLY VALVES (BURIED)

- .1 Install butterfly valves of the indicated size at locations shown on the drawings.
- .2 Properly join butterfly valves to the mains with mechanical joint connections according to the requirements of the manufacturer and recognized good practice.
- .3 Install valves level, so that the valve stems are vertical and plumb.
- .4 Set and maintain the valve box in a vertical position over the operating nut.
- .5 Properly support valve box in place with the cover set flush with finished grade.
- .6 Drainage from the valve box will be provided by placing crushed rock around the valve.

3.3 JOINTING OF PIPE

- .1 Wipe clean ends of pipe, rubber gaskets, fittings, etc., immediately before joining the pipes to remove foreign matter from the joints.
- .2 Make joints in accordance with the pipe Manufacturer's instructions.
- .3 Apply lubricant to the spigot up to the reference mark and to the face of the gasket (MJ gasket included).
- .4 Align and push together pipes in a manner that will ensure a satisfactory joint.
- .5 Pipes may be pushed together by means of a crow-bar solidly wedged into the ground, by using a suitable pipe puller at the joint, in some instances by very carefully pushing with a backhoe, or by any other method that may be approved by the Engineer.
 - .1 When pushing against the pipe, a block of wood must be used to prevent any damage to the pipe.

- .6 Where pressure air pipes are to be laid on a curve or curved alignment to avoid obstructions, the amount of deflection allowed shall not exceed that required for satisfactory connection of the joint. Maximum deflections in pipe joints shall be according to recommendations of pipe manufacturer.

3.4 TESTING

- .1 Test all air piping after installation.
- .2 All piping must pass the specified tests before being measured for payment. The cost of testing will be included in the tendered price for the installation of pipe and accessories.
- .3 Test as directed by the Engineer after backfilling sections of pipelines, prior to the placement of roadway base material or surface restoration.
- .4 Thoroughly flush the pipeline before pressure testing.
- .5 The pipeline will be tested in sections not exceeding 350 meters unless otherwise permitted by the Engineer.
- .6 Strut and brace all caps, bends, tees, valves and other parts to prevent movement when pressure is applied.
- .7 Fill the test section of the pipe slowly, taking care to expel all air from the high points.
- .1 If air valves, service connection or other means of venting air are not provided, drill and tap small holes for that purpose at high points. Also provide a suitable saddle, main stop, valve, corporation stop or approved equivalent, to vent air which can be shut when pressure is applied, and after satisfactory completion of the test must shut the valve and remove piping that may have extended to ground level.
- .8 After completion of the preliminaries described above, apply pressure to the pipeline using a suitable force pump equipped with a measuring tank.
- .9 The test section will normally be subjected to a minimum hydrostatic pressure of 1,000 kPa for 2 hours for air pressure pipes but in any case, the test pressure will be limited to 50% above the operating pressure for the pipes in use.
- .10 At the commencement of the test, increase the hydrostatic pressure to the pressure specified for inspection. Maintain pressure by pumping additional water into the main from the measuring tank.
- .11 The leakage is deemed as the amount of water supplied from the tank in order to maintain the specified pressure for a period of two (2) hours.
- .12 No pipe installation will be accepted until the leakage is less than the number of liters per hour as determined by the following formula:

$$L = \frac{n * d * \sqrt{P}}{130,000}$$

Where:

- L = allowable leakage in liters per hour
n = number of joints in section under test
d = nominal diameter of pipe in mm

P = test pressure in kPa

- .13 Should any test disclose leakage greater than that specified above, locate and repair the defects in the pipeline and fittings, and repeat the test until the leakage is within the specified allowance.

3.5 FLUSHING OF AIR PRESSURE PIPES

- .1 Thoroughly flush all air pressure pipes.
- .2 Flush using adequate volume and pressure to remove all loose material within the pipe.
- .3 Provide a screen or other acceptable apparatus at the lower end of the section being flushed to retain and dispose of all debris flushed from the pipe. Remove from adjacent sections, any debris not so retained.
- .4 Under no circumstances shall dirt be flushed into existing pipes.
- .5 Air piping shall be thoroughly drained after successful testing.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 The work to be performed under this section consists of the complete Wastewater Treatment Plant (WWTP) accessories, including safety rope system, floating baffles, and baffle curtain anchor posts, as outlined on the drawings, or as described in these specifications, or as directed by the Engineer.
- .2 The work under this section is closely related to other project work, especially site work and pipe systems, and the proper construction sequence and co-ordination must be applied.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures
- .2 Section 10 90 00 Air Piping Systems.
- .3 Section 31 23 33.01 Excavating Trenching and Backfilling.
- .4 Section 31 32 19.02 Geomembranes.
- .5 Section 33 05 16 Manholes and Catch basin Structures.
- .6 Section 33 31 13 Public Sanitary Utility Sewerage Piping.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 WARRANTY

- .1 The baffle shall come with a minimum two (2) year full (not pro-rated) warranty against defects in workmanship and installation effective as of the date of Substantial Completion. This warranty shall provide the Owner with 100% warranty coverage for not less than 2 years. This signed and sealed warranty certificate to be submitted no later than Substantial Completion. The warranty shall cover defects in workmanship and materials, which shall be repaired or replaced at no cost to the Owner and shall include all work incidental thereto.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Safety Rope System
 - .1 Earth anchors: Manta Ray Duckbill Guy Anchors, Model No. 68-DBU or approved equivalent.
 - .2 Rope: 19mm Polypropylene, sized as shown on the drawings.
 - .3 Cable: 3 mm dia. galvanized steel cable, supplied with the earth anchors.
 - .4 Buoy: closed cell polystyrene or PVC, 250 mm diameter, colour safety orange,
- .2 Anchor Posts for Floating Baffles
 - .1 Provide 200 mm diameter schedule 40 galvanized steel post at each end of the baffle with appropriate devices for fastening the baffle cable to the posts. Post to be concrete encased as shown on the drawings, or as otherwise specified by the baffle manufacturer. Each post shall have a plastic cover in safety yellow with at least one (1) circumferential reflective band; covers to be Bollardguard or approved equal.
- .3 Baffles:
 - .1 Approved Products:
 - .1 Director I manufactured by Environetics
 - .2 Slickbar MK-10
 - .3 Thermafab Curtain System using XR-5 8130 Reinforced Geomembrane, as manufactured by Seaman Corporation
 - .4 Approved equivalent
 - .2 Pre-fabricated hydraulic barrier requiring no on-site fabrication other than assembly of completed section and related components, ready for installation.
 - .3 Floating baffle material: polyester reinforced polymeric alloy membrane material ENV-3602-12-XR-5 or approved equal, to be designed for UV resistance and capable of withstanding the exposure and stresses proposed application.
 - .4 The floating baffle shall come complete with two tension members seamed under the flotation collar and the bottom edge of the curtain. The curtain shall also come with ballasts which are to include lifting lines. Provide all concrete required for these ballasts.
 - .5 Fasteners, connectors, cables, etc.: Stainless Steel Aircraft Cable type.
 - .6 Chains: galvanized steel.
 - .7 Provide intermediate anchors to limit the lateral movement of the baffle to no more than 2.0 m.

- .8 The baffle shall come complete with a single or multiple flow-through windows sized for a peak flow rate/day. This window shall be reinforced. Flow through velocity of the window shall not exceed the maximum.
- .9 The baffle shall be designed to fit the sides of the lagoon by tapering at the lagoon slope. The side slopes on the dikes are 2.5H:1V.
- .10 The baffle shall come with a flotation collar sealed in the baffle material.
- .11 If the baffle is to be manufactured in sections, the connection is to be made with a mechanical stainless steel bolt-through connector.

Part 3 Execution

3.1 INSTALLATION

- .1 Safety Rope System
 - .1 Install safety rope system around the lagoon perimeters as shown on the drawings.
 - .2 Anchor safety rope system to galvanized steel earth anchors at the top inside edge of the dikes at intervals as shown on the drawings with a maximum of 20 metres.
 - .3 Anchor rope to a 3 mm dia. galvanized steel cable supplied with the earth anchors.
 - .4 Attach buoy at the end of each rope and place in the water.
 - .5 Attach 8 mm polypropylene marine rope from one buoy to another all around the cell, with a sturdy knot ensuring resistance to ice movement, wave action, or pulling to 250 kg minimum.
- .2 Anchor Posts for Floating Baffles:
 - .1 Install plumb and in a vertical position as shown on the drawings and as specified.
 - .2 Install and secure covers as per the manufacturer's recommendations.
 - .3 Protect posts from damage during the construction period, and any required repairs will be the Contractor's responsibility throughout the warranty period, at no additional cost to the Owner.
- .3 Floating Baffles:
 - .1 Install as shown on the drawings and as specified, in accordance with manufacturer's recommendations.
 - .2 Install baffle after the lagoon cells have been filled.
 - .3 The manufacturer's representative shall verify and approve the installation.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This section covers items common to all sections of division 20, 22 and 23.

1.2 REFERENCES

- .1 All codes and standards to be of latest edition.
- .2 Contractors are advised that coordination with other trades is required.
- .3 Contractors are required to review with other sub contractors the work indicated on architectural, civil, electrical, structural drawings.

1.3 SCOPE OF WORK

- .1 The work to be performed under this section consists of the construction of the general mechanical works ventilation, plumbing and control accessories related to the building in accordance with the lines and dimensions shown on the drawings or as described in these specifications or as directed by the Consultant.
- .2 The Contractor shall provide all supervision, labour, materials, equipment, machinery, plant and all other items necessary to complete all mechanical systems. This shall include, but not limited to the following:
 - .1 Plumbing and drainage systems;
 - .2 Plumbing fixtures;
 - .3 Hot and cold domestic water piping and backflow preventers;
 - .4 Hot water heater;
 - .5 Process Piping;
 - .6 Valves and fittings;
 - .7 Exhaust fans, ductwork, louvre, motorized dampers, actuators and ventilation control;
 - .8 Grilles;
 - .9 Testing, adjusting and balancing (TAB) air distribution system, TAB report;
 - .10 Controls system;
 - .11 UV disinfection system;
 - .12 Aeration System;
 - .13 Mechanical instruments;
 - .14 Space temperature sensors by PLC panel;

1.4 PERMITS

- .1 In accordance with the General Conditions, obtain and pay for permits, certificate, licenses and other permits including environmental permit for fuel tank as required by municipal, provincial and federal authorities.

- .2 Provide appropriate notifications of project to municipal and provincial inspection authorities.
- .3 Obtain compliance certificates as prescribed by legislative and regulatory provisions of municipal, provincial and federal authorities as applicable to the performance of work.
- .4 Submit to Consultant, copy application forms and approval documents received from above referenced authorities.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittals Procedure.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Submit drawings for the following products.
 - .1 Pipe and fittings, valves, gauges, flow meters and transmitters, turbidity meters, chlorine analyser, chemical injection system and accessories, chemical storage tank and secondary containment, UV disinfection with control panel and accessories, inline mixer, cartridge filters and related components, pipe supports, pipe penetrations, thrust blocks, strainers, domestic water and sanitary piping, drain pipe, backflow preventors, domestic hot water tank, domestic water entrance, automatic trap primer, floor drains, cleanouts, hub drains, eye wash, domestic water booster pump system including controller, expansion tanks, penetration seals, standalone dehumidifier, vent piping, hose bibs, sampling sink, SS sink, exhaust fans, ductwork, louvers, dampers, actuators, grilles and diffusers, mini-split/heat pump unit including all related piping, sleeves, insulation, expansion joint, actuated valves, BFP, instrumentation, and all other components as identified in these specifications and the drawings.
 - .2 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Drawings and product data 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 current model production.
 - .5 Certification of compliance to applicable codes.
 - .4 In addition to transmittal letter referred to in Section 01 33 00 – Submittals Procedure: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 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.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for Ventilation.
 - .5 Approvals:
 - .1 Submit 1 copy of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
 - .6 Shop drawings:
 - .1 Provide all Mechanical Shop Drawings for project in O&M manual.
 - .7 Additional data:

- .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Consultant will provide 1 set of reproducible mechanical drawings. Contractor to provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for Ventilation, and Plumbing, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Consultant for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for Ventilation and Plumbing using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittals Procedure.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.9 EQUIPMENT INSTALLATION

- .1 In accordance with Manufacturer's instructions unless otherwise indicated.
- .2 Install isolation valves and either unions or flanges for isolation and service of each piece of equipment.

1.10 CLEARANCES

- .1 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 or components.
- .2 Coordinate with Manufacturer Agent, approved shop drawings to provide adequate service space.

1.11 TRIAL USAGE

- .1 General
 - .1 Commissioning requirements in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
 - .2 Consultant and Commissioning Agent may use equipment and systems for test purpose prior to acceptance. Supply labour, material and instruments required for testing.
- .2 Use of systems during construction
 - .1 Use of mechanical systems during construction may be required by Owner.
 - .2 Use of new and existing permanent heating and ventilation are permitted only under following conditions:
 - .1 Entire system is complete, commissioned, pressure tested, cleaned and flushed out.
 - .2 Specified water treatment system has been commissioned; water treatment is being continuously monitored.
 - .3 Building has been closed in; areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage.
 - .5 Supply ventilation systems are protected by 60% filters, inspected daily, and changed every 2 weeks or more frequently as required.
 - .6 Return systems have approved filters over openings, inlets and outlets.
 - .7 Systems will be:
 - .1 Operated as per Manufacturer's recommendations and instructions.
 - .2 Operated by Contractor.
 - .3 Monitored continuously by Contractor.
 - .8 Warranties and Guarantees are not relaxed.

- .9 Regular preventive and other Manufacturer's recommended maintenance routines are performed by Contractor at own expense and under supervision of Consultant and Consultant.
- .10 Refurbish entire system before static completion; clean internally and externally, restore to "as-new" condition and replace filters in air system.
- .3 Filters specified in this Section are over and above those specified in other Sections of this project.

1.12 REMOVALS

- .1 Contractor is responsible for disposal off-site of all items being removed as part of this Contract.
- .2 Contractor shall provide Owner with option to keep items being removed as part of this Contract prior to disposal off-site.

1.13 TESTS

- .1 Give 48 hours written notice of date for all tests.
- .2 Insulate or conceal work only after testing and approval by Consultant and Commissioning Agent.
- .3 Conduct tests in presence of Consultant and Commissioning Agent and local authority having jurisdiction where applicable.
- .4 Bear costs including retesting and making good.
- .5 Equipment: test as specified in relevant sections and Commissioning Sections.
- .6 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.14 INTERPRETATION OF PLANS AND SPECIFICATIONS

- .1 These specifications are to be considered as an integral part of the plans which accompany them and neither the plans nor the specifications shall be used alone. The drawings are considered an integral part of the specifications.

Any item which is omitted in one but which is reasonably implied in the other shall be considered properly and sufficiently specified and must, therefore, be provided by this Contractor
- .2 Misinterpretations of the plans or specifications shall not relieve this Contractor of responsibility; final interpretation of details and clauses remains with the Consultant.
- .3 Where uncertainty exists in the passing of pipes and location of equipment, the General Contractor and or project manager shall be consulted before work is started. Where such materials and equipment have been installed so as to cause interference with the inside treatment of the building, they shall be removed and relocated without additional cost to the Owner.
- .4 The plans do not necessarily show all valves, duct offsets, access panels, connections, balancing fittings, bases, isolators, flexible connections, drains, etc., and this Contractor shall not avail himself of these obvious omissions, but shall install the work complete in

essential details so that it will function properly, can be easily balanced and so that repairs and removal of equipment can easily be made.

- .5 Building dimensions shall not be scaled from the Mechanical plans but shall be obtained from on-site dimensions of the building. Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation. The Contractor shall be responsible to confirm on-site dimensions. In existing buildings, confirm dimensions prior to tender.

1.15 CO-OPERATION OF CONTRACTORS

- .1 This Contractor shall become familiar with the work of other contractors and in laying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays. Where interference exists, this Contractor shall notify the General Contractor and/or project manager and the Consultant before installing the work. Any changes in the work or alterations of the Mechanical Contractor's schedule of procedure required for such co-operation will not be considered as a claim for extra compensation.
- .2 Due to the complexities of many sub-trades, and the restrictive space available in this project, it is required that all trades co-operate closely so as to install all systems in their allotted locations as indicated on the drawings, or coordination on site.
- .3 The drawings are not intended to show all elbows, fittings and offsets required to perform the installation of the work where indicated on drawings. Contractor shall coordinate with all other trades and General Contractor on site. It is the responsibility of the Contractor to review site conditions prior to execution of work. Where services are shown to cross other building services, Contractor shall coordinate with other trades and determine best routing on-site prior to execution of work.
- .4 The Contractor shall review all Structural, Mechanical, Electrical and Architectural drawings to determine possible conflicts.
- .5 Contractor shall coordinate location of all hangers as to avoid interference with other trades.
- .6 No extras will be allowed for lack of coordination or if additional fittings are required to perform the work as shown on the drawings.

1.16 ERRORS AND OMISSIONS

- .1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.
- .2 Should this Contractor discover errors or discrepancies in the plans or specifications, he shall refer the matter to the Consultant for change or clarification and shall not proceed with that portion of work until advised by the Consultant to do so.

1.17 MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

- .1 General
 - .1 Electrical motors, for Mechanical equipment and systems specified by Mechanical division.

- .2 Mechanical responsibility is specified within these specifications and on mechanical drawings.
- .3 Control wiring and conduit is specified in electrical division except for conduit, wiring and connections 120 volt and lower which are related to control systems specified in Controls Division. Refer to Electrical Division for quality of materials and workmanship.
- .4 Motors shall be premium efficiency inverter duty rated for service with VFD's where VFD's specified.
- .5 All motors shall be high efficiency type.
- .6 All motor shall be CSA listed.

1.18 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 indicated.
- .3 For motors under 7.5 kw: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kw and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustments plates to allow for center line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

1.19 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia. holes on both shaft centers 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, minimum 1.6 mm 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, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

1.20 CONCRETE CURBS AND PADS

- .1 Concrete curbs and pads shall be performed by the General Contractor for the Mechanical Subcontractor.
- .2 The Mechanical Subcontractor shall provide and coordinate all templates, special cast-in-place feet or mounts and shall lay out the dimensions and locations of the curbs and pads.

1.21 SEQUENCING

- .1 This Mechanical Contractor shall allow for the works to be built in the order and manner directed.

1.22 SUPERVISION

- .1 This Contractor shall include the services of experienced superintendents, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and labourers, required to properly unload, install, connect, adjust start and operate and test the work involved

1.23 OPENINGS FOR EQUIPMENT

- .1 This Contractor shall be responsible for providing openings to allow the installation of all apparatus and large equipment in this Contract. This Contractor shall make all necessary arrangements to ensure that the required openings are provided and properly located.

1.24 MINIMUM REQUIREMENTS

- .1 All equipment supplied shall conform to and be labelled by CSA.
- .2 All equipment supplied shall be new and first-rate production. (No seconds)

1.25 OPENINGS, SLEEVES, CUTTING AND PATCHING

- .1 All openings in walls and floors necessary for the installation of equipment of the specification shall be provided by this Contractor.
- .2 Openings necessary in structural concrete floor, walls and beams shall be made with Schedule 40 steel sleeves installed prior to pouring of concrete. In floors, extend sleeve min. 50mm (2 in.) above finished floor to permit waterproofing.
- .3 Where openings in poured concrete floors or walls are necessary, core drilling only will be permitted.
- .4 This Contractor shall advise the Consultant of all such openings, their size and location and shall obtain his approval prior to cutting of openings.

- .5 In fire rated floors or walls, this Contractor shall seal all spaces between piping and sleeve with approved material "FIRESEAL" by 3m or equivalent. Submit 3M shop drawings

1.26 ROOF CUTTING AND PATCHING

- .1 All cutting of roof decks and penetrations of roof systems, including flashing, patching, or reinforcing of roofs for all mechanical services extending through roofs shall be done by the General Contractor.
- .2 This Contractor shall advise the General Contractor in sufficient advance time, the size and location of all roof openings required.

1.27 MATERIALS AND WORKMANSHIP

- .1 All materials installed shall be new, full weight, of the best quality with the same brand or manufacturer used for each class of material or equipment.
- .2 All materials and equipment shall be installed in a neat and workmanlike manner by competent specialists for each sub trade. The installation of any materials and equipment
- .3 Not meeting these standards may be condemned by the Consultant and shall be removed and reinstalled at no additional cost to the Owner. This Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner.
- .4 All tradesmen employed by this Contractor for this work shall be properly licensed journeymen and apprentices qualified to do work in each particular trade. The General Contractor shall have the right to examine each man's credentials and order any unqualified personnel away from the project.

1.28 DEFICIENCIES

- .1 The Consultant will notify this Contractor at various intervals of defective workmanship or installation, deficiencies, etc. This Contractor shall not request revised or updated lists without first submitting a current detailed, item by item, report on the status of all deficiencies as reported to the Contractor on a previous listing.
- .2 When this Contractor notifies the Consultant that the contract is ready for interim deficiency review, a comprehensive deficiency listing will be prepared. If such list exceeds twenty (20) items, the contract shall not be considered ready for final inspection and the Consultant need not furnish the Contractor with such listing.
- .3 Contractor shall sign, date, and return to Consultant the provided formal deficiency review lists to ensure the items have all been corrected prior to next review.

1.29 SUPPORTS

- .1 This Contractor shall supply and erect all structural work necessary for the proper installation and support of all apparatus and equipment under these specifications unless specified in Structural Division. This Contractor shall submit for approval to the Consultant shop drawings on all structural supports before installation of same.

1.30 GAUGES AND METERS

- .1 All gauge, meters and indicators shall be selected such that the expected operating parameter indicates 50% to 70% of the full-scale instrument range.
- .2 Temperature gauges shall be installed where indicated.

1.31 DEFINITIONS

- .1 As indicated: Means that the item or items specified are shown on the drawings.
- .2 Standard of Acceptance: Means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a reference standard, shall be deemed to supplement the standard.

1.32 ENERGY CONSUMPTION

- .1 Consultant may reject equipment submitted for approval or review on basis of performance or energy consumed or demanded.

1.33 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Line up equipment and similar items with building walls wherever possible.

1.34 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other divisions.

1.35 DIELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are joined

1.36 COSTS OF ALTERNATE MATERIALS

- .1 Contractor shall bear the cost of all changes required to connect, locate, install, support or integrate alternate equipment to that specified.

1.37 TEMPORARY STORAGE

- .1 This Contractor shall be responsible for materials temporarily stored on site.

1.38 CHANGES & EXTRAS

- .1 No change to the drawings and specifications will be accepted, if not authorized in writing by the Consultant.

- .2 All work carried out which does not conform to the plans and specifications shall be corrected at the Contractor's expenses.
- .3 The Owner reserves the right to change quantity, quality, or any kind of work or equipment described on the drawings or in the specifications without affecting the validity of the contract.
- .4 Monetary adjustments required by such changes shall be accepted in writing by the Consultant before alterations are proceeded with by the Contractor

1.39 LAWS & ORDINANCES

- .1 All work performed under this Division shall comply with the requirements of the authorities having jurisdiction, including, but not limited to, the following: Provincial Department of Labour, Provincial Department of Environment, Dominion Fire Commissioner, Provincial Board of Insurance Underwriters, Provincial Department of Health, Plumbing Inspector, Building Inspector, National Building Code of Canada, Local and Municipal By-Laws and Canadian Standards Association

1.40 WARRANTY

- .1 All mechanical work and equipment shall be guaranteed to work satisfactorily for a minimum period of one year from the date of acceptance of substantial completion of the contract, provided any failure is not due to neglect or improper use by the Owner.
- .2 Any certificate given, payment made, partial or entire use of the equipment by the Owner, shall not be construed as acceptance of defective work or improper materials.
- .3 This general guarantee shall not act as a waiver of any specified guarantee for any greater length of time.

1.41 DAMAGE BY LEAKS

- .1 This Contractor shall be responsible for damages to grounds, walks, roads, building, piping systems, electric system and their equipment and contents caused by leaks in the ventilation system being installed. The Contractor shall repair at his expense all damage to incur. All work shall be done as directed by the Owner's representative.

1.42 OPENINGS FOR EQUIPMENT

- .1 This Contractor shall be responsible for openings being left to allow the installation of all apparatus and large equipment in this contract. This Contractor shall make all necessary arrangements with the General Contractor to ensure that the required openings are left and properly located. The General Contractor shall be responsible for the tearing out and making good of any walls necessary for the passage of equipment

1.43 STAGING

- .1 This Contractor shall supply all staging and equipment necessary for the installation of his work

1.44 LABOUR AND WORKMANSHIP

- .1 All tradesmen employed by this Contractor for this work shall be properly licensed journeymen and apprentices qualified to do work in each particular trade. The Consultant shall have the right to examine each man's credentials and order any unqualified personnel away from the project.
- .2 This Contractor shall be completely responsible for the proper execution of the work as outlined in the plans and specifications. This Contractor shall assume responsibility for workmanship and material defects whether or not they are discovered by the Consultant.

1.45 COMMISSIONING

- .1 This project will be commissioned. The work of taking the mechanical systems from a static to dynamic state successfully will involve each subcontractor at various times and for various functions on the project. The owner will engage a Commissioning agent, whose requirements for the subcontractors are indicated in Section 01 91 13 – General Commissioning (Cx) Requirements.

In addition, subcontractors are advised that they will also be requested to:

- .1 Participate/Coordinate activities to demonstrate system to Consultant.
- .2 Participate with TAB contractor
- .3 Participate with electrical contractor.

1.46 CEILING COORDINATION

- .1 Contractor shall refer to architectural drawings for final coordination of all ceiling-installed components, such as diffusers, sprinklers, etc. The Architectural drawings shall govern.

1.47 ALTERNATES: APPROVED EQUALS

- .1 Material submitted or installed as substitution for material specified as “Standard of acceptance” shall be considered “alternate”. All approved equals or installed product differing from spec are considered “alternates”.
- .2 When the contractor substitutes any alternate for the specified material, he shall assume full responsibility and cost to ensure the mechanical systems operate to the full design intent.
- .3 Where such alternate requires modified services or connections such as piping, ductwork, devices, electrical, plumbing, drains, or other, the contractor shall at his expense furnish same.
- .4 Where such alternate requires additional equipment to function properly, contractor shall provide and install and completely look up same at his expense.

1.48 FLOOR PLANS AND SCHEMATICS

- .1 Should any pipe size discrepancies or other material discrepancies arise in reviewing floor plans vs. schematics, request clarification from Consultant.

1.49 FINAL TERMINATION AND CONTROLS COMMISSIONING

- .1 Final control wiring termination shall be conducted by the corresponding mechanical contractor. Controls commissioning shall be conducted by the corresponding mechanical contract with support from Electrical contractor.

Part 2 Products

2.1 MATERIALS – Not Used

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 99 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 DEMONSTRATION

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Contractor will record these demonstrations on video tape for future reference.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.6 PROTECTION

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

3.7 PERMITTING DOCUMENTS

- .1 The design drawings are intended to indicate the design requirements to the Contractor. It is the Contractor's responsibility to obtain all construction permits, and approvals from authorities. The Contractor shall be responsible to prepare all necessary sketches, drawings and submission documents required by the authorities in order to issue approvals and permits.
- .2 Contractor shall carry all costs associated with permitting 3rd party reviews, witnessing, and inspection.

3.8 OPTIMIZATION

- .1 The noted Contractors will provide in his quotation for systems optimization.
- .2 The Consultant's sequences and setpoints specified are intended as a guide designed to create safe, functional and comfortably operating mechanical systems. Each project has a unique set of site conditions which, during start-up and commissioning, will become evident. This Contractor shall allow time for optimizing of setpoints to improve the efficiency of the systems' operations, to lower overall energy use while maintaining the design objectives.
- .3 Optimization will require work on behalf of the EMCS and TAB Contractors and coordinated with the Heating and Ventilation Contractors. Each item will be reviewed with the Design Consultant before trial and if beneficial, adopted to core operating strategies and incorporated to record documents.

3.9 COMMISSIONING

- .1 Contractor shall perform commissioning activities in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.
- .2 Contractor shall be responsible to organize and coordinate commissioning activities with their sub-trades, schedule key personnel, provide all testing equipment required to perform commissioning activities and testing.
 - .1 Contractor shall be responsible to conduct and report on Contractor start-up (CSP) for all systems under their division.
 - .2 Contractor shall be responsible for Verification Program (VP) for all equipment and systems under the division.

- .3 Contractor shall be responsible to conduct functional testing under performance evaluation (PE) for all equipment and systems under their division.
- .4 Contractor shall be responsible to conduct training Owner personnel on all equipment and systems under their division.
- .5 Contractor shall be responsible to document all commissioning activities and testing and provide commissioning procedures required to re-commission equipment and systems in the future.
- .6 Contractor shall be responsible to collect, organize and turn over all information required to assemble Building Management Manual for the project.
- .3 This Contractor shall provide a start-up/commissioning report prior to final inspection confirming that all major pieces of equipment have been started in accordance with manufacturer's instructions. Report shall list each piece of equipment and shall include the name of the inspection authority giving permission for equipment start-up where applicable. Report must be signed and dated. Reports are required but not limited to the following equipment:
 - .1 Process Piping Instruments
 - .2 Complete Aeration System
 - .3 UV disinfection system
 - .4 Domestic Water Back Water Valves and trap primer
 - .5 Intake Louvres
 - .6 Exhaust Fans.

3.10 THERMOMETERS AND PRESSURE GAUGES

- .1 GENERAL
 - .1 Install devices of specified type where indicated. Range shall be selected for design/operating point to be approximately 50% of scale.
 - .2 Shock and vibration resistant.
 - .3 To ASME B40.
 - .4 Position devices for convenient viewing from floor.
- .2 THERMOMETER:
 - .1 Industrial, linear, variable-angle type, mercury-free, 200mm length.
 - .2 Install thermometer in minimum 100mm brass or stainless steel well to suit service.
- .3 PRESSURE GAUGES:
 - .1 Industrial, minimum 112mm face, with stainless steel bourdon tube, 0.5% accuracy or full-scale, liquid filled, rear pressure relief gaskets and diaphragm for corrosive service.
 - .2 Provide scrubber for pulsating service.
 - .3 Provide bronze stop cock.

3.11 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following test in accordance with Section 01 40 00 - Quality Requirements and submit report as described in PART 1 – SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturers verifying compliance or work, in handling, installing applying protection and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 SUBMITTALS AND AS SPECIFIED RESPECTIVE SECTIONS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review work, as directed in PART 1 – QUALITY ASSURANCE.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Requirements
 - .1 Section 22 & 23.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 20 05 01 – Common Work Results for Mechanical.
- .2 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.
 - .2 Dispose of unused paint and coating material at official hazardous material collections site approved by Consultant.
 - .3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer. Plastic nameplates to be durable in location and conditions of use.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Consultant.
 - .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Raw Water	Green	RAW WATER
Treated Water	Green	TREATED WATER

Wastewater	Green	WASTE WATER
Sanitary Vent	Green	SANITARY VENT

2.4 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.5 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.6 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.7 LANGUAGE

- .1 Identification in English and French.

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 TIMING

- .1 Provide identification only after painting specified Section 09 91 99 - Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC CSA registration plates as required by respective agency.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:

- .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in equipment rooms at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping, or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .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, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning and Waste Management.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and components for metering aeration and wastewater including installation.
- .2 Related Sections:
 - .1 Section 01 29 00 – Payment Procedures
 - .2 Section 20 05 01 – Common Work Results for Mechanical.
 - .3 Section 23 05 17 – Pipe Welding.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Fluid Meter's Handbook: Their Theory and Application, Sixth Edition 1971.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Submittals to include:
 - .1 Piping configuration and sizing - straight pipe upstream and downstream, distances to first weld, protrusion, thermowell, pressure tap.
 - .2 Service conditions.
 - .3 Full details of primary element - standard of design and construction, materials, type serial number, flow rate, differential pressure, irrecoverable head loss (IHL), calculation sheets.
 - .4 Accuracy statements for each component at specified flow rates and other conditions.
 - .5 Flow and temperature ranges.
 - .6 Signal processor calibration data.
 - .7 Minimum turndown ratio.
- .3 Quality assurance submittals: submit following in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.

Part 2 Products

2.1 AIR PIPING VACUUM GAUGES

Vacuum gauges will be installed as shown on the drawings. Vacuum gauges shall meet the following specifications:

- .1 Back inlet and outlet: 90°, 0 to –15" H₂O (0 to –4kPa) to be white with black figures and graduations c/w clear glass window;
- .2 Dual indication dial range: 6mm (1/4") NPT outlet, with snubber and needle valve, or approved equal.
- .3 Dial size: 88.9 mm (3 1/2");
- .4 Case, ring and pointer: Stainless steel;
- .5 Accuracy: 1% accuracy over middle half of scale, 2% over balance to conform to ANSI B40.1, Grade A;
- .6 Acceptable Product: The vacuum gauge shall be Dwyer Magnehelic Model 215 diaphragm gauge.

2.2 AIR PIPING PRESSURE GAUGES

Pressure gauges will be installed as shown on the drawings to monitor the air discharge pressure. Gauges shall meet the following specifications:

- .1 Dual indication dial range: 270°, 0 to 15 psi (0 to 100 kPa) to be white with black figures and graduations c/w clear glass window;
- .2 NPT brass socket: 6 mm (1/4");
- .3 Tube type: bronze bourdon with silicone dampened;
- .4 Gauge cock: 6 mm (1/4");
- .5 Dial size: 88.9 mm (3 1/2");
- .6 Case, ring and pointer: Stainless steel;
- .7 Accuracy: 1% accuracy over middle half of scale, 2% over balance to conform to ANSI B40.1, Grade A;
- .8 Acceptable Product: Terence No 890 standard bottom outlet, with Terence # 872-2 snubber and Terence # 735-2 needle valve or approved equal.

2.3 LEVEL CONTROLLERS

- .1 Ultrasonic level controller

The ultrasonic transducer shall be installed inside the existing control chamber (as shown on civil drawings) to measure the water level through the existing v-notch weir. The

scope of the mechanical work shall include the reuse of the existing bracket, and all related work for a complete installation of the transducer and controller. The facility start-up shall include the calibration and commissioning of this unit by a trained factory representative.

- .1 A total of one (1) ultrasonic transducer (mounted inside the existing control chamber) shall be installed. The 120v controller shall be installed inside the UV building. The controller to show instantaneous flow and shall also provide a 4-20mA signal to the PLC controller.
- .2 The ultrasonic controller shall be approved for hazardous locations. (CSA Class I, Div. 2)
- .3 The unit shall be equipped with a submergence shield.
- .4 The ultrasonic transducer shall be Siemens Milltronics Echomax XRS-5 transducer with required cable length. Length to be determined by contractor.
- .5 The transducer shall be mounted near the access hatch. The contractor is responsible to ensure that the existing bracket is compatible for the new transducer.
- .6 Spare parts: One (1) complete ultrasonic transducer.
- .7 The ultrasonic level controller shall be Siemens Sitrans LT500 (Dual point).
- .8 An approved alternate will be Krohne Optisound-VU31 Ultrasonic Measurement System.

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 INSTALLATION OF PRIMARY ELEMENT

- .1 Follow manufacturer's instructions.

3.3 INSTALLATION OF SIGNAL TRANSMISSION CABLE

- .1 Ground shielding at one point only.
- .2 Protect against RF interference.
- .3 Cross electrical cables, conduits at 90 degrees leaving at least 150 mm space between.

3.4 START-UP

- .1 Follow manufacturer's recommendations.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Management.

- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sectio 01 29 00 – PAYMENT PROCEDURES
- .2 Section 22 11 16 - DOMESTIC WATER PIPING

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
 - .1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit data for valves specified in this Section.

1.4 CLOSEOUT SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
 - .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials.

Part 2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 NPS 2 and under:
 - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: solder ends or grooved ends to ANSI/ASME B16.18.
 - .2 NPS 2 1/2 and larger:
 - .1 Flanged ends.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

.4 Globe Valves

- .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
- .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: handwheel.
- .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: handwheel.
- .4 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
 - .3 Operator: handwheel.
- .5 Angle valve, NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
 - .3 Operator: handwheel.
- .6 Standard of acceptance: Crane Fig.1.

.5 Swing Check Valves:

- .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
- .2 NPS 2 and under, swing type, bronze disc, Class 150:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

- .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .3 NPS 2-1/2 and up, flanged:
 - .1 To MSS SP-71, Class 125, 860 kPa, cast iron body, FF flange, regrind renewable seat, bronze disc, bolted cap.
- .4 NPS 2 to 4 for roll grooved end pipe:
 - To MSS SP-71, Class 125, 860 kPa, malleable or ductile iron body, bronze or stainless steel discs, stainless steel spring, stainless steel shaft, EPDM seat.
- .5 Acceptable Manufacturer (or approved equal):
 - .1 Crane
 - .2 Jenkins
 - .3 Watts
 - .4 Apollo
 - .5 Kitz
- .6 Silent Check Valves:
 - .1 NPS 2 and under:
 - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
 - .2 Pressure rating: Class 125.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
 - .4 Disc and seat: renewable rotating disc.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.
 - .7 Acceptable Manufacturer (or approved equal):
 - .1 Crane
 - .2 Jenkins
 - .3 Watts
 - .4 Apollo
 - .5 Kitz
 - .2 NPS 2-1/2 and over:
 - .1 Class 125, 860 kPa, cast steel, wafer style, bronze trim, stainless spring heavy duty spring in vertical down flow application.
 - .3 NPS 4 and over, for roll grooved end pipe:
 - .1 To MSS SP-71, Class 125, 860 kPa, malleable or ductile iron body, bronze or stainless steel discs, EPDM seat.
 - .4 Standard of Acceptance: Victaulic Series 716 and Series W715.
 - .5 Acceptable Manufacturer (or approved equal):
 - .1 Crane
 - .2 Jenkins
 - .3 Watts

- .4 Apollo
- .5 Kitz
- .7 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class 125 WOG
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders solder ends to ANSI/ASME 16.18.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.
 - .2 Acceptable Manufacturer (or approved equal):
 - .1 Crane 9202 or 9222,
 - .2 Jenkins 201SJ or 202 SJ,
 - .3 Watts B-6000 or B-6001,
 - .4 Red & White 5044A or 5049A,
 - .5 Kitz 58 or 59,
 - .6 Apollo 77C series
 - .7 Victaulic Series P569.
 - .8 For Aquatherm or Aquarise piping use compatible valves from respective pipe manufacturers.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.
- .4 Isolate equipment, fixtures and branches with ball valves.
- .5 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.2 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-05, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25,125 and 250.
 - .2 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS through 24.
 - .3 ANSI/ASME B16.34-04, Valves - Flanged, Threaded and Welding Ends.
- .2 ASTM International Inc.
 - .1 ASTM A126-04), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-67-02a, Butterfly Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit data for valves specified in this Section.

1.3 CLOSEOUT SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Stem packing: one for every 10 valves, each size, minimum 1.
 - .3 Gaskets for flanges: one for every 10 flanged joints, minimum 2.
 - .4 Valve handles: two (2) of each size.
 - .5 Discs: one for every 10 valves, each size, minimum 1.

Part 2 Products

2.1 BUTTERFLY VALVES - RESILIENT SEAT

- .1 Butterfly valves shall be sized in accordance with the drawings. Valves shall be butterfly valve type and complete with flange end connections with the following specifications:
 - .1 One (1) Piece Body: Ductile Iron to ASTM A536 or Cast Iron to ASTM A126 Class B;
 - .2 Type: Full Lug;
 - .3 Seat Material: EPDM;
 - .4 Disc Material: Stainless Steel 316;
 - .5 Shaft Material: Stainless Steel 316;
 - .6 Taper pin Disc shall not be pinned to shaft;
 - .7 Key: 316 Stainless Steel;
 - .8 Coating: Fused bonded epoxy coating or polyester coating suitable for exterior application;
 - .9 Nuts and Bolts: Stainless Steel 316;
 - .10 Operator:
 - .1 Valve diameter $\varnothing < 100\text{mm}$: Lever operator;
 - .2 Valve diameter $\varnothing \geq 100\text{mm}$: Handwheel with gear operator;
 - .11 Acceptable Product: Series 31 Bray butterfly valve, Dezurik, AT Controls NS Series or approved equal.

Part 3 Execution

3.1 PREPARATION

- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.

- .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Handle valve with care so as to prevent damage to disc and seat faces.
- .5 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.
- .6 It should be noted that the Contractor shall be responsible for touch-ups or repainting to correct damages to the finish from shipping or installation.
- .7 These valves shall come complete with all connections and flange adapters if required.

3.3 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Clean installed products in accordance with manufacturer's recommendation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sectio 01 29 00 – Payment Procedures
- .2 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
 - .1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with section 20 05 01 – Common Work Results for Mechanical.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in section 20 05 01 – Common Work Results for Mechanical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

- .2 Packaging Waste Management: remove of pallets, crates, padding, and packaging materials.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Stem packing: one for every 10 valves, each size, minimum 1.
 - .3 Gaskets for flanges: one for every 10 flanged joints, minimum 2.
 - .4 Pressure Reducing Valve: Spare part: One (1) complete repair kit per valve size.

Part 2 Products

2.1 PLUG VALVES

- .1 Plug valve shall be sized in accordance with the drawings. Valves shall be plug valve type internally and externally with a fusion bonded epoxy suitable for wastewater. Related nuts and bolts required on valve body shall be stainless steel 316. Valve to be complete with flange end connections.
- .2 Plug valves shall be quarter-turn, non-lubricated, eccentric type with resilient faced plug. Valve with the following specifications:
 - .1 Type: Plug Valve;
 - .2 Operating pressure range: 0-175 PSI;
 - .3 Body Type: Full flanged type in accordance with ANSI B16.1, Class 125;
 - .4 Body and Cover: ASTM A126 Class B cast iron;
 - .5 Plug: one-piece construction made of ASTM A536 ductile iron fully encapsulated with resilient facing as per AWWA C-517;
 - .6 Port: Not less than 100% of pipe area;
 - .7 Valve shall pass spherical solids equal to the pumps capability, minimum 75 mm spherical solid;
 - .8 Operator: Handwheel worm gear actuator with position indicator;
 - .9 Standard: Latest AWWA Standard C-517 for Eccentric Plug Valves;
 - .10 Opening direction: Counter-clockwise;
 - .11 Coating: Valve shall be coated inside and outside with fusion bonded epoxy suitable for wastewater applications;
 - .12 Acceptable Product: Valves will be Val-Matic Series 5600F/5800R, DeZurik, GA Industries or approved equal.

Part 3 Execution

3.1 INSTALLATION

- .1 Install valves as shown on drawings and as per manufacturer's recommendations.

- .2 It should be noted that the Contractor shall be responsible for touch-ups or repainting to correct damages to the finish from shipping or installation.
- .3 These valves shall come complete with all connections and flange adapters if required.

3.2 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL
- .3 Section 22 05 05 – INSTALLATION OF PIPEWORK
- .4 Section 22 11 16 – DOMESTIC WATER PIPING
- .5 Section 22 13 18 – DRAINAGE WASTE AND VENT PIPING – PLASTIC
- .6 Section 22 20 13 – PRESSURE PIPING
- .7 Section 23 34 00 – HVAC FANS
- .8 Section 23 31 13.01 – METAL DUCTS – LOW PRESSURE TO 500 PA

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A123-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A125-(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .3 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
 - .5 ASTM A653-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .2 Factory Mutual (FM)
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .4 Underwriter's Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:

- .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
 - .4 Upper attachment
 - .5 Middle attachment
 - .6 Pipe attachment.
 - .7 Riser clamps
 - .8 Shields and saddles
 - .9 Sway braces
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions for incorporations into manual.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 – Common Work Results for Mechanical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials.

Part 2 Products

2.1 SYSTEM DESCRIPTION

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

- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under 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 in accordance with MSS SP58.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

2.3 PIPE SUPPORTS

- .1 Finishes:
 - .1 Pipe hangers and supports: pre galvanized steel to ASTM A653 GR 33 by manufacturer or hot-dipped galvanized to ASTM A123.
- .2 Pipe channel support:
 - .1 Provide 12 gauge steel channel pipe support to MSS-SP-58 c/w galvanized hold down clamp and hilti bolts for each support.
 - .1 Acceptable Manufacturer (or approved equal):
 - .1 Grinnell
 - .2 Anvil
 - .3 Unistrut
 - .4 Myatt

2.4 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp to MSS-SP-58, type 19. ULC listed with hardened steel cup point setscrew, locknut.
 - .1 Rod: 13 mm FM approved.
 - .2 Acceptable Manufacturer: Anvil fig. 229 or approved equal.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, type 28 or 29 UL listed , FM approved To MSS-SP58, MSS-SP69.
 - .1 Acceptable Manufacturer: Anvil fig. 229 or approved equal.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:

- .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, type 19 ,UL listed, FM approved , to MSS-SP58 ,to MSS SP69.
 - .1 Acceptable Manufacturer: Anvil fig.61 or approved equal.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut, type 25 ,UL listed, FM approved, to MSS-SP58.
 - .1 Acceptable Manufacturer: Anvil fig.227 or approved equal.
- .4 Upper attachment to 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 Manufacturer: Anvil fig.281 or approved equal.
 - .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. UL listed, FM approved, to MSS SP69.
 - .1 Acceptable Manufacturer: Anvil, Plate fig.49, Eye Nut fig. 290, Expansion Case Fig. 117. or approved equal.
- .5 Upper attachment to steel joist:
 - .1 Piping NPS 2 and under: steel washer plate with double locking nuts.
 - .1 Acceptable Manufacturer: Anvil fig. 60 or approved equal.
 - .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 Manufacturer: Anvil: washer plate, fig. 60; clevis, fig 66; eye nut, fig 290. or approved equal.
- .6 Upper attachment to steel channel or angle (top):
 - .1 Piping NPS 2 and under; malleable iron "top of beam" C clamp to MSS-SP-58, type 19. ULC listed
 - .1 Acceptable Manufacturer: Anvil or approved equal.
 - Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP-58, type 25. ULC listed.
 - .1 Acceptable Manufacturer: Anvil: fig.227 or approved equal.
- .7 Upper attachment to wood joist (bottom):
 - Piping NPS 2 and under.
 - .1 Acceptable Manufacturer: Anvil Fig. 142 or approved equal.
- .8 Hanger rods: Carbon steel threaded rod material to MSS SP58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
 - .4 Acceptable Manufacturer: Anvil: fig.146 or approved equal
- .9 Pipe attachments: material to MSS SP58:

- .1 Cold piping, steel or cast iron: hot piping steel, with less than 25 mm horizontal movement; hot piping, steel, with more than 300 mm middle attachment (rod) length: adjustable clevis to MSS-SP-58, type 1. ULC listed.
 - .1 Acceptable Manufacturer: Anvil: fig.260 or approved equal
- .2 Cold copper piping, with less than 25 mm horizontal movement; hot copper piping, with more than 300 mm middle attachment (rod) length: adjustable clevis to MSS-SP-58, type 1 Copper plated. ULC listed.
 - .1 Acceptable Manufacturer: Anvil: fig.CT-65 or approved equal
- .3 Suspended hot piping, steel and copper, with horizontal movement in excess of 25mm; hot steel piping with middle attachment (rod) 300 mm or less; pipe roller to MSS-SP-58, type 43.
 - .1 Acceptable Manufacturer: Anvil: fig.174 or approved equal
- .4 Bottom supported hot piping, steel and copper: pipe roller stand to MSS-SP-58, type 45..
 - .1 Acceptable Manufacturer: Anvil: fig.271 or approved equal
- .5 Use insulation shields for hot pipework.
- .6 Oversize pipe hangers and supports.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.5 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized to MSS SP58, type 42, UL listed ,FM approved.
 - .1 Acceptable Manufacturer: Anvil fig 261 or approved equal
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
 - .1 Acceptable Manufacturer: Anvil fig CT-121 or approved equal
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.6 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield with uninterrupted vapor barrier to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
 - .1 Acceptable Manufacturer: Anvil fig 167 or approved equal
- .2 Insulated hot piping:
 - .1 Protective saddle with insulation under saddle.
 - .1 Acceptable Manufacturer: Anvil fig 160 to 166 or approved equal

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.8 HOUSE-KEEPING PADS

- .1 Housekeeping pads for all equipment by general contractor. Refer to structural/architectural drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

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 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .5 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .6 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as in table, whichever is more stringent.
 - .1 Plumbing piping: to Canadian Plumbing Code, or authority having jurisdiction.
 - .2 Fire protection: to applicable fire code

- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8m
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Rod Diameter NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	10 mm	2.4 m	1.8 m
1-1/2	10 mm	3.0 m	2.4 m
2	10 mm	3.0 m	2.4 m
2-1/2	10 mm	3.7 m	3.0 m
3	10 mm	3.7 m	3.0 m
3-1/2	10 mm	3.7 m	3.3 m
4	16 mm	3.7 m	3.6 m
5	16 mm	4.3 m	
6	22 mm	4.3 m	
8	22 mm	4.3 m	
10	22 mm	4.9 m	
12	22 mm	4.9 m	

- .7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.

- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Clean installed products in accordance with manufacturer's recommendation.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Related Requirements
 - .1 Sectio 01 29 00 PAYMENT PROCEDURES
 - .1 Section 22 11 16 DOMESTIC WATER PIPING
 - .2 Section 20 05 01 COMMON WORK RESULTS FOR MECHANICAL

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts
 - .3 CGSB 51.9-92, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01 – Common Work Results for Mechanical. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick, Canada.

1.5 QUALITY ASSURANCE

- .1 Qualifications:

- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards and member of TIAC.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 20 05 01 – Common Work Results for Mechanical.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
 - .1 Place excess or unused insulation and insulation accessory materials in designated containers.
 - .2 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.
 - .3 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

- .1 Mineral fibre: to CAN/ULC-S702 ASTM C547.
- .2 Maximum "k" factor: to CAN/ULC-S702.
- .3 Accepted Manufacturer (or approved equal):
 - .1 John Manville
 - .2 Fibrex
 - .3 Mason AK Board
 - .4 Industrial Insulation Group, LLC
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Insulation: to CGSB 51.9-92
 - .2 Mineral fibre: to CAN/ULC-S702 ASTM C547.
 - .3 Jacket: to CGSB 51-GP-52Ma.
 - .4 Maximum "k" factor: to CAN/ULC-S702 ASTM C547.
 - .5 Accepted Manufacturer (or approved equal):
 - .1 John Manville
 - .2 Fibrex
 - .3 Mason AK Board
 - .4 Industrial Insulation Group, LLC

2.3 INSULATION SECUREMENT

- .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, 19mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint or indicated by Consultant.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 92 00 - Joint Sealants.

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 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:

- .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, and flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: aluminum .

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)				
		Up to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 and up
Domestic HWS	A-3	25	25	25	38	38
Domestic CWS	A-3	25	25	25	25	25

- .5 Finishes:
 - .1 Concealed & exposed indoors: PVC
 - .2 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

- .3 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

- .1 Proceed in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sectio 01 29 00 – Payment Procedures
- .2 Section 22 05 05 – Installation of Pipework
- .3 Section 20 05 01 – Common Work Results for Mechanical.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 SANITARY AND STORM DRAINAGE SYSTEMS

- .1 Ensure that traps are fully and permanently primed.
- .2 Ensure that fixtures are properly anchored, connected to system.
- .3 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .4 Cleanouts: refer to Section 22 42 01 - Plumbing Specialties and Accessories.

1.4 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

1.5 TRAINING

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified herein.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.
- .2 Related Requirements
 - .1 Sectio 01 29 00 – PAYMENT PROCEDURES
 - .1 Section 22 20 13 – PRESSURE PIPING

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.
- .3 Quality assurance submittals: submit following in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Instructions: submit manufacturer's installation instructions.
 - .1 Consultant will make available 1 copy of systems supplier's installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials.

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

Part 2 Products

2.1 CLEANING SOLUTIONS

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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 FIELD QUALITY CONTROL

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Certified wood.
- .8 Low-emitting materials.

3.3 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Clean installed products in accordance with manufacturer's recommendation.
- .3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 22 05 05 - INSTALLATION OF PIPEWORK.
- .3 Section 22 07 15 - THERMAL INSULATION FOR PIPING
- .4 Section 22 42 01 - PLUMBING SPECIALTIES AND ACCESSORIES
- .5 Section 20 05 01 - COMMON WORK RESULTS FOR MECHANICAL

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-06, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-01, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 ASTM International Inc.
 - .1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-02a, Butterfly Valves.

- .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71-05, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)/Institute for Research in Construction
 - .1 NRCC 38728, National Plumbing Code of Canada (NPC) - 1995.
- .9 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 – Common Work Results for Mechanical.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Place materials defined as hazardous or toxic in designated containers.
- .2 Handle and dispose of hazardous materials in accordance with CEPA , TDGA , Regional and Municipal regulations.

Part 2 Products

2.1 GENERAL

- .1 All domestic water piping, fittings, valving, devices and equipment shall be UL classified in accordance with NSF-61 for potable water service. The system shall meet the low-lead requirements of NSF-372.

2.2 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground:
 - .1 Copper tube, hard drawn, type L: to ASTM B 88M.
 - .2 PEX Piping to CSA B137.5.
 - .2 Buried or embedded:
 - .1 Copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.
 - .2 PEX Piping to CSA B137.5.

- .3 All exposed piping to be copper tube, hard drawn, type L: to ASTM B 88M.

2.3 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger:
 - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
 - .2 PEX fittings to CSA B137.5 and F1960.
 - .3 Manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)
- .6 NPS 1 ½ and smaller:
 - .1 Wrought copper to ANSI/ASME B16.22 with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.
 - .2 PEX fittings to CSA B137.5.
- .7 NPS 2 and smaller:
 - .1 Precision, cold drawn, stainless steel with elastomer O-ring seals, suitable for working pressure to 3450-kPa.
 - .2 Standard of Acceptance: Victaulic Vic-Press for Schedule 10S Pipe.
- .8 All fittings shall be UL classified in accordance with NSF-61 for potable water service. The system shall meet the low-lead requirements of NSF-372.

2.4 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint at copper-tube dimensions, complete with EPDM-HP gasket. Installation-ready, suitable for direct stab installation without field disassembly. Standard of Acceptance: Victaulic Style 607H.
- .6 Dielectric connections between dissimilar metals:
 - .1 dielectric fitting, complete with thermoplastic liner.
 - .2 Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. Basis of Design: Victaulic Series 647.
 - .3 UL classified in accordance with NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372.
- .7 NPS 1 ½ and smaller: PEX fittings to CSA B137.5

- .8 NPS 2 and larger: PEX fittings to CSA B137.5 and ASTM F 1960. Elbows, adapters, couplings, plugs, tees, multi-port tees and valves

All pipe joints for PEX piping to be jointing systems as supplied by pipe manufacturer. Do not join PEX piping below floor.

2.5 VALVES

- .1 Refer to Section 22 05 23.01 Valves- Bronze.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with NPC, local authority having jurisdiction and Province of project location Plumbing Code.
- .2 Install pipe work in accordance with Section 22 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install CWS piping below and away from DHW and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

3.3 PRESSURE TESTS

- .1 Conform to requirements of Section 20 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.4 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial and Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.5 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction approval of Consultant.
- .2 Coordinate with Section 22 20 13 – Pressure Piping.
- .3 Upon completion, provide laboratory test reports on water quality for Consultant approval.

3.7 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 DHW storage tank up to design temperature slowly.
 - .4 Monitor piping DHW and DCW 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.

3.8 PERFORMANCE VERIFICATION

- .1 Scheduling:

- .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterilize DCW and DHW 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 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.
 - .7 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 22 05 05 - Installation of Pipework.

3.10 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Clean installed products in accordance with manufacturer's recommendation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 22 05 05 – INSTALLATION OF PIPEWORK
- .3 Section 22 05 29 – HANGER AND SUPPORTS FOR HVAC PIPING
- .4 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM D2235-04, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D2564-04e1, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-Series B1800-06, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MATERIAL

- .1 Adhesives and Sealants: in accordance with Section 07 92 00 - Joint Sealants.

2.2 PIPING AND FITTINGS

- .1 PVC-DWV
 - .1 Certified to **CSA B181.2**, made to Schedule 40 thickness
 - .2 Exhibits a Flame Spread Rating of not greater than 25 as per ULC S102.2 test methods.
 - .3 Size range 1-1/2" - 24"
 - .4 Permitted inside a building; above ground, underground and part of the building sewer system. Not permitted for use in Air Plenum, Vertical Service Spaces and High-Rise Buildings.
 - .5 To ensure the full integrity of the completed system, all components shall be supplied by one manufacturer.
 - .6 Approved manufacturer or equal.
 - .1 IPEX System 15
 - .2 Westlake Pipe and Fittings – Napsys – LR PVC DWV 25
- .2 XFR DWV
 - .1 Certified to **CSA B181.2** and made to Schedule 40 thickness.
 - .2 System XFR listed to ULC S102.2 to exhibit a Flame Spread Rating of not greater than 25 as well as a Smoke Developed Classification of not greater than 50. Permissible for use in High-Rise Buildings and Air Plenums as per NBCC.
 - .3 System XFR DWV is not permitted in Vertical Service Space.
 - .4 To ensure the full integrity of the completed system, all components shall be supplied by one manufacturer. Mixed use of multiple manufacturer brands of pipe and fittings would make the Flame and Smoke listings invalid
 - .5 Approved manufacturer or equal.
 - .1 IPEX System 15
 - .2 Westlake Pipe and Fittings – Napsys – LR PVC DWV 25
- .3 PVC SDR-35/28
 - .1 Pipe certified to CSA B182.2
 - .2 Conform to ASTM D3034, ASTM F679, BNQ 3624-130 and BNQ 3624-135 standards.
 - .3 Pipe stiffness must be 320kpa (46psi) for DR35 and 625kpa (90psi) for DR28.
 - .4 Permitted buried inside a building.
 - .5 Approved manufacturer or equal.
 - .1 IPEX System 15
 - .2 Westlake Pipe and Fittings – Napsys – LR PVC DWV 25

- .4 ABS-DWV
 - .1 Pipe to be certified to CSA B181.1
 - .2 Available in nominal sizes from 1 1/4" to 6".
 - .3 Permitted inside building above and underground and is not permitted for use in non-combustible buildings.
 - .4 Approved manufacturer or equal.
 - .1 IPEX System 15
 - .2 Westlake Pipe and Fittings – Napsys – LR PVC DWV 25

- .5 BDS PVC
 - .1 BDS manufactured to B182.1 **WILL NOT BE ACCEPTED.**

2.3 JOINTS

- .1 Solvent Cementing
 - .1 Cements shall be CSA certified and meet the requirements of ASTM D2564 for PVC and ASTM D2235 for ABS.
 - .2 Clean all joints with ABS or PVC - Cleaner
 - .3 All work carried out to CSA Standard B181.1-M90 and B181.2-M90 recommended practice for the installation of ABS or PVC DWV pipe fittings
 - .4 One-Step Cement may be used for sizes 1-1/2" to 6" only.
 - .5 For sizes 8" to 24", PVC-DWV (IpeX - System 15) and IpeX- XFR -Two-Step cement must be used in conjunction with PVC-DWV (IpeX - System 15) and IpeX XFR primer.
 - .6 Consideration may also be given to the use of pressure cement for sizes over 12".
 - .7 Proper solvent cementing procedures must be followed at all times.
 - .8 Approved manufacturer or equal.
 - .1 IPEX System 15
 - .2 Westlake Pipe and Fittings – Napsys – LR PVC DWV 25
- .2 PVC-DWV & XFR DWV
 - .1 MJ Grey™ Couplings
 - .1 MJ Grey Couplings are a mechanical joint assembly suitable for use on PVC-DWV (IPEX System 15) or System XFR DWV piping sizes 8" through 12", are certified to CSA B602 and are listed to ULC S102.2 to exhibit a Flame/Smoke rating of 25/50
- .3 PVC SDR-35/28
 - .1 Gaskets certified to CSA B182.2 and conform to ASTM D3034, ASTM F679, BNQ 3624-130 and BNQ 3624-135 standards Injection-mold gasketed PVC fittings shall be certified to CSA B182.1 or CSA B182.2. Fabricated fittings must conform to CSA B182.2 and ASTM F679. Sealing gaskets shall meet the requirements of CSA B182.2 and ASTM F477 and pipe joints shall withstand 345kpa (50psi) hydrostatic pressure.

- .4 **ABS-DWV**
 - .1 Fittings to be certified to CSA B181.1 and is available in nominal sizes from 1 1/4" to 6". Permitted inside building above and underground and is not permitted for use in non-combustible buildings.
 - .2 Approved manufacturer or equal.
 - .1 IPEX System 15
 - .2 Westlake Pipe and Fittings – Napsys – LR PVC DWV 25

2.4 BACKWATER VALVE

- .1 Valve shall be PVC in-line backwater valve designed to be installed on PVC DR-35 Sanitary Pipe as per CSA/CAN3 B70-M86.
- .2 Valve to be normally open.
- .3 Valve to be equipped with removal lid for inspection and cleaning.
- .4 Acceptable products: In-line Backwater Valves, as manufactured by Napco Pipe or approved equal.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with National Plumbing Code, local authority having jurisdiction.
- .3 Solvent Cementing
 - .1 To make consistently good joints, the following points should be clearly understood and followed.
 - .1 The joining surfaces must be softened and made semi-fluid.
 - .2 Sufficient cement must be applied to fill the gap between pipe and fitting.
 - .3 Assembly of pipe and fittings must be made while the surfaces are still wet and cement is still fluid.
 - .4 Joint strength develops as the cement dries. In the tight part of the joint the surfaces will tend to fuse together; in the loose part, the cement will bond to both surfaces.
 - .5 It is recommended that installers verify for themselves that they can make satisfactory joints under varying conditions.

- .6 It is recommended that the installers received personal instruction from trained instructor or experienced installers. Contact your local manufacture or supplier for additional information and or instruction.

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 Ensure 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 ensure traps are fully and permanently primed.
- .3 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Clean installed products in accordance with manufacturer's recommendation.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 22 05 17 - Pipe Welding.
- .4 Section 20 05 53.01 - Mechanical Identification.

1.2 REFERENCES

- .1 American Iron and Steel Institute (AISI)
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
 - .2 ASME B31.1-07, Power Piping.
- .3 ASTM International
 - .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .2 ASTM A193/A193M-08b, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - .3 ASTM A194/A194M-08b, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - .4 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .4 CSA International
 - .1 CSA B51-09, Boiler, Pressure Vessel and Pressure Piping Code.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide Project Record Documents in accordance with section 20 05 01 – Common Work Results for Mechanical supplemented with:
 - .1 Information relating to elevations, inverts and location of piping.
 - .2 Valve data.
 - .3 Details of permanent instrumentation.
 - .4 Drainage provisions at low points.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in section 20 05 01 – Common Work Results for Mechanical.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial regulations.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Packaging Waste Management: remove for reuse and return of packaging materials.

Part 2 Products

2.1 PIPE AND FITTINGS FOR UV PIPING

- .1 Piping and fittings:
 - .1 Interior of building: shall be Schedule 10 type 304L stainless steel as shown on the drawings. The fittings shall be welded stainless steel fittings as shown on the drawings. All piping inside the building shall be cleaned by acid wash.
 - .1 Stainless steel Sch. 10 piping may also be roll-grooved for Victualic fittings, Victualic flanges and Victualic Style 89 rigid coupling with ductile iron housing conforming to ASTM A-536, Grade 65-45-12. All connections shall include EPDM gaskets (printed).
 - .2 All buried pipes shall be Schedule 40 type 304L stainless steel unless specified otherwise.
 - .3 All buried stainless steel fittings shall be welded.
 - .4 Piping shall be supported as shown on the drawings.
- .2 Gaskets:
 - .1 Will be 1.6 mm thick, rubber and flat ring.
- .3 Nuts and Bolts:

- .1 All nuts and bolts shall be heavy head machine bolts and nuts, stainless steel Type 316, for inside the building. Use a suitable thread compound to prevent galling when tightening the bolts. All nuts shall be re-tightened after initial installation to ensure that they have not become loose.

2.2 PIPE AND FITTINGS FOR AIR TREATMENT PIPING

- .1 Piping and fittings:
 - .1 Blower mechanical piping will be Schedule 10 stainless steel pipe with welded schedule 10 stainless steel flanges and fittings.
 - .2 Bolts will be hex head heavy machine bolts and nuts, to be high strength low alloy steel for steel fittings and 316 stainless steel on stainless steel fittings. Gaskets will be 3 mm thick minimum, EPDM (printed), flat ring.
 - .3 Bolts and nuts for Victaulic couplings shall be heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.
- .2 Transition of piping (interior piping to exterior piping)
 - .1 As shown on the drawings, transition from Schedule 10 Steel to Stainless Steel Schedule 40 piping will be done inside of the building.
 - .2 The Stainless Steel piping and fittings to be buried connection point shall be welded and included a 25 MPa concrete thrust block, properly sized.
 - .3 All buried pipe shall be Schedule 40 type 304L stainless steel unless specified otherwise.
 - .4 All buried stainless steel piping shall be welded.
- .3 Painting of Air Piping
 - .1 In order to ensure corrosion protection for the carbon steel Schedule 10 blower air piping, the air inlet and air discharge piping shall be protected with a heavy duty, high temperature resistant coating with a long lasting resistance to salts, water, alkalis and weathering.
 - .2 All valves inside the blower building will remain factory painted.
 - .3 Surface preparation – Steel pipe shall be dry, free of any oil or grease, abrasive, blasted to a Steel Structures Painting Council SSPC-SP-6 standard for a commercial finish.
 - .4 Primer – the primer shall consist of one (1) coat of carboline 893 epoxy gray colour applied by spray to a dry film thickness of 75 microns (3mils), or approved equal.
 - .5 Topcoat – the topcoat shall consist on one (1) coat of carboline epoxy gray colour applied by spray to a dry film thickness of 75 microns (3mils), or approved equal. Colour to be selected by owner.
 - .6 Epoxy primer and topcoat will be applied on the carbon steel Schedule 10 pipeline from the flanges of the inlet filter/silencers to all piping inside the blower building.
 - .7 All stainless steel piping shall remain unpainted, but cleaned and polished with an acid wash cleaner, all in accordance with the stainless steel Manufacturer's

recommendations. Buffing of pipes with rotary equipment and steel brush (grinder, buffer) will not be permitted.

- .8 All new and existing piping shall be painted.

2.3 VALVES

- .1 Refer to Section 22 05 23.06 – Wastewater Valves
- .2 Refer to Section 22 05 23.05 – Butterfly Valves

2.4 PRESSURE GAUGES

- .1 Refer to Section 22 05 20 – Meters and Gauges for Wastewater System.

2.5 FABRICATION

- .1 Do work in accordance with ASME B31.1.
- .2 Joints:
 - .1 Accessible locations: screwed, flanged or welded to match piping specification.
 - .2 Elsewhere: welded throughout, except at flanged components.
 - .3 Grooved joints on applicable systems in lieu of welded, flanged, or screwed joints and components.
- .3 Branch connections:
 - .1 Use butt or socket-weld fittings.
 - .2 Mains NPS 2-1/2 and smaller: use weldolets, threadolets, or 2 Mpa half couplings as reinforcements.
 - .3 Mains NPS 3 and larger: welded branch connections can be used.
 - .4 In grooved systems: tees and reducing tees can be used.

Part 3 Execution

3.1 PREPARATION

- .1 Lay out work in accordance with lines and grades as indicated.
- .2 Verify lines, levels, dimensions as indicated against established benchmarks. Report discrepancies to Consultant and obtain written instruction.
- .3 When required by Consultant, provide drawings showing relative locations of various services.

3.2 WELDING

- .1 Perform welding in accordance with Section 23 05 17 - Pipe Welding supplemented as specified herein.
- .2 Notwithstanding the requirements of referenced section, the following shall apply:
 - .1 Welding to be in accordance with ASME B31.1.

- .2 Welding to be executed by certified pipe welders.
- .3 Pipe fitting to be executed by certified pipe fitters.

3.3 GROOVED JOINTS

- .1 Install grooved joints in accordance with manufacturer's latest published installation instructions.
- .2 Ensure grooved ends are: clean, free from indentations, projections, and roll marks in the area from pipe end to groove.
- .3 Select gaskets with elastomer grade suitable for service and produced by coupling manufacturer.

3.4 INSTALLATION

- .1 Installation to be performed by certified pipe fitters.
- .2 Install pipework as shown on drawings.
- .3 Clearances:
 - .1 Maintain clearance around systems, equipment and components and between pipes and structures for O M to manufacturer's recommendations.
- .4 Flanges: use suitable graphite lubricant on bolts and nuts.
- .5 Butterfly valves: install between weld-neck flanges.
- .6 Branch take-offs:
 - .1 Use welding tees.
 - .2 Where reducing tees of proper size are unavailable, use available tees with reducers. Tees with increasers not acceptable.
- .7 Cap open ends of piping during installation. Remove foreign material from inside piping.
- .8 Grade nominally horizontal piping at 0.4% slope to high point for air removal.
- .9 Flanges: tighten bolts evenly with torque wrench.
- .10 Revisions to location of piping require written approval of Consultant.
- .11 Connections to equipment:
 - .1 Use flanged valves for isolation and ease of maintenance and assembly.

3.5 PIPE SUPPORTS

- .1 Install to manufacturer's recommendations and as shown on drawings.

3.6 VALVES

- .1 Install as shown on drawings.
- .2 Install in accordance with manufacturer's recommendations.

3.7 FIELD QUALITY CONTROL

- .1 Inspections:
 - .1 Leave joints in piping systems uncovered until tests are completed and system inspected as directed by Consultant.
 - .2 Consultant to inspect new piping prior to hydrostatic pressure tests for compliance with approved drawings and specifications.
 - .3 Obtain from Consultant requirements for inspection and testing of system modifications, design changes and repairs performed in-house.
 - .4 Pay costs for inspections.

3.8 HYDROSTATIC PRESSURE TESTS:

- .1 Refer to Section 33 31 13 – Public Sanitary Utility Sewerage Piping

3.9 FLUSHING AND CLEANING

- .1 Refer to Section 33 31 13 – Public Sanitary Utility Sewerage Piping

3.10 COMMISSIONING

- .1 Instrumentation: verify accuracy of pressure gauges by comparison with calibrated test instruments.
- .2 Full scale tests: upon completion, conduct full scale tests at maximum design flow rates, operating temperatures and pressures for continuous consecutive period of 2 hours to demonstrate compliance with design requirements.

3.11 IDENTIFICATION

- .1 In accordance with Section 20 05 53.01 - Mechanical Identification, supplemented as specified herein.
- .2 In addition, identify piping at building entries.

3.12 DEMONSTRATIONS

- .1 Operate at design temperatures, pressures, flow rates for consecutive period of 2 hours to demonstrate compliance with design criteria and design intents.
- .2 Demonstrations also to show completeness of O&M personnel training.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 22 05 05 – INSTALLATION OF PIPEWORK.
- .3 Section 22 11 16 – DOMESTIC WATER PIPING
- .4 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 CSA International
 - .1 CSA-B64 Series-11, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79-08, Commercial and Residential Drains and Cleanouts.
 - .3 CAN/CSA-B356-10, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .3 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP 2007 Version.
- .4 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101-R2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
 - .2 PDI-WH201-R2010, Water Hammer Arresters Standard.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 20 05 01 – Common Work Results for Mechanical and 01 35 43 - Environmental Procedures. Indicate VOC's:
- .3 Shop Drawings:

- .1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions construction and assembly details accessories for following: RP BFP, Hose bibb, trap primer, vacuum breaker, pressure gauge, water filter, floor drain, cleanout, strainer, pressure relief valve, water hammer arrestor.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
 - .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.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 20 05 01 – Common Work Results for Mechanical with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: to CSA B79.
- .2 Standard of acceptance for floor drains shall be ZURN. Also acceptable provided the specifications are met will be: Jay. R. Smith, Watts and Mifab.
 - .1 FD (Regular Round Drain with Membrane Clamp)
 - .1 Epoxy coated cast iron body, bottom outlet, combination invertible membrane clamp and adjustable collar with weepage holes and Bronze strains, and traps primer tapping

- .2 Acceptable Material:
 - .1 ZURN ZNX-415-A-P, Mifab.

2.2 HUB DRAINS

- .1 Hub drains shall consist of a 75mm diameter PVC Sh. 40 pipe through floor, extending 50mm above finished floor elevation.

2.3 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.
- .2 Access Covers:
 - .1 Wall Access: face or wall type, polished nickel bronze round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: cast iron
 - .3 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
 - .4 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.
 - .3 Type I: soil & waste stacks and rainwater leaders: Standard of Acceptance: Zurn Z1445, Mifab.
 - .4 Access door to be 7" x 7" or 9" x 9". Standard of Acceptance: Zurn ZANB 1460-10, Mifab.
 - .5 Type II: Standard of Acceptance: Zurn, Mifab.
 - .1 Floor Type: Cleanout:
 - .2 Finished Concrete ZN1400
 - .3 Finished Concrete Heavy Traffic ZN1400-HD
 - .4 Finished Carpeted ZN1400-CM
 - .5 Finished Terrazzo ZN1400-Z
 - .6 Finished Tiled ZN1400-X

2.4 HOSE BIBS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.
- .2 See Drawing Schedule

2.5 WATER HAMMER ARRESTORS

- .1 Stainless steel construction, bellows type: to PDI-WH201.

- .2 Acceptable Material:
- .1 Zurn Z1700 Size No. 100.
 - .2 Amtrol Diatrol 536.
 - .3 Precision Plumbing Products.
 - .4 Jay R. Smith.
 - .5 Mifab.
 - .6 Approved equal.

2.6 BACK FLOW PREVENTERS

- .1 To CSA-B64, application as indicated. Reduced pressure principle type, double check valve assembly, and back flow preventer with intermediate atmospheric vent or vacuum breaker.

.2

Sizes: 6mm to 75mm (1/4" to 3")	Watts LF009
Sizes: 65mm to 250mm (2 1/2" to 10")	Watts 957BFF Stainless Steel

- .3 Acceptable Material (or approved equal):

- .1 Watts.
- .2 FEBCO.
- .3 Wilkins
- .4 Apollo
- .5 Conbraco

2.7 VACUUM BREAKERS

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric and hose connection
- .2 Materials to be body and cap - brass; spring - stainless steel stem and seat - brass.

Vacuum Breakers	Pressure Vacuum Breakers
Sizes: 9mm and 12mm (3/8" and 1/2")	Watts 008 QT – Spill Resistant Pressure vacuum breaker
Sizes: 20mm and 25mm (3/4" and 1")	Watts 008 QTS – Spill Resistant Pressure vacuum breaker
Sizes: 12mm to 50mm (1/2" to 2")	FEBCO 765 Pressure vacuum breaker

- .1 Standard of Acceptance: Watts

- .1 APOLLO
- .2 Conbraco
- .3 FEBCO
- .4 Approved Equal

2.8 PRESSURE REGULATORS

- .1 Capacity: as indicated.
 - .1 Inlet pressure: 1034 kPa.
 - .2 Outlet pressure: 413 kPa.
- .2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62.
- .3 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

2.9 STRAINERS

- .1 860 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.
- .3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.10 EXPANSION TANK

- .1 Domestic system Watts PLT-5 or equivalent from Wilkins, Expanflex or Taco with 40 PSI precharge. Set expansion tank pressure 3 psi lower than system operating pressure. Contractor shall submit commissioning report verifying tank precharge pressure and system pressure, with pumps off, has been tested.

2.11 STAND-ALONE DEHUMIDIFIER

- .1 A stand-alone dehumidifier shall be supplied for this project with the following specifications:
 - .1 Moisture removal: 90 Litres/day;
 - .2 Unit to be on wheels and considered portable;
 - .3 Dehumidistat operating range from 20 to 80%;
 - .4 Internal condensate pump capable of pumping 5.15m with 6.1m of hose. Drain hose to be piped to nearby floor drain;
 - .5 Shall have 5-year warranty period;
 - .6 The Stand-Alone Dehumidifier is not shown on drawings. Exact location will be discussed during construction.
 - .7 Approved Product: Supply Quest Hi-E Dry 195 or approved equivalent.

2.12 FIRE EXTINGUISHER

- .1 Fire extinguishers to be supplied for this project shall have the following specifications:

- .1 Dry chemical (multi-purpose ABC);
- .2 10 lb. capacity;
- .3 Shall be wall mounted with a wall bracket.

2.13 TRAP SEAL PRIMERS

- .1 Provide priming device with R.P. type BFP Watts Series 009 or equivalent from Wilkins c/w drain to nearest services in conjunction with electric trap primer unit. Trap primer unit shall consist of a 120 volt solenoid valve and copper manifold header for multiple pipes. System must be connected to nearest ½" DCW service with ball type service valve and strainer. System must introduce a regulated equal amount of water to each floor drain and shall be c/w a test switch, built-in timer and in-line replaceable fuse. Entire assembly must be contained within a cabinet with an access door by manufacturer. Strainer and BFP shall be mounted external to cabinet in a serviceable location.
- .2 Acceptable Material (or approved equal):
 - .1 P.P.P. Prime Time Trap Primer, Mifab or approved equal.
- .3 Site Fabricated assemblies will not be accepted in lieu of unit specified. No exceptions.

2.14 EYE WASH STATION

- .1 An eye wash station shall be supplied to meet ANSI Z358.1-2009 Standard and installed where shown on the drawings as per manufacturer's recommendations. The eye wash station shall have the following specifications:
- .2 Gravity fed eyewash with insulated jacket.
- .3 "J" Hook for wall mounting.
- .4 Heating unit designed to maintain water temperature near 29 degrees Celsius.
- .5 Hydrosep Water Preservative.
- .6 Nema 4.
- .7 Power: 120 V.
- .8 Vessel: High visibility polyethylene tank.
- .9 Flow: minimum of 1.5 L/m for 15 minutes.
- .10 Unit shall be CSA approved.
- .11 Unit shall be supplied with one (1) year of water treatment additive.
- .12 Acceptable Products: Encon Safety Products Model 01104070 or approved equal.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.3 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada, provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as 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.

3.5 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures where indicated.

3.6 BACK FLOW PREVENTERS

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
 - .1 Drains.
 - .2 Backwater Valves.
 - .3 Water Make-up Assembly.
 - .4 Grease Interceptors.
- .2 Mount in between 750mm-1500 mm above finish floor in accessible location as per code
- .3 Pipe discharge to terminate over nearest drain or service sink.

3.7 BACKWATER VALVES

- .1 Install where indicated.

3.8 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.9 TRAP SEAL PRIMERS

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.
- .3 Install soft copper tubing to floor drain.

3.10 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.11 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only 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.
- .3 Provide continuous supervision during start-up.

3.12 TESTING AND ADJUSTING

- .1 General:
 - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
 - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.

- .3 Check operations of flushing features.
- .4 Check security, accessibility, removability of strainer.
- .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.
- .7 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .8 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .9 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .10 Wall, ground hydrants:
 - .1 Verify complete drainage, freeze protection.
 - .2 Verify operation of vacuum breakers.
- .11 Pressure regulators, PRV assemblies:
 - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .12 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.
- .13 Hose bibbs, sediment faucets:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.

3.13 CLOSEOUT ACTIVITIES

- .1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.
- .2 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

3.14 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 20 05 01 – Common Work Results for Mechanical.

3.15 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sectio 01 29 00 PAYMENT PROCEDURES
- .2 Section 20 05 01 COMMON WORK RESULTS FOR MECHANICAL
- .3 Section 20 05 53.01 MECHANICAL IDENTIFICATION
- .4 Section 22 05 17 PIPE WELDING
- .5 Section 22 05 29 HANGER AND SUPPORTS FOR HVAC PIPING
- .6 Section 22 08 01 PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEMS
- .7 Section 22 08 02 - CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS
- .8 Section 22 11 16 DOMESTIC WATER PIPING
- .9 Section 22 13 18 DRAINAGE WASTER AND VENT PIPING – PLASTIC
- .10 Section 22 20 13 PRESSURE PIPING

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B139-04, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .4 National Fire Code of Canada (NFCC 2005)
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

- .1 Sustainability Standards Certification:
 - .1 Low-Emitting Materials: provide listing of sealants and coatings used in building, comply with VOC and chemical component limits or restriction requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging.

Part 2 Products

2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
 - .1 Primers, Paints and Coating: Apply in accordance with manufacturer's recommendations for surface conditions.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 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.

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer, National Fire Code of Canada and CSA B139.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer and CSA B139, or as indicated without interrupting operation of other system, equipment, components.

3.4 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .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.
 - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

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 Install pipework to CSA B139.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards.
- .6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible and as indicated.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Use ball valves at branch take-offs for isolating purposes except where specified.

3.7 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for firestopping.
 - .2 Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

3.8 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 22 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 00 – Cleaning and Waste Management.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.9 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Consultant 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 2 hours minimum unless specified for longer period of time in relevant mechanical sections and provide written confirmation to Consultant.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.
- .6 Insulate or conceal work only after approval and certification of tests by Consultant.

3.10 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Consultant.
- .2 Request written approval by Consultant 5 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing equipment and components by this work.

3.11 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Waste Management: separate waste materials for reuse recycling.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sectio 01 29 00 - PAYMENT PROCEDURE
- .2 Section 22 05 05 - INSTALLATION OF PIPEWORK
- .3 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL

1.2 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2007, Power Piping.
 - .2 ANSI/ASME B31.3-2006, Process Piping.
 - .3 ANSI/ASME Boiler and Pressure Vessel Code-2007:
 - .1 BPVC 2007 Section I: Power Boilers.
 - .2 BPVC 2007 Section V: Nondestructive Examination.
 - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
 - .1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA W47.2-M1987(R2008), Certification of Companies for Fusion Welding of Aluminum.
 - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
 - .3 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.
 - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
 - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
 - .6 CSA W178.2-2008, Certification of Welding Inspectors.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 20 05 01 – Common Work Results for Mechanical.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welders:
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate from the province of New Brunswick for each procedure performed from authority having jurisdiction.
 - .3 Submit welder's qualifications to Consultant.
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
 - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
 - .2 Inspectors:
 - .1 Inspectors qualified to CSA W178.2.
 - .3 Certifications:
 - .1 Registration of welding procedures in accordance with CSA B51.
 - .2 Copy of welding procedures available for inspection.
 - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.
 - .4 Welder and Mechanical Contractor shall have a valid provincial welding licence of the project location.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 20 05 01 – Common Work Results for Mechanical.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials.

Part 2 Products

2.1 ELECTRODES

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

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

- .1 Welding: in accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, special procedures specified elsewhere in Division 22 and applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

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

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Consultant before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Consultant.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

- .1 General:
 - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Consultant.
 - .2 Inspect and test 5 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination magnetic particle (hereinafter referred to as "particle") tests spot full gamma ray radiographic (hereinafter referred to as "radiography") tests.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations:
 - .1 Upon failure of welds by visual examination, perform additional testing as directed by Consultant of total of up to 10% of all welds, selected at random by Consultant by radiographic means. All radiographic testing will be carried out at contractor's expense.

3.6 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Waste Management: separate waste materials for reuse recycling.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL
- .3 Section 22 31 13.01 METAL DUCTS – LOW PRESSURE TO 500 PA.
- .4 Section 23 34 00 – HVAC FANS

1.3 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Consultant within 30 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

- .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started confirm in writing to Consultant adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Consultant in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.9 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.10 START OF TAB

- .1 Notify Consultant 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.

1.11 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5 %, minus 5 %.

1.12 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.13 INSTRUMENTS

- .1 Prior to TAB, submit to Consultant list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Consultant.

1.14 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.16 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 1 copy of TAB Report to Consultant for verification and approval, in English in D-ring binders, complete with index tabs.

1.17 VERIFICATION

- .1 Reported results subject to verification by Consultant.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by Consultant.
- .4 Pay costs to repeat TAB as required to satisfaction of Consultant.

1.18 SETTINGS

- .1 After TAB is completed to satisfaction of Consultant, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Consultant.

1.20 AIR SYSTEMS

- .1 Standard: TAB standards of AABC
- .2 Do TAB of systems, equipment, components, and controls specified in Division 23 including, but not limited to the following measurements:
 - .1 Air Velocity
 - .2 Static pressure
 - .3 Velocity pressure
 - .4 Temperature

- .5 Cross Sectional Area
- .6 RPM
- .7 Election power
 - .1 Voltage
 - .2 Current draw.
- .8 Location of equipment measurements:
 - .1 Inlet and outlet of each:
 - .1 Fan
 - .2 Coil
 - .3 Filter
 - .4 Damper
 - .5 Other auxiliary equipment
- .3 Qualifications: personnel performing TAB current member in good standing of AABC and NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC and NEBB.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL
- .3 Section 23 31 13.01 METAL DUCTS - LOW PRESSURE TO 500 PA.

1.2 REFERENCES

- .1 Definitions:
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
 - .5 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .6 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

- .9 ASTM C1136-12 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- .10 ASTM C1290-11, Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC ducts.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/GSB 51.10-92, Mineral Fibre Board Thermal Insulation.
 - .3 CAN/CGSB 51.11-92, Mineral Fibre Blanket Thermal Insulation.
- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.
- .3 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: as specified, includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre duct board to ASTM C612 and CGSB 51-GP-10M, minimum R value R4 per inch. Plastic corner bead glued and taped with metallic tape on all corner and edges for mechanical room ducts, plenums and exposed ductwork. Insulation with FSK facing to ASTM A1136 and factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section). Cover all exposed plenum and duct insulation from exterior to equipment with 1577CW aluminium Venture Clad Jacketing system.
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 ACCESSORIES

- .1 Tape: self adhesive, 100 mm wide, aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - .1 Acceptable Manufacturer (or approved equal):
 - .1 Fattal Insultape by S. Fattal Canvas Inc.
- .2 Contact adhesive: quick-setting
 - .1 Asbestos free
 - .2 5m²/L
 - .3 Acceptable Manufacturer (or approved equal):
 - .1 Armstrong 520

- .2 Childers CP.82
 - .3 Forster 85-20
 - .3 Lap Seal adhesive: quick-setting for joints and lap sealing of vapour barriers, water based, fire retardant type, compatible with insulation.
 - .1 Asbestos Free
 - .2 6 m²/L
 - .3 Acceptable Manufacturer (or approved equal):
 - .1 Childers CP.80
 - .2 Forster 85-75
 - .4 Pins.
 - .1 Weld pins 4 mm diameter, with 35 mm diameter head for installation through insulation. Length to suit thickness of insulation.
 - .2 Acceptable Manufacturer (or approved equal):
 - .1 Duro Dyne
 - .2 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 Manufacturer (or approved equal):
 - .1 Duro Dyne spotter pins with spotter clips or stop clips as required
 - .5 Stick on pins will not be accepted.

2.4 JACKETS

- .1 Aluminum:
 - .1 Apply in exposed areas on rigid duct insulation: Venture Clad 1577 CW.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B

- .3 Apply materials in accordance with manufacturer's instructions and as indicated.
- .4 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .6 Hangers and supports in accordance with Section 22 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .7 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.
- .8 Use stand-offs for duct mounted control accessories.
- .9 Apply 1mm thick galvanized sheet metal corners to ductwork in mechanical rooms.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: conform to following table:

air ducts	TIAC Code	Vapour Retarder	Thickness (mm)
Fresh air intake plenum and duct	C-1	yes	50
Exhaust air	C-1	yes	50

- .1 Finishes: conform to following table:

TIAC Code		
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed	CRF/1	CRD/2

3.5 CLEANING

- .1 Clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL
- .3 Section 23 07 13 - DUCT INSULATION.
- .4 Section 23 33 00 - AIR DUCT ACCESSORIES.
- .5 Section 23 33 15 - DAMPERS - OPERATING
- .6 Section 23 37 20 - LOUVRES, INTAKES AND VENTS.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
 - .1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

- .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports:
 - .1 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.
 - .2 Construction IAQ Management Plan:
 - .1 Submit Indoor Air Quality (IAQ) Plan for construction pre-occupancy phases of building.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance Section 20 05 01 – Common Work Results for Mechanical and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

- .2 Seal classification:
 - .1 Class C: transverse joints and connections made airtight with gaskets, sealant tape, or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Seal all ductwork
- .2 Sealant: water soluble, flexible, nontoxic. Sealant to be used with woven fabric tape. Temperature range of minus 20 degrees C to plus 93 degrees C.
- .3 Maximum flame spread rating: 25
- .4 Smoke development rating: 50
- .5 Solvent based sealant will not be accepted.
- .6 Duct tape will not be accepted as primary sealant.
- .7 Acceptable Manufacturer (or approved equal).
 - .1 Transcontinental multipurpose
 - .2 United Metal Unigrip

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
- .2 Acceptable Manufacturer (or approved equal).
 - .1 Duro Dyne FT-2

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to ASHRAE and SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: centreline radius: 1.5 times width of duct.
 - .2 Round: centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.

- .6 Offsets:
 - .1 Short radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.6 ALUMINUM

- .1 Used for plenums only.
- .2 To ASHRAE and SMACNA. Aluminum type: 3003-H-14.
- .3 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA or as indicated.
- .4 Joints: to ASHRAE and SMACNA be continuous weld. Seal all joints on the inside.
- .5 Slope horizontal branch ductwork down towards drain in air handler. Slope header ducts down toward risers.
- .6 Fit base of risers with 150 mm deep drain sump and 32 mm drain connection, with deep seal trap and drain line to open funnel drain.

2.7 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 22 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to ASHRAE and SMACNA.
 - .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE, SMACNA and the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 820, ASHRAE, SMACNA, and as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct and ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE and SMACNA and as indicated.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install fire dampers and fire stop flaps to NFPA 90A
- .6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .7 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining where indicated.
- .8 Install balancing dampers at all branch ducts and as indicated.
- .9 Mount dampers according to damper manufacturer's recommendations.
- .10 At completion of project dents in exposed ductwork will not be accepted. Dented ductwork will result in the entire length being replaced by this contractor.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing in accordance with ASHRAE SMACNA as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.4 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake;
 - .2 Plenums;
 - .3 Exterior ductwork system;
 - .4 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Weld joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards fume hoods served.
 - .1 Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve trap primer and discharging to open funnel drain or as indicated.

3.5 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA to manufacturer's recommendations.
- .2 All duct joints to be sealed with duct sealant and porous tape imbedded in sealant.
- .3 Bed tape in sealant and recoat with minimum of 2 coat of sealant to manufacturers recommendations.
- .4 Duct tape will not be accepted.
- .5 Do not insulate duct until sealant work is approved by Consultant.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 20 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 20 05 01 – Common Work Results for Mechanical.
- .3 Section 23 31 13 – Metal Ducts – Low Pressure to 500 PA.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
 - .5 Dampers

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 20 05 01 – Common Work Results for Mechanical with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 2 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².
 - .2 Material shall meet NFPA 90A and 90B and have a maximum flame spread index of 25 and a maximum smoke developed index of 50.
 - .3 Maximum 10" length of fabric.
- .3 Acceptable Material (or approved equal)
 - .1 Duro-Dyne

2.3 MULTI-BLADED BALANCING DAMPERS

- .1 Install in rectangular/square duct mains.
- .2 Factory manufactured of material compatible with duct.
- .3 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .4 Maximum blade height: as indicated 100 mm.
- .5 Bearings: pin in bronze bushings or self-lubricating nylon.
- .6 Linkage: shaft extension with locking quadrant.
- .7 Channel frame of same material as adjacent duct, complete with angle stop.
- .8 Maximum leakage: 2 % at 1000 Pa.

2.4 GAS DETECTION SYSTEM FOR H₂S/CH₄

- .1 Methane and Hydrogen Sulphide Detection System for Waste Water Treatment Plant Application.
 - .1 Supply a multi-channel, gas detection system controller, **model CGAS-SC-2RS**, for the monitoring of Methane (CH₄) and Hydrogen Sulphide (H₂S) gases, housed in a rugged, water / dust tight, corrosion resistant polycarbonate enclosure with hinged, secured door. System power shall be 115 VAC nominal. The system shall have three analog inputs to accommodate up to three (3) remote mount, explosion-proof, sensor transmitters. Area of monitoring coverage is up to 3,000 - 5,000 square feet per sensor. When installing the gas detection controller it must be fitted with proper liquid tight conduit hubs to prevent water ingress into the junction box wherever conduit enters the enclosure.

- .2 Supply a remote mount, combustible gas sensor transmitter model **ESH-A-CCH4-100** for the monitoring of Methane gas over a range of 0 - 100% LEL. The transmitters shall be housed in cast aluminum, explosion-proof, weather-proof junction box with threaded, secured caps. The remote sensor transmitter shall connect to the controller with 3-conductor, 16 - 18 gauge shielded wire in conduit. Installation height for the combustible sensor is on or near the ceiling. Methane gas is lighter than air. Transmitters installed in the hazardous area must be installed as per local electrical code requirements for wire, conduit and electronics in hazardous areas. Transmitters must be fitted with proper liquid tight conduit hubs to prevent water ingress into the junction box.
- .3 Supply a remote mount, toxic gas sensor transmitter model **CXT-A-H2S** for the monitoring of Hydrogen Sulphide gas over a range of 0 – 500 ppm. The transmitter shall be housed in cast aluminum, explosion-proof, weather-proof junction box with threaded, secured caps. The remote sensor transmitter shall connect to the controller with 3-conductor, 16 - 18 gauge shielded wire in conduit. Installation height for the toxic gas sensor is 4 – 6 feet AFF. Transmitters installed in the hazardous area must be installed as per local electrical code requirements for wire, conduit and electronics in hazardous areas. Transmitters must be fitted with proper liquid tight conduit hubs to prevent water ingress into the junction box.
- .4 Supply a strobe light to be used as remote warning device outside the facility. The strobe alarm device shall be powered by and controlled (switched on and off) by the gas detection system to include a “Strobe” output and be weather proof for outdoor installation.
 - .1 Supply and install signage at the strobe alarm. Sun and weather resistant lamacoid, 11"x17". "DO NOT ENTER IF RED STROBE LIGHT IS FLASHING, HAZARDOUS ATMOSPHERE OR REDUCED OXYGEN MAY CAUSE ASPHYXIATION OR EXPLOSION". Refer to CSA and Worksafe standard signage.
- .5 The gas detection controller shall provide a LCD digital display for real time indications of gas values, including alarm status low ,medium and high, and fault for any channel. 4-20mA inputs and outputs. Two (2) alarm relays, each rated 5 A at 240 VAC. The system must be accurate enough to measure to government workplace hazardous gas exposure standards. The system shall also provide field adjustable time delays for “delays on make” and “delays on break” for each sensor to allow custom configuration of ventilation control by the system relays, if desired.
- .6 The controller shall provide a circuit test code to allow the user to confirm system operation and alarm and exhaust fan control from the panel. Installation height for the controller is 5 - 6 ft from the floor.
- .7 **System operation shall be as follows:**

- .1 System relays are normally energized in non-gas-alarm state so they act in fail-safe operation. Relay control is picked up from "N/C and "COM" relay wiring terminals of the controller.
- .2 Upon detection of 10% LEL CH₄ or 10 ppm of H₂S in air the system shall illuminate the Low alarm LED (amber) and the low gas alarm relay shall activate the ventilation system through the building's PLC.
- .3 Upon detection of 20% LEL CH₄ or 15 ppm of H₂S in air the system shall illuminate the HIGH alarm LED (red), the PDC's audible alarm and the HIGH gas alarm relay shall de-energize activating the remote strobe light and the ventilation system shall continue to operate through the building's PLC.
- .4 The local audible alarm can be silenced from the front panel push button. In the event of a fail condition, the local audible alarm shall be activated, the fail LED on the front panel shall illuminate red and the remote strobe light shall be activated.
- .5 The contractor shall provide all wiring, conduit and interconnection required under local electrical codes for a successful installation. System shall be tested and commissioned after installation by CETCI authorized dealer representative, with a report provided after the site visit.
- .8 Supply and install all necessary conduit and wiring for the above equipment for power and control, including the output relay contact to the strobe light and the SCADA monitoring system in accordance within the general project specifications.
- .9 Provide Verification of gas detection system with test gas kit.
- .10 Acceptable Manufacturers (or approved equal):
 - .1 Critical Environment Technologies Canada Inc (Standard of Acceptance)
 - .2 Mine Safety Appliances Company
 - .3 RKI Instruments
 - .4 Vulcain
 - .5 Honeywell

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 20 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 23 33 00 - AIR DUCT ACCESSORIES
- .3 Section 23 37 20 - LOUVRES, INTAKES AND VENTS.
- .4 Section 23 31 13.01 - METAL DUCTS - LOW PRESSURE TO 500 PA

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 20 05 01 – Common Work Results for Mechanical with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section

Part 2 Products

2.1 MOTORIZED DAMPERS

- .1 Size limitations:
 - .1 Blades maximum 150 mm wide and 1200 mm long.
 - .2 Modular maximum 1200 mm wide and 2400 mm high.
 - .3 Multiple sections with stiffening mullion and jack shafts
- .2 Materials:
 - .1 Frame: Extruded aluminum.
 - .2 Blades: two sheets 0.8 mm thick or 1.6 mm thick extruded aluminum (Air Foil Cross Section).
 - .3 Bearings: Celcan inner bearing fixed to 11.11 mm aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in frame. Provide additional thrust bearings for vertical blades.
 - .4 Linkage: zinc plated steel.
 - .5 Seals: Blade Gasket - extruded EPDM. Frame
 - .6 Seals - Extruded TPE. Gaskets secured in an integral slot within aluminum extrusion.
 - .7 Internally insulated blades with expanded polyurethane foam and thermally broke. Complete blade insulation of R-2.29 and temperature index of 55.
- .3 Performance characteristics:
 - .1 15.2 L/s per m² maximum allowable leakage against 1.0 kPa static pressure.
 - .2 Temperature range minus 40C to 90C
- .4 Actuators
 - .1 Dampers complete with electric actuators and end switches where required. Actuators shall be Belimo AF24 series.
- .5 Acceptable Manufacturers (or approved equal):
 - .1 Tamco
 - .2 Alumavent
 - .3 Ventex
 - .4 Ruskin

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 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.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 20 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL
- .3 Section 23 31 13.01 - METAL DUCTS - LOW PRESSURE TO 500 PA
- .4 Section 23 33 15 – DAMPERS - OPERATING

1.2 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2010, Standards Handbook.
 - .2 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18, Primer, Zinc Rich, Organic.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in New Brunswick, Canada.
 - .2 Provide:
 - .1 Fan performance curves showing point of operation, bhp, kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with 2 speed motor.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Provide:
 - .1 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 20 05 01 – Common Work Results for Mechanical with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 WALL EXHAUST FAN

- .1 Aluminum wall exhaust style housing with backward-inclined aluminum wheel, wall cap, corrosion-resistant fasteners, lifting lugs, NEMA-1 toggle disconnect switch wired in junction box, with drain through, and birdscreen.
- .2 Fan shaft shall be mounted in ball bearing pillow blocks. Motor shall be ODP-type high efficiency.
- .3 Electrics: Refer to Schedule on drawings
- .4 Performance: Refer to Schedule on drawings
- .5 Acceptable Material (or approved equal.). Also refer to schedule on drawings:
 - .1 Greenheck CW series
 - .2 PENN
 - .3 ACME
 - .4 Soler & Palau
 - .5 Loren Cook
 - .6 Twin City Fan
 - .7 Approved Equal

Part 3 ExecutionExecution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings. flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Bearings and extension tubes to be easily accessible.
- .3 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 20 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – PAYMENT PROCEDURES
- .2 Section 20 05 01 – COMMON WORK RESULTS FOR MECHANICAL
- .3 section 23 31 13.01 – METAL DUCTS - LOW PRESSURE TO 500 PA.
- .4 Section 23 33 15 – DAMPERS

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 20 05 01 – Common Work Results for Mechanical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 20 05 01 – Common Work Results for Mechanical with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 DRAINABLE FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Size: 152.4 mm deep and dimensions as indicated
- .3 Blades and frames: Shall be 0.081-inch (2.0 mm) thick extruded aluminum, alloy 6063-T5. Blades shall be stationary, incorporate drainable gutters, and be spaced 4-1/2-inches (114.3 mm) on center. Jamb frames shall incorporate drainable gutters to ensure resistance to water penetration.
- .4 Material: extruded aluminum alloy 6063-T5
- .5 Mullions: quantity as per manufacturers instruction.
- .6 WELDED ASSEMBLY: Join stationary blade, head, sill and jamb frames with fillet welds concealed from view, unless the size of the louver makes screwed connections between louver sections necessary. Louver blades shall be joined to each jamb frame with fillet welds produced with the Pulsed Gas Metal Arc Welding (GMAW/ Mig) process
- .7 STRUCTURAL SUPPORT: Manufacturer shall design and furnish all supports required to withstand a wind force of not less than 1.2 kPa. Louvers 1,800 mm wide x 3,600 mm high or 3,600 mm wide x 1,800 mm high will be fabricated and installed in multiple sections. Louver blades, frames, mullions and anchorages shall be demonstrated to withstand the specified wind design load
- .8 Screens:
- .1 Bird screen and insect in coil aluminum frame
- .9 Finish: Baked Enamel Finish
- .10 Colour: to Consultant's approval.
- .11 Performance ratings:
- .1 Free area: 0.8 m²
- .2 Minimum free area velocity at beginning of point of water penetration: 6.35 m/s
- .3 Minimum air volume flow rate at beginning point of water penetration: 5.06 m³/s
- .4 Maximum static pressure at beginning point of water penetration: 0.045 kPa
- .12 Acceptable Manufacturer (or approved equal):
- .1 E.H. Price DE635
- .2 Airolite
- .3 Ventex

- .4 Alumavent
- .5 Ruskin

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 20 05 01 – Common Work Results for Mechanical.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 20 05 01 – Common Work Results for Mechanical.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CSA C22.2 No.41-07, Grounding and Bonding Equipment.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper compression connectors to CSA C22.2 as required sized for conductors.
- .2 Bolt-on style connectors are not permitted.

Part 3 Execution

3.1 INSTALLATION

- .1 Install, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.
- .3 Do not install more than three (3) connections per junction box unless specifically permitted by Consultant (in writing).

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 Payment Procedures
- .2 Section 26 05 00 Common Work Results for Electrical

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Insulated grounding conductors: green, copper conductors, size as indicated.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .4 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 Compression style conductor connectors.
 - .4 Thermite welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

2.2 COPPER-BONDED GROUNDING RODS

- .1 High carbon steel core and tip
- .2 Copper coating, minimum coating of 10mils, UL 467
- .3 Each rod to have certifications roll-stamped
- .4 19 mm diameter by minimum 3 m long.
- .5 Acceptable Material: nVent or approved alternate

2.3 EXOTHERMIC WELDING

- .1 Contractor shall purchase new moulds for the project for all various configurations of conductors and bus assemblies.
- .2 Contractor shall follow manufacturer recommendations for exothermic weld process and provide photos of each side of each weld joint.
- .3 Each weld joint shall be evaluated by the engineer, if weld joint is found unacceptable by industry standards, the conductor and bus shall be replaced with new. A weld joint may be deemed unacceptable for the following conditions but not limited to:
 - .1 Excessive heat marks on conductors or busing
 - .2 Spilling of weld material out of mould
 - .3 Porous weld due to water.
 - .4 Carbon traces from oil contamination
 - .5 Low fill.
 - .6 Including all molds, consumables and compounds.
- .4 Acceptable exothermic welding system by Burndy and Erico

2.4 GROUNDING BUS BAR

- .1 Material: Solid Copper
- .2 Physical Attribute – Number of Holes: 0
- .3 Dimensions: As per drawings
- .4 Acceptable Manufacturer: Burndy BBB4XXUD series

2.5 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Run ground wire in conduit where indicated.
- .2 Top of ground rod to be 1m from finished surface.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermite process connections.
- .6 All connections to ground buses shall be by thermite weld or permanent crimp.
- .7 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .8 Soldered joints not permitted.
- .9 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solder less lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .10 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .11 Connect building structural steel and metal siding to ground by welding copper to steel.
- .12 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .13 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end and load end.

- .14 Circuits being extended by new junction box or connection into a new panelboard shall be c/w bonding bushing and #12 conductor to panel board bond bar.

3.2 ELECTRODES

- .1 Install rod electrodes and make grounding connections as indicated.
- .2 Bond separate, multiple electrodes together.
- .3 Use size copper conductors for connections to electrodes, sized as indicated.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.4 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size as indicated.

3.5 GROUND GRID

- .1 Drive three -19 mm diameter x 3 m copper clad ground rods at least 3 m apart in original undisturbed ground. If rods will not penetrate permafrost, drive at angle not more than 60 degrees from vertical, and in same direction. Rods must be driven, not trenched.
- .2 Install ground wire from service neutral bar to rods and where buried use bare copper not smaller than size #1/0 AWG stranded and at least 640 mm below ground. Bond ground conductor, or short tap from it, to outside metal sheathing of building close to power service conduit. Use lug or cast clamp, with bronze or plated bolt, nut and washers (not sheet metal screw or wood screw). Remove paint from sheathing for good contact. Conduit is required only on outside wall of building. Indoors, run bare and fasten as specified for equipotential bonding wire.
- .3 Install electrode interconnections where metal parts, circuits or grounding conductors and/or electrodes are in proximity to lightning rod conductors.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Specification.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results - Electrical.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41mm, 2.5mm thick, surface mounted or suspended as indicated.

2.2 UNI STRUT

- .1 Hot dipped galvanized type;
- .2 All fittings shall be fabricated from steel conforming to ASTM specifications;
- .3 Structural grade steel conforming to ASTM specifications;
- .4 All fittings and supports shall match main Unistrut channel and be of same make.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 53 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 53 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 10mm dia. minimum threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Do not support conduit from other conduit.
- .15 Set strut system components into final position true to line, level and plumb, in accordance.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-21, Canadian Electrical Code, 2021, Part 1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Interior junction and pull boxes shall be NEMA 3R PVC.
- .2 Covers Flush Mounted: 27mm minimum extension all around, screw-on flat cover.
- .3 Covers Surface Mounted: screw-on turned edge covers

2.2 CABINETS

- .1 Construction: NEMA 3R PVC hinged door, handle, latch lock 2 keys and catch.
- .2 Type E Empty: flush overlapping sides mounting as indicated.
- .3 Type T Terminal: flush overlapping sides mounting as indicated containing 19mm G1S plywood backboard.

2.3 EXPLOSION PROOF JUNCTION BOXES

- .1 Exterior junction and pull boxes for control cables shall be explosion proof NEMA 4X 304 stainless steel, single door, enclosures with hinged cover, door latch, and inner panel.

- .2 Provide 600V, CSA rated DIN rail mounted terminal blocks as required;
- .3 Size as required to for cabling and connections.
- .4 Acceptable Manufacturers: Eaton Crousse Hinds "EJB" Series.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install pull boxes so as not to exceed 30 m of conduit run or 2-90° bends between pull boxes.
- .4 Maximum three (3) connections per junction box unless explicitly permitted by Engineer
- .5 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.
- .6 All underground boxes shall be flush with final grade, provide suitable drainage to avoid water build up.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-21, Canadian Electrical Code, 2021, Part 1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1-21.
- .2 103 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 51 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted PVC conduit, minimum size 102 x 54 x 48mm.
- .3 102mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 CONDUIT BOXES

- .1 PVC FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.4 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.5 IDENTIFICATION

- .1 All boxes installed on ceilings shall have their covers color coded, as described in these specifications.

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 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 Provide correct size of openings in boxes for conduit connections. Reducing washers are not allowed.
- .4 All boxes shall be installed recessed/flush unless indicated otherwise.
- .5 Install all outlet boxes in exterior walls with flexible vapour barrier and seal with caulking.
- .6 Vacuum clean interior of device boxes before installation of devices.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
- .2 CAN/CSA C22.2 No. 18.3 Conduit, Tubing and Cable Fittings.
- .3 CSA C22.2 No. 56 Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M Electrical Metallic Tubing.
- .5 CAN/CSA C22.2 No. 18.1 Metallic Outlet Boxes.
- .6 CAN/CSA C22.2 No. 18.4 Hardware for the Support of Conduit, Tubing and Cable.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 CONDUITS

- .1 Galvanized Steel conduit: to CSA C22.2 No. 45
- .2 OCAL conduit: to CSA C22.2 No.56-17

- .3 Rigid PVC conduit: to CSA C22.2 No. 211.2
 - .1 Use of DB2 conduit shall not be permitted.
- .4 Conduit and liquid-tight flexible conduit, complete with anti-short bushings: to CSA C22.2 No. 56-04, steel and liquid-tight flexible metal.
- .5 21mm and larger conduit only approved. Use of smaller conduit requires special approval from Engineer

2.2 CONDUIT FASTENINGS

- .1 Two hole PVC straps for conduits larger than 53mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5m on centre.
- .4 Hot dipped galvanized threaded rods, 6mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit. To CAN/CSA C22.2 No. 18, Manufactured for use with conduit specified.
- .2 Ensure factory "ells" where 90 degrees bends for 27 mm and larger conduits.
- .3 Connections for liquid tight flexible conduit shall be watertight compression type galvanized steel

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for minimum 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 EYS FITTINGS

- .1 Minimum turning radius.
- .2 Integral bushing in conduit hubs to protect conductor insulation from damage.
- .3 Taper-tapped hubs to ensure ground continuity.
- .4 Vertical female fitting.

2.6 FISH CORD

- .1 Polypropylene. With lengths of cord indicated.

2.7 SEALANT

- .1 Conduits entering any wall from the exterior shall be sealed internally and externally.
- .2 Internal sealant acceptable product:

- .1 Hydra-seal S60 or approved alternate
- .3 External sealant acceptable product:
 - .1 Link Seal "ES" Series or approved alternate

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 The Contractor is responsible to confirm conduit entry points on all equipment and route conduit as required to enter equipment in the manufacturer designated areas. This includes changing from under slab routing to above routing and associated cost with this.
- .3 The Contractor is responsible to have areas with under slab conduits surveyed and route conduits as required for the exact equipment approved during shop drawings. Any rework or removal of concrete slabs due to uncoordinated work shall be the responsibility of the contractor at no additional cost to the contract.
- .4 Surface mount conduits unless otherwise noted.
- .5 All underground or in concrete conduit to be PVC.
- .6 Keep conduit as high as possible
- .7 Support of electrical systems raceway shall be independent of any type of suspended ceiling support rods, wires, etc. and mechanical piping or duct systems.
- .8 Liquid Tight Flexible Conduit:
 - .1 Use liquid tight flexible metal conduit shall be only for connections in wet environments. Include a separate ground wire. Liquid tight flexible metal conduit length shall not exceed 1.5m for connection to equipment, support liquid tight flexible metal conduit 300mm from junction box.
 - .2 Liquid tight flexible conduit shall not be run in enclosed walls.
- .9 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .10 Minimum conduit size for lighting and power circuits: 21 mm.
- .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Install fish cord in empty conduits. Fish cord to have lengths indicated on them.
- .13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.

- .15 Maximum spacing between supports as follows:
 - .1 1 m for 21 mm trade size conduit and smaller.
 - .2 1.5 m for 27 mm to 35 mm trade size conduit.
 - .3 2 m for 41 mm trade size and larger.
- .16 Conduit not to be installed horizontally on walls.
- .17 Conduit to be off set 51mm (2") min from metal decking/roofing
- .18 Conduit not to be installed on floors, all conduit to be installed over head. Conduit needing to be installed to equipment within open room with high ceilings, to be installed on Unistrut structure as required to feed equipment. Head room to be clear to 8 feet.
- .19 Conduit sealing shall be done in accordance with CEC section 6 and 22.
- .20 Sufficient drainage to prevent water and moisture build-up.
- .21 Installed in such a way to prevent water from entering building.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on suspended or surface channels.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 76 mm parallel to steam or hot water lines with minimum of 27mm at crossovers.
- .6 Do not run conduits on underside of roofs/steel decking, conduits shall be spaced a minimum of 150mm from roof decking.

3.4 CAST IN PLACE AND BELOW SLAB CONDUITS

- .1 Conduits shall be installed on a minimum 50mm bed of sand and all rocks in the area shall be removed.

3.5 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 Common Work Results for Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.47-M90(R2007), Air-Cooled Transformers (Dry Type).
 - .2 CSA C9 Dry-Type Transformers.
 - .3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN DESCRIPTION

- .1 Transformer:
 - .1 Type: ANN.
 - .2 K4 rated or as indicated on drawings
 - .3 3 phase, as indicated, 600V primary, secondary as indicated on drawings, 60 Hz.
 - .4 Voltage taps: standard.
 - .5 Insulation: 150 degrees C temperature rise.
 - .6 Insulation: 220 degrees C temperature class
 - .7 Efficiency as per CSA C802.2.
 - .8 Basic Impulse Level (BIL): standard.
 - .9 Hipot: standard.
 - .10 Average sound level: standard
 - .11 Impedance at 170 degrees C: standard
 - .12 Enclosure: NEMA 3R, removable metal front panel and drip hood.
 - .13 Mounting: floor or wall.
 - .14 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .15 Copper windings.
 - .16 Winding configuration to be as noted on drawings.
 - .17 Voltage Regulation to be 4% or better.
 - .18 Vibration isolation pads
 - .19 Voltage connections to be coordinate with drawings to allow accessibility.
- .2 Acceptable Manufacturers: Delta, Hammond Power Solutions, Rex Power Magnetics or approved equivalent.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 8.
- .3 Nameplate wording as per drawings

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for dry type transformers installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Mount dry type transformers as indicated.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections in accordance with wiring diagram.
- .7 Energize transformers after installation is complete.
- .8 Make conduit entry into bottom 1/3 of transformer enclosure or as required by manufacturer.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29–M Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .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.
 - .3 All provisional space shall be fully bussed and breaker ready.
- .2 600V and 250V panelboards: bus and breakers (symmetrical) interrupting capacity as per drawings.
- .3 Allow for 25% space in all types of panelboards for future growth.
- .4 Enclosure to be:
 - .1 NEMA 1 rated for Blower Building.
 - .2 NEMA 3R rated for UV Building.
- .5 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.
- .6 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .7 Two keys for each panelboard and key panelboards alike. Turn over keys to building Owner.
- .8 Copper bus with neutral of same ampere rating of mains, unless noted otherwise.
- .9 Mains: suitable for bolt-on / bolt to bus breakers.
- .10 Trim with concealed front bolts and hinges.
- .11 Trim and door finish: baked enamel.
- .12 Copper ground bus.
- .13 Surface mounted panelboards shall have drip cover
- .14 Complete with main breakers where indicated.
- .15 Electrical Distribution to be one manufacturer throughout entire project.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Thermal, magnetic or electronic tripping as required by indicated rating, manufacturer's equipment selection and coordination study.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.

- .5 Lock-on devices for fire alarm, door supervisory, intercom, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 8 engraved as indicated on drawings.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

2.4 FINISHES

- .1 Exterior Factory powder coated as per color requirements in section 26 05 00 (Color noted in primary column of conduit identification matching voltage of equipment.)
- .2 Supply 2 spray cans touch up paint.

2.5 ACCEPTABLE MANUFACTURERS

- .1 Acceptable manufacturer:
 - .1 Eaton
 - .2 Schneider
 - .3 Siemens

2.6 MANUFACTURER

- .1 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant.
- .2 Contractor shall be responsible for alternate products physical dimensions to ensure fitment at final install location. Installation shall follow all CEC requirements.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on fire rated plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.

- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Provide new updated panel directories for existing panels.

3.2 TESTS

- .1 Test each branch breaker to verify that it controls the load indicated on the drawing and panel directory.

3.3 CLEANING

- .1 The Contractor shall vacuum inside panelboards as required. At end of construction the interior of panelboards shall be clean.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SWITCHES

- .1 15A, 120 V, single pole switches as indicated.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Switches of one manufacturer throughout project.
- .4 Acceptable products:
 - .1 Toggle switch:
 - .1 Hubbell #HBL1201-W.
 - .2 Leviton #1201-2-W.
 - .3 Pass & Seymour #15ACI-W.
 - .4 Or approved equal by Eaton.
- .5 Each light switch shown on plans (new and existing) shall have the circuit number and supplying panelboard permanently identified. This identification shall be a mechanically attached lamicaid nameplate, and shall be visible when the coverplate is in place, and shall be in a position not likely to be painted over, and shall not be on the coverplate itself. Lamicaid shall be white in colour with black lettering.

2.2 RECEPTACLES

- .1 Duplex heavy duty receptacles, CSA type 5-15 R, 5-20R, 125 V, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 PVC weatherproof boxes with heavy duty while in use cover plates shall be used on the exterior of the building.
 - .7 Receptacles of one manufacturer throughout project.
 - .8 Acceptable materials:
 - .1 5-15R: Hubbell #5262BW
 - .2 5-20R: Hubbell #5362BW
 - .3 Or approved equal by Leviton, Pass & Seymour and Eaton.

- .2 Each receptacle shown on plans (new and existing) shall have the circuit number and supplying panelboard permanently identified at the outlet. This identification shall be a lamicoid nameplate, mechanically attached and shall be visible when the receptacle coverplate is in place, and shall be in a position not likely to be painted over, and shall not be on the coverplate itself.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Coverplates from one manufacturer throughout project.
- .3 Stainless steel cover plates for wiring devices mounted in surface-mounted FS or FD PVC type conduit boxes.
- .4 Weatherproof while in use coverplates shall be cast aluminium, Nema 3R, Extra Duty rated, lockable type. Acceptable product:
 - .1 Hubbel #WP26E
 - .2 Or approved Equal by Pass and Seymour.
 - .3 Or approved Equal by Leviton.

2.4 ELECTRONIC TIME CLOCK

- .1 7 day electronic programmable astronomic time switch
- .2 Enclosure: Type 3R gray painted plastic c/w see-through door.
- .3 Input voltage : 120VAC
- .4 Automatic daylight saving time (on/off)
- .5 Minimum 28 on, 28 off set points/events
- .6 4 astronomic events
- .7 Contact rating : 30A @ 120VAC
- .8 2 - NO contact
- .9 Acceptable material: Intermatic ET2000 series or approved equal

2.5 CAMLOCK

- .1 304 Stainless Steel construction.
- .2 NEMA 3R rated
- .3 Color coded camlock receptacles with angled camlock plate.
- .4 Bottom access door.
- .5 304 Stainless Steel door with pad-lock compatible handle.
- .6 600V, 200A rated
- .7 Five (5) wire lug configuration
- .8 Acceptable manufacturer: FOXFAB #FFCC-C1-200-C4-G-304-LA

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
 - .4 Supply box extenders as required for wall construction and finishes, confirm wall types with architectural plans and specifications.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.
 - .3 All receptacles shall be installed with the "U" ground at the top.
 - .4 All receptacles mounted horizontal shall be oriented with ground to the left.
 - .5 Supply box extenders as required for wall construction and finishes, confirm wall types with architectural plans and specifications.
- .3 Cover plates:
 - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .4 Switches and/or receptacles fed by different systems (normal versus essential) shall not be installed in same box.

3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

Neqotkuk
Upgrade of Neqotkuk
Wastewater Treatment Facility
Neqotkuk, NB

WIRING DEVICES

Section 26 27 26
Page 5 of 5
April 2025
Project No. 2308072.001

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results - Electrical.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 EXTRA MATERIALS

- .1 Provide three spare fuses of each type and size installed.

Part 2 Products

2.1 FUSES - GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

- .2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 1 copy of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Consultant for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Consultant. Unless complying with this requirement, Consultant reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

- .3 Contractor's name and address and person responsible for project.
- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title:
 - .2 End user's reference number:
 - .3 List of circuit breakers:

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Circuit breakers to have minimum symmetrical RMS interrupting capacity rating as indicated on drawings.
- .5 Thermal, magnetic or electronic tripping as required by indicated rating, manufacturer's equipment selection and coordination study.
- .6 Contractor to coordinate breaker sizes between panel legends and documents and notify Consultant of differences prior to submitting Shop Drawings.

2.2 GFCI BREAKERS

- .1 Ground fault circuit interrupter (GFCI) breakers to CAN/CSA-C22.2 No. 144, Class "A" Type.
- .2 Single pole GFCI breakers, rated as noted c/w test and reset functions.

2.3 ACCEPTABLE MATERIALS

- .1 Breakers shall be compatible with panelboards specified in the “Panelboards Breaker Type” Section and shall meet the short circuit interrupting ratings as indicated.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 - Common Requirements - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-C22.2 No.144.1-06, Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA):
 - .1 NEMA PG 2.2-1999, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144 NEMA PG 2.2.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 RECEPTACLE

- .1 Self-contained ground fault protector unit with 15 A, 120V (or 20A where noted) circuit interrupter and grounded duplex receptacle complete with:
 - .1 Test and Reset feature.
 - .2 Solid state ground sensing device.
 - .3 Flush mounted with white nylon face plate.
 - .4 Tamper proof where indicated.
 - .5 Indicator light.

- .2 Receptacles of one manufacturer throughout project.
- .3 Acceptable product:
 - .1 5-15R: Hubbell #GFSG5262W
 - .2 5-20R: Hubbell #GFSG5362W
 - .3 Or approved equal by Leviton or Pass & Seymour.
- .4 Each receptacle shown on plans (new and existing) shall have the circuit number and supplying panelboard permanently identified at the outlet. This identification shall be a lamicoid nameplate, mechanically attached and shall be visible when the receptacle coverplate is in place, and shall be in a position not likely to be painted over, and shall not be on the coverplate itself.

Part 3 Execution

3.1 INSTALLATION

- .1 Neutral must not be grounded on load side of ground fault relay.
- .2 Phase conductors and neutral must pass through zero sequence transformers.
- .3 Use GFI breakers for circuits where shown.
- .4 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Requirements - Electrical and co-ordinate with Division 01- General Requirements.
- .2 Demonstrate simulated ground fault tests.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
- .2 Leave Work area clean at end of each day.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.

Neqotkuk
Upgrade of Neqotkuk
Wastewater Treatment Facility
Neqotkuk, NB

GROUND FAULT CIRCUIT
INTERRUPTERS – CLASS ‘A’

Section 26 28 20
Page 3 of 3
April 2025
Project No. 2308072.001

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 Payment Procedures
- .2 Section 26 05 00 Common Work Results for Electrical.

1.2 REFERENCES

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4 Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162 and UL 98).
 - .2 CSA C22.2 No.39-13, Fuse holder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible, single & double throw, Non-fusible, heavy duty, Horsepower rated disconnect switch in CSA enclosure , to CAN/CSA-C22.2 No.4, size as indicated.
- .2 Provision for padlocking in off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.

- .4 Fuses: size as indicated, type manufacturers recommendations unless otherwise indicated.
- .5 Fuse holders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 Fused double throw as indicated.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Enclosure: Nema Type 3R or as indicated.
- .10 Acceptable Manufacturers: Eaton, Schneider.
- .1 Electrical Distribution to be one manufacturer throughout entire project.

2.2 SERVICE DISCONNECT

- .1 Provision for padlocking.
- .2 Service entrance rated.
- .3 Fusible switch in CSA enclosure.
- .4 Heavy duty single throw, fusible disconnect switches, current ratings and voltage as indicated on drawings.
- .5 Acceptable Manufacturer:
 - .1 Match power distribution manufacturer.

2.3 MANUAL TRANSFER SWITCH

- .1 Fusible, heavy duty, Rating as indicated, CSA enclosure to CAN/CSA-C22.2 No.4, size as indicated.
- .2 Provision for padlocking in on-off-on switch position by locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuse holders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- .5 Quick-make, quick-break action.
- .6 ON-OFF-ON switch positions indication on switch enclosure cover. Label positions as follows;
 - .1 ON – Normal Power.
 - .2 OFF – OFF.
 - .3 ON – Portable Generator Power.
- .7 NEMA 1 enclosure.
- .8 Acceptable Manufacturer:
 - .1 Match power distribution manufacturer.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 lamicoid nameplate.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.
 - .2 Inform Engineer 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 Engineer.

3.2 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Contractor to use factory knockouts where possible.
- .3 Disconnect to be labelled with circuit number and equipment tag/name

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 26.
- .2 Section 01 29 00 Payment Procedures.

1.2 REFERENCES

- .1 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000 (R2005) : Electromechanical contactors and motor-starters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results - Electrical.
 - .1 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with applicable specifications.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding packaging materials in accordance with applicable specifications.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to NEMA standard. IEC half size starters not acceptable.
- .2 Acceptable Manufacturers: Eaton, Schneider, ABB.
 - .1 Electrical Distribution to be one manufacturer throughout entire project

2.2 MANUAL MOTOR STARTER

- .1 Manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 Three overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
 - .1 Toggle: heavy duty labelled as indicated.
 - .2 Indicating light: heavy duty type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 VARIABLE FREQUENCY DRIVES

- .1 This specification describes the electrical, mechanical, environmental, and reliability requirements for three phase, variable frequency drives as specified herein and as shown on the contract drawings.
- .2 The variable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of IEC, UL, CUL, CSA, and NEMA.
- .3 When requested by the Engineer the following product information shall be submitted: Descriptive bulletins, product sheets, typical harmonic currents
- .4 Operation and maintenance manuals shall include the following information: Instruction books, recommended renewal parts list, drawings and installation information.
- .5 The VFD shall be rated for 600 Vac. The VFD shall provide microprocessor-based control for three-phase induction motors. The controller's full load output current rating shall be based on 50°C ambient and 10kHz switching frequency below 40Hp and 3.6 kHz switching frequently 40 Hp and above to reduce motor noise and avoid increased motor losses.
- .6 The VFD shall be of the Pulse width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output VIA a two-step operation. Adjustable Current Source VFDs are not acceptable. Insulated Gate Bipolar Transistors (IGBT's) shall be used in the inverter section. Bipolar Junction Transistors,

- GTO's or SCR's are not acceptable. The VFD shall self-protect against over-temperature operating conditions.
- .7 The VFD shall have an efficiency, at full load and speed, that exceeds 95% for VFD below 15Hp and 97% for drives 15Hp and above. The efficiency shall exceed 90% at 50% speed and load.
 - .8 The VFD shall maintain the line side displacement power factor at no less than 0.96, regardless of speed and load.
 - .9 The VFD shall have a one (1) minute overload current rating of 150% and a 2 (two) second overload current rating of 250%.
 - .10 The VFD shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with horsepower and current rating within the capacity of the VFD.
 - .11 The VFD shall have an integral EMI/RFI filter as standard.
 - .12 The VFD shall limit harmonic distortion reflected onto the utility system by utilizing the standard 3% nominal impedance integral ac three-phase line reactor.
 - .13 The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
 - .14 Standard operating conditions shall be:
 - .1 Incoming Power: Three-phase, 600 Vac (+10% to -15%) and 60Hz (+/- 5Hz) power to a fixed potential DC bus level.
 - .2 Frequency stability of +/- 0.05% for 24 hours with voltage regulation of +/- 1% of maximum rated output voltage.
 - .3 Speed regulation of +/- 0.5% of base speed.
 - .4 Load inertia dependant carryover (ride through) during utility loss.
 - .5 Insensitive to input line rotation.
 - .6 Humidity: 0 to 95% (non-condensing and non-corrosive).
 - .7 Altitude: 0 to 3,300 feet (1000 meters) above sea level.
 - .8 Ambient Temperature: -100C to 500C.
 - .9 Storage Temperature: -400C to 600C.
 - .15 Control Functions:
 - .1 Frequently accessed VFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VFD enclosure. The VFD shall have an alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, and particularly those that use alphanumeric codes and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.

- .2 The keypad shall include a Local/Remote pushbutton selection. Both start/stop source and speed reference shall be independently programmable for Keypad, Remote I/O, or Field Bus.
- .3 The keypad shall have copy / paste capability.
- .4 Upon initial power up of the VFD, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.
- .5 Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows TM based software. In addition the software shall permit control and monitoring via the VFD RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided.
- .6 The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information.
- .16 The operator shall be able to scroll through the keypad menu to choose between the following:
 - .1 Monitor
 - .2 Operate
 - .3 Parameter setup
 - .4 Actual parameter values
 - .5 Active faults
 - .6 Fault history
 - .7 LCD contrast adjustment
 - .8 Information to indicate the standard software and optional features software loaded.
- .17 The following setups and adjustments, at a minimum, are to be available.
 - .1 Start command from keypad, remote or communications port
 - .2 Speed command from keypad, remote or communications port
 - .3 Motor direction selection
 - .4 Maximum and minimum speed limits
 - .5 Acceleration and deceleration times, two settable ranges
 - .6 Critical frequency avoidance
 - .7 Torque limit
 - .8 Multiple attempt restart function
 - .9 Multiple preset speeds adjustment
 - .10 Catch a spinning motor start or normal start selection
 - .11 Programmable analog output
 - .12 DC brake current magnitude and time
 - .13 PID process controller
- .18 The VFD shall have the following system interfaces:

- .1 Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided.
- .2 Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided.
- .19 The VFD shall include the following protective features as a minimum: over-current, overvoltage, inverter fault, under-voltage, Input Phase loss, Output phase loss, under-temperature, over-temperature, Motor stalled, Motor over-temperature, Motor underload, Logic voltage failure, Microprocessor failure
- .20 The VFD shall provide ground fault protections during power-up, starting, and running. VFD's with no ground fault protection during running are not acceptable.
- .21 Diagnostic Features to include: Fault History, Record and log faults, Indicate the most recent first, and store up to 30 faults;
- .22 Communication card for interface with Ethernet IP control system.
- .23 The VFD enclosure shall be NEMA 1.
- .24 The VFD shall come complete with disconnecting means.
- .25 The VFD shall have complete front accessibility with easily removable assemblies.
- .26 Input Voltage: 600 volts, 3-phase, +10% to -15%.
- .27 Output rating as indicated for heavy duty application.
- .28 VFDs shall be wall mounted in the existing blower building.
- .29 Acceptable material: ABB ACQ-580 Series

2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 MANUFACTURER

- .1 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant.
- .2 Contractor shall be responsible for alternate products physical dimensions to ensure fitment at final install location. Installation shall follow all CEC requirements.

2.6 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.7 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 00 - Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.2 Description of System

- .1 Lighting system shall consist of specified light fixtures in the fixture schedule and shall include all associated frames, supports, hangers, spacers, stems, aligner canopies, junction boxes and other hardware for a complete and proper installation.
- .2 Catalogue numbers indicated in the fixture schedule are a luminaire design series reference and do not necessarily represent the exact catalogue number, size, voltage, wattage, type of lamp, driver, finish trim, ceiling type, mounting hardware or special requirements as specified or as required by the particular installation. Contractor shall provide complete luminaire to correspond with the features, accessories, number of lamps, wattage and/or size specified in the text description of each luminaire type. The Contractor shall notify the engineer of part number to text description discrepancies. The Contractor shall review the luminaire description and part number dimensions and verify the dimensions of the luminaires on the drawings, drawing luminaires dimensions shall govern. Additional features, accessories and options specified shall be included.
- .3 Recessed luminaires shall have frames that are compatible with the ceiling systems.
- .4 Luminaire voltage shall match the voltage of the circuit serving the luminaires.
- .5 If alternate acceptable manufacturer is selected by Contractor and shop drawings for alternate product are provided twice and rejected twice due to not meeting the specification, the contractor will provide complete lighting package that the lighting design is based on at no additional cost.

1.3 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, latest revision, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ASTM International Inc.
 - .1 ASTM F1137, latest revision, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
 - .2 ASTM A123/A123M, latest revision, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 A1008/A1008M, latest revision, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low –Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened.

- .3 Illuminating Engineering Society of North America (IESNA)
 - .1 IES Lighting Handbook, Reference and Application.
 - .2 IES LM-79, latest revision, Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
 - .3 IES LM-80, latest revision, Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
 - .4 IES TM-21, latest revision, Projecting Long Term Lumen Maintenance of LED Light Sources
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005, latest revision, Lighting Equipment.
- .6 Underwriters' Laboratories of Canada (ULC) and Underwriters' Laboratories of Canada (UL)
 - .1 UL 94, latest revision, Test for Flammability of Plastic Materials for Parts in Devices and Appliances.
 - .2 UL 508, latest revision, Industrial Control Equipment.
 - .3 ANSI/UL 8750, latest revision, Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Product.
- .6 Design Lights Consortium (DLC).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 for each type of luminaire, for review by the Engineer. Shop drawings shall include the following:
 - .1 Physical description of luminaire including dimensions, finishes and all accessories applicable to the installation under this project.
 - .2 Description of the driver and associated surge suppression.
 - .3 Photometric data, certified by a qualified independent testing agency, in IESNA format, based on certified results of laboratory tests for the driver/LED array combination applicable to the installation under this project. (LM-79 test report)
 - .4 Energy efficiency data. (LM-79 report)
 - .5 Description of lumen maintenance for the driver/LED array combination applicable to the installation under this project. (in accordance with TM-21)
- .2 Manufacturer's Instructions: submit manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area;
- .2 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return pallets, crates, padding and packaging materials.
- .5 Divert unused materials from landfill to recycling facility.

1.6 QUALITY ASSURANCE

- .1 Manufacturer's Warranty: submit manufacturer's standard warranty document and include in the Operation and Maintenance Manual.
- .2 Manufacturer's warranty shall include as a minimum the replacement of all failed components within an LED light fixture, including but not limited to LED arrays and LED drivers for a period of five (5) years from the date of substantial completion.
- .3 The manufacturer's warranty letter shall be furnished by the Electrical Distribution Agency responsible for the lighting system for this project. The letter shall include as a minimum the following:
 - .1 Contact information for the Electrical Distribution Agency
 - .2 The description of the warranty and the warranty period for the product(s)
 - .3 The effective date of the warranty
 - .4 A reference number for the particular project for ease of reference

1.7 COORDINATION

- .1 Coordinate layout and installation of luminaires with ceiling system and other construction that penetrates ceilings or is supported by them including mechanical systems, fire suppression and partition assemblies.
- .2 Coordinate luminaire layout in each area with mechanical systems installer to eliminate depth and location conflicts.

Part 2 Products

2.1 GENERAL

- .1 All LED luminaires shall conform to UL 8750.
- .2 All LED luminaires shall have published supporting LM-79 and LM-80 reports for the driver/LED array combination applicable to the installation under this project.
- .3 All LED luminaires shall be Restriction of Hazardous Substance Directive (RoHS) compliant.
- .4 All LED luminaires shall have published reports confirming the maintenance of the rated lumen output to 70% at 50,000 hours, as a minimum. Measurement of such must be in accordance with TM-21.

- .5 Light fixture manufacturer shall be a company with a minimum of 5 years of success manufacturing LED light fixtures for the Canadian market. The agency representing the manufacturer shall be an established company that has had and currently maintains a locally run and operated business in New Brunswick for at least five years. A listing of five (5) projects shall be provided (if requested) where the manufacturer's similar products have been used in Canada, including location, contact person and telephone number.

2.2 FINISHES

- .1 As indicated in luminaire schedule.

2.3 LUMINAIRES MANUFACTURERS

- .1 Luminaires manufacturers and model numbers are as per drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Refer to architectural reflected ceiling plans for coordination of luminaire locations with mechanical HVAC and sprinkler, and electrical ceiling devices. Where conflicts occur, coordinate with Engineer-Architect.
- .2 In accessible ceiling spaces, flexible conduit used for luminaire wiring shall not exceed 1500mm of length run from a rigidly supported junction box, support flexible conduit 300mm from junction box.
- .3 Adjust aperture flanges or rings of all recessed luminaires in order to remain flush with the finished ceiling. Trim shall completely conceal ceiling opening.
- .4 Luminaires shall not be secured to ductwork or other raceways/systems.
- .5 Adhere to manufacturer's installation guidelines regarding proper thermal management.
- .6 Exterior wall mounted fixtures are to be complete with backbox and seal around fixture to exterior wall.
- .7 Provide adequate support to suit ceiling system.
- .8 For suspended ceiling installations (Acoustic tile and Gypsum) support luminaires independent of ceiling with safety chains at two (2) diagonal corners minimum for 305mm x 1220mm & 610mm x 610mm Luminaires. At four (4) corners for 610mm x 1220mm Luminaires, one (1) location for downlights.
- .9 Provide all required supports, hardware and brackets for installation of luminaires.
- .10 Contractor to coordinate with casework supplier/manufacturer for luminaires and switches installed in casework.
- .11 Contractor to coordinate with contractor responsible for gypsum installation.

3.2 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141, Emergency Lighting Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period.

Part 2 Products

2.1 BATTERY UNITS

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 12 V DC.
- .4 Operating time: 30 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON'.
- .10 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 6W.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Auxiliary equipment:
 - .1 Auto Test/diagnostic required for Battery Units.
- .13 Acceptable manufacturers:
 - .1 As per drawings.

2.2 REMOTE HEADS

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 12 V, DC.
- .3 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 6W.
- .4 Acceptable manufacturers:
 - .1 As per drawings.

2.3 WIRING OF REMOTE HEADS

- .1 Conduit: type PVC, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: RW90 type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.
- .4 Make final connection of all battery units at same time to ensure the diagnostic cycles for all units will be synchronized. Make note of date/time and include in manuals.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results - Electrical.

Part 2 Products

2.1 EXIT SIGNS

- .1 Exit lights: to CSA C22.2 No.141.
- .2 Housing: as indicated in luminaire schedule
- .3 Finish: as indicated in luminaire schedule.
- .4 Lamps: LED-3W maximum, 25-year operating life.
- .5 Pictogram type, green on white (or lightly tinted background) running man with arrow graphic viewable (where required).
- .6 Mounting as indicated
- .7 Quantity of faces as required

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, National Building Code, NFPA standard and local regulatory requirements.
- .2 Connect exit lights to circuit indicated.

- .3 Ensure that exit light circuit breaker is locked in on position.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.46-M1988(R2006), Electric Air-Heaters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-08, Enclosures for Electrical Equipment (1000 V Maximum).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect unit heaters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection, and fan-delay switches.
- .3 Heater voltage, wattage as indicated.
- .4 Fan motor: totally enclosed type with resilient mounts.
- .5 Built-in fan motor thermal overload protection.
- .6 Hangers: as required for wall or ceiling applications.
- .7 Elements: mineral insulated copper coated steel sheath with aluminum, continuous helical brazed fins.
- .8 Cabinet: aluminum, 1 mm thick, fitted with brackets for rod or wall mounting.
- .9 Phosphatized and finished with 2 coats baked enamel in standard colour.
- .10 Acceptable Manufacturers: As per heater schedule.

2.2 CONTROLS

- .1 Built in 24V relay.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for unit heaters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Engineer of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations indicated.
- .3 Make power and control connections.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by unit heaters installation.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements common to sections of Division 26 – Electrical, Division 27 – Communications and Division 28 – Electronic Safety and Security.
 - .2 All equipment purchased as specified within this specification to be purchased from an authorized distributor in the province of New Brunswick.

1.2 RELATED REQUIREMENTS

- .1 Division 01 – General Requirements.
- .2 10 81 00 - Supply and Installation of Blowers
- .3 22 05 20 - Meters and Gauges for Waste Water Systems
- .4 23 33 15 - Dampers - Operating
- .5 23 34 00 - HVAC Fans
- .6 Division 27 - Communications
- .7 Division 40 – Common Work Results for Process Integration

1.3 REFERENCES

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 Canadian Standards Association (CSA)
 - .1 CSA C22.1-21, Canadian Electrical Code, 2021, Part 1, Safety Standard for Electrical Installations. (CEC)
 - .2 CAN3-C235-19, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .3 CSA-Z462-18, Workplace Electrical Safety
 - .2 National Research Council of Canada
 - .1 National Building Code of Canada – 2020 (NBC)
 - .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.4 MEASUREMENT AND PAYMENT

- .1 Refer to Section 01 29 00 – Payment Procedures.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with applicable sections of the specification.
- .2 Electrical Contractor Requirements:
 - .1 Prior to starting work, the following is required to be provided by the Electrical Contractor:
 - .1 Electrical Contractor to provide list of employees for project and list of qualifications. Including but not limited to, Project Manager, Site Supervisor, Team Leads, and etc.
 - .2 3 sample projects of equivalent physical size, monetary value, scope of work, type of construction.
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS in accordance with Construction and Hazardous Materials Section.
- .4 Shop drawings:
 - .1 Submit wiring diagrams, coordination drawings and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation between equipment and other trades.
 - .2 The contractor shall submit a list of all shop drawings to the engineer for review within 5 weekdays of project kick off meeting. The contractor shall update the list as required with new products and dates of reviews. Shop drawings will not be reviewed until complete list is provided.
 - .3 The contractor shall submit all shop drawings within 20 weekdays of kick off meeting. There shall be no adjustment to the contract value due to increase in product pricing. Shop drawings received outside of this schedule are not guaranteed to be reviewed within 5 weekdays and associated delays/costs will be this contractor's responsibility.
 - .4 Shop drawings required to be re-submitted shall be re-submitted within 10 weekdays.
 - .5 Shop drawings shall have the first page of each device stamped by the electrical contractor, stating they have thoroughly reviewed each device.
 - .6 Shop Drawings will only be accepted as PDF/Digital format. Scanned copies of Printed PDF's will not be accepted.
 - .7 Shop drawings shall be submitted as systems, broken out devices will not be reviewed and will be rejected.
 - .8 If shop drawings are rejected twice, Electrical Contractor will be invoiced at \$500.00 (excluding HST) per shop drawing (per device/piece of equipment) for the required further reviews. This clause will be applied at the Engineer's discretion.

- .9 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .10 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .11 Submit required number of copies of drawings to authority having jurisdiction.
- .12 If changes are required, notify Consultant of these changes before they are made.
- .13 Shop drawings not meeting the requirements of the statements above will be rejected and only reviewed once meeting the requirements listed.
- .14 Providing equipment meeting the specification is the responsibility of the Contractor, the Consultant review of the shop drawings does not remove this requirement from the Contract.
- .5 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment or material is not available, submit such equipment and material to authority having jurisdiction for approval by a certified agency of Standard Council of Canada (SCC) before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant.
- .6 Manufacturer's Field Reports: submit to Engineer manufacturer's written report, within 3 days of review, verifying compliance of Work of electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with applicable sections of the specification.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.
- .3 In addition to technical data the Electrical Contractor shall also include:
 - .1 Names, addresses and phone numbers of local supplier for items included in the maintenance manual
 - .2 Copy of reviewed shop drawings.
 - .3 Copy of Electrical Specifications.
 - .4 Names, addresses and phone numbers of Electrical Sub-contractors.
 - .5 Inspection certificates and verification reports.
 - .6 Letter or certificate of warranty.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with applicable sections of the specification.
- .2 Material Delivery Schedule: Provide consultant with schedule within 2 weeks after award of contract for all long delivery items.
- .3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .4 Storage and Handling Requirements:
 - .1 Store materials: off ground or indoors, in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect all materials from damage to finish or material.
 - .3 Replace defective or damaged materials with new.
- .5 Packaging Waste Management: remove for reuse and recycling of pallets, crates, or packaging materials as specified in Construction Waste Management Plan in accordance with applicable sections of the specification.

1.8 ADDENDA AND REVISIONS

- .1 All addenda, instructions and revisions issued during the tendering period shall become part of the Contract Documents and shall be included in the Tender, and shall take precedence over the previous instructions.
- .2 The Owner and Engineer reserve the right to make revisions to the drawings during the period of construction and these shall take precedence over previously issued drawings. All revisions to the work shall be executed by duly authorized change orders with the amount of addition or deduction to the contract amount approved by the Owner before the execution of any work associated with the revision is undertaken.

- .3 Material quotes and hourly breakdowns are required to be submitted with all request for changes.

1.9 SUBSTITUTIONS

- .1 It is the intent of these drawings to establish the required quality of materials. Where manufacturer names or catalogue references are used, it is done in order to establish the required quality, style, size or function. Products of other manufacturers will not be permitted after the signing of the contract. The decision as to suitability shall rest with the Engineer.
- .2 Should the contractor propose to furnish material and equipment other than those specified, they shall submit a written request for any or all substitutions prior to the tender closing date. Such a request shall be accompanied by a complete description including manufacturer, brand name, catalogue number and technical data for all items. If requested by the Engineer, the contractor shall submit for inspection a sample of the proposed item.
- .3 All material not meeting the specifications above shall not be allowed on the project site.
- .4 Substitutions affecting the design will not be permitted. Additional costs to any other trade as a result of a change or substitution by this contractor shall be the responsibility of this contractor.
- .5 The listing of a manufacturer as acceptable does not imply acceptance of all products of that manufacturer and only products meeting the specifications will be accepted.

1.10 SCOPE OF WORK

- .1 The Electrical Contractor shall furnish all labour, material, tools, appliances and equipment to entirely complete and provide the operation of the electrical systems.
- .2 In submitting a tender price / quote for this project, the Contractor is confirming they have reviewed the construction documents, existing condition (at a non-destructive site investigation level), constructability and equipment requirements of this contract. The Contractor confirms they have the required information to complete this project within the project timeline, requirements and the constructability of the documents.
- .3 Contractor to review existing site for indicated routing. Changes to routing due to site conditions are to be included at no additional cost post award
- .4 It is the responsibility of the Electrical Contractor to review all conductor sizing and adjust all sizing based on voltage drop requirements by the CEC and other applicable Codes/standards. In bidding these documents, the Electrical Contractor is confirming they have reviewed and adjusted all conductor sizing as required. Conductor sizing cannot be reduced from what is indicated on the documents.
- .5 When other Contractors (general or other subs) are required to create interference / coordination documents for ceilings, walls or any spaces, this contractor to include any associated costs for coordinating all electrical equipment's within these documents.
- .6 The overall intention is to provide a functioning complete electrical installation in all aspects, and all items reasonably inferable as called for by the drawings and specifications, and by normally accepted good practice, notwithstanding that every item

necessarily required may not be particularly mentioned. This Contractor shall fulfill his obligation and not take advantage of any unintentional errors or omissions, should any exist, to the detriment of the Owner's interest. The work shall include but not be limited to:

- .1 Removal/decommissioning of all electrical equipment with chlorination building
 - .2 Removal of existing devices/systems as shown or required for installation of new devices/systems
 - .3 Installation of power distribution
 - .4 Branch circuit wiring
 - .5 Lighting installation
 - .6 Coordination with the Utility company for service upgrade. This includes disconnection and reconnection of electrical services for buildings as indicated on drawings.
 - .7 Coordination with other trades. See also Architectural, Structural, Mechanical and Mechanical Process specifications and drawings.
 - .8 Coordination with Owner and Consultants
- .7 Documents provided by Consultant are to be provided back to Consultant in the same format and quality. Reports, deficiency lists provided in a PDF format are to be provided back in a PDF format.
- .8 No heavy machines are to be used to dig around live electrical trenches/underground conduits.

1.11 ELECTRICAL DRAWINGS

- .1 The electrical drawings which constitute an integral part of this contract shall serve as working drawings. They indicate the general layout of the complete electrical system arrangements of feeders, circuits, outlets, switches, controls, panelboards, service equipment, communications, underground duct banks, overhead pole lines, power center, etc..
- .2 Field verification of scale dimensions on drawings is directed since actual locations, distances, and levels will be governed by the field conditions.
- .3 All discrepancies related to the electrical work shall be promptly brought to the attention of the Engineer for clarification.
- .4 Contractor to allow for site adjustment of all devices/equipment/panels/switchgear/etc within 3 meters.

1.12 EXISTING CONDITION AND EXAMINATION OF DRAWINGS

- .1 The Electrical Contractor shall become completely familiar with the drawings and specifications, as well as construction methods of other trades related to the work to avoid possible interferences on the project. Should drastic changes be necessary to resolve such conflicts, this Contractor shall notify the Engineer and secure written approval and agreement on the necessary adjustments before the installation is started.

- .2 Before submitting the tender, this Contractor should visit the site and become familiar with site conditions, availability of storage space and all other factors that might influence the tender submittal. No extra will be awarded for not allowing for above.
- .3 The contractor shall determine all working conditions and rigidly comply. Conditions that require special consideration include but not limited to: Dust, Noise, Vibration, Water, Working hours, Continuity of power, Access to area of work, Physical protection of Owner's facility and equipment.
- .4 Bidders shall thoroughly review the site existing conditions prior to tender close. Bidders in preparing their tender find any areas of concern or require additional information on constructability shall notify the Engineer, who will send written instructions or clarification to all bidders. No extras will be allowed due to failure to account for site conditions or working conditions.
- .5 Conduit and cable routings indicated on the drawings are diagrammatic only. All routings shall be confirmed prior to tender close. In determining pathways throughout the building, the contractor shall allow for adjustments to the pathway, additional supporting methods required and relocation of existing services.
- .6 Site work indicated is to show general raceway location. The bidder shall determine the proposed pathway prior to tender close. Any site work shown shall be restored at end of construction to conditions the same or better than existing. Any asphalt repairs shall be repaired with asphalt type matching existing as a minimum. Any work shown near sidewalks, curbs grassed areas to be presumed as disturbed, the bidder shall allow in their price restoration of all disturbed conditions.
- .7 The Contractor shall supply site locates in the area of all underground work. the Contractor shall formally request in writing any as-builts/record drawings of the existing site. The contractor shall carry all costs for site locates including scoping of existing underground services to located depth and direction of the service. All site services shall be considered as required to be located prior to excavation, this includes but is not limited to electrical, natural gas, plumbing, drainage, etc.
- .8 The exact rough in dimensions and connection points shall be determined from shop drawings and on-site measurements.

1.13 DISCREPANCIES

- .1 Bidders in preparing their tender, finding any errors, omission, or discrepancies in the drawings, specifications or other documents, or having any doubt in the intent or meaning of any part thereof, shall immediately notify the Engineer, who will send written instructions or clarification to all bidders. Any questions must be submitted in writing no later than three (3) working days prior to the Tender closing date. Where such discrepancies exist, and it is evident that this Contractor could not have properly tendered without clarifications and where such clarification was not requested, no extra to the contract will be considered in order to have the installation properly made. The Owner and Engineer will not be responsible for oral instruction.
- .2 Equipment and devices called out for on the plans and specification are to be assumed as supplied by the contractor. Any equipment noted to be supplied by others shall follow the requirements of the drawings and specification for the contractor's responsibility in supplying accessories, conductors etc, and providing a final connection to the equipment.

- .3 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.

1.14 SYSTEM STARTUP

- .1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 The Contractor, upon completion of the installation, shall provide training with all systems. Operators Manuals and Users Guides shall be provided prior to the time of training.

1.15 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Obtain an electrical work permit and pay associated fees.
- .3 Notify Engineer of changes required by the Electrical Inspection Department.

1.16 WARRANTY

- .1 Warranty duration: 12 calendar months following Substantial Completion.
- .2 Coverage: warrant against failure to perform to characteristics as specified.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.
- .4 Loads listed on panel legends are estimated, contractor shall only use fixed or know loads for calculations.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material equipment in accordance with required sections.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, for approval by a certified agency of Standard Council of Canada (SCC) before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble all control panels and component assemblies.

- .4 Electrical Distribution to be one manufacturer throughout entire project.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring conduit: in accordance with Section 26 05 34 – Conduit, Conduit Fastenings and Conduit Fittings. All wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings shall not be the responsibility of this contractor unless otherwise noted.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities and Consultant.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
- .1 Nameplates: plastic laminate lamacoid 3 mm matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with adhesive backing.
- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
Size 8	Approximately 150 x 75 mm, final size adjusted as required.	As indicated on drawings	12 mm high letters

- .2 Labels: plastic laminate lamacoids.
- .3 Cabinets, Junction and pull boxes are to be labeled with voltage, system and all circuits that enter/pass through them and the room they serve. Lamcoid to be mechanically affixed, by means of rivets, to cover. All systems shall be labelled as such, ex. Data/telephone/power, etc.
- .4 Wording on nameplates to be approved by Consultant prior to manufacture.

- .5 Allow for minimum of twenty-five (25) letters per nameplate.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.
- .10 Lamacoids installed on Panelboards, Motor Control Centers, Splitter Troughs, Transformers shall indicate the following information in the following order;
 - .1 Designation name of Equipment;
 - .2 Voltage, number of phases and wires;
 - .3 Designation of Power Source and Circuit number;
 - .4 Example:

PANEL N – 150 A
120/208V – 3PH – 4W
FED FROM PNL CDP-A, CCT #1,3,5
- .11 Lamacoid labels installed on combination starters, magnetic starters, manual starters and all various system controls, control panels, and disconnect switches shall contain the following information in the following order:
 - .1 Designated name of equipment;
 - .2 Voltage, number of phases and wires;
 - .3 Branch circuit breaker number.
- .12 Each receptacle shown on plans shall have the circuit number and supplying panelboard permanently identified at the outlet. This identification shall be a lamicoid nameplate, self adhesive attached and shall be visible when the receptacle coverplate is in place, and shall be in a position not likely to be painted over, and shall not be on the coverplate itself.
- .13 Each light switch, wall mounted occupancy sensor or dimmer shown on plans (new and existing) shall have the circuit number and supplying panelboard permanently identified. This identification shall be a self adhesive attached lamicoid nameplate, and shall be visible when the coverplate is in place, and shall be in a position not likely to be painted over, and shall not be on the coverplate itself.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Device box conduits shall be labelled within 300mm of conduit coupler to box.
- .3 Code with plastic tape at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .4 Existing services within an area of renovation shall be color coded by this contractor if none are present.
- .5 Coordinate with Mechanical contractor for identification of controls conduits.
- .6 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Service	Prime	Auxiliary
250V to 749V Normal	Blue	
50V to 249V Normal	Green	
Emergency Lighting	Red	Brown
Data (includes Fiber, multimedia)	White	Yellow
Controls	Brown	Orange

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC-2Y-1.

Part 3 Execution

3.1 SITE REVIEWS

- .1 The below site reviews are to review work which has been completed. Site reviews are not intended to provide Contractor with check list to complete project. Site reviews will only review work completed and not listed work yet to be completed. It is the Contractor's responsibility to ensure the required work is completed and ready for review.
- .2 The following site reviews, with requirements listed below, are required to be completed by the Engineer. Contractor is required to ensure 10 working days noticed is provided, provide signed letter stating the site is ready for the requested review and to schedule testing requirements from other required parties:
 - .1 Interim:
 - .1 Equipment on walls are installed, labelled and ready to be closed in.
 - .2 Substantial
 - .1 All systems have been installed, tested and commissioned, with applicable reports.

- .3 In the event the Engineer arrives on site to complete the requested site review and the site is not ready for review, the Engineer has the right to inform the Contractor that the site is not ready as requested, won't be reviewed and will invoice the Contractor \$500.00 (excluding HST) for the unnecessary site visit. Site visits outside of the Moncton, Dieppe, Riverview City limits, an additional cost of \$0.61 per km will be added from Office of the Engineer to site (round trip). The invoice for the above will be applied at the discretion of the Engineer.

- .1 The definition of site not meeting the requested review level will be up to the Engineer to use their professional judgement. An example of this would be:

- .1 Not meeting the above description with over 10 unique deficiencies.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 TEST RESULTS

- .1 Submit test results to Consultant for review.
- .2 Contractor to allow 10 working days review period between tests reports being provided and equipment being used/permanently energized.
- .3 Testing methods and test results: to CSA, CEC and authorities having jurisdiction.
- .4 Remove and replace conductors found damaged, with new materials.
- .5 Provide required labour and tools, if during testing Consultant requests equipment be opened and removed from their housings to examine equipment, terminations and connections.

3.5 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
- .1 Sleeves through concrete: schedule 40 steel pipe sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .4 Any conduit installed below grade shall be Schedule 40 rigid PVC. Type DBII shall not be accepted.

- .5 All concrete encased trenches shall follow the requirements of the trench reinforcement detail.

3.6 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.

3.7 MOUNTING HEIGHTS

- .1 For existing areas, that require renovations all mounting heights shall match existing heights unless otherwise noted on the drawings. New construction shall follow heights below.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Equipment mounting height from finished floor to centerline of equipment item unless indicated otherwise:
 - .1 Local switches: 1100 mm.
 - .2 Receptacles:
 - .1 General: 1200 mm.
 - .2 Above top of counters or counter splash backs: 250 mm.
 - .3 Exterior: 1000mm and coordinate with architectural elevations.
 - .3 Emergency lighting: 2100 mm above finished floor.
 - .4 Exit light: 300 mm above door frame.
- .4 Attach electrical equipment, components and devices directly to structure and structural supporting elements.

3.8 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings. Provide letter indicating settings have been set and verified.

3.9 CO-ORDINATION WITH SUPPLY AUTHORITY

- .1 Electrical contractor shall co-ordinate installation of Supply Authority equipment and connection of electrical service with Supply authority to minimize inconvenience to Owner and other trades.
- .2 Include all customer contributions required by the Supply Authority in the tender price. The contractor shall include a sum of Two Thousand Five Hundred Dollars (\$2,500) for

the utility customer contribution. The final amount will be adjusted by change order based on actual invoiced amount from the supply authority.

- .3 Contractor to coordinate with NBPC for pole holding requirements during trench excavation and relocation of service entrance, guy poles.
- .4 Contractor shall engage NBPC on contract award to coordinate and determine site servicing, and requirements to provide servicing as outlined within contract documents. Any project delays caused due to improper coordination and lack of shall be the contractor's expense to cover and make good.

3.10 CO-ORDINATION WITH OTHERS

- .1 Electrical contractor shall co-ordinate the installation of equipment to minimize inconvenience to Owner and other sub-contractors.
- .2 Work by other contractors will be done concurrently with work in this contract. This contractor shall schedule and arrange the work and store materials in co-operation so as to avoid interference with others.

3.11 CUTTING, PATCHING AND PAINTING

- .1 The contractor shall be responsible for all cutting required to complete the work shown on the drawing and described herein.
- .2 All holes through concrete or masonry shall be made by core drilling. Care must be taken to contain dust and debris.
- .3 The contractor shall neatly patch all surfaces cut or damaged as a result of this contract.
 - .1 All patching shall be of matching material and carried out by tradesmen trained and skilled in the work to be done.
- .4 The contractor shall re-paint all surfaces as required. All painting shall be carried out by skilled tradesmen.
- .5 All patching, painting and sealing shall be to the satisfaction of the Owner and Engineer.
- .6 If the above work is completed by other trades/contractors, it is the responsibility of this contractor to coordinate this work during tender/bidding phase. No extra will be provided due to this lack of coordination.

3.12 FIELD QUALITY CONTROL

- .1 Qualifications: Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction and as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician to perform specific task.
 - .2 Permitted activities: determined based on the training level attained and demonstration of ability to perform specific duties
- .2 Health and Safety Requirements: Complete construction in accordance with occupational health and safety regulations.

- .3 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 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .4 Conduct following tests in accordance with various sections.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .5 Carry out tests in presence of Consultant and provide 10 working days notice.
- .6 Voltage Tests: Ensure voltage drop at maximum potential drop of 3% for 120 V, and 208V branch circuits, 2% on feeder circuits. Voltage drop shall meet CEC and ASHRAE requirements.
- .7 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .8 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.13 SYSTEM STARTUP

- .1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.

- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .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 aspects of its care and operation.

3.14 CLEANING

- .1 Progress Cleaning: clean in accordance with applicable sections of the specification.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean within all equipment prior to start-up/applying power.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with applicable sections of the specification.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with applicable sections of the specification.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.15 RECORD DRAWINGS

- .1 Two sets of white prints shall be maintained for the exclusive purpose of recording deviations from that shown on the contract drawings. One set shall be kept up to date at all times. At the completion of the project the information shall be transferred to the second set of drawings and to a set of reproducible CAD drawings. Both sets shall be turned over to the Owner.
- .2 Drawings to indicate all routing for panel feeders, major conduit run areas, panel marshalling boxes and equipment installed within ceiling spaces.

3.16 GUARANTEE

- .1 Guarantee material and workmanship to be free from defect for a period of one (1) year or longer where specified otherwise, after issuing of the certificate of substantial completion.
- .2 Make good, at the Owner's convenience, all defects covered by this guarantee without additional cost to the Owner.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results - Electrical.
- .2 Section 01 29 00 – Payment Procedures.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18 (R2009), Outlet Boxes, Conduit Boxes and Fittings and associated hardware.
 - .2 CAN/CSA-C22.2 No.65 (R2008), Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-,1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with.
- .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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2 No. 65-03, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No. 65-03, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors to: EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded, copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper bar.
 - .5 Sized for conductors as indicated.
- .4 Weatherproof connectors for TECK cable, flexible conduit, as required to: CAN/CSA-22.2 No. 18.1.
- .5 Joints required in connecting all wiring up to and including # 8 are to be made using twist-on connectors.
- .6 Joints for all other wiring shall be made using colour-keyed compression type connectors followed by a layer of CSA approved vinyl plastic tape.

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 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65-03.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 26 05 00 – Common Work Results – Electrical.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3-09, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-M89 (R2004), Type TECK 90 Cable Latest Edition.

1.3 PRODUCT DATA

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding packaging materials in accordance with Section 01 61 00 – Common Product Requirements.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: solid for #10 AWG and smaller; stranded for #8 AWG and larger. Minimum size: #12 AWG.
- .2 Conductors: size as indicated, with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .3 Conductors: all wiring shall be copper.
- .4 Neutral conductor insulated for 600V shall be continuous with no fuses, switches, or breaks of any kind.
- .5 The voltage drop shall in no case exceed 3% for branch circuits.
- .6 The voltage drop shall in no case exceed 2% for distribution.
- .7 Voltage drop to be calculated based on 80% of the circuit breaker current rating for all branch circuits.
- .8 Voltage drop for motor branch circuits shall be calculated based on current equal to 80% of the ampacity of the branch circuit conductors.
- .9 Conductor sizes specified on drawings are the minimum required. Upsize conductor sizes as required so that the voltage drop is less than the maximum value permitted. No extra will be awarded due to not allowing for Voltage drop.

- .10 AC90 cabling shall not be permitted to be installed.

2.2 TECK 90 CABLE

- .1 Cable to CAN/CSA-22.2 No 131: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 VFD CABLES (0-1000V)

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Class B stranded, un-coated annealed copper conforming to ASTM B-3 and B-8.
 - .2 Grounding wires, three class B stranded, un-coated annealed copper confirming to ASTM B-3 and B-8.
- .3 Insulation:
 - .1 Cross linked polyethylene XLP with overall PVC jacket.
 - .2 Rating: 600V/2kV or as indicated.
- .4 Shield: 5 mil un-coated copper tape is helically wrapped over the twisted assembly with a 50% overlap. Shield shall be in contact with the ground wire.
- .5 Outer Jacket: A black, flame-retardant polyvinyl chloride (PVC) jacket meeting the requirements of UL Standard 1277 is applied
- .6 Match to existing type supplied with Pump.

- .7 Acceptable Manufacturer: Southwire or acceptable alternate.

2.4 MULTI-CONDUCTOR CONTROL CABLE

- .1 Multi conductor 16 AWG control cable with PVC jacket.
- .2 Conductors: stranded copper with XLPE cross linked polyethylene.
- .3 Outer jacket: PVC (Polyvinyl chloride) rated for operation at a temperature range from - 40°C to 90°C. Installation temperature range: -25°C to 40°C
- .4 Type CIC to CSA specification C22.2 no.131.
- .5 Acceptable material: Belden cat.no.2210_ series or equivalent.

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 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.3 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 No wiring within walls.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

3.4 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34.

- .2 In underground ducts and trenches in accordance with applicable codes standards.

3.5 INSTALLATION OF TECK CABLE 0-1000V

- .1 Group cables wherever possible on channels.
- .2 Installed cables securely supported by straps or hangers.
- .3 TECK90 cables shall be installed in accordance with manufacturer's installation instructions and specifications.
- .4 Cables shall be properly supported and secured to prevent damage or movement during installation and use.
- .5 Wherever possible, cables shall be installed in a straight line with a minimum bend radius of 10 times the cable diameter.
- .6 All joints and terminations shall be properly sealed and protected from moisture, corrosion, and environmental factors.
- .7 TECK90 cabling shall follow building lines and established reference points throughout the TECK90 cable installation process, without deviation or shortcuts. Any deviations from the specified routes shall be approved in writing by the Engineer or the Departmental representative.
- .8 "Shortest Path" routing will not be acceptable, and Engineer reserves the right to have the contractor remove and re-do wiring.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
 - .1 Leave Work area clean at end of each day.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all labor and equipment necessary for removal and disposal of all trees including dead-falls, logs stumps, embedded logs and other perishable matter from the full width of the right-of-way, easements and defined working areas in order to carry out the installation of services, and/or construction of lagoon berms, road, building, or parking lot.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 31 14 13 - Soil Stripping and Stockpiling.
- .3 Section 32 91 19.13 - Topsoil Placement and Grading.

1.3 DEFINITIONS

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, fences marked for removal, and surface debris.
- .2 Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.
- .3 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.
- .4 Grubbing consists of excavation and disposal of stumps, roots, and other embedded or partially embedded organic matter including boulders and rock fragments of specified size to not less than specified depth below existing ground surface.

1.4 STORAGE AND PROTECTION

- .1 Prevent damage to adjacent properties, fencing, natural features, bench marks existing buildings, existing pavement, utility lines, water courses, and root systems of trees which are to remain.
 - .1 Repair damaged items to approval of Engineer.
 - .2 Replace trees designated to remain, if damaged, as directed by Engineer.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse or recycling in accordance with local solid waste disposal procedures.
- .2 Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuel wood can be produced as saleable timber.
 - .1 Trim limbs and tops and saw into saleable lengths.

- .2 Stockpile adjacent to site.

Part 2 Products

2.1 MATERIALS

- .1 Bituminous based paint of standard manufacture specially formulated for tree wounds.
- .2 Soil Material for Fill:
 - .1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.
 - .2 Remove and store soil material for reuse.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION

- .1 Inspect site and verify with Engineer items designated to remain.
- .2 Locate and protect existing structures and features within the work area.
- .3 Locate and protect utility lines: preserve in operating condition active utilities traversing site.
 - .1 Notify Engineer immediately of damage to or when unknown existing utility lines are encountered.
 - .2 When utility lines which are to be removed are encountered within area of operations, notify Engineer in ample time to minimize interruption of service.
- .4 Notify utility authorities before starting clearing and/or grubbing.
- .5 Obtain all necessary permits prior to start of any clearing and grubbing operations.
- .6 Keep roads and walks free of dirt and debris.

3.3 LIMITS OF WORK

- .1 The Engineer will identify the limits with ribbons or similar means. The limits for grubbing may be different from the clearing limits.

- .2 Confirm clearing limits prior to the start of grubbing and notify the Engineer of any discrepancies or additional Clearing work that may be required. Only do additional Clearing upon authorization of the Engineer or due to a safety hazard.

3.4 CLEARING

- .1 Clearing includes felling, trimming, cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, rubbish occurring within cleared areas.
- .2 Clear as indicated directed by Engineer by cutting all vegetation at height of not more than 200 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 200 mm above ground surface.
- .3 Bulldozing of trees is not permitted.
- .4 Cut off branches, remove any deadfalls and cut down trees overhanging area cleared as directed by Engineer.
- .5 Cut off unsound branches on trees designated to remain as directed by Engineer.
- .6 Provide equipment suitable for efficiently carrying out this work.
- .7 Clear boundaries to produce as straight and uniform a finished line as possible.
- .8 Leave ground surface in a condition suitable for grubbing and to the approval of the Engineer.
- .9 Where ground conditions are not suitable for access by heavy equipment, use directional hand felling and harvesting. When cable skidders are used, avoid rutting soft ground areas by utilizing the full range of the cables.
- .10 Clearing shall not be performed within the thirty (30) meters buffer zone for watercourses and wetland areas except as specifically permitted under the NB Department of the Environment "Certificate of Approval to Construct" or as directed by the Engineer. There shall be no long skids of timber on steep slopes adjacent to watercourses and no felling or skidding of trees across a watercourse.

3.5 GRUBBING

- .1 Remove all stumps, roots, and other embedded or partially embedded vegetative material from the designated area.
- .2 After the removal of large stumps, a root rake may be employed. The objective is to remove the vegetative/organic material while removing a minimum of soil from the site.
- .3 Leave the ground surface in a condition suitable for stripping operations and to the approval of the Engineer
- .4 Ensure that no isolated areas are created by the grubbing operation that would prevent normal runoff from the site.
- .5 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .6 Grub out stumps and roots to not less than 200 mm below ground surface.

- .7 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m³.
- .8 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.6 REMOVAL AND DISPOSAL

- .1 Remove cleared and grubbed materials to acceptable disposal area indicated on the Drawings.
- .2 Salvage merchantable timber, unless otherwise approved by the Engineer
- .3 Cut timber greater than 125 mm diameter to 2400 mm lengths and stockpile as indicated. Stockpiled timber becomes property of the Contractor.
- .4 Supply all equipment required for collection, loading, transportation, and disposal of cleared and grubbed material. Load trucks and secure loads so as to prevent the dropping of any material across the site or on any roadways used between the work site and the disposal site.
- .5 Non-merchantable trees not felled by cutting may be shredded in place using equipment designed for that purpose only if approved by the Engineer but shall not be permitted if the site is to be grubbed or if stripping for re-use of material is to be done. Where permitted, non-merchantable trees, and all brush and slash produced from the work, may be shredded or chipped and evenly distributed over the ground within the clearing limits.
- .6 Under no circumstances shall material resulting from the grubbing operation be disposed of under fill or embankments, nor shall excavation be combined with the grubbing operation.
- .7 Remove diseased trees identified by Engineer and dispose of this material to approval of Engineer.

3.7 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for stripping of topsoil, installation of services, construction of roadways, or other work to be done to approval of Engineer.
- .2 Minimize ground disturbance to minimize the potential for erosion and sedimentation of the watercourses and wetlands.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

- .1 Excavating, trenching and backfilling for building footing and foundations, slabs, subsurface utilities within building footprint and parking lot area.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 07 11 13 - Damproofing and Waterproofing
- .3 Section 07 21 13 - Building Insulation.
- .4 Section 31 23 33.01- Excavating, Trenching and Backfilling

1.3 REFERENCES

- .1 Geotechnical Investigation Report prepared by Englobe Corp. dated November 1, 2024.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³
 - .5 ASTM D4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide the Consultant with the following information before the commencement of the work and at any time during the construction at the request of the Consultant (at no cost to the Owner):
 - .1 Testing geotechnical firm hired by owner, and coordinated by contractor to complete the following analyses and collect samples at the proposed site:
 - .1 Source of supply of aggregate
 - .2 Sieve analysis
 - .3 Micro-Deval Analysis (not to exceed the requirements of Table 201-1 (25%) of the NBDTI Specifications (latest edition) for Aggregate Base Material

- .4 Freeze-thaw – (not to exceed the requirements of Table 201-1 (20%) of the NBDTI Specifications (latest edition)
- .5 Flat and Elongated Particles (not to exceed the requirements of Table 201-1 (35%) of the NBDTI Specifications (latest edition)
- .6 Plasticity Index (not to exceed the requirements of Table 201-1 (3%) of the NBDTI Specifications (latest edition) for Aggregate Base Material
- .7 Standard Proctor and Optimal Moisture values.
- .3 When submitting results to the Engineer the geotechnical testing firm must confirm that the materials meets the Specifications and that it is or is not suitable for the intended use. This is to be in letter report format submitted directly to the Engineer
- .4 The Owner reserves the right to reject any source of supply of aggregate base on the basis of past field performance, document by the records and experience of the Owner and/or the Engineer with a specific material, regardless of compliance with physical requirements of grading limits.
- .5 Samples:
 - .1 Allow continual sampling by Engineer during production if required.
 - .2 Provide Engineer with access to source and processed material for sampling.
 - .3 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's.
 - .2 Replace defective or damaged materials with new.
- .3 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .4 Develop [Construction Waste Management Plan] [Waste Reduction Workplan] related to Work of this Section.

1.6 EXISTING CONDITIONS

- .1 Results of soils tests and conditions are available for inspection from the Engineer. These are for general information only.

1.7 DEFINITIONS

- .1 Rock excavation: excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of 0.76 cubic metre.

- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.
- .3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.8 INSPECTION AND TESTING

- .1 Testing of materials and compaction will be carried out by the testing laboratory designated by the Engineer in accordance with Section 01 45 00 Quality Control.
- .2 Compaction densities are percentages of maximum Modified Proctor dry density as determined by ASTM D1557.

1.9 PROTECTION

- .1 Conduct with Engineer condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey benchmarks and monuments which may be affected by Work.
- .2 Take necessary precautions to protect existing or newly constructed works.
 - .1 If undermining occurs, correct by breaking out and repairing existing structure and/or replacing disturbed foundation material with fill concrete, grout, sand etc., as directed by the Engineer
 - .2 All protective and corrective work to be at the expense of the Contractor.
- .3 The above applies to all electrical cables, poles, sewers and other appurtenances already constructed in the area, whether above ground or underground.
 - .1 Should damage of any kind, including settlement or lateral movement of adjacent structures, utilities or surface features occur as a result of the work, such conditions and any resultant damage to be immediately rectified at the Contractor's expense and to the satisfaction of the Engineer

PART 2 Products

2.1 MATERIALS

- .1 Structural Fill: well-graded, granular soil with a maximum particle size of 75 millimeters and a maximum of 10 percent passing the 75 micron sieve, such as pit run, quarried rock fill or sandstone.
 - .1 Aggregate to be quarried from a source that is solid in situ.
 - .2 Aggregate to meet the following requirements:

Test and Method	Maximum % Loss
Micro-Deval (MTO LS-608)	30
Freeze Thaw (MTO LS-614)	20

Flat & Elongated Particle @ 4:1 (MTO LS-608) 35

Plasticity Index (ASTM D4318) 5

- .3 Aggregate to be produced by the processing of rock and conform to the grading limits specified in the following Table when tested to ASTM C136 and ASTM C117:

ASTM Sieve Size	Percent Passing
75.0 mm	95 - 100
63.0 mm	85 - 100
50.0 mm	73 - 95
37.5 mm	58 - 87
31.5 mm	-
25.0 mm	-
19.0 mm	35 - 69
12.5 mm	-
9.5 mm	25 - 54
4.75 mm	17 - 43
2.36 mm	12 - 35
1.18 mm	8 - 28
0.300 mm	4 - 16
0.75	0 - 10

- .2 Type 1 Fill: Crushed stone, approved by Engineer prior to placement. Gradations to be within limits specified in the following Table, when tested to ASTM C136 and ASTM C117:

Sieve Size (mm)	Percent Passing
19 mm	75 - 100
12.5 mm	-
9.5 mm	50 - 80
4.75 mm	30 - 70
2.00 mm	20 - 45
0.425 mm	10 - 25
0.180 mm	-
0.75	0-5

- .3 Type 2 Fill: Crushed, pit run or screened stone or gravel, approved by Engineer prior to placement. Gradations to be within limits specified in the following Table, when tested to ASTM C136 and ASTM C117:

Sieve Size (mm)	Percent Passing
-----------------	-----------------

75 mm	100
5 mm	35-60
0.80	0 - 7

- .4 Type 3 Fill: Selected site material from excavation or other sources, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials, and approved by Engineer prior to placement and for use intended.
- .5 Type 4 Fill: Drainage stone for foundation drainage piping, unfrozen and free from clay lumps, cementation, organic material, and other deleterious materials shall be 100% fractured, crushed stone aggregate devoid of mineral fines. All particles smaller than 6 mm shall be produced by manufactured means only. Rounded sands, semi-angular river rock and soft aggregates are prohibited.

Sieve Size (mm)	Percent Passing
-----------------	-----------------

60 mm	100
50 mm	90 - 100
25 mm	35 - 100
19 mm	15 - 85
12.5 mm	0 - 53
9.5 mm	0 - 30
4.75 mm	0 - 4
1.18 m	0 - 2

- .6 Sand: Sand, free from clay, shale and organic matter, for bedding of slab and surround of underground services.
- .7 Rigid Insulation: by Section 07 21 13.
- .8 Geotextile Filter Fabric: to NBDOT W-2, Geotextile separator, non-woven, needle punched polyester.
 - .1 Acceptable Products:
 - .1 Trevira 1120,
 - .2 Terrafix 360R,
 - .3 Armtec 200.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Engineer of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If, in the opinion of Consultant materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source or

demonstrate that material from source in questions can be processed to meet specified requirements.

- .3 Advise Consultant 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 Execution

3.1 General

- .1 The General Contractor shall follow the recommendations outlined in the Geotechnical Investigation Report 2308072.001_Neqotkuk WWTF_Geo_20241101 prepared by Englobe dated November 1, 2024.
 - .1 Any discrepancies with this specification to be brought to the attention of the Engineer.
 - .2 The most stringent requirement will prevail.
- .2 The Contractor shall advise Engineer two weeks in advance of intended use of materials to allow sufficient time for sampling and testing.
- .3 Submit samples of granular materials to be used in the works when requested by the Engineer
- .4 Approval of a sample does not mean acceptance of the whole source.
- .5 Each load of material received at the job site shall be subject to all the requirements of that material.
- .6 The costs of any additional testing of backfill, as deemed necessary by the Engineer to determine the acceptability or degree of compaction shall be paid by the Contractor.
- .7 Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing weather or other conditions of the field.
- .8 At all times, the Contractor shall drag, blade or slope the fill to provide proper surface drainage.
- .9 Materials to be compacted shall be placed in layers not exceeding 300 millimetres in loose thickness or no thicker than can be adequately compacted by anticipated compaction equipment, whichever is less, and be of the proper moisture content.
 - .1 Submit technical data for compaction equipment when requested by the Engineer
- .10 Final grades shall be within 13 mm of the levels shown on the drawings.
- .11 All areas shall be sloped to avoid puddles.
- .12 It shall be the responsibility of the Contractor to repair all damage and correct all deficiencies which may result from the settlement of backfill areas.

3.2 PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Identify required lines, levels, contours, and datum.
- .3 Identify known underground, above ground, and aerial utilities. Stake and flag locations.
- .4 Notify utility company to remove or relocate utilities.
- .5 Protect above and below grade utilities which are to remain.
- .6 Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- .7 Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

3.3 STOCKPILING AND DISPOSAL

- .1 All excess material suitable for backfill must be hauled to designated areas and spread to the lines and grades as directed by the Engineer
- .2 Stockpile fill materials in areas designated by the Engineer-Architect.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .3 Protect fill materials from contamination.
- .4 Excess material unsuitable for backfill shall become the property of the Contractor and be disposed of offsite.
 - .1 It will be the Contractor's responsibility to acquire permission and all permits for the disposal site.
 - .2 Submit copies of all obtained permits to the Engineer when requested.
- .5 In case of a dispute, the Engineer shall be the sole judge as to which material is unsuitable and shall be hauled away.

3.4 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while work is in progress.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 All excavations and trenches shall be kept free from water. Dams, dykes or other work necessary for dewatering including duplicate pumps of sufficient capacity for the purpose, shall be placed at the Trade Contractor's expense.
- .4 The discharge of water from any dewatering operation shall be in accordance with the Erosion and Sedimentation Control Plan.
- .5 Protect installed foundations from freezing and frost penetration prior to completion of Work as directed by the Engineer

3.5 EXCAVATION AND TRENCHING

- .1 Excavate to lines, grades, elevations and dimensions as indicated or required.

- .2 Excavate subsoil required to accommodate building foundations, slabs-on-grade, mechanical work electrical work and construction operations as required.
- .3 Trench-excavate rock for footings to a depth 300 mm lower than the bottom of footing.
- .4 Excavation shall include the removal of all water, ice, snow and material of any nature which interferes with construction work.
- .5 Excavation must not interfere with bearing capacity of adjacent foundations.
- .6 For trench excavation, unless otherwise authorized by Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations.
- .7 All earth banks created by excavating shall be sloped at sufficient angle to prevent sliding or caving in and if they are not adequately sloped, then shoring and/or trench boxes must be used.
- .8 Earth bottoms of excavations to be rock, level, free from loose, soft or organic matter.
- .9 Notify Engineer when bottom of excavation is reached.
- .10 Obtain Engineer approval of completed excavation.
- .11 Hand trim make firm and remove loose material and debris from excavations.
- .12 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .13 Where excavation carried out exceeds the limits authorized by the Engineer the costs of such unauthorized excavation shall be borne by the Contractor as shall all necessary structural fill required to fill the void.
- .14 Removals:
 - .1 Remove obsolete buried services within 2m of foundations. Cap cut-offs.

3.6 **FILL TYPES AND COMPACTION**

- .1 Use fill of types as indicated or specified below. Compaction densities are obtained from ASTM D1557.
 - .1 Under Slab:
 - .1 From top of existing building pad to 375 mm below the top of the slab use Structural Fill.
 - .2 From 150 mm below the top of the slab to below the top of the slab use Type 1 Fill.
 - .3 Compact to 95%.
 - .2 Under Footings:
 - .1 Use Structural Fill. Footings may bear on bedrock only on approval of Engineer
 - .2 Compact to 100%.
 - .3 Exterior side of perimeter foundation walls:
 - .1 Type 2 Fill

- .2 Compact to 95%
- .4 Fill to correct over excavation:
 - .1 Use Structural Fill.
 - .2 Compact to 100%.
- .5 Fill-to-sub-grade:
 - .1 Use Type 2 Fill or approved Type 3 Fill.
 - .2 Compact to 100%.
- .6 Sand fill for subsurface trench installations: Compact to 95%.
- .7 Backfill for trenches within building area:
 - .1 Use Structural Fill or Type 1 Fill.
 - .2 Compact to 95%.

3.7 BACKFILLING

- .1 Coordinate placement of underslab vapour barrier and rigid insulation prior to backfilling.
- .2 Do not proceed with backfilling operations until Engineer has inspected and approved installations.
- .3 Proof roll slab-on-grade area with 8 tonne roller prior to placement of fill.
 - .1 Undercut any loose or soft areas and fill to sub grade level.
- .4 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .5 Do not use backfill material which is frozen or contains ice, snow or debris.
- .6 Place backfill material in uniform layers up to grades indicated.
 - .1 Compact each layer before placing succeeding layer.
- .7 Do not backfill around or over mechanical and electrical installations until Work has been reviewed by Engineer

3.8 PROTECTION

- .1 Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
- .2 Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

3.9 REPAIRS DURING WARRANTY PERIOD

- .1 During the specified guarantee period, make good any damage to slabs, walks, roads, etc., due to settlement of backfilled areas.
 - .1 All such repairs shall be made at the Contractor's expense upon notification by the Engineer

- .2 Should the Contractor fail to carry out the necessary maintenance within 5 days after receiving written instruction from the Engineer the Engineer will carry out the work and deduct the cost incurred from the money owing the Contractor.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all labour, materials and equipment necessary for excavation and for trenching sanitary mains, air piping systems, laterals and appurtenances, including bedding, backfilling, and restoration and maintenance of the trenches. If approved for re-used, the excavated and ditched material shall be stockpiled on-site at the designated area (as shown on the drawings) for re-use. Refer to Section 31 11 00 when clearing and grubbing is required prior to trench excavation.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 10 90 00 - Air Piping Systems.
- .3 Section 31 11 00 - Clearing and Grubbing.
- .4 Section 32 11 16.01 – Granular Sub-Base
- .5 Section 33 05 16 – Manholes and Catch Basin Structures
- .6 Section 33 11 16 - Site Water Utility Distribution Piping
- .7 Section 33 31 13 – Public Sanitary Utility Sewerage Piping

1.3 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422-63 (2002), Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698 (00ae1), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

- .4 New Brunswick Department of Transportation Standard Specifications (latest edition)

1.4 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
- .1 Rock: solid material in excess of 1.00 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 m³ bucket. Frozen material not classified as rock.
- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .3 Common excavation will include all material including rock excavation in all cases except for pipe trenching.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Unsuitable materials:
- .1 Weak, chemically unstable, and compressible materials.
- .2 Frost susceptible materials:
- .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422: Sieve sizes to CAN/CGSB-8.1.
- .2 Table:
- | Sieve Designation | % Passing |
|-------------------|-----------|
| 2.00 mm | 100 |
| 0.10 mm | 45 - 100 |
| 0.02 mm | 10 - 80 |
| 0.005 mm | 0 - 45 |
- .3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- .6 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.
- .7 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .8 Subgrade: the surface of mass excavation and embankment finished to lines and elevations indicated.
- .9 Install and be responsible for shoring and bracing as required.
- .10 When support of excavation is required, engage services of qualified Professional Engineer who is registered or licensed in Province of New Brunswick, to design shoring and bracing and inspect its installation.

- .11 Provide record copy of drawings signed and sealed by Professional Engineer responsible for their preparation.
- .12 Submit design and supporting data at least two weeks prior to commencing Work.
- .13 Keep design and supporting data on site.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Control:
- .3 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .2 Submit records of underground utility locates, indicating location plan of existing utilities as found in field.
- .4 Provide the Engineer with the following information before the commencement of the work and at any time during the construction at the request of the Engineer (at no cost to the Departmental Representative):
 - .1 Approved testing geotechnical firm to complete the following analyses and collect samples at the proposed site:
 - .1 Source of supply of aggregate
 - .2 Sieve analysis
 - .3 Micro-Deval Analysis (not to exceed the requirements of Table 201-1 (25%) of the NBDTI Specifications (latest edition) for Aggregate Base Material
 - .4 Freeze-thaw – (not to exceed the requirements of Table 201-1 (20%) of the NBDTI Specifications (latest edition)
 - .5 Flat and Elongated Particles (not to exceed the requirements of Table 201-1 (35%) of the NBDTI Specifications (latest edition)
 - .6 Plasticity Index (not to exceed the requirements of Table 201-1 (3%) of the NBDTI Specifications (latest edition) for Aggregate Base Material
 - .7 Standard Proctor and Optimal Moisture values.
- .5 When submitting results to the Engineer, the geotechnical testing firm must confirm that the materials meets the Specifications and that it is or is not suitable for the intended use. This is to be in letter report format submitted directly to the Engineer.
- .6 The Departmental Representative reserves the right to reject any source of supply of aggregate base on the basis of past field performance, document by the records and experience of the Departmental Representative and/or the Engineer with a specific material, regardless of compliance with physical requirements of grading limits.
- .7 Samples:
 - .1 Allow continual sampling by Engineer during production if required.
 - .2 Provide Engineer with access to source and processed material for sampling.

- .3 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.6 EXISTING CONDITIONS

- .1 Examine soil report prepared included in this document in Appendix A.
- .2 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Confirm locations of buried utilities by careful test excavations or soil hydrovac methods.
 - .6 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
 - .7 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before removing or re-routing.
 - .8 Record location of maintained, re-routed and abandoned underground lines.
 - .9 Confirm locations of recent excavations adjacent to area of excavation.

Part 2 Products

2.1 MATERIALS

- .1 Imported fill and Subgrade material for Access Road: properties to meet NBDTI Borrow 'A' material as described in Item 121 of the Standard Specifications, latest edition.
- .2 Bedding material for all pipes (sanitary sewer, culverts, and laterals outside of building footprint): material in accordance with NBDTI Standard Specifications, latest edition, Item 201 and following requirements, for normal dry trench conditions:
 - .1 Crushed stone:
 - .1 To consist of clean, hard, sound and durable uncoated particles that do not contain friable, soluble or reactive mineral, free from soft or disintegrated pieces, mud, dirt, clay, organic, frozen lumps or other deleterious materials or conditions that would make the crushed rock prone to decomposition or disintegration, or present any environmental hazard, from the presence of the parent material or its by-products, when exposed to the natural elements after placement in the work, as described in Item 201 of the NBDTI Standard Specifications (latest edition).
 - .2 The crushed rock, when tested in accordance with the N.B. Department of Transportation's method with standard laboratory sieves, will conform to Table 201-2 (Crushed Rock, 19 mm % Passing gradation) of the N.B. Department of Transportation Standard Specifications (latest edition).

.3 Other properties as noted in Clause 1.5.2.1.

- .3 Bedding material in wet trench conditions (generally termed “drainage stone”): gradation as follows:

ASTM Sieve size	% passing
20.0 mm	100 -
14.0 mm	40 - 80
10.0 mm	20 - 62
5.0 mm	0 - 20
2.5 mm	0 - 10
0.08 mm	0 - 3

- .1 Must have Engineer's approval prior to use.
- .2 Completely wrap in non-woven geotextile filter fabric in order to limit migration of fine materials into the rock.
- .3 At least 50% of the particles retained on the 5 mm sieve shall have one or more surfaces formed by the fracture of a larger particle.
- .4 The plasticity index of that fraction of the aggregate base material passing the No. 40 sieve shall not exceed 3 (three).
- .5 Provide the Engineer with the following information before the commencement of the work and at any time during the construction at the request of the Engineer (at no cost to the Departmental Representative):
 - .1 Source of supply of aggregate;
 - .2 Sieve analysis.
- .6 The analyses are to be completed by an approved testing geotechnical firm and samples must be collected at the proposed site by the same firm:
- .7 The Departmental Representative reserves the right to reject any source of supply of aggregate on the basis of past field performance, document by the records and experience of the Departmental Representative and/or the Engineer with a specific material, regardless of compliance with physical requirements of grading limits.
- .8 In certain locations where it is important to prevent the flow of water through the granular bedding material typically used for the pipelines, clay bedding material may be specified.
 - .1 The source of clay material for this use shall be approved by the Engineer.
 - .2 Provide the results of testing conducted by a certified testing laboratory to confirm that the following material specifications are met:
 - .3 Particle size range is to be determined by ASTM D2487 and 422-63. Acceptable size ranges by weight are:
 - .1 Percent fines (passing 75 um sieve): greater than or equal to 50%
 - .2 Clay content: greater than or equal to 20%
 - .3 Sand content: less than or equal to 45%
 - .4 Atterberg Limits are to be determined by ASTM D4318. Acceptable Limits are:
 - .1 Plasticity Index (PI): greater than or equal to 20%
 - .2 Liquid Limit (LL): greater than or equal to 30%

- .5 Laboratory hydraulic conductivity shall be determined by ASTM 5084 on at least three (3) samples that have been compacted to 98% standard Proctor maximum dry density (as per ASTM D 698). The hydraulic conductivity shall not exceed 5×10^{-10} m/s for the material to be suitable.
- .4 Common backfill: selected material from excavation or other sources, approved by Engineer for use intended, unfrozen and free from roots, brush, organic material, rocks larger than 200 mm, cinders, ashes, sods, refuse or other deleterious materials.
- .5 Imported fill material shall be a sound, durable, granular material free from clay, frozen lumps, organic or deleterious matter and conform to the following gradation limits:

ASTM Sieve size	% passing
112 mm	100 -
80 mm	95 - 100
20 mm	15 - 100
5 mm	0 - 80
0.080 mm	0 - 10

- .6 Unshrinkable fill: proportioned and mixed to provide:
- .1 Portland cement: CSA Standard CAN3-A5-M, Type 10 or Type 30 (High Early Strength for winter construction).
- .2 Supplementary cementing materials, when permitted, shall conform to the requirements of CSA Standard CAN3-A23.5-M.
- .3 Fine and coarse aggregate: CSA Standard CAN3-A23.1-M. The gradation shall conform to Table 1 of the CSA Standard for 10 mm minus.
- .4 Mixing water: CAN3-A23.1-M
- .5 Air-entraining admixtures: CSA Standard CAN3-A266.1-M.
- .6 Mix Design for Non-compressible Fill
- .1 Maximum cement content: 25 kg/m³
- .2 Maximum strength at 28 days (measured in accordance with CAN3-A23.2-9C): 0.40 MPa
- .3 Slump (measured in accordance with CAN3-A23.2-5C): 150-200 mm
- .4 Air content (measured in accordance with CAN3-A23.2): 4% - 6%
- .7 Prior to the production of unshrinkable fill for use, provide to the Departmental Representative a certificate from the Departmental Representative's testing company stating that the fill to be supplied conforms to the above requirements.
- .7 Sand (bedding for conduits outside of building): hard, granular, sharp material, well-graded from coarse to fine, free of impurities, chemicals or organic matter, and graded as follows:

Sieve Designation (mm)	Cumulative % Passing
5 mm	100
0.16 mm	0-5

- .8 Granular base and sub-base material for trench restoration shall conform to Section 32 11 23 Aggregate Base Courses and Section 32 11 16.01 Granular Sub-Base and NBDTI Standard Specification Section 203.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Engineer of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If, in the opinion of Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source or demonstrate that material from source in questions can be processed to meet specified requirements.
- .3 Advise Engineer 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION/PROTECTION

- .1 Protect existing features in accordance applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Engineer approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

- .5 Protect buried services that are required to remain undisturbed.

3.4 STOCKPILING

- .1 Stockpile fill materials in areas designated by Engineer.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.5 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Engineer's review and approval details of proposed dewatering or heave prevention methods.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures and in a manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.
- .7 Construct any temporary ditches, berms, sumps, etc. required and provide pumps, hoses, power supplies, etc., as required to keep the site and all excavations acceptably dewatered to enable the work to be done properly and without delay.
 - .1 This includes dewatering from all sources, including precipitation, runoff, snowmelt, groundwater, pipe flows, etc. This also includes maintaining the site properly dewatered for the installation of the HDPE liner in the WWTP.
 - .2 Maintain site work and site ditching to continuous drainage.
 - .3 Disposed of water pumped from the trench by directing flows to sedimentation ponds prior to discharge into adjacent ditches and watercourses.
 - .4 Dewatering shall not be measured for separate payment but is considered incidental to the work.

3.6 EXCAVATION

- .1 Install "bump ahead" and "bump" signs at all trenches in roadways. Signs are to remain until final lift of asphalt is completed.

- .2 Repair removed or damaged pavement or surfaces beyond the limits specified above, at no expense to the Departmental Representative.
- .3 At all road crossings and other points as directed by the Engineer, bridge trenches in a secure manner, and in such a manner as to prevent any serious interruption of traffic upon the roadway or sidewalks and to afford the necessary access to public and private premises.
 - .1 Under no circumstances will temporary dumping of material or stockpiling of material on the surface of the road be permitted during construction of the works.
- .4 At the end of each working day, restore all disturbed drainage ditches and re-install the culvert pipes that were removed or disturbed during the work in progress, incidental to the work.
- .5 Excavate to lines, grades, elevations and dimensions as indicated.
- .6 Excavation must not interfere with bearing capacity of adjacent foundations.
- .7 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .8 Install barricades on both sides of any area where the depth of the trench is greater than 3000 mm from the adjacent original ground surface. These barricades will not be measured for separate payment but shall be considered incidental to the work.
- .9 For trench excavation, unless otherwise authorized by Engineer, do not excavate more than 20 m of trench in advance of installation operations.
 - .1 Excavate all trenches according to the requirements of the General Regulation 91-191 under the Occupational Health and Safety Act of the Province of New Brunswick, latest revision.
 - .2 A certified trench box or cage may be required in all pipeline installations in order to keep the amount of surface restoration to a minimum.
 - .3 Multiple trench boxes or cages may be required in all pipeline installation exceeding the single trench box height.
 - .4 The requirement for trench box will be as shown on the drawings or as identified separately herein.
 - .5 Backfill all trenches at the end of the day unless special permission is given by the Engineer to leave them open and that all traffic control and safety requirements are met.
 - .6 Protect trenches not backfilled at night with Jersey barriers on the traffic side and an acceptable continuous barricade on the side away from the roadway. These barricades will not be measured for separate payment but shall be considered incidental to the work.
 - .7 If work is stopped on the whole or any part of the trench and the trench is left open for an unreasonable length of time in advance of the placing of the pipe, when directed by the Engineer, refill such trench or part thereof at his own expense, and will not again open such trench or part thereof until he is ready to proceed with construction.

- .8 If the Contractor should refuse, neglect, or fail to refill completely such trench within two hours after receipt of notice in writing to do so, the Engineer may order the refilling of the trench with the cost and expense thereof to be charged to the Contractor and the Departmental Representative will recover the amount of such cost and expense out of any monies due or to become due to the Contractor. The Engineer may stop the excavation and any other portion of the work and require the Contractor to complete the system and backfilling up to such a point as he may direct. The Contractor will not become entitled to demand or receive any allowance or compensation other than an extension of time of completion for as many days as the Engineer may determine.
- .9 Protect all excavations during the course of the day's work.
- .10 Width of trench at pipe depth in common excavation: 600 mm to no more than 900 mm greater than the outside diameter of the pipe.
 - .1 Trench width for multiple pipes in a common trench: one pipe plus a minimum of 300 mm clearance between service lateral pipes, and a minimum of 600 mm for main pipes, plus the width of the additional pipes.
- .11 Remove and replace unstable or unsuitable soil within the limits of the specified trench excavation that cannot be re-used for backfill and replace with suitable material from the pipe trench excavation in 300 mm layers compacted to 95% of maximum dry density as determined by ASTM D 698.
 - .1 Replace unsuitable soil removed with suitable material from the pipe trench, as determined by the Engineer, included in the pipe price.
 - .2 Extra payment will only be made where it is necessary to import replacement fill material to the site.
- .12 Excavate trench to the depth required for placing of the pipe bedding material.
- .13 Excavate and remove unsuitable material where the bottom of the trench at sub-grade is found to be unstable or unsatisfactory, to the width and depth as directed by Engineer.
- .14 Dewater trench for the proper placing of the bedding material and pipe.
- .15 Restore sub-grade by backfilling with suitable material from the trench excavation, as determined by the Engineer or with pipe bedding material in 150 mm layers compacted to 95% of maximum dry density as determined by ASTM D 698.
- .16 Widen trenches where required and as appropriate to allow adequate clearances for the installation of manholes and other appurtenances.
- .17 In locations where the trench must be excavated across or along paved surfaces, remove pavement and road surfaces as a part of the trench excavation. The amount removed will depend upon the width of trench specified for the installation of the pipe. The width of pavement removed along the normal trench will not exceed the required width of the trench specified by more than 150 mm on each side as laid out on site.
- .18 Comply with the trenching safety requirements of New Brunswick Regulation 91-191 under the Occupational Health and Safety Act, regardless of marked width of proposed pavement removal.

- .10 Where excavation depths and/or soil conditions require a trench width greater than 4 m at the surface, limit asphalt removal to 4 m and use a trench box (cage).
 - .1 Ensure the height of the trench box is sufficient to keep the top width of the trench less than 4 m wide while meeting trench safety requirements.
- .11 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Engineer.
- .12 Restrict vehicle operations directly adjacent to open trenches.
- .13 Dispose of surplus and unsuitable excavated material in approved location on site.
- .14 Do not obstruct flow of surface drainage or natural watercourses.
- .15 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .16 Notify Engineer when bottom of excavation is reached.
- .17 Obtain Engineer approval of completed excavation.
- .18 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Engineer.
- .19 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with approved fill material compacted to not less than 100% maximum dry density as determined by ASTM D 698.
 - .2 Fill under other areas with approved fill material fill compacted to not less than 95 % maximum dry density as determined by ASTM D 698.
- .20 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Engineer.
- .21 Use proper and acceptable methods for excavation which will at all times be subject to the Engineer's approval and will employ such safe slope angles, shores, piling, bracing, etc., as may be necessary for the protection of workmen. Earth slides or slips and over excavation together with any subsequently required fill attributable to the negligence or carelessness of the Contractor will not be considered as part of the work.
- .22 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .23 Restrict vehicle operations directly adjacent to open trenches.
- .24 Do not obstruct flow of surface drainage or natural watercourses.

3.7 REMOVAL AND DISPOSAL OF ASPHALT AND CONCRETE

- .1 Cut and remove all asphalt or concrete as marked or specified, within the limits of the proposed work.

- .2 Cutting of asphalt must be done by using a saw to give a square, undamaged edge for bonding. UNDER NO CIRCUMSTANCES WILL RIPPING OR CUTTING OF ASPHALT BY EXCAVATION MACHINERY BE ALLOWED. Cut asphalt parallel to the centerline of the trench unless otherwise directed by the Engineer.
 - .1 This work must be done in a manner which leaves the sub-base undisturbed insofar as possible.
- .3 Where concrete sidewalk has been overlayed by a layer of asphalt, the removal will be considered as removal of concrete only.
- .4 Provide traffic control and signage during the cutting and removal process to protect the public and ensure the work is carried out in a safe manner.
- .5 Place barricades and warning signs shall be placed around the work area.
- .6 Unless otherwise specified or directed by the Engineer, all asphalt and concrete materials removed under this Section will become the property of the Contractor and shall be properly loaded, transported and disposed of incidental to the work.

3.8 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated.
- .2 Bedding methods and materials must conform to the pipe manufacturer's requirements for all materials that are being bedded.
- .3 The use of excavated material for bedding is strictly forbidden unless otherwise directed and approved in writing.
- .4 Place bedding and surround material in unfrozen condition.
- .5 Place bedding in layers to a depth of 150 mm or 300 mm in rock and compacted to a density of 95% of maximum as determined by ASTM D 698.
- .6 Place bedding in 150 mm lifts to a minimum height of 300 mm over the top of the pipe. The bedding shall be tamped or rodded by hand under the haunches of the pipe upon placing of the first lift. Place and compact succeeding layers to a density 95% of maximum as determined by ASTM D 698.
- .7 Pipe-bedding material shall not be placed in water or trenches having soft and unstable bottom conditions.
 - .1 Where water from any source is found in the trench, provide pumps, hoses, power supplies, etc., as required to keep the trenches acceptably dewatered during the work. Dispose of water pumped from the trenches in an environmentally acceptable method. Dewatering will not be measured for separate payment but is considered incidental to the work.
- .8 Compacting equipment for pipe bedding material shall be suitably sized so as not to cause damage to the pipe or movement of the pipe due to impact and vibration and of ample size to provide the degree of compaction specified.
- .9 The completed bedding shall meet the requirements for a Class "B" bedding, on PVC, Corrugated Metal Pipe, Ductile Iron and all lateral piping and for a modified Class "B" bedding on concrete pipe.

3.9 BACKFILLING

- .1 Do not proceed with backfilling operations until Engineer has inspected and approved installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Clean and stockpile or dispose of excess backfill material at the end of each day's work.
- .5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .6 Where the excavated material is unsuitable for ordinary backfill, dispose of this material in accordance with the General Conditions, and backfill with imported granular material upon written order from the Engineer.
 - .1 Backfill trenches with imported granular material in layers not exceeding 300 mm after compaction. Compact to 95% of the maximum density as determined by ASTM D 698.
- .7 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading.
- .8 Place unshrinkable fill in areas as indicated.
 - .1 When the Engineer designates that unshrinkable fill is to be placed as backfill when a utility has been repaired or installed, bedded and protected with sand as required, fill the trench with non-viscous, non-compressible fill, up to the underside of pavement materials.
 - .2 When unshrinkable fill is being used in a watermain trench, place full-width horizontal 50 mm polystyrene board insulation at approximately 100 mm above buried pipe.
 - .3 Consolidate and level unshrinkable fill with internal vibrators.
- .9 Install perimeter drainage and filter fabric in backfill as indicated.
- .10 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 approved by the Engineer. If any work is covered without approval of the Engineer it must, if required, be uncovered for examination.

3.10 RESTORATION

- .1 Conduct and confine all construction operations within the limits of the work as shown on the Drawings or as laid out by the Engineer.
- .2 The entire site and all properties, facilities, structures, fences, shrubs, lawns, trees, signs, driveways, sidewalks, ditches, culverts, appurtenances, etc. affected by the work must be

- fully restored to original or better condition before issuance of the "Certificate of Final Acceptance".
- .3 Replace topsoil as indicated.
 - .4 Reinstall lawns to elevation which existed before excavation. Hydraulic seeding shall be as required by Section 32 92 19.16.
 - .5 Reinstall pavements disturbed by excavation to thickness, structure and elevation which existed before excavation.
 - .6 Clean and reinstall areas affected by Work as directed by Engineer.
 - .7 Clean-up and re-establish ditches disturbed during the installation of pipelines at no extra cost to the Departmental Representative.
 - .8 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
 - .9 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.
 - .10 Trench maintenance: Maintain all trenches until issuance of the "Certificate of Final Acceptance".
 - .1 Maintain trenches in travelled roads with granular base course only until such time as asphalt can be placed to allow a smooth travel surface.
 - .2 Inspect trench backfill conditions and conduct a weekly program of trench maintenance or daily when weather or traffic conditions dictate, until issuance of the "Certificate of Final Acceptance".
 - .11 Dust Prevention:
 - .1 Assume responsibility for dust prevention on any street or site where works have been or are being carried out, until such works are restored to original condition or upon issuance of the "Certificate of Final Acceptance".
 - .2 Dust prevention includes sweeping of paved roadways and/or sidewalks and flushing of same, when deemed necessary by the Engineer and at the end of each working day. All methods of dust prevention must be approved by the Engineer.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all labour, materials, equipment and incidentals necessary to complete the installation of a chain link fence, and construction security fence, in accordance with the Drawings.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 03 30 00 – Cast-in-Place Concrete.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A90/A90M-09, Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - .3 A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A123/A123M-09, Standard Specification for Zinc (Hot Dip Galvanized) coatings on Iron and Steel Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
 - .5 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 CSA International
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A3000-08, Cementitious Materials Compendium.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit, in advance of the commencement of the work, the manufacturer's certification that the materials supplied meet the specified requirements, and the

manufacturer's recommended procedures for installation and instructions for handling.

- .2 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 Common Product Requirements and 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 in accordance with manufacturer's recommendations.
 - .2 Store and protect fence and gate materials from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Chain-link fence fabric: to CAN/CGSB-138.1.
 - .1 Type 1, Class A, medium style, Grade 2.
 - .2 Height of fabric: as indicated.
 - .3 50 mm diamond mesh pattern, constructed of #9 gauge steel wire.
 - .4 Hot-dipped galvanized after fabrication or woven from electro-galvanized wire with an average weight of zinc coating not less than 366 gm/sq.m. (1.2 oz/sq. ft.) of uncoated surface, Type 1, Class A or B, Style 2, 3.5 mm (9ga.) medium.
 - .5 Bottom selvedge: knuckled and reinforced with #9 gauge electro-galvanized steel wire.
 - .6 The top selvedge of the fabric shall be twisted.
- .3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.
- .4 Line posts: 60 mm OD Schedule 40, 4.0 mm minimum wall thickness, minimum mass of 5.45 kg/m, scale-free, hot-dipped galvanized tubular steel pipe.
- .5 Terminal posts (end and corner posts): 89 mm OD, Schedule 40, 5.5 mm minimum wall thickness, minimum mass of 11.28 kg/m, scale free, hot-dipped galvanized steel pipe, complete with stretching bands and bars for attaching

fabric to the post and bands for attaching the brace equipment. Posts shall be provided with caps without projections to match the overhand tops.

- .1 For gate panels over 8.4 m² but less than 13.0 m², a 114 mm OD Schedule 40 post is required.
- .2 For gates over 13.0 m², a 168 mm OD Schedule 40 post is required.
- .6 Top rails: 43 mm OD, schedule 40, 3.6 mm wall thickness, minimum mass of 3.38 kg/m, scale free, hot-dipped galvanized steel pipe connected at the joints with sleeves that allow for construction and expansion.
- .7 Tension wire: to CAN/CGSB-138.2, single strand, galvanized steel wire.
- .8 Tie wire fasteners: aluminum wire.
- .9 Tension bar: to ASTM A653/A653M, 5 x 20 mm minimum galvanized steel.
- .10 Fittings and hardware: to CAN/CGSB-138.2, hot-dipped galvanized steel.
- .1 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.
- .2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.
- .3 High strength aluminum alloy overhang tops to provide waterproof fit, to hold top rails.
- .4 Projection of approximately 300 mm long to project from fence at 45 degrees above horizontal.
- .5 Turnbuckles to be drop forged.
- .6 Braces: brace end and corner posts by a diagonal brace of the same material as the top rail, from the post to a concrete encased footing, as shown on the Drawings. Corner posts shall be braced in both directions. All other locations shall be braced horizontally between posts using the same material as the top rail.
- .11 Organic zinc rich coating: to CAN/CGSB-1.181 MPI #18.

2.2

FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1 Grade 2.
 - .2 For pipe: 550 g/m² minimum to ASTM A90.
 - .3 For other fittings: to ASTM A123/A123M.

Part 3

Execution

3.1

EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Engineer.
- .2 Inform Engineer of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.
- .4 Assume responsibility to verify all dimensions, details and requirements of the work prior to installation, in order to provide a quality finished fence.

3.2 PREPARATION

- .1 Grading:
 - .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Compact the ground along the fence line before starting fence erection.
 - .2 Provide clearance between bottom of fence and ground surface of 30 mm to 75 mm.
 - .3 All fence grades and line shall be subject to the approval by the Engineer.

3.3 ERECTION OF FENCE

- .1 Securely install all fittings and fence components in accordance with the fence manufacturer's recommendations.
- .2 Erect fence along lines as indicated in the field and to CAN/CGSB-138.3.
- .3 Details of construction are to be in accordance with the Drawings, which forms part of this specification.
- .4 Excavate post holes to dimensions indicated.
- .5 Space line posts 3 m apart, measured parallel to ground surface, and with uniform spacing within each straight run unless noted otherwise on drawings.
- .1 If an obstruction or major ground elevation difference prevents placing a post at 3 m from an adjacent post, place post not less than 2.4 m from the next post and in no case more than 3 m.
- .6 Install additional straining posts at sharp changes in grade and where directed by Engineer.
- .7 Install end posts and gate and corner posts according to site plan, unless directed otherwise by the Engineer.
- .8 Install corner post where change in alignment exceeds 10 degrees or change in elevation exceeds 1 in 3.
- .9 Install end posts at end of fence and at buildings.
- .1 Install gate posts on both sides of gate openings.
- .2 If end or gate post adjoins a building wall, install post as close to wall as possible.

- .10 Provide concrete footings for all corner, end, gate posts and diagonal braces, except as may be noted otherwise on the Drawings. Line posts will not be set in concrete unless otherwise indicated.
- .1 Use forming tubes in granular soils and any other location where the hole does not remain open to the required dimension.
 - .1 Backfill around form tubes with excavated material except in clay or rock where the footing shall be backfilled with gravel.
 - .2 Tamp backfill in layers not greater than 200 mm thick.
- .2 Minimum depth: 1500 mm.
- .3 Minimum diameter: 300 mm.
- .4 Dewater footing excavations before concrete is placed.
- .11 Place concrete in post holes then embed posts into concrete to depths indicated. Embed diagonal brace posts to minimum 915 mm depth.
 - .1 Center posts in concrete, in line within 6 mm.
 - .2 Extend concrete 50 mm above ground level and slope to drain away from posts.
 - .3 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
 - .4 Install gate posts at same elevation regardless of ground contour.
 - .5 When the concrete in the footings is set, install post bands from the top without spreading.
- .12 Line posts and any other posts not set in concrete: drive posts into the soil to a depth of 915 mm.
 - .1 Install posts plumb and in line within 6 mm.
 - .2 If the presence of rock or cobbles prevents driving posts into the soil without damage, excavate holes for the posts.
 - .3 Backfill with excavated material, except in clay or rock, where backfill material will be gravel.
 - .4 Tamp backfill in layers 200 mm thick and compact to 95% of maximum dry density to ASTM D698.
- .13 Install fence fabric after concrete has cured, minimum of 5 days.
- .14 Install privacy slats as per manufacturers recommendations.
- .15 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface at inclination as indicated.
 - .1 Install braces on both sides of corner and straining posts in similar manner.
 - .2 Install diagonal brace at end and corner posts, from the post to a concrete encased footing, as shown on the Drawings. Install horizontal brace between posts at other locations as determined in the field by the Engineer.
- .16 Install overhang tops and caps.

- .17 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .18 Install bottom tension wire outside the line posts and inside the fabric at the mid-level of the bottom diamond, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands closed wire ring or twisted wire tie.
- .19 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 300 mm intervals. Install fabric on the outside of line posts, top rail and bottom tension wire
- .1 Knuckled selvedge at bottom.
- .2 Twisted selvedge at top.
- .3 The fabric shall be continuous between 89 mm dia. posts. If necessary to join two (2) lengths of fabric, splice using existing fabric wires without altering the diamond mesh pattern. Splicing by overlap will not be permitted.
- .4 Break fabric at each end, gate and corner post, and secure to the post by a draw bar and a minimum of six 6 evenly spaced offset bands.
- .20 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals 500 mm intervals on the top rail and 400 mm intervals on line posts.
- .1 Give tie wires minimum two twists.
- .2 The top of the fabric shall not be below the top of the top rail.
- .21 Install grounding rods as indicated.
- .22 Protect fence from damage during the construction period, and assume responsibility for any repairs required throughout the warranty period at no additional cost to the Owner.

3.4 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged.
- .1 Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This Section includes the supply of all labour, equipment and materials topsoiling of property for the purposes of establishing or restoring ground cover. Property will be restored immediately following the site works, and as determined by the Engineer.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 Payment Procedures.
- .2 Section 32 92 19.16 Hydraulic Seeding.

1.3 REFERENCES

- .1 Agriculture and Agri-Food Canada
 - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment
 - .1 PN1340-2005, Guidelines for Compost Quality.

1.4 DEFINITIONS

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Inform the Engineer of proposed source of topsoil and sod before work begins.
 - .3 Quality control submittals :
 - .1 Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in PART 2 - SOURCE QUALITY CONTROL.
 - .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
-

Part 2 Products

2.1 TOPSOIL

- .1 Topsoil recovered from other Contract work and approved by the Engineer shall be used before any imported topsoil material is brought to the site.
- .2 Topsoil for seeded areas: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70 % sand, minimum 7 % clay, and contain 2 to 10 % organic matter by weight.
 - .2 Contain no toxic elements or growth inhibiting materials, admixture of subsoil, refuse, roots, stumps, sod, and stones larger than 20 mm.
 - .3 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .4 Consistence: friable when moist.
 - .5 pH: 6.0 to 7.0.
 - .6 Topsoil may be salvaged and stockpiled from other Contract work if approved by the Engineer.
 - .1 If screening is required to remove objectionable material this shall be done incidental to the work. Topsoil recovered from other Contract work shall not be measured for separate payment.

2.2 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Fertility: major soil nutrients present in following amounts:
 - .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
 - .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
 - .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
 - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - .6 Ph value: 6.5 to 8.0.
 - .2 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.
 - .1 Approved product: Scotts Turfbuilder, Nutrite Nutri S Starter Fertilizer, Nu-Gro Turf Starter or approved equivalent.
 - .2 Formulating ratio of:
 - 2:4:1 80% SCU for spring and early fall planting (6-12-3)
 - 1:4:1 100% SCU for late fall planting (6-24-6)
-

- .3 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.
- .4 Sand: washed coarse silica sand, medium to coarse textured.
- .5 Limestone:
 - .1 Ground agricultural dolomitic limestone containing total 85% carbonates.
 - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .6 Erosion control agent: emulsified asphalt to CAN/CGSB-16.2, Type 2 or polyvinyl acetate polymer.
- .7 Water: clean, fresh and free from impurities that inhibit plant growth.
 - .1 Provide water at no cost to the Owner.

2.3 SOURCE QUALITY CONTROL

- .1 Advise Engineer of sources of topsoil manufactured topsoil to be utilized with sufficient lead time for testing.
- .2 Contractor is responsible for amendments to supply topsoil as specified.
- .3 Soil testing by recognized testing facility for PH, N, P and K (nitrogen, phosphorous, potassium), and organic matter. If test results indicate amendments are required, work will not commence until corrected and accepted by the Engineer.
- .4 Testing of topsoil will be carried out by testing laboratory designated by Engineer.
 - .1 Soil sampling, testing and analysis to be in accordance with Provincial standards.

Part 3 Execution

3.1 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct. If discrepancies occur, notify Engineer and do not commence work until instructed by Engineer.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Grade areas adjacent to existing finished areas to make a smooth connection with these areas and to ensure proper drainage across finished surfaces.
- .4 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface.

- .3 Dispose of removed material off site.
- .5 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
 - .1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.2 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil on dry, unfrozen ground free of snow, ice, standing water or very wet and soft conditions after Engineer has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 50 mm below finished grade.
- .4 Spread topsoil minimum depths (after settlement) indicated on drawings.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.
- .6 Fine grade topsoil to lines and elevations indicated, leaving surface smooth and uniform with a fine loose texture. Obtain approval of topsoil grade and depth before proceeding with seeding.

3.3 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Engineer.
 - .1 Leave surfaces smooth, uniform and firm against deep footprinting.

3.4 ACCEPTANCE

- .1 Engineer will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.5 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required as directed by Engineer.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This Section includes the supply of all labour, equipment and materials for hydraulic seeding of property for the purposes of establishing or restoring ground cover. Property will be restored immediately following the installation of the pipe systems, new building construction as determined by the Engineer.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 31 23 33.01 Excavating, Trenching and Backfilling.
- .3 Section 31 92 19.13 – Topsoil Placement and Grading

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule hydraulic seeding to coincide with preparation of soil surface.
 - .2 Schedule hydraulic seeding between dates recommended by New Brunswick Department of Transportation specifications.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 03 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for seed, mulch, tackifier, fertilizer, liquid soil amendments and micronutrients.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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

1.5 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Qualifications:
 - .1 Landscape Contractor: to be a Member in Good Standing of New Brunswick Horticultural Trades Association.
 - .2 Landscape Planting Supervisor: Landscape Industry Certified Technician with Softscape Installation designation.

- .3 Landscape Maintenance Supervisor: Landscape Industry Certified Technician with Turf Maintenance designation.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Labelled bags of fertilizer identifying mass in kg, mix components and percentages, date of bagging, supplier's name and lot number.
 - .2 Inoculant containers to be tagged with expiry date.
 - .3 Prepared materials such as seed, fertilizer, lime, binder, dyes, etc., brought to the site shall be brought to the site in their factory containers/bags clearly marked as to material and mix components.
- .3 Storage and Handling Requirements:
 - .1 Store fertilizer in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.7 WARRANTY

- .1 For seeding, 12 months warranty period is extended to 1 full growing season.
- .2 Contractor hereby warrants that seeding will remain free of defects for 1 full growing season.
- .3 End-of-warranty inspection will be conducted by Engineer.

1.8 SCHEDULING

- .1 Schedule hydraulic seeding to coincide with preparation of soil surface.

Part 2 Products

2.1 MATERIALS

- .1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.
 - .1 Grass mixture: "Certified", "Canada No. 1 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations" and having a minimum germination of 75% and minimum purity of 97%. Provide Pure Live Seed (PLS) weight certificates for germination and purity.
 - .1 Grass seed mixture: Low maintenance seed mixture:
 - .1 40% Creeping Red Fescue.
 - .2 20% Hard Fescue.

- .3 15% Canada Blue Grass.
 - .4 10% Alsike or White Clover.
 - .5 10% Annual Rye Grass.
 - .6 5% Red Top.
 - .2 Native wetland seed mix: appropriate to Region and sourced in consultation with NBDELG.
- .2 Mulch (for seeding): specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with following properties:
 - .1 Type I mulch:
 - .1 Made from wood cellulose fibre.
 - .2 Organic matter content: 95% plus or minus 0.5%.
 - .3 Value of pH: 6.0.
 - .4 Potential water absorption: 800-900% (by weight).
 - .2 Type II mulch:
 - .1 Made from newsprint, raw cotton fibre or straw, processed to produce fibre lengths of 15 mm minimum and 25 mm maximum. Greater proportions of ingredients to be straw.
- .3 Straw or hay mulch (for ground cover or residual seeding): unprocessed form such as bales or rolls of straw or hay in air-dry condition, or other similar material approved by the Engineer, and is substantially free of noxious weed seeds and objectionable foreign matter.
- .4 Tackifier: water dilutable, liquid dispersion containing polyvinyl acetate terpolymer emulsion or colloidal polyacharide tackifier, adhering to mulch during manufacturing, non-toxic and without germination or growth inhibiting factors.
- .5 Water: free of impurities that would inhibit germination and growth.
- .6 Fertilizer:
 - .1 To Canada "Fertilizers Act" and Regulations.
 - .2 Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.
- .7 Inoculants: inoculant containers to be tagged with expiry date.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for hydraulic seeding in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.

- .2 Inform Engineer of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLERS

- .1 Use installers members in Good Standing of New Brunswick Horticultural Trades Association.

3.3 PROTECTION OF EXISTING CONDITIONS

- .1 Protect structures, signs, guide rails, fences, plant material, utilities and other surfaces not intended for spray.
- .2 Immediately remove any material sprayed where not intended as directed by Engineer.
- .3 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water.
- .4 Fine grade areas to be seeded free of humps and hollows.
 - .1 Ensure areas are free of deleterious and refuse materials.
- .5 Cultivate areas identified as requiring cultivation to depth of 25 mm.
- .6 Ensure areas to be seeded are moist to depth of 150 mm before seeding.
- .7 Obtain Engineer's approval of grade and topsoil depth before starting to seed.
- .8 Lime soil prior to hydroseed application. Perform soil test to determine pH and other deficient nutrients. Apply additives as per manufacturer's recommendations to correct deficiencies.

3.4 FERTILIZING PROGRAM

- .1 Fertilize prior to fine grading applying fertilizer equally distributed in accordance with the agreed program between Contractor and Engineer.
- .2 Fertilize during establishment and warranty periods applying fertilizer equally distributed in accordance with agreed program between Contractor and Engineer.

3.5 PREPARATION OF SLURRY

- .1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Engineer. Supply equipment required for this work.
- .2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
- .3 After materials are in seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.6 HYDRAULIC SEEDING EQUIPMENT:

- .1 Ensure seed is placed under supervision of certified Landscape Planting Supervisor.
- .2 Slurry tank.

- .1 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.
 - .2 Pumps capable of maintaining continuous non-fluctuating flow of solution.
 - .3 Supplied with not less than 6 spray pattern nozzles.
 - .4 Capable of seeding by 50 m hand operated hoses and appropriate nozzles.
 - .5 Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".
 - .6 Equipped with flotation tires so no tire depressions exceeding in 12 mm depth result.
- .3 Slurry mixture applied per hectare.
 - .1 Seed: Grass mixture: Application rate 150 kg/ha for Seed Type 1 and 245 kg/ha for Seed Type 2 or as recommended by manufacturer.
 - .2 Mulch: 1250 kg/ha depending on the slope and as recommended by the supplier.
 - .3 Tackifier: 20 kg, or as recommended by manufacturer.
 - .4 Water: Minimum 30,000 L or quantity as required to form slurry in accordance with manufacturer's recommendations.
 - .5 Fertilizer: apply at rate of 600 kg/ha, ration 5-20-20 or as recommended by the supplier.
- .4 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
 - .1 Using correct nozzle for application.
 - .2 Using hoses for surfaces difficult to reach or irregular to travel upon and to control application.
- .5 Blend application 300 mm into adjacent grass areas or previous applications to form uniform surfaces.
- .6 Re-apply where application is not uniform.
- .7 After hydraulic seeding has been applied, roll the area with a roller having a mass of 50 kg/m of width. The roller shall be pulled by equipment with high flotation tires so that no ruts, depressions, or other damage to the work surface results.
- .8 Remove slurry from items and areas not designated to be sprayed.
- .9 Obtain approval from Engineer prior to carrying out hydraulic seeding after the week of September 30th.
- .10 Hydraulic seeding done between May 1st and Labour Day must produce a satisfactory growth over at least 95% of the area hydroseeded in the growing season of that year.
 - .1 Reseed areas of poor or no growth which exceed five percent (measured cumulatively) of the area hydroseeded.

- .11 Cover all hydroseed with blown straw or hay if hydroseed is being applied after Labour Day. Straw / Hay rate: 4500 kg/ha. Only straw shall be used for wetland applications; hay will not be permitted over wetland seeding.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
 - .1 Clean and reinstate areas affected by Work.

3.8 PROTECTION

- .1 Protect seeded areas from trespass until plants are established.
- .2 Remove protection devices as directed by Engineer.

3.9 STRAW / HAY MULCH EROSION CONTROL

- .1 Mulch seeded areas within forty-eight 48 hours of the seeding having been placed. Mulch unseeded areas within forty-eight 48 hours of being directed by the Engineer to do so.
 - .1 Only straw shall be used for wetland applications; hay shall not be used over wetland seeding.
- .2 Apply mulch uniformly to the designated areas at a rate of 4500 kg/ha ($\pm 15\%$). Thin or break apart and disperse lumps and thick clumps of mulch.
- .3 Apply binder in accordance with the manufacturer's recommendations. Add sufficient environmentally acceptable green dye to the mixture to confirm application.
- .4 When applied the mulch shall form an absorptive mat, which will allow moisture to percolate into the underlying soil.
- .5 Mulch may be combined with the other materials and distributed in a single operation using a hydroseeding unit, or the mulch may be applied separately and the coloured binder solution sprayed on the placed mulch within 48 hours of its placement.
- .6 Rough ground and/or steep slopes require more mulch and binder per hectare than finished and/or flatter ground. Adjust material application quantities as required to ensure that the specified application rates are achieved.
- .7 Take reasonable care to prevent application of overspray onto structures or unintended areas. Immediately remove any overspray applications on structures or areas not intended for coverage, in a method approved by the Engineer.
- .8 Maintenance:

- .1 Maintain the mulched area under the maintenance requirements of this contract until the work has been accepted by the Owner ("Date of Substantial Completion") or until no longer required as determined by the Engineer.
- .2 Monitor and maintain the mulched area by repairing all damaged mulch and by re-mulching bare spots resulting from the wind, water or other causes. This will include adding additional mulch as required, using the procedures as specified herein.

3.10 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Ensure maintenance is carried out under supervision of certified Landscape Maintenance Supervisor.
- .2 Perform following operations from time of seed application until acceptance by Engineer.
- .3 Grass Mixture:
 - .1 Monitor all seeded areas during the maintenance period. Water grassed and seeded areas adequately to assure continued growth. Control watering to prevent washouts. Water will not be provided by the Owner.
 - .2 Mow grass to height of 60 mm when it first reaches a height of 80 mm. Clippings which could smother grass shall be removed.
 - .3 Do not cut when the site is so wet that mowing will cause ruts in the soil.
 - .4 Fertilize grassed areas after first mowing using a turf starter type fertilizer, at the manufacturer's recommended rate.
 - .5 Carry out subsequent cuttings of the seeded areas until the work has been accepted by the Owner "Date of Substantial Completion".
 - .6 If, within eight (8) weeks of placement, any seeded areas fail to grow acceptable in the opinion of the Engineer, they shall be re-seeded by the Contractor under the maintenance requirements of this Contract.

3.11 ACCEPTANCE

- .1 Seeded areas will be accepted by Engineer provided that:
 - .1 Plants are uniformly established and seeded areas are free of rutted, eroded, bare or dead spots.
 - .2 Areas have been mown at least twice.
 - .3 Areas have been fertilized.
- .2 Areas seeded in fall will achieve final acceptance in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.12 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Repair and reseed dead or bare spots to satisfaction of Engineer.

- .2 Mow areas seeded, remove clippings that will smother grassed areas, as directed by Engineer, minimum of two times.
- .3 Fertilize seeded 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 At the end of the warranty period, repeat items 2-3.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section specifies requirements for supplying, producing and placing gravel or quarried stone as a granular sub-base to lines, grades and typical cross sections indicated on plans or as directed by the Engineer.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 32 23 33.01 – Excavating, Trenching and Backfilling.
- .3 Section 32 11 23 – Aggregate Base Courses.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C131-06, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .6 ASTM D1883-07e2, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .7 ASTM D4318-10, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide the Engineer with the following information before the commencement of the work and at any time during the construction at the request of the Engineer (at no cost to the Owner):
 - .1 Approved testing geotechnical firm to complete the following analyses and collect samples at the proposed site:
 - .1 Source of supply of aggregate
 - .2 Sieve analysis

- .3 Micro-Deval Analysis (not to exceed the requirements of Table 201-1 (25%) of the NBDTI Specifications (latest edition) for Aggregate Base Material
 - .4 Freeze-thaw – (not to exceed the requirements of Table 201-1 (20%) of the NBDTI Specifications (latest edition)
 - .5 Flat and Elongated Particles (not to exceed the requirements of Table 201-1 (35%) of the NBDTI Specifications (latest edition)
 - .6 Plasticity Index (not to exceed the requirements of Table 201-1 (3%) of the NBDTI Specifications (latest edition) for Aggregate Base Material
 - .7 Standard Proctor and Optimal Moisture values.
- .3 When submitting results to the Engineer, the geotechnical testing firm must confirm that the materials meets the Specifications and that it is or is not suitable for the intended use. This is to be in letter report format submitted directly to the Engineer.
- .4 The Owner reserves the right to reject any source of supply of aggregate base on the basis of past field performance, document by the records and experience of the Owner and/or the Engineer with a specific material, regardless of compliance with physical requirements of grading limits.
- .5 Samples:
- .1 Allow continual sampling by Engineer during production if required.
 - .2 Provide Engineer with access to source and processed material for sampling.
 - .3 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section as per NBDTI standards.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations and erosion and sedimentation control plan.
 - .2 Replace defective or damaged materials with new.
- .3 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.

Part 2 Products

2.1 MATERIALS

- .1 Granular sub-base material: in accordance with NBDTI Standard Specifications, latest edition, Item 201 and following requirements:
 - .1 Crushed rock, crushed gravel, pit run or imported crushed sandstone.
 - .1 Consisting of clean, hard, sound and durable particles free from soft or disintegrated pieces, mud, dirt, organic or other deleterious materials as

described in Item 201 of the NBDTI Standard Specifications (latest edition).

- .2 Aggregate sub-base properties shall meet the requirements of Table 201-1 of the N.B. Department of Transportation and Infrastructure Standard Specifications (latest edition).
- .3 The Engineer must approve the sandstone pit and the area in the pit which the Contractor uses as his source of material. The Contractor will be required to provide a sieve analysis and freeze thaw of the proposed material, at his expense.
- .4 The crushed rock, crushed gravel, pit run or crushed sandstone when tested in accordance with the N.B. Department of Transportation and Infrastructure's method with standard laboratory sieves, will conform to Table 201-2 (Crushed Rock, 75 mm % Passing gradation), Table 201-3 (Crushed Gravel, 75 mm % Passing gradation), Table 201-4 (Pit Run) and Table 201-5 (Crushed Sandstone Sub-base, 100 mm % Passing gradation) of the N.B. Department of Transportation and Infrastructure Standard Specifications (latest edition).
- .5 Other properties as noted in Article 1.5.2.1.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Engineer of proposed source of aggregates and provide access for sampling 2 weeks minimum before starting production.
- .2 If, in the opinion of Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source or demonstrate that material from source in questions can be processed to meet specified requirements.
- .3 Advise Engineer 2 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for granular sub-base installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.
 - .2 Inform Engineer 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 Engineer.

3.2 PREPARATION

- .1 Prior to the placing of granular sub-base, shape subgrade properly and compact so as to be firm and able to support the construction equipment without displacement.

- .2 Correct soft or yielding subgrade and make stable before sub-base construction proceeds.
- .3 Remove all ponded water from the area prior to placing any granular sub-base material.
- .4 Maintain sufficient crown at all times during construction to ensure ready runoff of surface water.
- .5 Where the gradation of the subgrade soil and the sub-base are such that mixing of the two materials may occur, place an approved geotextile fabric.

3.3 PLACING

- .1 Place granular sub-base after all required piping has been placed and subgrade is inspected and approved by Engineer.
- .2 Placing:
 - .1 Construct granular sub-base to depth and grade in areas indicated and dimensions as shown on the drawings or as directed by the Engineer.
 - .1 Material placed wider or deeper than specified will not be measured for payment.
 - .2 Ensure no frozen material is placed.
 - .3 Place material only on clean unfrozen surface, free from snow or ice.
 - .4 Place granular sub-base materials using methods which do not lead to segregation or degradation.
 - .5 Shape sub-base by means of a blade grader (other than a tractor).
 - .6 Ruts formed by hauling or traffic will be dragged full at least once a day or as often as necessary to prevent cutting through the surface material.
 - .7 Place material to full width in uniform layers not exceeding 300 mm compacted thickness.
 - .1 Engineer may authorize thicker lifts if specified compaction can be achieved.
 - .2 Maximum lift thickness to be determined in the field by a test strip, to ensure the maximum effectiveness and compatibility of the compaction equipment with respect to the material being placed for each piece of equipment and each material type. The test strip shall be conducted in the presence of the Engineer and the approved testing company's inspector, and shall occur prior to the placement of any further material in the work.
 - .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 - .9 When sub-base material is placed over geotextile fabric, carefully place the first layer of sub-base material and spread with a dozer so there is no traffic on the geotextile until the first layer of 300 mm of sub-base has been spread and compacted.
 - .10 Remove and replace portion of layer in which material has become segregated during spreading.

3.4 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.

- .2 Compact to density of not less than 95 % maximum dry density in accordance with ASTM D 698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
 - .1 Make water truck(s) available to apply water for compaction purposes as required, incidental to the work.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Engineer.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .7 Compact each layer thoroughly over its entire width before placing the next layer.
 - .1 Operate sufficient compaction equipment at all times to thoroughly compact the material at the rate at which it is being placed.

3.5 PROOF ROLLING

- .1 For proof rolling use a fully loaded tandem truck. Make sufficient passes of proof rolling equipment to subject every point on surface to at least one pass of loaded tire and confirm no greater than 25 mm deflection occurs. Perform proof rolling in the presence of Engineer.
- .2 Obtain written approval from Engineer to use non standard proof rolling equipment.
- .3 Proof roll at level in sub-base as indicated.
 - .1 If non standard proof rolling equipment is approved, Engineer will determine level of proof rolling.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove sub-base and subgrade material to depth and extent as directed by Engineer.
 - .2 Backfill excavated subgrade with sub-base material and compact in accordance with this section.
 - .3 Replace sub-base material and compact.
- .6 Where proof rolling reveals areas of defective sub-base, remove defective materials to depth and extent as directed by Engineer and replace in accordance with this section at no extra cost.
- .7 Maintain the finished aggregate base conditions until asphalt concrete is applied.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

3.7 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.8 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Engineer.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section specifies requirements for supplying, producing and placing crushed gravel or quarried stone as a granular base to lines, grades and typical cross sections indicated, or as directed by the Engineer.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 31 23 33.01 Excavating, Trenching and Backfilling
- .3 Section 32 11 16.01 Granular Sub-Base.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C131-06, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .5 ASTM D1883-07e2, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .6 ASTM D4318-10, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide the Engineer with the following information before the commencement of the work and at any time during the construction at the request of the Engineer (at no cost to the Owner):
 - .1 Approved testing geotechnical firm to complete the following analyses and collect samples at the proposed site:
 - .1 Source of supply of aggregate
 - .2 Sieve analysis

- .3 Micro-Deval Analysis (not to exceed the requirements of Table 201-1 (25%) of the NBDTI Specifications (latest edition) for Aggregate Base Material
 - .4 Freeze-thaw – (not to exceed the requirements of Table 201-1 (20%) of the NBDTI Specifications (latest edition)
 - .5 Flat and Elongated Particles (not to exceed the requirements of Table 201-1 (35%) of the NBDTI Specifications (latest edition)
 - .6 Plasticity Index (not to exceed the requirements of Table 201-1 (3%) of the NBDTI Specifications (latest edition) for Aggregate Base Material
 - .7 Standard Proctor and Optimal Moisture values.
- .3 When submitting results to the Engineer, the geotechnical testing firm must confirm that the materials meets the Specifications and that it is or is not suitable for the intended use. This is to be in letter report format submitted directly to the Engineer.
- .4 The Owner reserves the right to reject any source of supply of aggregate base on the basis of past field performance, document by the records and experience of the Owner and/or the Engineer with a specific material, regardless of compliance with physical requirements of grading limits.
- .5 Samples:
- .1 Allow continual sampling by Engineer during production if required.
 - .2 Provide Engineer with access to source and processed material for sampling.
 - .3 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements with manufacturer's written instructions as per NBDTI standards.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations erosion and sedimentation control plan.
 - .2 Replace defective or damaged materials with new.
- .3 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.

Part 2 Products

2.1 MATERIALS

- .1 Granular base: material in accordance with NBDTI Standard Specifications, latest edition, Item 201 and following requirements:
 - .1 Crushed stone:
 - .1 To consist of clean, hard, sound and durable particles free from soft or disintegrated pieces, mud, dirt, organic or other deleterious materials as

described in Item 201 of the N.B. Department of Transportation and Infrastructure Standard Specifications (latest edition).

- .2 Aggregate base properties: to Table 201-1 of the N.B. Department of Transportation and Infrastructure Standard Specifications (January 2011).
- .3 Under no circumstances will Pit Run material will be accepted as aggregate base.
- .4 The crushed rock, when tested in accordance with the N.B. Department of Transportation and Infrastructure's method with standard laboratory sieves, will conform to Table 201-2 (Crushed Rock, 31.5 mm % Passing gradation) of the N.B. Department of Transportation and Infrastructure Standard Specifications (latest edition).

2.2 SOURCE QUALITY CONTROL

- .1 Inform Engineer of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If, in the opinion of Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source or demonstrate that material from source in questions can be processed to meet specified requirements.
- .3 Advise Engineer 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 PREPARATION

- .1 Prior to the placing of granular base, shape sub-base properly and compact so as to be firm and able to support the without displacement.
- .2 Match sub-base profile to that required to result in the final roadway surface profile and crown when all sub-base, base and pavement materials have been placed.
- .3 Correct soft or yielding sub-base and make stable before base construction proceeds.
- .4 Remove all ponded water from the area prior to placing any granular base material.
- .5 Place approved geotextile fabric where the gradation of the subgrade soil and the sub-base are such that mixing of the two materials may occur.

3.2 PLACEMENT AND INSTALLATION

- .1 Place granular base after sub-base surface is inspected and approved in writing by Engineer.
- .2 Placing:

- .1 Place aggregate base material on the tops of dikes as final finish when all other work that requires excavation or re-shaping of the dikes has been completed.
 - .1 Areas that have been completed may be done when so authorized by the Engineer.
- .2 Construct roadway granular base to depth and grade in areas indicated and dimensions as shown on the drawings or as directed by the Engineer.
 - .1 Material placed wider or deeper than specified will not be measured for payment.
- .3 Maintain sufficient crown at all times during construction to ensure ready runoff of surface water.
- .4 Ensure no frozen material is placed.
- .5 Place material only on clean unfrozen surface, free from snow and ice.
- .6 Placing on a wet or muddy surface will not be permitted.
- .7 Place material using methods which do not lead to segregation or degradation of aggregate.
- .8 Fine grade the surface and ensure it has been graded and compacted as required under this Section.
- .9 Spread the aggregate base material for the top of dikes in a single layer sufficient to give a finished thickness of 100 mm after compaction.
- .10 Place roadway aggregate base material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 Engineer may authorize thicker lifts (layers) if specified compaction can be achieved.
- .11 Care shall be taken when placing the aggregate base material that no material runs off the top surface and down the sides of the dike. Any material that runs down the side of the dike shall be removed incidental to the work. Any material that has been contaminated by soil or other materials such that it no longer meets the specifications shall not be reused in the work.
- .12 Shape the material to the lines and grades provided by the Engineer. All humps, hollows, and depressions will be eliminated during shaping.
- .13 The material will be shaped by means of a blade grader (other than a tractor) while being compacted.
- .14 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .15 Exercise proper care in the placing, spreading and compaction of this material to prevent any damage to other structures and/or systems. This shall include but not be limited to dikes, aeration system piping and valves, chambers, manholes, and fencing.
- .16 Ruts formed by hauling or traffic will be dragged full at least once a day or as often as necessary to prevent cutting through the surface material.
- .17 When completed, the surface will be smooth, hard, free from ruts, waves, and undulations and competent in the opinion of the Engineer to provide adequate support for the road or dike surface.

- .18 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .19 For asphalt driveways, place granular base material 300 mm thick. When matching existing driveway conditions, place crushed stone to depth indicated by the Engineer.
- .3 Compaction Equipment:
 - .1 Ensure compaction equipment is capable of obtaining required material densities.
- .4 Compacting:
 - .1 Commence compaction immediately following the spreading and shaping of each layer.
 - .2 Compact to density not less than:
 - .1 Roadway: 95% maximum dry density to ASTM D698.
 - .3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .4 Apply water as necessary during compacting to obtain specified density.
 - .1 Make water truck(s) available to apply water for compaction purposes as required, incidental to the work.
 - .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Engineer.
 - .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
 - .7 Compact each layer thoroughly over its entire width before placing the next layer.
 - .1 Operate sufficient compaction equipment at all times to thoroughly compact the material at the rate at which it is being placed.
- .5 Proof rolling:
 - .1 For proof rolling use a fully loaded tandem truck. Make sufficient passes of proof rolling equipment to subject every point on surface to at least one pass of loaded tire and confirm no greater than 25 mm deflection occurs. Perform proof rolling in the presence of Engineer.
 - .2 Obtain written approval from Engineer to use non standard proof rolling equipment.
 - .3 Proof roll at level in granular base as indicated.
 - .1 If use of non standard proof rolling equipment is approved, Engineer to determine level of proof rolling.
 - .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove base, sub-base and subgrade material to depth and extent as directed by Engineer.
 - .2 Backfill excavated subgrade with sub-base material and compact in accordance with Section 32 11 16.01 - Granular Sub-Base.

- .3 Replace sub-base material and compact in accordance with Section 32 11 16.01 - Granular Sub-base.
- .4 Replace base material and compact in accordance with this Section.
- .6 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent as directed by Engineer and replace with new materials in accordance with Section 32 11 16.01 - Granular Sub-base and this section at no extra cost.
- .7 Maintain the finished aggregate base conditions until asphalt concrete is applied.

3.3 SITE TOLERANCES

- .1 Finished base surface to be within the following limits:
 - .1 Road: within plus or minus 10 mm of established grade and cross section but not uniformly high or low.
 - .1 Perform grade checks at every stake location for fine grading.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

3.5 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Engineer.

END OF SECTION

Part 1 General

1.1 WORK INCLUDES

- .1 This section includes the supply of all equipment, labor and materials for the complete removal and dewatering of the in-situ municipal sludge throughout the entire Wastewater Treatment Facility. Refer to Appendix B for Sludge Survey Summary Letter that presents the approximate volume and location of the sludge accumulation in 2020.
- .2 The work includes processing of dredged material such as screening, separation and dewatering as required. All components and facilities are to be provided by the Contractor.
- .3 The work includes the final disposal at an approved facility.
- .4 The work includes all mobilization and demobilization required to complete the work.

1.2 EXISTING CONDITIONS

- .1 A survey was conducted on October 15th, 2020 to provide information regarding the existing sludge elevations in the lagoon. Results from the survey indicated that approximately 2,000 cubic meters of sludge was present at the time of the survey. The revised estimate of volume is expected to be 2800 cubic meters, understanding that sludge volumes have increased proportionally.
- .2 Assuming an average Total Solids concentration of 5%, the estimated Bone Dry Metric Tonne (BDMT) shall be **140**.

1.3 SCOPE OF WORK

- .1 Mobilization and demobilization.
 - .1 This includes mobilization and demobilization of all equipment required for sludge dredging, dewatering, transportation and disposal.
 - .2 This includes all work related to set-up, construction of temporary working pad and temporary access, road shaping of site, imported and re-used materials, temporary ditching, removal and installation of fencing, removal of materials at completion of work, set up of all equipment, cables, hoses, crane rentals, equipment tear-down, clean-up, and all related work all as required for a complete assembly and removal of the facility.
 - .2 Sludge Dredging, Dewatering, Transportation, and Disposal
 - .1 The Contractor shall remove approximately 140 BDT, including but not limited to the following:
 - .1 The supply and transportation of all labour, equipment, materials, equipment, water, jersey barriers, electricity, concrete anchors, polymer (including sludge laboratory testing), polymer feed system, coordination with regulatory body, and incidentals as shown, specified, and required in connection with the
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installation of the mobile lagoon dredge and mechanical dewatering plant (as required), in accordance with the lines, grades, design, and dimensions as specified herein in order to complete the sludge removal of the entire cell by **centrifuge dewatering method**, including, but not limited to:

- .1 Sludge tank(s) including agitators and rotating screen, properly sized by the Contractor for this application (as required).
- .2 Polymer system as required for the project.
- .3 Conveyers properly sized for this project (as required).
- .4 Dredge properly sized for this project and capable of removing the sludge at the rate required to meet the project schedule while working in the project conditions including head, water depth, etc. The dredge shall remove the maximum amount of sludge while protecting the existing lagoon base / clay liner.
- .5 The dredge shall be capable of removing sand, mud, dirt, sludge and waste products as required for the site-specific conditions.
- .6 The dredge shall be complete with a mud shield, double fuel tank, the required cables, hoses, jersey barriers, etc. required for a proper installation and operation.
- .2 The Contractor is required to determine the present characteristics of the sludge, including any jar testing or other analyses required to confirm chemical feed requirements and total bone dry sludge quantities.
- .3 A copy of the already-completed sludge survey can be found in the Appendix B of these specifications.
- .4 Fresh water will not be provided by the Owner and shall be provided by the Contractor. Any pumps or generators required are to be provided by the Contractor.
- .5 The Contractor shall determine the required working platform and temporary access road for their equipment.
- .6 The working platform, and temporary access road area shall be restored to existing conditions or better shall be incidental to the work.
- .7 The Contractor is responsible to remove and dispose of the dewatered sludge at an approved bio solids facility.

1.4 REGULATORY REQUIREMENTS

- .1 The Contractor shall comply with all municipal, provincial and federal codes and regulations and obtain all necessary permits relating to the project.
- .2 In addition to the above, the work shall be conducted in accordance with the Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment and Disposal (2006).

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sludge removal equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
 - .1 Contractor to submit a complete dewatering plan to the Engineer for review and approval.
 - .2 Contractor to submit a complete submittal for all material and equipment used on site.
- .3 Bio Solids Processing Facility
 - .1 Contractor to identify a suitable biosolids processing facility and to verify the capability of the selected facility and the facility's willingness to accept the material prior to submitting a bid. Failure by the successful bidder to verify the processing facility shall not result in additional cost to the Owner.
- .4 Inform the Engineer at least four (4) weeks prior to beginning work.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

Part 2 Products

2.1 POLYMER

- .1 An initial laboratory testing of the sludge is to be conducted by the Contractor to determine type and amount of the polymer to be consumed based on flocculation, separation of material and water clarity.

2.2 DREDGING EQUIPMENT

- .1 The dredge shall be capable of removing the sludge deposited at the bottom and side slopes of the lagoon without damage to the lagoon liners, with the lagoon at or near full operating depth. The dredge shall also be capable of working around existing in-lagoon features including aeration headers, diffusers, and baffle curtains without the need for such features to be removed. Individual aeration headers/diffusers can be isolated for short duration. All isolation of such units shall be performed by AFNWA staff.
 - .2 The Contractor is to coordinate all aspects of the dredging and other site operations with the lagoon operators and other sub-contractors.
 - .3 The sludge dredging and dewatering equipment shall have a capacity that allows for complete dredging and processing of the sludge within a maximum period of three (3) weeks. All equipment shall have backup capability on-site for the largest unit out of service.
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2.3 SLUDGE PROCESSING

- .1 Dewatered sludge from the on-site sludge processing operation shall be ultimately disposed of at an approved biosolids processing facility. The Contractor is responsible to verify the capability and the willingness of the facility to accept the material.
- .2 The Contractor is required to verify the requirements of the selected disposal facility for dewatered sludge quality and characteristics. Provide any additional equipment and/or materials such as screening equipment or chemical dosing equipment to ensure all requirements of the facility are met.
- .3 The sludge processing equipment and method shall be capable of meeting the minimum solids target specified without any requirement for additional settling time. There is insufficient space on the site to allow for storage of material for settling or other passive dewatering methods.
- .4 The dewatering equipment shall have a minimum solids capture rate of 90% under all operating conditions.
- .5 The dewatered solids shall be free of stones, sticks or debris.
- .6 The Contractor shall consult with the approved waste sludge disposal facility on polymer options which will both allow the contractor to achieve the required % solids as per the Tender and meet the requirements for acceptance at the facility.
- .7 All by-products of processing equipment and facilities used to process the sludge dredged from the lagoon (including but not limited to screenings, stones and dewatered sludge that is less than the required dryness) if not suitable for transportation and ultimate disposal at the preferred disposal facility, shall be disposed of by the Contractor in accordance with the standards and regulations of New Brunswick and at the Contractor's expense.
- .8 All requirements for utilities, shelter, personnel and materials required by such equipment shall be arranged and provided by the Contractor, unless specifically noted otherwise.
- .9 Filtrate from the dewatering operation may be directed back to the influent end of the lagoon. Coordinate with Consultant and Municipality of Arcadia staff to ensure proper filtrate return.

2.4 TEMPORARY STORAGE

- .1 Temporary storage facilities at the lagoon site shall be provided at the Contractor's expense as necessitated by the Contractor's methods. The Contractor shall review temporary storage requirements prior to commencement. All temporary storage facilities shall be approved by the Consultant prior to installation and use.
 - .2 Temporary storage facilities including tanks, containers, piles and others, shall be of substantial construction and shall not result in uncontrolled discharge of stored material.
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- .3 Dewatered sludge material shall be removed from the lagoon site within 24 hours of being extracted from the lagoon. No temporary storage is to be used for dewatered material.
- .4 There is minimal space on site for temporary storage facilities and the Contractor shall be responsible to review the site prior to bidding and adjust methods or storage requirements to suit the available space.

2.5 TEMPORARY POWER

- .1 The Contractor shall include all temporary power equipment required for all on-site operations including dredging, sludge dewatering, and lagoon draining.

2.6 TEMPORARY PUMPING AND PIPING

- .1 The Contractor shall provide all temporary pump equipment and piping for completion of the work as specified.

2.7 CLEAN WATER REQUIREMENTS

- .1 Any water requirements shall be the responsibility of the Contractor and shall be incidental to the work.

Part 3 Execution

3.1 PRODUCT DELIVERY

- .1 All equipment required for the sludge removal and related components shall be delivered to the project site in a safe manner ready to be installed. If a crane is required, it is to be provided by the Contractor incidental to the work. Setting-up the plant, tear down/loading of dewatering equipment and placing dredge into and out of the water shall be considered incidental to the work.

3.2 POWER REQUIREMENTS

- .1 Any power requirements shall be the responsibility of the Contractor and shall be incidental to the work.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

1.1 WORK INCLUDED

- .1 This section includes the supply of all labour, materials and equipment necessary for the complete installation and/or abandonment of all sanitary manholes and control chambers as shown on the drawings and herein specified.
- .2 This section also includes the supply and installation of sluice gates, gate valves, and weir gates used for controlling the flow of sewage at various points in a sewage treatment plant receiving municipal wastewater.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 31 23 33.01 Excavating Trenching and Backfilling.
- .3 Section 33 31 13 Public Sanitary Utility Sewerage Piping.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM A48/A48M-03(2012), Standard Specification for Gray Iron Castings.
 - .2 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM B148-14 Standard Specification for Aluminum-Bronze Sand Castings.
 - .4 ASTM C117-13, Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .5 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .6 ASTM C139-11, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .7 ASTM C478M-13, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .8 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
 - .9 ASTM D1248-12 Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - .10 ASTM F593 -13a Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - .11 ASTM F594 -09e1 Standard Specification for Stainless Steel Nuts.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group

- .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
- .3 CSA A257, Standards for concrete pipe and manhole sections.
- .4 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .5 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
- .4 American Water Works Association
 - .1 AWWA C509-09 Resilient-Seated Gate Valves for Water Supply Service

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for manholes and control chambers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 It is the Contractor's responsibility to approve all Shop Drawings and verify their correctness.
 - .2 Review of the Contractor's drawings by the Engineer shall not relieve the Contractor of the responsibility for the correctness thereof, nor from the results arising from any error or omission in details of design.
 - .3 Prior to the production of fill concrete for use in this contract, provide to the Engineer a certificate from a certified testing company stating that the concrete to be supplied conforms to the requirements of this Section.

1.5 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 – Quality Control.
- .2 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect manholes and chambers from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.7 SCHEDULING OF WORK

- .1 Schedule work to minimize interruptions to existing services and to maintain existing flow during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

Part 2 Products

2.1 MATERIALS

- .1 Cast-in-place concrete:
 - .1 In accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .2 Benching requirements:
 - .1 Benching shall be concrete with a 28 day compressive strength of 25 MPa.
 - .3 Concrete reinforcement: in accordance with Section 03 20 00 - Concrete Reinforcing.
- .2 Concrete Formwork: in accordance with Section 03 10 00 Concrete Forming and Accessories.
- .3 Pre-Cast Concrete Manholes/ Structures: to CSA A257.4 and ASTM C478.
 - .1 Approved product: L.E. Shaw Ltd., Strescon or approved equivalent.
 - .2 Joints between sections: rubber gasket, Ram-Nek gasket and waterproofing membrane as indicated on the detail drawings and to CSA A257.3.
 - .1 Waterproofing membrane: Bakor Blueskin WP 200 c/w Aquatac Primer, Colphene 3000 by Soprema c/w Elastocol Stick Primer or approved equivalent.
 - .3 Precast base sections with reinforced concrete slab within:
 - .1 Rubber gaskets to suit the inlet and outlet pipes and factory installed benching.
 - .2 Benching to minimize hydraulic losses through chamber.
 - .3 Channels and benching: smooth and uniform and not less than 75% of the diameter of the largest pipe.
 - .4 Locking Hatches Requirements
 - .1 Hatch assemblies: checkered aluminum designed for direct traffic street locations that will receive continuous AASHTO H-20 wheel loads and shall be securely anchored to the concrete flat top cover. The frames shall be pre-cast into the chamber top slab.
 - .2 Covers: 90° minimum opening, equipped with an automatic hold-open arm and safety grating (traffic bearing class)

- .3 Approved products: ITT Flygt Safe-Hatch system (Part No. 13-FLE-914x914-HDAOSH), Barnes Access Doors J-HD H20 c/w safety grate system as manufactured by Crane Pumps and Systems or approved equivalent.
- .5 Pad Locks: long or short style (as required for proper installation) weather resistant pad locks keyed to the Owner's master key system.
- .4 Sluice Gates: Fontaine Series 20, Armtec Model 10-10 stainless steel, Orbinox MU Sluice Gate or approved equivalent.
 - .1 Full-framed, self-contained, stainless steel units, complete with stem guides, operators, and appurtenances, as shown on the drawings.
 - .2 Completely factory assembled, shipped as a unit, and be able to be installed without disassembly by the Contractor.
 - .3 Gate and frame: Type 304 L stainless steel with all welds conforming to ASME Standards Section IX.
 - .4 The entire unit is to be water blasted to remove any scale.
 - .5 All contacting parts shall be machined for precision adjustment, free movement, minimum tolerances, and interchange ability.
 - .6 The gate shall move in the frame guides on neoprene seals and shall seat on a replaceable neoprene seal, with a friction coefficient of 0.2 or less.
 - .7 Lift nut: aluminum bronze ASTM B148 Alloy C95200.
 - .8 Gate frame: rigid, welded unit to be mounted on a flat, vertical concrete wall across the circular opening to be controlled. The frame shall allow for the gate to be moved fully clear of the circular opening so there is no obstruction to flow when opened.
 - .9 Guide frames shall extend to form posts for the support of the yoke, and shall be reinforced as required. Yokes shall be separate components mechanically fastened to the posts. Maximum deflection of the yoke shall not exceed 5 mm under full load. The yoke shall include an ultra-high molecular weight polyethylene (UHMWPE) thrust collar. Each gate shall have two side wedges to seat the gate to the seal only as it moves into its final closing position to minimize wear of the seal.
 - .10 The gate shall be complete with a 50 mm square nut for valve key operation and shall have a non-rising stem. On non-rising stems, an integral tube in the gate shall be provided to hide the stem and protect it from debris.
 - .11 The stem connection to the gate shall be of the clevis type or thrust nut as required, and shall be capable of withstanding at least twice the maximum thrust required for operation.
 - .12 An anchor bolt hole template shall be provided with each gate. A resilient, non-degradable gasket is to be supplied with each gate to make the gate to wall joint watertight. Anchor bolts and epoxy grout shall be supplied with each gate.
 - .13 Stem supports shall be provided as required, also to be attached to flat, vertical concrete walls and/or round vertical concrete walls as required.

- .14 The gates shall come complete with one (1) opening key suitable for the 50 mm nut and to pass through the opening in the chamber covers. The Contractor shall be responsible for the supply of this key in accordance with the manufacturer's shop drawings and installation manuals.
- .5 Chamber Insulation: Styrofoam HI-40, or approved equivalent.
 - .1 Insulation: 50 mm rigid insulation.
 - .2 Minimum characteristics:
 - .1 Compressive strength: 275 Kpa
 - .2 Water absorption (% by volume): Max. 0.7%
 - .3 Capillarity: none
 - .4 Shear strength: 275 Kpa

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for manholes and catch basin structures installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.
 - .2 Inform Engineer 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 Engineer.

3.2 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.

3.3 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 Position metal inserts in accordance with dimensions and details as indicated.

3.4 INSTALLATION

- .1 Construct manholes and control chambers of pre-cast concrete sections according to drawing details.
- .2 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .3 Complete units as pipe laying progresses.
 - .1 Maximum of 3 units behind point of pipe laying will be allowed.

- .4 Install manholes and chambers at the locations indicated on the drawings.
- .5 Dewater excavation to approval of Engineer and remove soft and foreign material before placing concrete base.
- .6 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% corrected maximum dry density maximum density to ASTM D 698.
- .7 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
 - .2 Make each successive joint watertight with Engineer's approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .4 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
- .8 Compact granular backfill to 98% corrected maximum dry density maximum density to ASTM D 698.
- .9 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .10 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
 - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .11 Set frame and cover on top section to elevation as indicated.
 - .1 Paved roadways: 10 mm below finished grade and conforming to crown of road.
 - .2 Gravel roadways: 25 mm below finished grade.
 - .3 Off traveled roadways: 50 to 100 mm above finished grade.
 - .1 Include lock-down frame and cover.
 - .1 Approved product: R12S or approved equivalent.
 - .4 If adjustment required use concrete ring.
- .12 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .13 Install safety platforms in manholes having depth of 5 m or greater, as indicated.

3.5 SLUICE GATES, WEIR GATES, AND GATE VALVES

- .1 Install in accordance with manufacturer's recommendations in locations as shown on the Drawings.
- .2 Restrain all gate valves.
- .3 Support valves with a Stainless Steel Support as shown on the drawings.

3.6 CHAMBER INSULATION

- .1 Insulate the inside of the chamber walls with 50 mm rigid insulation.
- .2 Extend insulation as shown on the drawings, or as otherwise specified by the Engineer.
- .3 Place insulation on the chamber wall prior to backfilling.

3.7 FIELD QUALITY CONTROL

- .1 Test all sanitary sewer manholes for leakage.
- .2 Notify the Engineer at least forty-eight (48) hours in advance of performing sanitary manhole ex-filtration tests.
- .3 Should the sanitary sewer main ex-filtration tests prove unsatisfactory, the Contractor shall excavate to determine the cause, make repairs, backfill and retest at his own expense.

3.8 SANITARY MANHOLE VACUUM TEST (AIR)

- .1 To latest version of ASTM C1244M
- .2 Conduct testing one manhole at a time:
 - .1 Plug all lift holes. Plug all pipe inlets discharging into the test manhole and all pipe outlets discharging from the test manhole. Install a bulkhead on the test manhole.
 - .2 Use a vacuum pump to increase the negative pressure to 27.6 KPa (4.0 psi). Close the vacuum source. Begin recording of the test time. Allow the negative pressure to increase to 24.1 KPa (3.5 psi).
 - .3 Engineer will calculate the allowable leakage and notify the Contractor. If the actual leakage time is greater than the allowable leakage time, the test section is acceptable.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning.

3.10 PROTECTION

- .1 Protect installed products and components from damage during construction.

- .2 Repair damage to adjacent materials caused by installation.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all labour, materials and equipment and incidentals necessary for the complete installation of all water service laterals and insulation as shown on the drawings and herein specified.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 31 23 33.01 - Excavating Trenching and Backfilling.

1.3 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300-10, Standard for Hypochlorites.
 - .2 ANSI/AWWA B301-10, Standard for Liquid Chlorine.
 - .3 ANSI/AWWA B303-10, Standard for Sodium Chlorite.
 - .4 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - .5 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
 - .6 ANSI/AWWA C800-05, Standard for Underground Service Line Valves and Fittings.
- .2 ASTM International
 - .1 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .2 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube Metric.
 - .3 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .3 CSA International
 - .1 CAN/CSA-B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CAN/CSA-B137.1-09, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.

- .2 CAN/CSA-B137.3-09, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

1.7 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .3 Notify Departmental Representative minimum of 24 h in advance of interruption in service.
- .4 Notify fire authority and Departmental Representative of planned or accidental interruption of water supply to hydrants.
- .5 Provide and post "Out of Service" sign on hydrant not in use.
- .6 Advise Departmental Representative of anticipated interference with movement of traffic.

Part 2 Products

2.1 SERVICE CONNECTIONS

- .1 Minimum 19 mm Q-Line water service tubing meeting the latest CSA Standard B137.9 and ASTM Standard F1282.

- .2 Corporation main stops: Mueller, Ford, Cambridge or A. Y. MacDonald brass, meeting ASTM B62 with bronze ground key type with inlet end having the Standard Corporation Threads to AWWA C800 and outlet having copper or kitec compression type connection.
- .3 Service saddles for PVC pipe: Concord Clow D-71, Smith-Blair TaperSeal, Robar or Romac type, cast-iron body with wide flat stainless steel band and components. Service saddles must be used for all service connections on PVC pipe and all taps larger than 25 mm diameter. Service saddles for all services larger than 25 mm require two wide straps.
- .4 Corporation curb stops: Mueller, Ford, Cambridge, or A.Y. MacDonald brass, meeting ASTM B62 with bronze ground key type with both inlet and outlet ends having copper or kitec compression type connections. Stainless steel liners are to be inserted into the ends of Muncipex tubing for all connections to compression service brass.
- .5 Corporation service boxes: for 19 mm and 25 mm services shall have a 25 mm upper section and be adjustable for a depth of bury 1.8 m - 2.1 m and shall be Mueller Type A-726, Clow D1, or approved equal, with stainless steel stationary rods and stainless steel cotter pins, or standard rod with properly sized zinc anode and Type A-800 cover.
- .6 Service connections for PVC pipe:
 - .1 Service connections less than 100 mm: Corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100 mm and over: Use tee fitting or tapping valve and sleeve.
- .7 Bronze type service clamps: for PVC pipe service connections.
 - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
 - .2 Clamps to be tapped with threads to ANSI/AWWA C800.

2.2 BEDDING AND BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.3 PIPE DISINFECTION

- .1 Liquid chlorine to ANSI/AWWA B301, to disinfect water mains.
- .2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative 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 Departmental Representative.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of Departmental Representative.
 - .2 Remove defective materials from site as directed Departmental Representative.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of not less than 1.8 m from finished grade or as indicated.
- .3 Trench alignment and depth require Departmental Representative approval prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95 % maximum density to ASTM D698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.5 SERVICE CONNECTIONS AND CHLORINATION POINTS

- .1 Terminate building water service 2 m outside building wall, refer to Mechanical specifications for plumbing installation.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops as indicated.
- .3 The location of water service laterals shall be as per the construction drawings or as located in the field by the Departmental Representative.

- .4 Corporation main stops shall be spaced a minimum of 300 mm apart on the water main and a minimum of 300 mm from the end of the pipe.
- .5 Tapping of water mains shall be with the use of proper tools and equipment and according to recognized good practice and in compliance with the pipe manufacturer's specifications. The water main shall be tapped at a $67\frac{1}{2}^{\circ}$ angle from the top centerline of the pipe.
- .6 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .7 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .8 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater.
- .9 A "goose neck" shall be provided in service lateral piping as detailed on the construction drawings and shall have a maximum deflection of $22\frac{1}{2}^{\circ}$.
- .10 All connections on service laterals shall be of the Compression type.
- .11 The corporation curb stop and service box shall be installed at locations as indicated on the construction drawings (at street line, whenever possible).
- .12 Leave corporation stop valves fully open.
- .13 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .14 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.

3.6 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 300 m of pipe.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D698.
- .6 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D698.

3.7 INSULATION

- .1 Insulation shall be installed in the locations as shown on the drawings and as directed by the Departmental Representative.
- .2 Insulation shall be installed at the top of bedding level for a width of 1200 mm. The insulation shall be 50 mm thick unless otherwise noted on the drawings.
- .3 Joints between sheets of insulation shall be secured with an appropriate sheeting tape.
 - .1 Acceptable material: duct tape or approved equal
- .4 Insulation shall be covered with a minimum of 150 mm of bedding before backfilling.

3.8 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 98 % maximum density to ASTM D698.
 - .1 In other areas, compact to at least 98 % maximum density to ASTM D698.

3.9 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: under direct control of Departmental Representative.
 - .1 Notify Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
8	75
10	115
12	150
- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed to Departmental Representative's approval, introduce strong solution of chlorine as approved by Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7 Disinfect water mains.
- .8 Rate of chlorine application to be proportional to rate of water entering pipe.
- .9 Chlorine application to be close to point of filling water main and to occur at same time.

- .10 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .11 Flush line to remove chlorine solution after 24 hours.
- .12 Measure chlorine residuals at extreme end of pipe-line being tested.
- .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of two days.
 - .2 At least one set of samples shall be collected from every 366 m (1200 ft) of the new water main, at every hydrant and at the beginning and end of new lines.
 - .3 Samples will be taken by the Contractor with the presence of the Departmental Representative. The Contractor shall notify the Departmental Representative not less than forty-eight hours in advance of readiness to sample.
 - .4 Should contamination remain or recur during this period, repeat disinfecting procedure.
- .14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .15 After adequate chlorine residual (not less than 50 ppm) has been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
 - .2 Total residual chlorine still present in the water used to disinfect the water main shall be reduced to a maximum of one part per million if released to an environment other than a sanitary or combined sewer pipe.

3.10 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all labour, materials and equipment and incidentals necessary for the complete installation of all sanitary sewer mains, sanitary sewer laterals and insulation and testing of all sanitary sewer mains as shown on the drawings and herein specified.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 – Payment Procedures.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Section 33 05 16 - Manholes and Catch basin Structures.

1.3 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 ASTM International
 - .1 ASTM C76M-10a, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .2 ASTM C117-04, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM C443M-07, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .5 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft4-lbf/ft3 (600 kN-m/m3)).
 - .6 ASTM D2680-01(2009), Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - .7 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .8 ASTM D3350-10, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .3 CSA International
 - .1 CSA A3000-08, Cementitious Materials Compendium.
 - .2 CSA A257 Series-09, Standards for Concrete Pipe and Manhole Sections.

- .3 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings, and Means of Joining.
- .4 CSA B1800-11, Thermoplastic Non-pressure Pipe Compendium.
 - .1 CSA B182.1-11, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .3 CSA B182.6-11, Profile Polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .4 CSA B182.11-11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Engineer 24 hours minimum in advance of any interruption in service.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 00 02 – Standard General Requirements.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Certification to be marked on pipe.
- .4 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and manufacturer's written instructions.
- .2 Load and unload pipe and accessories by lifting with hoists and slings, on pallets, or careful skidding so as to prevent shock and damage.
- .3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .4 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.

- .2 Store and protect pipes and coatings from damage.
- .3 Replace defective or damaged materials with new.
- .4 Do not drop or drag pipe.
- .5 Avoid severe impact blows, abrasion damage, and gouging or cutting of PVC pipe by metal surfaces or rocks.
- .6 For pipe handled on skidways, do not skid or roll pipe against pipe already on the ground.
- .7 Avoid stressing bell joints and damage of bevel ends.

Part 2 Products

- .1 Sanitary sewer pipe and gaskets will be supplied by the Contractor. Sewer pipe gaskets to be supplied to the Contractor by the pipe manufacturer.
- .2 Joints to be push-on type and must be watertight.

2.2 PLASTIC PIPE

- .1 Polyvinyl chloride (PVC) pipe: to CSA B137 and ANSI/AWWA C900.
 - .1 Series 160 SDR: 26, white.
 - .2 Pressure Class: 160
 - .3 Gasket bell end.
 - .4 Pipe joints: bell and spigot with rubber gaskets solvent welded joints or mechanical joints to ANSI/AWWA C111/A21.11, with transition gaskets to pipe manufacturer's specifications. This is a push-on joint and must be watertight. The bell will be an integral and homogeneous part of the pipe barrel with no reduction in the wall thickness.
 - .5 Rubber gaskets: to CSA B137.3 and ASTM D2241 ANSI/AWWA C111/A21.11. Gaskets for mechanical joints to be duck-tipped transition gaskets for PVC.
- .2 Fittings:
 - .1 Ductile Iron to AWWA C153, 2415 kPa Class.
 - .2 PVC pressure fittings to AWWA C907 and CSA B137.3.
 - .1 Class 160 (DR26) .
 - .2 Push-on bell and spigot type.

2.3 MARKER TAPE

- .1 Metal marker tape:
 - .1 50 mm wide.
 - .2 To carry the message "CAUTION – SEWER MAIN BURIED"

2.4 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.5 BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.6 INSULATION

- .1 Insulation: extruded, expanded closed-cell polystyrene insulation with the following minimum characteristics:
 - .1 Compressive strength – 210 kPa;
 - .2 Water absorption (% by volume) - Max. 0.7%;
 - .3 Capillarity (none);
 - .4 Shear strength - 275kPa.
- .2 Acceptable Products:
 - .1 Styrofoam HI-40, Celfort 300 as manufactured by Owens Corning, or approved equivalent.

2.7 LAYOUT EQUIPMENT

- .1 In laying out the sewer lines, the Engineer will establish only the locations and elevations of manholes.
- .2 Use approved laser beam instrumentation and techniques to determine intermediate line and grade for all pipes except where and when the Engineer may allow other methods to be used.
 - .1 Install laser beam in the pipe, just above the pipe, or in the bottom of the manhole, unless otherwise approved by the Engineer.
- .3 Use an approved laser sighting triangle or template to set each pipe.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.
 - .2 Inform Engineer of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Engineer.
- .2 Clean and dry pipes and fittings before installation.
- .3 Obtain Engineer's approval of pipes and fittings prior to installation.

3.3 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of Engineer prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 300 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% maximum density to ASTM D 698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material or lean mix concrete mud slab, as indicated on drawings.

3.5 INSTALLATION

- .1 Install sanitary sewer mains according to the sizes and locations indicated on the drawings.
- .2 Provide and use proper implements, tools and facilities for safe and efficient execution of the work.
- .3 Lay and join pipes to ASTM C12.
- .4 Lay and join pipes in accordance with manufacturer's recommendations, in accordance with recognized good practice and to approval of Engineer.
- .5 Handle pipe using methods approved by Engineer.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
 - .2 Carefully lower pipe and fittings into trench in such a manner as to prevent damage to them. Do not drop pipe or fittings into trench.
- .6 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Minimum grade, unless otherwise indicated:
 - .1 Pipe diameter 200 mm to 300 mm: 0.4%
 - .2 Permanent dead-end sewers: 0.6%

- .2 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .3 Remove and re-lay any pipe which is not in true alignment or shows undue settlement after laying.
- .7 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .8 Do not lay pipe on a foundation into which frost has penetrated, or at any time when the Engineer may deem that there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation.
- .9 Inspect pipe thoroughly before and after laying. Remove defective or damaged pipe from the site and replace with new sound material.
- .10 Trenches where pipe laying is in progress are to be kept dry. Pipes are not to be laid in water or upon wet bedding. Dewater excavations as required.
- .11 Thoroughly clean pipes as they are laid and protect pipes from dirt and water.
- .12 No length of pipe shall be laid until the preceeding length has been thoroughly bedded and secured in place so as to prevent movement or disturbance of the pipe.
- .13 Do not walk on or work over pipes until there is a minimum of 300 mm of cover over them, except as necessary in refilling trench and compacting the bedding material.
- .14 Joint deflection permitted within limits recommended by pipe manufacturer.
- .15 Water to flow through pipe during construction, only as permitted by Engineer.
- .16 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .17 Install plastic pipe and fittings in accordance with CSA B182.11.
- .18 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material. Wipe clean ends of pipe, rubber gaskets, fittings, etc. immediately before jointing.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Apply lubricant as approved by the pipe manufacturer to the spigot up to the reference mark and to the face of the gasket (mechanical joint gaskets included).
 - .7 Complete each joint before laying next length of pipe.
 - .8 Minimize joint deflection after joint has been made to avoid joint damage.
 - .1 Joint deflection permitted within limits recommended by pipe manufacturer.

- .9 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
- .10 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .11 Pipes may be pushed together by means of a crow-bar solidly wedged into the ground, by using a suitable pipe puller at the joint, or in some instances by very carefully pushing with the backhoe, or by any other method approved by the engineer.
 - .1 Use a block of wood when pushing against the pipe to prevent damage,
- .12 Ensure pipe gaskets are not rolled, pinched, dislodged, or torn during jointing.
- .19 When stoppage of Work occurs, block pipes as directed by Engineer to prevent creep during down time.
- .20 Plug lifting holes with pre-fabricated plugs approved by Engineer, set in shrinkage compensating grout.
- .21 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .22 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .23 Connections to existing piping:
 - .1 Install new pipes to within 2 m of existing pipe, but do not make connection until all downstream system work is complete and ready to receive wastewater flows.
 - .2 Install watertight plug at the end of new pipe to prevent groundwater, dirt or debris from entering the pipe. Obtain survey coordinated of end of the pipe to facilitate the location of the pipe later.
 - .3 When the remainder of the system is ready to receive wastewater flows, excavate the end of the new pipe and complete the connection. The Contractor shall as part of the work supply plugs and pumps to by-pass existing flows while the connection is being made. The sewer section and manhole to be leakage tested prior to opening this pipe section to use.
 - .4 The Contractor shall be aware that at these connection points it may not be possible for all work can be done at one time and shall allow for this in pricing the work.
 - .5 Use prefabricated saddles or field connections approved by Engineer, for connecting pipes to existing sewer pipes.
 - .6 Joints to be structurally sound and watertight.

3.6 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Engineer has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.

- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 1 m of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D 698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% maximum density to ASTM D 698.
- .7 When field test results are acceptable to Engineer, place surround material at pipe joints.

3.7 INSULATION

- .1 Install insulation in the locations shown on the drawings and as directed by the Engineer.
- .2 Install insulation 50 mm thick at 300 mm above the pipe for a width of 1200 mm.
- .3 Level and prepare the surface on which the insulation is to be placed so the insulation is not cracked or broken when backfilled.
- .4 Secure joints between sheets of insulation with an appropriate sheeting tape. Acceptable product: duct tape, or approved equivalent.
- .5 Cover insulation with a minimum of 150 mm of bedding before backfilling.

3.8 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Install marker tape 600 mm above the top of the pipe.
- .3 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.
- .4 Under paving and walks, compact backfill to at least 98% maximum density to ASTM D 698.
 - .1 In other areas, compact to at least 98% maximum density to ASTM D 698.
- .5 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.9 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Engineer, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Provide all labour, equipment and materials required to provide leakage tests on sanitary sewer mains and manholes.

- .5 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
 - .1 Where the groundwater table may normally be below the level of the pipeline, test the pipeline using an air exfiltration method. Where the groundwater table may normally be above the level of the pipeline, test the pipeline using an air infiltration method.
- .6 Do infiltration and exfiltration test to ASTM C828.
- .7 Do infiltration and exfiltration testing as specified herein and as directed by Engineer.
 - .1 Perform tests in presence of Engineer.
 - .2 Notify Engineer 48 hours minimum in advance of proposed tests.
- .8 Carry out tests on each section of sewer between successive manholes including service connections.
- .9 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .10 Exfiltration test:
 - .1 Do exfiltration test to ASTM C969. Exfiltration tests are to be done on all sewer mains and manholes where the internal surcharge will be more than 300 mm above the invert of the pipes.
 - .2 Plug pipe outlets that discharge into the upstream manhole and plug the outlet of the test section at the downstream manhole; the plug in the test section at the upstream manhole shall have a fitting to permit connection of an air hose;
 - .3 Using a low-pressure air pump, apply a pressure of 27.6 kPa to the test section;
 - .4 Close the valve between the air pump and the test section and allow the pressure to drop to 24.1 kPa and begin recording the test time at this point;
 - .5 The Engineer will calculate the allowable exfiltration. If the actual leakage time is greater than the allowable, the section tested has passed the test.
 - .6 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
 - .7 Immediately prior to test period add water to pipeline until there is head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
 - .8 Duration of exfiltration test: 2 hours.
 - .9 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
- .11 Infiltration test:
 - .1 Do infiltration tests to ASTM C1618 for concrete pipe and F1417 for PVC pipe testing using low pressure air.

- .2 Plug pipe outlets that discharge into the upstream manhole and plug the outlet of the test section at the downstream manhole; the plug in the test section at the upstream manhole shall have a fitting to permit connection of a vacuum hose;
 - .3 Use a vacuum pump to increase the negative pressure to 27.6 kPa Close the vacuum source and allow the negative pressure to decrease to 24.1 kPa; begin recording of the test time;
 - .4 The Engineer will calculate the allowable infiltration; if the actual leakage time is greater than the allowable then the test section is acceptable.
 - .5 Test all pipe less than 1200 mm in diameter from manhole to manhole. Test all pipe 1200 mm in diameter or greater one joint at a time.
 - .6 The maximum allowable leakage per joint tested individually shall be that calculated for a 1 metre length of pipe of that diameter at the rate of 0.001 cubic metres per minute square metre of internal pipe surface area.
 - .7 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
 - .8 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
 - .9 Install watertight plug at upstream end of pipeline test section.
 - .10 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
 - .11 Prevent damage to pipe and bedding material due to flotation and erosion.
 - .12 Place 90 degrees V-notch weir, or other measuring device approved by Engineer in invert of sewer at each manhole.
 - .13 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
- .12 Infiltration and exfiltration: not to exceed following limits in L per hour per 100 m of pipe, including service connections.

Nominal Pipe diameter (mm)	Asbestos-Cement or Plastic pipe (L/h/100 m of pipe)	Concrete or Vitrified Clay pipe (L/h/100 m pf pipe)
100	3.88	25.5
125	4.62	30.0
150	5.51	34.0
200	7.45	41.5
250	9.39	49.5
300	11.33	56.5
350	13.27	63.5
400	14.91	70.0
450	16.84	76.0
500	18.78	81.5
550	20.72	87.0

600	22.80	92.5
700	26.53	102.0
800	30.11	110.5
900	33.69	118.0
1000	37.56	124.5
1100	41.29	130.0
1200	45.01	135.0

- .13 Leakage: not to exceed following limits in litres per hour per 100 m of sewer for diameter tested including service connections:
 - .1 Exfiltration, based on 600 mm head: 0.175 L.
 - .2 Infiltration: 0.150 L.
- .14 Repair and retest sewer line as required, until test results are within limits specified.
- .15 Repair visible leaks regardless of test results.
- .16 Television and photographic inspections:
 - .1 Clean sewers, manholes, and all related appurtenances of all foreign material either by flushing or by hand.
 - .1 Intercept any debris by installing a basket or other suitable device at the downstream end of the section(s) being flushed
 - .2 Video inspection is not permitted before or during the flushing operation.
 - .3 After flushing but before the video inspection begins, add enough water to the upstream manhole so it can be seen flowing at the downstream manhole.
 - .4 Carry out inspection of installed sewers by passing the video camera through the sewer pipe in the direction of the flow.
 - .1 One hundred percent (100%) of the sewers will be video inspected.
 - .5 Provide means of access to permit Engineer to do inspections.
 - .6 The sewer will be inspected for alignment and obstructions. Water ponding in gravity sewers that cannot be eliminated by flushing and cleaning will be considered as evidence of pipe settlement.
 - .7 Any and all defects such as water ponding, leaking joints, sags, improper grade or alignment, excessive deflection, obstructions, etc. may be cause for rejection and such defects must be repaired by the Contractor at no expense to the Owner. The Engineer shall make the decision if such defects warrant correction.
 - .8 The Project Inspector shall be present when new sewer is being video inspected.
 - .9 Details of requirements for closed circuit television inspection are included in Appendix "B", at the end of these Specifications.
 - .10 Payment for inspection services in accordance with Measurement and Payment in PART 1.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section includes the supply of all labour, materials and equipment and incidentals necessary for the complete installation of all storm pipes, including weeping tile as shown on the drawings and herein specified.

1.2 RELATED REQUIREMENTS

- .1 Section 01 29 00 Payment Procedures.
- .2 Section 31 23 33.01 Excavating, Trenching and Backfilling.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM C76M-10a, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .2 ASTM C443M-10, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .3 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 CSA International
 - .1 CSA A3000-08, Cementitious Materials Compendium.
 - .2 CSA A257 Series-09, Standards for Concrete Pipe and Manhole Sections.
 - .3 CAN/CSA G401-07, Corrugated Steel Pipe Products.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Inform Engineer at least 4 weeks before beginning Work, of proposed source of bedding materials and provide access for sampling.
- .4 Certification: to be marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Carefully lower culvert pipes into trench in such a manner as to prevent damage to them. Under no circumstances shall culvert pipes be dropped into a trench.

Part 2 Products

2.1 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC): to CSA B182.2.
 - .1 Standard Dimensional Ratio (SDR): 28.
 - .2 Gasket to ASTM D3212 and integral bell system with no reduction in the wall thickness.
 - .3 Nominal lengths: 6 m.
 - .4 Color coded "white".
 - .5 Fittings: SDR28 to CSA B182.2 and ASTM D3034, colour coded "white".
 - .6 Perforations as noted on drawings.

2.2 CHECK VALVE

- .1 Tideflex Series TF-1 Duckbill Check Valve or approved equivalent;
 - .1 Shall be sized as noted on the drawings.

2.3 GRANULAR BEDDING AND BACKFILL

- .1 Granular bedding and backfill material to Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Granular bedding and surrounding material for weeping tile is to be **clear stone**, wrapped in non-woven (N2) geotextile filter fabric.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe culvert installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.
 - .2 Inform Engineer 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 Engineer.
- .2 Prior to placing the pipe adjacent to the foundation. Remove all defective pipes from the site and replace with sound material. All dirt and gravel must be kept out of the joint and all gaskets kept clean.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Obtain Engineer's approval of trench line and depth prior to placing bedding material or pipe.

3.4 BEDDING

- .1 Dewater excavation, as necessary, to allow placement of pipe bedding in dry condition.
- .2 Place 200 mm minimum thickness of approved granular material on bottom of excavation and compact to 95% minimum of maximum density to ASTM D 698.
- .3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Engineer, free from sags or high points.
- .4 Place bedding in unfrozen condition.

3.5 INSTALLATION

- .1 Lay pipe drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with bed throughout full length.
- .2 Begin laying at outlet and proceed in upstream direction.
- .3 Lay perforated pipes with perforations at 4 o'clock and 8 o'clock positions.
- .4 Lay bell and spigot pipe with bell ends facing upstream.
- .5 Make joints tight in accordance with manufacturer's instructions.
- .6 Plug open upstream ends of pipes with watertight concrete, steel or wood bulkheads.

- .7 Surround pipe with bedding gravel and compact as per manufacturer's recommendations.
- .8 Surround and cover drain with filter material in uniform 150 mm layers to an elevation of at least 150 mm above top of drain and compact to at least 95% maximum density to ASTM D 698.

3.6 BACKFILLING

- .1 Backfill around and over piping as indicated or as directed by Engineer.
- .2 Place granular backfill material, in 150 mm layers to full width, so as not to displace it laterally or vertically.
- .3 Compact each layer to 98% maximum density to ASTM D 698 taking special care to obtain required density under haunches.
- .4 Place backfill in unfrozen condition.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 43 Environmental Procedures.

1.2 ENVIRONMENTAL REQUIREMENTS

- .1 Operation of construction equipment in water is prohibited.
- .2 Use borrow material from watercourse beds only after receipt of written approval from Engineer and authority having jurisdiction.
- .3 Design and construct temporary crossings to minimize environmental impact to watercourse/wetland.
- .4 Constructing temporary crossings of watercourses where spawning beds are indicated is prohibited.
- .5 Dumping excavated fill, waste material, or debris in watercourse or wetland is prohibited.
- .6 Underwater blasting is not permitted.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 EXISTING CONDITIONS

- .1 Maintain existing flow pattern in natural watercourse systems.
- .2 In natural systems maintain existing riffle pool and step pool patterns.
- .3 In wetland systems, maintain existing hydrological conditions.

3.2 SITE CLEARING AND PLANT PROTECTION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to drawings.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Minimize disturbance to vegetated buffer zones and protect trees and plants on site and adjacent properties where indicated.
- .3 Wrap trees and shrubs adjacent to construction work, storage areas and trucking lanes in burlap.
- .4 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .5 Leave cuttings from trees and other vegetation on site as brush piles to allow for natural degradation.
 - .1 Secure large piles with degradable materials to prevent interference with watercourse.
- .6 Remove only trees that may offer future blockage problems as instructed by Engineer
- .7 Leave roots mass and stumps in place.
- .8 Maintain temporary erosion and pollution control features installed under this contract.

3.3 DRAINAGE

- .1 Pumping water containing suspended materials into watercourse is prohibited.
- .2 Establish rock chute spillways to accommodate safe surface water entry to watercourse as directed by Engineer
- .3 Install drop pipe inlet system as directed by Engineer

3.4 SITE RESTORATION

- .1 Establish vegetated buffer zones with suitable vegetation to minimum 3 m along edge of watercourse banks as determined by Engineer
- .2 Plant vegetation natural to area, suitable for application without requirement for fertilizers, pesticides and other chemicals.
- .3 Control stream bank erosion in lower section of watercourse with irregular shaped rip rap underlain with non-toxic recycled content filter cloth of size determined by Engineer
- .4 Control stream bank erosion in upper section of watercourse by planting suitable vegetation as directed by Engineer
 - .1 Ensure planting occurs within 5 days after work on watercourse is complete.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 29 00 Payment Procedures.
- .2 Section 26 05 00 Common Work Results for Electrical.

1.2 REFERENCES

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 Canadian Standards Association (CSA)
 - .1 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS in accordance with Construction and Hazardous Materials Section.
- .3 Shop drawings:
 - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .4 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment or material is not available, submit such equipment and material to authority having jurisdiction for approval by a certified agency of Standard Council of Canada (SCC) before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant.

- .5 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work of electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 In addition to technical data the Electrical Contractor shall also include:
 - .1 Names, addresses and phone numbers of local supplier for items included in the maintenance manual.
 - .2 Copy of reviewed shop drawings.
 - .3 Names, addresses and phone numbers of Electrical Sub-contractors.
 - .4 Inspection certificates and verification reports.
 - .5 Letter or certificate of warranty.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Material Delivery Schedule: Provide Consultant with schedule within 2 weeks after award of contract for all long delivery items.
- .3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .4 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from damage to finish or material.
 - .3 Replace defective or damaged materials with new.

1.6 ADDENDA AND REVISIONS

- .1 All addenda, instructions and revisions issued during the tendering period shall become part of the Contract Documents and shall be included in the Tender, and shall take precedence over the previous instructions.
- .2 The Owner and Consultant reserve the right to make revisions to the drawings during the period of construction and these shall take precedence over previously issued drawings. All revisions to the work shall be executed by duly authorized change orders with the amount of addition or deduction to the contract amount approved by the Owner before the execution of any work associated with the revision is undertaken.

1.7 SUBSTITUTIONS

- .1 It is the intent of these drawings to establish the required quality of materials. Where manufacturer names or catalogue references are used, it is done in order to establish the required quality, style, size or function. Products of other manufacturers will not be

permitted after the signing of the contract. The decision as to suitability shall rest with the Consultant.

- .2 Should the contractor propose to furnish material and equipment other than those specified, they shall submit a written request for any or all substitutions prior to the tender closing date. Such a request shall be accompanied by a complete description including manufacturer, brand name, catalogue number and technical data for all items. If requested by the Consultant, the contractor shall submit for inspection a sample of the proposed item.
- .3 All material not meeting the specifications above shall not be allowed on the project site.
- .4 Substitutions affecting the design will not be permitted. Additional costs to any other trade as a result of a change or substitution by this contractor shall be the responsibility of this contractor.
- .5 The listing of a manufacturer as acceptable does not imply acceptance of all products of that manufacturer and only products meeting the specifications will be accepted.
- .6 All requests to be received minimum 5 days prior to tender close.
- .7 Faxes are not acceptable as form of communication.

1.8 SCOPE OF WORK

- .1 The Electrical Contractor shall furnish all labour, material, tools, appliances and equipment to entirely complete and provide the operation of the electrical systems.
- .2 The overall intention is to provide a functioning complete electrical installation in all aspects, and all items reasonably inferable as called for by the drawings and specifications, and by normally accepted good practice, notwithstanding that every item necessarily required may not be particularly mentioned. This Contractor shall fulfill his obligation and not take advantage of any unintentional errors or omissions, should any exist, to the detriment of the Owner's interest. The work shall include but not be limited to:
 - .1 Wastewater Treatment Facility – Blower Building Control Panel
 - .1 Supply and installation of a new Control panel.
 - .2 Make all terminations of field devices inside of Control Panel.
 - .3 Programming of PLC and SCADA shall be by the Owner. Any required programming software shall be provided with the Control panel.
 - .2 Wastewater Treatment Facility – UV Building Marshalling Panel
 - .1 Supply and installation of a new Marshalling panel to connect to Control Panel.
 - .2 Make all terminations of field devices inside of Marshalling Panel.
 - .3 Coordination with other trades. See also Mechanical specifications and drawings.

1.9 ELECTRICAL DRAWINGS

- .1 The electrical drawings which constitute an integral part of this contract shall serve as working drawings. They indicate the general layout of the complete electrical system

arrangements of feeders, circuits, outlets, switches, controls, panelboards, service equipment, communications, fire alarm systems, underground duct banks, overhead pole lines, power center, etc..

- .2 Field verification of scale dimensions on drawings is directed since actual locations, distances, and levels will be governed by the field conditions.
- .3 All discrepancies related to the electrical work shall be promptly brought to the attention of the Consultant for clarification.

1.10 EXISTING CONDITION AND EXAMINATION OF DRAWINGS

- .1 The Electrical Contractor shall become completely familiar with the drawings and specifications, as well as construction methods of other trades related to the work to avoid possible interferences on the project. Should drastic changes be necessary to resolve such conflicts, this Contractor shall notify the Consultant and secure written approval and agreement on the necessary adjustments before the installation is started.
- .2 Before submitting the tender, this Contractor shall visit the site and become familiar with site conditions, availability of storage space and all other factors that might influence the tender submittal.
- .3 The contractor shall determine all working conditions and rigidly comply. Conditions that require special consideration include but not limited to: Dust, Noise, Vibration, Water, Working hours, Continuity of power, Access to area of work, Physical protection of Owner's facility and equipment.
- .4 No extras will be allowed due to failure to account for site conditions or working conditions.
- .5 The exact rough in dimensions and connection points shall be determined from shop drawings and on site measurements.

1.11 DISCREPANCIES

- .1 Bidders in preparing their tender, finding any errors, omission, or discrepancies in the drawings, specifications or other documents, or having any doubt in the intent or meaning of any part thereof, shall immediately notify the Consultant, who will send written instructions or clarification to all bidders. Where such discrepancies exist and it is evident that this Contractor could not have properly tendered without clarifications and where such clarification was not requested, not extra to the contract will be considered in order to have the installation properly made. The Owner and Consultant will not be responsible for oral instruction.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

- .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for both languages.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material equipment in accordance with Section 02 – General Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, for approval by a certified agency of Standard Council of Canada (SCC) before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring conduit: in accordance with Section 26 05 34 – Conduit, Conduit Fastenings and Conduit Fittings. All wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings shall not be the responsibility of this contractor unless otherwise noted.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements from inspection authorities and Consultant.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: plastic laminate lamacoid 3 mm matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters

Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Consultant prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
Telephone	Green	
Other Communication Systems	Green	Blue

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC-2Y-1.

2.10 SCADA INTEGRATION

- .1 The Owner will be responsible to provision a new SCADA system for the operation of the new facilities and equipment.

2.11 SCADA SYSTEM COMMUNICATION

- .1 All Communication will be via Ethernet matching the protocol of the selected PLC.
- .2 Communications to UV Building Marshalling panel to utilize Fiber connection.
- .3 Communications to SCADA system from Wastewater Treatment Facility Control panel to utilize Cellular communication.

2.12 CONTROL PANEL

- .1 Refer to drawings and section 40 05 13 Instrumentation – Control Panels for Wastewater System.

Part 3 Execution

3.1 INSTALLATION BY CONTRACTOR

- .1 The input devices for the control system shall be as follows:
 - .1 Building Temperature
 - .2 Flow Meters
 - .3 Pressure Transmitters
 - .4 Level Transmitters
 - .5 UV Control Panel, coordinate with manufacturer.
 - .6 Other devices as per drawings

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.5 CO-ORDINATION WITH OTHERS

- .1 Electrical contractor shall co-ordinate the installation of equipment to minimize inconvenience to Owner and other sub-contractors.

- .2 Work by other contractors will be done concurrently with work in this contract. This contractor shall schedule and arrange the work and store materials in co-operation so as to avoid interference with others.

3.6 FIELD QUALITY CONTROL

- .1 Qualifications: Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction and as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician to perform specific task.
 - .2 Permitted activities: determined based on the training level attained and demonstration of ability to perform specific duties
- .2 Health and Safety Requirements: Complete construction in accordance with occupational health and safety regulations.
- .3 Conduct following tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
 - .1 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .2 Systems: fire alarm communications.
- .4 Carry out tests in presence of Consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.7 SYSTEM STARTUP

- .1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .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 aspects of its care and operation.

3.8 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse or recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 RECORD DRAWINGS

- .1 Refer to Section 26 05 00 – Common Work Results for Electrical.

Two sets of white prints shall be maintained for the exclusive purpose of recording deviations from that shown on the contract drawings. One set shall be kept up to date at all times. At the completion of the project the information shall be transferred to the second set of drawings and to a set of reproducible CAD drawings. Both sets shall be turned over to the Owner.

3.10 GUARANTEE

- .1 Guarantee material and workmanship to be free from defect for a period of one (1) year or longer where specified otherwise, after issuing of the certificate of substantial completion.
- .2 Make good, at the Owner's convenience, all defects covered by this guarantee without additional cost to the Owner.

Part 1 General

1.1 SUMMARY

- .1 Provide only CSA approved materials and meet all applicable industry standards and codes.
- .2 Control panels shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking should be located so as to be clearly visible to qualified persons before examination, adjustment, servicing or maintenance of the equipment. All components used interior to the control panel to be "touch safe" to person or persons opening the control panel while energized.
- .3 All Control Panel Wiring to be "Touch Safe" as per IP20 Standards. This rating assures that a probe approximately the size of a finger is not able to make contact with any hazardous or energized parts.
- .4 Clearly indicate on the door of the control panel if there can be more than one voltage source.
- .5 All control panels to be constructed and certified as per the most recent edition of CSA C22.2 No.286.

Part 2 Products

2.1 GENERAL

- .1 Refer to Bill of Materials in drawings for products. Alternates to be reviewed by Consultant prior to ordering.

2.2 PANEL INSPECTION

- .1 Owners representative is to be given the opportunity inspect control panel construction at the control panel assembly shop prior to panel being relocated to the Construction site.
- .2 Panel assembler to provide photos of panel construction progress to Owner's representative during construction progress for review.
- .3 Contractor is to give Owner's representative minimum 5 business day notice prior to relocating Control Panel from the panel assembly shop to the Construction site.
- .4 Contractor is to assist Owner's representative with function testing control panel in the panel shop. These tasks may include but not be limited to:
 - .1 Voltage measurements
 - .2 Current measurements (4-20mA VDC, Up to 20Amp AC/DC)
 - .3 Continuity measurements
 - .4 Install temporary jumper wires
 - .5 Push to test of all relays
 - .6 Simulation of Relay Logic Circuits

- .5 Depending on the progress of Construction as well as the completeness of the PLC program the testing noted in Item 3.1.3 may or MAY NOT include testing with the PLC.

2.3 INSTALLATION

- .1 Contractor is responsible for installation, wiring, testing, and assisting the Owner representative in commissioning of all PLC equipment, PLC communication equipment, PC equipment and Operator interfaces.
- .2 The Contractor shall supply and deliver to the Owner's Representative any of the computer and PLC products identified herein for the purpose of programming. The Owner's Representative will advise the contractor when and which items will be required on a later date. The Contractor will pay all costs associated with handling, extended warranties, etc.
- .3 Contractor shall supply all required cabling to connect hardware above.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 26 – Electrical.

1.2 INSTALLATION DESCRIPTION

- .1 Furnish all labour, materials, equipment and appurtenances required to provide an open channel, gravity flow, ultraviolet (UV) disinfection system complete and operational with all control equipment and accessories as specified. This system shall be capable of disinfecting effluent to meet water quality standards specified
- .2 The UV Disinfection System is to be installed at an aerated lagoon WWTP, to be placed stainless steel effluent channel inside a building. The WWTP will be an aerated lagoon consisting of aerated treatment cells designed to treat the wastewater to 20 mg/L TSS and 20 mg/L BOD5, before the UV disinfection system. This is to be considered in the UV system design.

1.3 MEASUREMENT AND PAYMENT

- .1 Refer to Section 20 05 01 – Common Work Results for Mechanical

1.4 REFERENCES

- .1 Reference Standards:
 - .1 US EPA Design Manual - Municipal Wastewater Disinfection (EPA/625/1-86/021.
 - .2 Standard Methods for the Examination of Water and Wastewater, latest edition.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for UV System and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Complete assembly and installation drawings, together with detailed specifications and data covering material used and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittal section. The data and specifications for each until shall include, but not be limited to, the following:
 - .1 Complete description in sufficient detail to permit an item by item comparison with the specification;
 - .2 Dimensions and installation requirements;

- .3 Descriptive information including catalog cuts and manufacturer's specifications for all components;
- .4 Electrical schematic and layouts;
- .5 Hydraulic calculations demonstrating compliance with the specified hydraulic characteristics;
- .6 Experience documentation;
- .7 Bioassay validation report for proposed system to verify that the proposed system and number of lamps delivers specified UV dose.

1.6 START-UP ASSISTANCE AND TRAINING

- .1 In addition to the Installation Manual, furnish the necessary skilled technical personnel to check the installation, carry out an evaluation of, and start-up the equipment supplied under this contract. These personnel shall be available on site for not less than two (2) full days of eight (8) hours each. Also during this time on site, the Supplier's personnel shall instruct the Consultant fully on the operation, adjustment, and maintenance of all equipment furnished.
- .2 Furnish the necessary skilled technical personnel to check the operation and carry out an evaluation of the equipment supplied under this contract at 1-year from the date of substantial completion. Evaluation of the equipment supplied will include a written inspection report that will be submitted to the Departmental Representative.
- .3 These two (2) days of on-site assistance and training and evaluation at the 1-year mark will not be paid separately, but are considered incidental to the work and is to include all transportation, accommodation, personnel, and related costs. If additional on-site time is required from the personnel, it must be requested by the Consultant writing and will be paid at the all inclusive per diem rate to be provided by the Contractor prior to Substantial Completion. This does not include any time or costs to carry out repairs under the warranty, which is incidental to the contract.
- .4 The Supplier shall not charge for office technical support provided during the warranty period.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit to the Consultant prior to Substantial Completion a formal quote for additional on-site technical services / operator training beyond the scope of work as described in these Specifications. This fee shall be an all-inclusive per diem rate, including the services of a qualified technical representative, include all travel, accommodation, general expenses, and salary costs associated with such on-site services based on an eight (8) hour working day.
- .3 Operating and Maintenance Manuals:
 - .1 Supply written operating and maintenance instructions, sufficiently comprehensive to enable the operator to operate and maintain the equipment supplied.

- .2 All information in the O & M Manuals shall be clear and legible. Any data sheets with information on multiple model or optional equipment shall be clearly marked to indicate the information which applies to the equipment supplied.
- .3 Arrange in a hard cover, durable, three-ring binder.
- .4 Number pages consecutively.
- .5 Arrange manual in three sections: General; Equipment; and Operating and Maintenance Procedures. Each section is to include at least the following information:
 - .1 General
 - .1 Summary of Information Page: project name, equipment description, order number, serial numbers, manufacturer's nearest service representative, date prepared (and revised if necessary);
 - .2 Index for the O & M Manual;
 - .3 Warranty Information;
 - .4 Listing and explanation of abbreviations used.
 - .2 Equipment
 - .1 Provide details for all components provided including shop drawings; certified performance curves or data; parts diagram and parts list; materials of construction; product specifications; physical characteristics, serial numbers; performance specifications, drawings with dimensions, etc.
 - .3 Operating and Maintenance Procedures
 - .1 Provide normal start-up and shut-down procedures; maintenance checklist with maintenance operation and frequency; lubricant points diagrams; cleaning procedures, bulb replacement procedure, recommended spare parts list for minor field repairs; alignment instructions; troubleshooting tips; preventative maintenance inspection and monitoring charts.
 - .2 Any other instructions or information the Consultant should have for the safe and reliable operation of the equipment.

1.8 GUARANTEE

- .1 The equipment furnished under this section shall be free of defects in material and workmanship, including damages that may be incurred during shipping for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- .2 The UV lamps are to be warranted for a minimum of 12,000 hours. Pro-rated lamp warranties will not be accepted.
- .3 All travel expenses, accommodation, etc. for a service visit required under the warranty period will be included in the warranty.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 UV DISINFECTION SYSTEM

- .1 Approved System: UV3600K-PTP c/w U-Shaped Turn-Box, as manufactured by Trojan Technologies Inc., London, Ontario, Canada (or approved equivalent) as supplied by:
 - .1 Atlantic Purifications (Attention: Ian Johnston)
10 Ferguson Street, P.O. Box 877
Dartmouth, NS, B2Y 3Z5
(902) 469-2806
 - .2 Requests for approved equivalents must be submitted a minimum of ten (10) working days prior to Tender closing, as the supplier will be required to complete and submit a technical questionnaire providing relevant data for the evaluation of the proposed system no less than five (5) working days before receipt of Tenders, in accordance with Section 00 21 13 Instructions to Bidders.
- .2 Design Criteria:
 - .1 Provide equipment which will disinfect an effluent (from the partially aerated polishing cell) with the following characteristics:
 - .1 Peak Flow Rate: 2,690 m³/day (709,615 US GPD)
 - .2 Average Design Flow Rate: 930 m³/day
 - .3 Design Total Suspended Solids: <25 mg/l, 30 day average
 - .4 Annual Effluent Temperature: 0°C – 29°C
 - .5 Ultraviolet Transmittance @ 253.7 nm: >40%
 - .6 Max Mean Particle Size: 30 microns
 - .7 Effluent Standard to be Guaranteed: 200 Fecal Coliform per 100 ml, based on a 30 day geometric mean of consecutive daily grab samples, with no limit on incoming coliform counts.
 - .8 Effluent standards shall be achieved regardless of influent count to UV system.
 - .2 The UV equipment will be installed in pre-fabricated stainless steel channel with u-shaped turn-box having dimensions and respecting the tolerances as shown on the drawings. The fixed serpentine effluent weir must be perfectly level.
- .3 Performance Requirements:
 - .1 The UV system shall be designed to deliver a minimum UV dose of 30,000 µWs/cm² or 30 mJ/cm², at peak flow with a UV Transmission of >40% and at

- end of lamp life (accounting for quartz sleeve absorption, sleeve fouling, lamp aging, etc.), as calculated by the Point Source Summation Method and verified through independent third party bioassay in accordance with US EPA Design Manual – Municipal Wastewater Disinfection (EPA/625/1-86/021). The manufacturer's bioassay report must clearly demonstrate that the proposed UV system design and number of lamps will deliver the specified dose.
- .2 The UV system shall produce an effluent conforming to the following discharge limit: 200 fecal coliform /100 ml, based on a 30 day Geometric Mean, with no limit on incoming coliform counts. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, latest edition.
 - .3 Provide a UV disinfection system complete with UV lamp modules, level control weir, and UV monitoring system as shown on the Contract Drawings and as herein specified.
 - .4 The system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves and ballasts, and while cleaning the sleeves.
 - .5 The system will be housed inside a building but shall be designed for complete outdoor installation without shelter or supplemental cooling or heating required.
 - .4 Metal components in contact with effluent: Type 304 or Type 316 stainless steel.
 - .5 Wiring exposed to UV light: Teflon™ coated.
 - .6 Lamp Array Configuration:
 - .1 Uniform array with all lamps parallel to each other and to the flow. The lamps shall be evenly spaced in horizontal and vertical rows with centerline spacing equal in both directions.
 - .2 The single array pattern shall be continuous and symmetrical throughout the reactor.
 - .3 The system shall be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent.
 - .7 UV Module:
 - .1 Each UV lamp module shall consist of four (4) lamps and their corresponding electronic ballast.
 - .2 Each lamp shall be enclosed in its individual quartz sleeve, one end of which shall be closed and the other end sealed by a lamp end seal and holder.
 - .3 All wires connecting the lamps to the ballasts shall be enclosed inside the stainless steel frame of the UV Module and not exposed to the effluent. Systems where lamp wiring is submerged in the effluent and exposed to UV light will not be allowed.
 - .4 Each UV module shall be provided with a standard 120 Volt plug and weatherproof cable for connection to a receptacle. The cable shall be no longer than 10 feet (3.0 m). A total of twelve (12) UV modules will be supplied, six (6) per bank. Lamp status will be displayed on top of each UV module using watertight LED indicator lights.

- .5 Modules materials of construction shall be stainless steel type 316, anodized aluminum, quartz 214, and Teflon™, with UL rating of Type 6P and will be approximately 173.2 cm long (68.2”), 5.74 cm wide (2.26”), and 51.2 cm high (20.17”) weighing approximately 17 kg (38 lbs).
- .8 UV Lamps:
 - .1 Low pressure mercury slimline lamps of the hot cathode instant start design. The coiled filamentary cathodes to be heated by the arc current.
 - .2 The filament shall be of the clamped design, significantly rugged to withstand shock and vibration.
 - .3 Electrical connections at one end.
 - .4 Each connection shall have only two pins.
 - .5 90% of UV output shall be within the wavelengths of 233.7 to 273.7 nm.
 - .6 Rated to produce zero levels of ozone.
 - .7 Lamp bases: metal and ceramic construction resistant to UV and ozone.
 - .8 The lamp shall incorporate a dielectric barrier or pin isolator. The pin isolator shall consist of a non-conductive divider placed between the lamp pins to prevent direct arcing across the pins in moist conditions.
 - .9 The operating life of the lamps will be guaranteed for 12,000 hours, non-pro-rated.
 - .10 Independent validation of lamps aging factor is required.
- .9 Lamp End Seal and Lamp Holder:
 - .1 The open end of the lamp sleeve shall be sealed by means of a Black Ryton material nut which threads onto a sleeve cup and compresses the sleeve O-ring.
 - .2 The sleeve nut shall have a knurled surface to allow a hand grip for tightening. The sleeve nut shall not require any special tools for removal.
 - .3 The lamp shall be held in place by means of a moulded lamp holder that will incorporate two seals. The lamp holder shall seal against the inside of the quartz sleeve to act as a second seal in series with the external O-ring seal.
 - .4 The second seal on the lamp holder shall isolate and seal the lamp from the module frame and all other lamps in the module.
 - .5 In the event of a quartz sleeve fracture the two seals of the lamp holder shall prevent moisture from entering the lamp module frame and the electrical connections to the other lamps in the module.
 - .6 The lamp holder shall also incorporate a UV resistant plastic stop that will prevent the lamp sleeve from touching the steel sleeve cup.
- .10 UV Lamp Sleeves:
 - .1 Type 214 clear fused quartz circular tubing as manufactured by General Electric or equivalent.
 - .2 Lamp sleeves shall be domed at one end.
 - .3 Quartz to be rated for UV transmission of 89% and not subject to solarization.
 - .4 Nominal wall thickness: 1.0 to 2.0 mm to maximize UV transmission.

- .11 Effluent Channel:
 - .1 UV system to be provided with two (2) effluent channels/banks installed in series, in a u-shaped configuration complete with drain, UV module support racks (1/bank) and a downstream level control weir in the second/last channel in series. The u-shaped turn-box to be provided by the UV manufacturer as part of the system. The module support racks (x2) and serpentine level control weir (x1) are pre-installed in the channel by the UV manufacturer.
 - .2 Please refer to the tender drawings for dimensions
- .12 UV Lamp Module Support Rack:
 - .1 UV system shall be provided with UV module support racks for each bank.
 - .2 The module support rack shall be Type 304 stainless steel and be mounted to the concrete channel walls at elevation shown on the drawings. The pre-assembled UV modules are then installed into the support rack by hand.
 - .3 The module support rack shall be designed so that no ultraviolet light will radiate above the channel when the UV lamp modules are energized and fully immersed in the effluent.
- .13 Effluent Level Controller (Weir):
 - .1 Located at discharge end of the UV channel and sized to fit the channel location shown on the drawings.
 - .2 Weir shall be designed to maintain a minimum channel level of 30.5 cm (12 inches) to keep lamps submerged at all times.
 - .3 Constructed of Type 304 stainless steel.
 - .4 Weir shall be welded water tight and include a drain.
 - .5 To be supplied by manufacturer.
- .14 Electrical:
 - .1 The UV disinfection system shall be divided into twelve (12) UV modules.
 - .2 Interconnecting Cables to be standard 120 Volt, weatherproof, 10 feet (3.0 m) long and shall be suitable for outdoor installation.
 - .3 Power Distribution Receptacles:
 - .1 120 Volt receptacles rated for continuous outdoor use shall be provided. Receptacles shall be of the duplex type complete with ground fault interrupter circuitry.
 - .2 Receptacles to be provided by the UV Manufacturer.
 - .4 Power Consumption:
 - .1 Maximum power draw to UV System shall be 4,200 watts (assumes both banks all lamps on).
 - .2 All electrical supplies shall be 120 Volt, 60 Hz.
 - .3 A separate 120 volt, 5 amp supply to be provided for the Monitoring System.
- .15 Power Distribution Receptacle (PDR):

- .1 Duplex ground fault interrupter receptacle(s) shall be provided by the UV Manufacturer.
- .2 Contractor to supply appropriate 120 Volt, single phase, 60 Hz circuit to power the PDRs which have a total current draw of approximately 19.2 amps. Contractor to be responsible for distributing the power from the main 120 Volt feed to the individual PDRs. Responsibility to be all encompassing and in accordance with the local electrical codes.
- .16 Monitoring System:
 - .1 One (1) submersible UV sensors shall continuously monitor the UV intensity produced in each bank of UV lamp modules. The sensors shall measure the germicidal portion of the light emitted by the UV lamps.
 - .2 UV intensity shall be indicated on a 3 character display in mW/cm^2 .
 - .3 Elapsed time in hours (lamp age) shall be indicated on a 5 character display.
 - .4 Both displays shall utilize LEDs and shall be visible through the panel door.
 - .5 One (1) dry contacts shall be provided for remote indication of Low UV intensity alarm.
 - .6 Monitoring System shall be enclosed in a fiberglass Type 4X wall mounted panel and is to be located less than twelve (12) feet (3.66 m) from the LED end of the UV Module.
- .17 Maintenance Rack:
 - .1 One (1) Type 304 stainless steel maintenance rack shall be supplied. The rack shall be designed to hold UV modules during service or maintenance.
- .18 Transition Connections:
 - .1 One (1) inlet and one (1) outlet transition box will be supplied by the UV manufacturer.
 - .2 One (1) u-shaped turn-box will be supplied by the UV manufacturer.
 - .3 The material of construction for the transition boxes will be stainless steel type 304, 14 gauge.
 - .4 Openings on the transition boxes (for flange connections) conform to ANSI standards and have dimensions as shown on the Contract Drawings.
- .19 Portable UVT Field Meter
 - .1 Provide a portable UVT field meter to allow measurement of UV Transmittance.
 - .2 The device shall have a range of 0 – 100% Transmittance with 0 – 2 Absorbance and an accuracy of $\pm 0.5\%$ UVT. The device shall include a back-lit LCD display.
 - .3 Acceptable product: Real UVT Field Meter as manufactured by Real Tech Ltd. and supplied by Atlantic Purification, or approved equivalent.
 - .4 It is to be noted that the portable UVT field meter shall be supplied by the same supplier as for the UV system.
- .20 Spare Parts:
 - .1 Four (4) UV lamps

- .2 Four (4) Quartz sleeves
- .3 Four (4) Lamp holder seals
- .4 One (1) Operators Kits including face shield, gloves and cleaning solution.

Part 3 Execution

3.1 INSTALLATION

- .1 Installation of UV system shall be included in this contract and shall be done in accordance with the manufacturer's instructions.
- .2 Clear water for testing of the equipment is the responsibility of the Contractor and will not be provided by the Departmental Representative.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Progress Cleaning: Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Appendix A – Geotechnical Investigation Report

Neqotkuk WWTF Improvements

Geotechnical Investigation

Atlantic First Nations Water Authority Inc.
Final Report

November 1, 2024
2308072.001



eNGLOBE

Atlantic First Nations Water Authority Inc.

Prepared by:

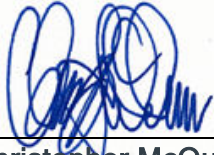


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Table of Contents

1	Introduction	1
2	Site and Project Description	1
3	Subsurface Exploration Program	1
4	Subsurface Conditions.....	2
4.1	Rootmat/Topsoil	2
4.2	Fill	2
4.3	Alluvium	3
4.3.1	Sand and Gravel	3
4.3.2	Silt.....	3
4.4	Bedrock.....	3
4.5	Inferred Groundwater	3
5	Discussion.....	4
5.1	Site Preparation, Excavation and Earthworks.....	4
5.1.1	Excavation	4
5.1.2	Subgrade Preparation	4
5.1.3	Backfilling.....	5
5.2	Engineered Fill	5
5.3	Re-use of Existing Soil	6
6	Engineering Recommendations	6
6.1	Bearing Capacity	6
6.2	Frost Depth	7
6.3	Seismic Design	7
6.4	Waterproofing and Drainage	7
7	Construction Considerations	7
7.1	Earthwork in Wet and Cold Environments	7
7.2	Bedrock Excavation.....	8
7.3	Temporary Excavations.....	8
7.4	Dewatering.....	8
7.5	Materials Testing and Inspection	9
8	Closure	9

TABLES

Table 1: Summary of Subsurface Conditions2

Table 2: Limit States Design Parameters6

APPENDICES

Appendix A	Exploration Location Plan
Appendix B	Symbols and Terms and Borehole Records
Appendix C	Laboratory Test Results

1 Introduction

At your request, Englobe Corp. (Englobe) has carried out a geotechnical investigation at the site for the development of a new ultraviolet (UV) light treatment one-storey building at the Neqotkuk Wastewater Treatment Facility in Neqotkuk, New Brunswick. The proposed project also includes the decommissioning of the chlorination building that is adjoining the proposed UV building location. The purpose of the study was to assess the subsurface conditions and to make recommendations for earthworks construction and foundation design.

This report presents our observations and engineering recommendations associated with the geotechnical investigation of the site. Included herein are the factual results of the field investigation including a discussion of field procedures, subsurface conditions, laboratory analysis and recommendations for site development.

2 Site and Project Description

The project site is located within the fenced area of the existing Neqotkuk Wastewater Treatment Facility, in Neqotkuk, New Brunswick. The property includes parts of a parcel identified by Service New Brunswick as Property Identification (PID) number 65040297. The proposed project consists of building a new UV treatment facility including a new building and associated buried infrastructure on the existing berm of the wastewater lagoon. According to the site plan, the proposed building footprint is approximately 65 square meters, and the finished floor elevation is planned to be at 84.15 meters. The infrastructure associated with the building is anticipated to be approximately 5 meters below the ground surface.

The site is currently occupied by a lagoon, two buildings housing infrastructure for the existing sewage treatment (i.e., the chlorination and blower buildings), and a service road. The proposed site is bordered by the Saint John River to the west and north, a quarry to the south and residential dwellings to the east. Site topography is generally flat; However, topographic survey information was not provided.

3 Subsurface Exploration Program

The geotechnical subsurface investigation included the advancement of a total of three boreholes identified as BH24-01 to BH24-03. The boreholes were advanced to depths ranging from approximately 5.79 to 7.32 meters below the existing grade. The boreholes were drilled using a track-mount drill rig supplied by Lantech Drilling Services Inc., of Dieppe, New Brunswick on September 25, 2024, under the supervision of Englobe personnel. The borehole locations were determined by tape measurement from existing site features and are shown in the Exploration Location Plan in Appendix A. The elevations of the boreholes were determined via LiDAR surface.

The boreholes were advanced using solid-stem augers with field sampling and testing performed in the open borehole. Standard Penetration Tests (SPT) were performed at regular intervals in the boreholes to obtain blow counts (i.e. N-values) using a 50-millimeter outside-diameter split-barrel sampler in general accordance with ASTM International (ASTM) standard D1586 *Standard Test Method for Standard Penetration Test (SPT)*. Soil samples obtained were logged and transported to our laboratory for further classification.

4 Subsurface Conditions

The following section describes and summarizes the subsurface conditions encountered. The appended Symbols and Terms used on Borehole and Test Pits Records in Appendix B, provide a brief explanation of the terminology and graphics used.

The subsurface conditions encountered during the field program generally consisted of rootmat and topsoil, fill and alluvium. A summary of the encountered geologic conditions is described in the sections below and included in Table 1 as well as on the Borehole Records shown in Appendix B.

Table 1: Summary of Subsurface Conditions

Borehole	Surface Elevation (meters) ¹	Borehole Depth (meters)	Rootmat and Topsoil Thickness (meters)	Fill Thickness (meters)	Alluvium Thickness (meters)	Inferred Groundwater Depth (meters)
BH24-01	84.06	7.32	NE	2.59	>4.73	NE
BH24-02	84.01	5.79	0.06	2.37	>3.36	NE
BH24-03	84.05	6.70	NE	2.59	>4.12	NE

¹Elevations determined via LiDar Surface.

NE: Not Encountered

>: Greater than

Field and laboratory soil classification was performed in general accordance with the system recommended in the Canadian Foundation Engineering Manual, 4th edition.

Note that the stratigraphic boundaries detailed in this section typically represent a transition of one soil or bedrock type to another and do not necessarily indicate an exact plane of geologic change. Subsurface conditions may vary between and beyond the testing locations.

4.1 Rootmat/Topsoil

A layer of rootmat and topsoil was encountered at the ground surface of borehole BH24-02. The layer consisted of brown sandy silt with high organic content. The rootmat was approximately 0.06 meters in thickness, where encountered.

4.2 Fill

A layer of fill was encountered around the existing lagoon in each borehole at the ground surface or beneath the rootmat and topsoil. Although records were not available, the fill is believed to have been placed for the construction of the lagoon berm. The fill consists of brown sand and gravel, some silt. The

fill layer was loose to very dense in compactness condition. The thickness of the fill layer ranged from approximately 2.37 to 2.59 meters.

One sample was tested to determine the moisture content in accordance with ASTM D2216 *Standard Test Method for Laboratory Determination of Water Content of Soil and Rock by Mass* and also tested for gradation in accordance with ASTM D6913 *Standard Test Methods for Particle-Size Distribution of Soil Using Sieve Analysis*. The results are presented in the appended Borehole Records in Appendix B and on the Laboratory Test Results in Appendix C.

4.3 Alluvium

A layer of alluvium was encountered below the fill in each borehole. The alluvium is stratified with two distinguishable interbedded layers, a sand and gravel and a silt layer. The thickness of the alluvium was 3.36 to greater than 4.73 meters in thickness. Generally, the density of the alluvium increased with depth in each borehole. Each borehole terminated within a sand and gravel layer.

4.3.1 Sand and Gravel

Native alluvial sand and gravel was encountered in each borehole below the fill. The layer consisted of brown sand and gravel, some silt. The sand and gravel was loose to dense in compactness condition. The alluvial sand and gravel ranged from 2.14 to greater than 4.73 meters in thickness.

One sample was tested to determine the moisture content in accordance with ASTM D2216 and also tested for gradation in accordance with ASTM D6913. The results are presented in the appended Borehole Records in Appendix B and on the Laboratory Test Results in Appendix C.

4.3.2 Silt

A layer of native alluvial silt was encountered interbedded within the alluvial sand and gravel in boreholes BH24-02 and BH24-03. The layer consisted of brown sandy silt, trace gravel. Some traces of organic matter were observed in the silt layer. The layer was loose in compaction condition. The alluvial silt ranged from 0.28 to 1.06 meters in thickness.

One sample was tested to determine the moisture content in accordance with ASTM D2216 and also tested for gradation in accordance with ASTM D6913. The results are presented in the appended Borehole Records in Appendix B and on the Laboratory Test Results in Appendix C.

4.4 Bedrock

Bedrock was not encountered within the depth of exploration.

According to the Bedrock Geology of the Aroostook area (NTS 21 J/13), the regional bedrock consists of late Ordovician to early Silurian era, dark grey to bluish grey, massive to abundantly laminated, very fine-grained argillaceous limestone interbedded with calcareous shale of the White Head Formation, Matapedia Group.

4.5 Inferred Groundwater

Groundwater was not observed at the time of the exploration program. Groundwater levels observed over a short duration may not be representative of the actual site conditions. Groundwater levels can be

expected to fluctuate during periods of heavy precipitation associated with seasonal weather trends, a particular event, site use, adjacent site use, and construction activity.

5 Discussion

The project site is located at the Neqotkuk Wastewater Treatment Facility in Neqotkuk, New Brunswick. The project includes the construction of a new 65-square-meter UV treatment facility with associated infrastructure. The geotechnical investigation was conducted within the proposed development's footprint.

Subsurface conditions in the area of the proposed development include rootmat and topsoil, fill, alluvial sand and gravel, and alluvial silt. Bedrock was not encountered during the investigation program. Inferred groundwater was not encountered during the exploration program. The following paragraphs present a discussion of site development based on the subsurface conditions.

5.1 Site Preparation, Excavation and Earthworks

5.1.1 Excavation

Anticipated excavated materials for foundation construction, as well as buried utility installation on the project site will include rootmat and topsoil, fill and alluvial sand and gravel and silt. Bedrock was not encountered during the investigation program. We anticipate site soils can be excavated with conventional excavation equipment. Subgrade preparation for the various portions of the project are discussed herein. Consideration for temporary and permanent slopes as well as excavation dewatering as provided in Section 7 - Construction Considerations.

5.1.2 Subgrade Preparation

5.1.2.1 General

Construction operations should ensure that subgrades are maintained in a dry and stable condition. In open areas, the subgrades should be graded to avoid ponding and promote the flow of water off the subgrades. In trenches, subgrades should be dewatered by pumping. Construction traffic movement should be limited to the extent possible on exposed subgrades to prevent subgrade softening. Minimizing exposed subgrades will also limit subgrade disturbance from precipitation. Haul road construction should be considered to concentrate construction traffic movements to improved subgrade areas.

5.1.2.2 Pipe Subgrades

Based on the anticipated depth of excavation for buried infrastructure including service manholes and piping, subgrade will consist of alluvial sand and gravel. Once the design pipe invert subgrade level is reached by excavation, the resulting surface should be inspected to identify loose or soft areas requiring further overexcavation. Loose or soft areas should be overexcavated and reinstated with approved imported engineered fill such as 150-millimeter-minus crushed rock.

Pipes and drainage structures should be supported on a minimum of 150 millimeters of pipe bedding material meeting the gradation requirements of New Brunswick Department of Transportation and

Infrastructure (NBDTI) *Standard Specifications for Highway Construction* for pipe bedding. Pipe bedding should be compacted as discussed herein in Section 5.1.3.

5.1.2.3 Building Subgrades

Rootmat and topsoil are not suitable for foundation and slab support and should be removed, where encountered, within the building footprint and footing bearing zone defined as the area extending downward and outward from footing edges at one horizontal to one vertical (1H:1V). The existing lagoon berm consists of fill that is loose to compact in-situ. Construction records indicating the fill was placed in a controlled manner and compacted to a specified target were not provided and as such, the existing fill should be removed from the building footprint and footing bearing zone. The existing alluvium may remain in place provided organics, if encountered, are removed.

Following the removal of unsuitable soils, exposed subgrades should be compacted with a highway roller, or approved compaction equipment, as directed by the geotechnical engineer. A geotextile filter fabric and a HX-series geogrid should then be placed on the subgrade in accordance with manufacturer's specifications. Alternatively, a thin concrete mud slab may be placed over approved subgrades as protection from moisture-induced damage.

5.1.3 Backfilling

Soil backfill should be placed in lifts not exceeding 300 millimeters in loose thickness and be compacted throughout the lift thickness with suitable equipment to at least 98 percent of the standard Proctor maximum dry density as determined in accordance with standard ASTM D698 *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lb-f/ft³ (600 kN-m/m³))*. The backfill should be verified by means of in-place density testing using a nuclear density gauge in accordance with ASTM D6938 *Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*.

We anticipate the reuse of excavated soils as common borrow fill to reinstate trenches to design subgrade elevation or as engineered fill in the building footprint. Excavated in-situ soils are anticipated to consist of granular fill and possibly alluvial sand and gravel. Existing site soils are moisture sensitive and therefore reuse will be contingent to a large extent on the condition of the soil after excavation, handling, and stockpiling.

Excavated soils, if permitted to dry and/or protected from precipitation, should be free of rootmat/topsoil, other organics, or other deleterious material. Oversized particles, such as cobbles and boulders should be removed from the backfill.

5.2 Engineered Fill

Unless otherwise specified, the imported engineered fill to achieve pavement section subgrades or as trench backfill should consist of well-graded, granular soil with a maximum particle size of 100 millimeters and a maximum of 10 percent passing the 75-micron sieve, such as pit run or quarried rock fill. Quarried sandstone may be used as engineered fill provided it meets the requirements of Item 121 of the New Brunswick Department of Transportation and Infrastructure (NBDTI) *Standard Specifications for Highway Construction* for Borrow A. The first lift of backfill in the footing zone of influence may be 600 millimeters in thickness and consist of 200-millimeter-minus crushed rock provided the lift is compacted with a highway roller.

5.3 Re-use of Existing Soil

Rootmat and topsoil, and alluvial silt containing organic matter are not suitable for foundation support or reuse as engineered fill in the foundation zone of influence or as backfill in pipe trenches. These soils containing organic material may be reused in landscape areas.

Excavated granular fill and alluvial sand and gravel may be selectively used as engineered fill provided particles greater than 150 millimeters in diameter are removed, it is free of organics, frost and other deleterious materials, and it can be placed and compacted to the criteria established for engineered fill in Section 5.2. It can also be reused in landscape areas

For excavated soil planned for reuse as engineered fill, the moisture content should be maintained below the optimum moisture content by one to two percent to achieve adequate compaction and maintain stability. Excavated soils are not anticipated to dry readily for reuse outside of summer months and only if lifts are permitted to air dry. The reuse of existing soil will be contingent to a large extent on the condition of the soil after excavation, handling and stockpiling. Stockpiled soil should be covered if the forecast calls for precipitation.

Based on the heterogeneous nature of the in-situ soils, determining a representative moisture-density relationship may not be feasible. We recommend, at minimum, a Proctor test be completed on each apparent different soil type planned for reuse and moisture contents be determined for stockpiles prior to use.

Should compaction not be achieved because of the heterogeneity of the soil, we recommend full-time inspection of the compactive effort for the new building and a rolling pattern be completed for each day of trench backfilling in consideration with the moisture content determined from the stockpile. The lift thickness is a function of the compaction equipment used for backfilling and should be approved by the geotechnical engineer.

6 Engineering Recommendations

6.1 Bearing Capacity

Building foundations supported on shallow, spread-footing foundations should be founded on compacted native alluvium or compacted engineered fill over native alluvium as discussed in Section 5.1.2.3. Geotextiles or a mud slab should be used to maintain subgrade stability. The recommended Limit States Design geotechnical resistances are shown in the following Table 2.

Table 2: Limit States Design Parameters

Limit States Design Parameter	Strip Footings	Square Footings
Factored Geotechnical Resistance at Ultimate Limit States (ULS)	175	225
Geotechnical Resistance at Serviceability Limit States (SLS)	150	175

Strip footings are assumed to be at least 600 millimeters wide whereas the minimum width for square column footings is assumed to be 1,500 millimeters. Bearing capacities herein should be reviewed by a geotechnical engineer if different foundation sizes are used.

The ultimate limit states (ULS) recommended herein are based on a maximum allowable settlement of 25 millimeters. The ULS factored bearing resistance was developed using a bearing resistance factor of 0.5. The serviceability limits states (SLS) are based on an allowable differential settlement of 19 millimeters. Unfactored loads should be used with the serviceability bearing pressures in accordance with the 2020 National Building Code of Canada (NBCC). The recommended factored geotechnical resistances assume vertical loading for structures away from the crest of slopes.

6.2 Frost Depth

Footings should be located sufficiently deep to prevent the migration of frost fronts below exterior foundations. The calculated frost depth for the project, based on available meteorological data for the Aroostook region, the nature of the development and subsurface information from the exploration program, is approximately 1.80 meters. Exterior foundations scheduled to be located above the anticipated frost depth should be protected using rigid polystyrene insulation. An insulation detail can be prepared, if requested.

6.3 Seismic Design

Based on the subsurface conditions encountered at the site and the anticipated depth of foundation elements, the Site Classification for Seismic Site Response is Site Class E in accordance with NBCC requirements. The susceptibility of the site to liquefaction in the event of an earthquake is beyond the scope of this report.

6.4 Waterproofing and Drainage

If below-grade structures are anticipated, foundation perimeter drains should be installed and connect to an approved storm sewer system. Foundation wall waterproofing may consist of foundation sealant. To prevent adfreeze forces against exterior foundation walls, we recommend backfilling with soil with less than 10 percent fines and/or the use of a bond breaker, such as corkboard, foam insulation or plastic sheeting.

7 Construction Considerations

The following comments on specific construction aspects of the project are provided for guidance. The contractor undertaking the work should make their own interpretation of the factual information provided in this report as it affects their construction procedures and scheduling.

7.1 Earthwork in Wet and Cold Environments

Site soils may be susceptible to softening in the presence of water and construction traffic; therefore, excavations and exposed surfaces should be maintained in a dry condition. Subgrade surfaces disturbed or softened during construction should be over-excavated and replaced with engineered fill meeting the requirements of Section 5.2.

For winter construction, the potential exists for the onset of frost if exposed subgrade soils are not insulated during cold weather construction. Frost can occur in fine-grained soils due to the expansion of water during the freezing process and produce displacement when drained during a seasonal thaw. In addition, the compaction effort applied to frozen soil cannot be accurately verified with a nuclear density gauge. Proofrolling inspection of frozen soil may suggest subgrades are temporarily stable but still soften during a seasonal thaw.

During cold-weather construction, fill imported to the site should be newly quarried, placed and compacted immediately following delivery to the site. Compaction testing and proof rolling activities should be completed immediately following the initial compactive effort. Failing areas should be remediated before the onset of frost.

Fill should not be placed on frozen, or snow and ice-covered subgrades. In excavations, subgrade surfaces should be covered with insulating blankets or heated tarps if the forecast calls for below freezing conditions.

7.2 Bedrock Excavation

Bedrock was not encountered during the exploration program and is not anticipated for building construction.

7.3 Temporary Excavations

Excavations in existing site soils are expected to remain temporarily stable at side slopes of 1H:1V while, long-term stability, can be achieved at 3H:1V. Excavations below the water table and in saturated conditions may require flattening of the slopes. Shoring may be required for deep excavations depending on site restrictions.

Safe excavation slopes are the responsibility of the earthwork's contractor. As a minimum, temporary excavations must be sloped in accordance with the applicable New Brunswick Occupational Health and Safety Guidelines. If an excavation cannot be properly sloped or benched, the contractor should install an engineered shoring system to safely support the temporary excavation. Temporary slopes should be protected from surface-runoff erosion by means of berms and swales located along the top of the slope and by means of plastic sheeting placed over the slope.

Excavation slopes should be checked regularly for signs of instability and flattened as required. Soil stockpiles should not be located within 1.5 times the height of the excavation depth to avoid surcharging the excavation walls.

7.4 Dewatering

The groundwater table was not encountered during the investigation program however, construction dewatering may be required in deep excavations for utilities.

If required, dewatering may be accomplished by using submersible pumps. Pumps should be located sufficiently deep to lower groundwater levels a minimum of 600 millimeters below subgrade elevation. Water pumped from excavations is expected to contain fine-grained soils and will require care in the disposal. Provision for proper site drainage in accordance with applicable municipal, provincial, and federal environmental requirements should be made at the construction stage.

7.5 Materials Testing and Inspection

During construction of the proposed development, we recommend a geotechnical engineering firm be retained by the owner and/or the contractor to provide ongoing consultation, confirm the recommendations herein are followed, and ensure the materials used during construction meet specifications. Englobe can provide these services if requested.

8 Closure

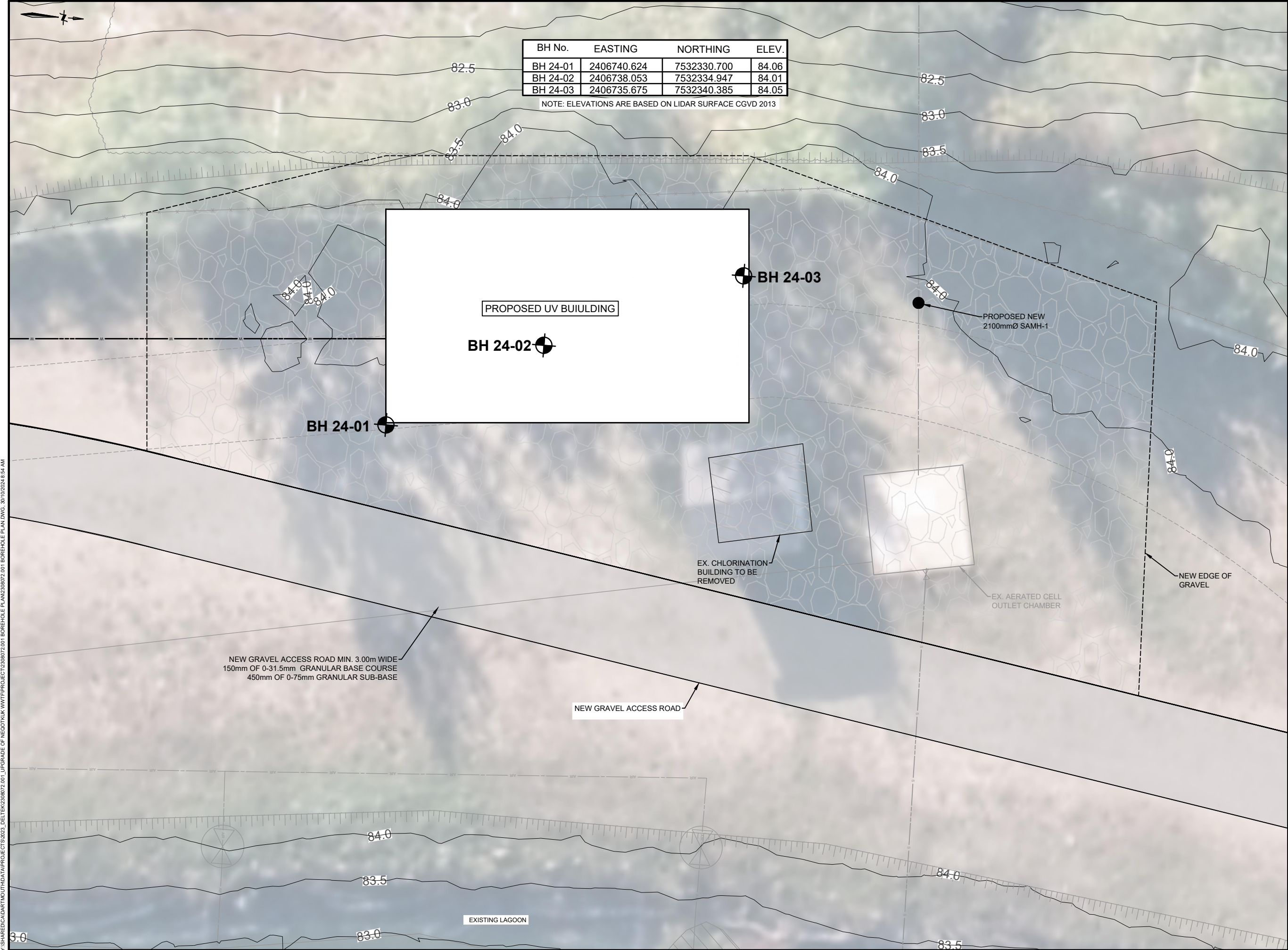
The geotechnical investigation undertaken has involved random sampling of site conditions. Should any conditions be encountered during constructions that are contrary to those reported herein, we request immediate notification so that reassessment can be undertaken.

Appendix A

Exploration Location Plan



eNGLOBE



Y:\SHARED\CAD\ART\MO\DATA\PROJECTS\2023_DELTERK2308072.001_UPGRADE OF NEQOTKUK WWT\PROJECT\2308072.001_BOREHOLE PLAN.DWG, 30/10/2024 8:54 AM

NOTES

LEGEND:

BH  BOREHOLE

A.O	OCT 03/24	ISSUED FOR BOREBOLES	TWA	KKM
NO.	DATE	REVISIONS	BY	APPR.




PROJECT TITLE

UPGRADE OF NEQOTKUK
WASTEWATER TREATMENT
FACILITY

NEQOTKUK N.B.

DRAWING TITLE

EXPLORATION LOCATION PLAN

Scale  (1:50 FULL SCALE)	Drawn By TWA	Design By KKM
	Checked By TD	Cadd Check TS
	Sheet	1 of 1

File Name
2308072.001 BOREHOLE PLAN.DWG

Drawing No.
2308072.001-P01

Appendix B

Symbols and Terms and Borehole Records



eNGLOBE

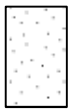
SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

STRATA PLOT

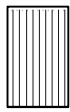
Strata plots symbolize the soil or bedrock descriptions, using a combination of the following basic symbols.



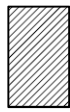
Boulders
Cobbles
Gravel



Sand



Silt



Clay



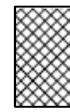
Topsoil
Organics



Asphalt



Concrete



Fill



Glacial Till



Bedrock

SOIL SAMPLES

Sample Type

A	- auger sample
B	- block sample
C	- core sample
D	- drive sample
G	- grab (bulk) sample
SS	- split spoon sample
U	- tube sample (thin wall)
W	- wash or air return sample
HQ, BQ, NQ	- Rock core sample

Sample Condition

	- undisturbed
	- disturbed
	- no recovery

Water Level Measurement

	Measured in standpipe, piezometer, or well
	Inferred groundwater condition

Standard Penetration Resistance (N-Value) – unless otherwise noted this column refers to the Standard Penetration Test N-Value: the number of blows for a 140 pound (64 kg) 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. Where insufficient penetration was achieved and N-Values cannot be presented, the number of blows is reported over sampler penetration in millimeters (e.g. 50/75). No corrections have been applied to the N-Values presented in the log.

Dynamic Cone Penetration Test (DCPT) – performed using a standard 60-degree apex cone connected to 'A' size drill rods. Applied energy is as per the Standard Penetration Test [140 pound (64 kg) hammer falling 30 inches (760 mm)]. The DCPT value is represented as the number of blows of the hammer required to drive the penetrating cone one foot (300 mm) into the soil.

SOIL TESTING

Soil Testing Descriptors

MA	- mechanical grain size analysis (reported separately)
ϕ	- moisture content
C	- consolidation test (reported separately)
D_R	- relative density
k	- permeability coefficient (reported separately)
pp	- pocket penetrometer strength
q	- triaxial compression test
UCS	- unconfined compressive strength
SB	- shear box test (reported separately)
TV	- torvane shear strength
VS	- vane shear strength
γ	- unit weight of soil or rock
γ_d	- dry unit weight of soil or rock
ρ	- density of soil or rock
ρ_d	- dry density of soil or rock

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

The classification of soil types are made in accordance with the Canadian Foundation Engineering Manual (5th Edition)

SOIL DESCRIPTIONS

Common Soil Descriptors

<i>Rootmat/Topsoil</i>	- Organic matter (roots, moss, topsoil) typical forming a vegetative mattress, and/or capable of supporting vegetative growth
<i>Fill</i>	- Material identified as placed by others
	- <i>Glacial Till</i> – unsorted sediment from glacial sources
<i>Native Inorganic Soils</i>	- <i>Marine Soils</i> – glacial or post-glacial soils, commonly stratified
	- <i>Alluvial/Fluvial Soils</i> – material deposited by water courses, commonly stratified
<i>Peat</i>	- Partially decayed vegetation (humas) material that has accumulated in a water-saturated environment
<i>Bedrock</i>	- Deposit of rock beneath soil and other broken or unconsolidated material (regolith)

Soil Structure Descriptors

<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 layers of different soil types (e.g. silt and sand/silt and clay)
<i>Well-Graded</i>	- Having a generally uniform distribution in a range of grain sizes, with no dominating size
<i>Poorly Graded</i>	- predominantly of one grain size

Terminology used for describing soil strata based on the proportion of individual particle size present:

<i>main component</i>	(gravel, sand, silt, clay)	>35 % and main fraction
<i>“and”</i>	(and gravel, and silt, etc.)	>35 %
<i>adjective</i>	(gravelly, sandy, silty, clayey, etc.)	20 % – 35 %
<i>“some”</i>	(some sand, some silt, etc.)	10 % - 20 %
<i>“trace” or “occasional”</i>	(trace sand, trace silt, etc.)	1 % - 10 %

COMPACTNESS CONDITION

The standard terminology to describe soils, as determined by the Standard Penetration Test N-Value: the number of blows for a 140 pound (64 kg) hammer falling 30 inch (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil.

Compaction Condition Cohesionless Soils

Compactness Condition	SPT N-Index
Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	> 50

Consistency and Undrained Shear Strength of Cohesive Soils

Consistency	Undrained Shear Strength		SPT N-Index
	(Kips/ft ²)	(kPa)	
Very Soft	< 0.25	<12	0 – 2
Soft	0.25 – 0.5	12 – 25	2 – 4
Firm	0.5 – 1.0	25 – 50	4 – 8
Stiff	1.0 – 2.0	50 – 100	8 – 15
Very Stiff	2.0 – 4.0	100 – 200	15 – 30
Hard	> 4.0	> 200	> 30

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

ROCK DESCRIPTIONS

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. Reported as the fraction of all pieces of intact and sound rock core equal to or greater than 4 inches (100 mm) are summed and divided by the total length of core run (as per ASTM 6032)

TCR (Total Core Recovery) denotes the percentage of solid (cylindrical) core retrieved from a borehole of any orientation. Reported as the fraction of all pieces of solid (cylindrical) core are summed and divided by the total length of core run.

FI (Fracture Index) denotes the number of naturally occurring fractures within a given length of core. Reported as a simple count of naturally occurring fractures.

Rock Quality Descriptors

Rock Mass Quality	RQD	Alternate (Colloquial) Rock Mass Quality
Very Poor	0 – 25	Very Severely Fractured crushed
Poor	25 – 50	Severely Fractured shattered of very blocky
Fair	50 – 75	Fractured blocky
Good	75 – 90	Moderately Jointed sound
Excellent	90 - 100	Intact very sound

Rock Discontinuity Descriptors

Spacing (mm)	Discontinuities	Bedding
< 20	Extremely close	Laminated
20 – 60	Very close	Very thin
60 – 200	Close	Thin
200 – 600	Moderately close	Medium
600 – 2000	Wide	Thick
2000 – 6000	Very wide	Very thick
> 6000	Extremely wide	-

Rock Strength Descriptors

Strength Classification	Grade	Unconfined Compressive Strength (MPa)	Point Load Index (MPa)
Extremely Weak	R0	0.25 – 1	-
Very Weak	R1	1 – 5	-
Weak	R2	5 – 25	-
Medium Strong	R3	25 – 50	1 – 2
Strong	R4	50 – 100	2 – 4
Very Strong	R5	100 – 250	4 – 10
Extremely Strong	R6	> 250	> 10

Rock Weathering Descriptors

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering, slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces, all rock material may be discolored
Moderately	W3	Less than half of the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half of the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil, original mass is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.



Client:

Neqotkuk First Nation

BOREHOLE REPORT

Project n°: 02308072.001

Borehole n°: BH24-01

Start Date: 2024-09-25

Project: Neqotkuk WWTF Improvments

Location: Neqotkuk First Nation

Coordinates (m): North 7532330.700 (Y)

East 2406740.624 (X)

Elevation 84.06 (Z)

Bedrock: m End depth: 7.32 m

DEPTH - ft	DEPTH - m	STRATIGRAPHY			WELL DETAILS	WATER LEVEL (m)	SAMPLES					FIELD AND LABORATORY TESTS	
		ELEVATION - m DEPTH - m	SOIL OR BEDROCK DESCRIPTION	SYMBOLS			TYPE-NUMBER DUPLICATE	SUB-SAMPLE	CONDITION	RECOVERY (mm)	N-value or RQD	RESULTS	NATURAL WATER CONTENT AND LIMITS (%) Wp W WL UNDRAINED SHEAR STRENGTH (kPa) DYNAMIC PENETRATION STANDARD PENETRATION
		0.00 0.00	FILL SAND and GRAVEL, some silt, brown, very dense to loose.										
1							SS-01			300	60		
2							SS-02			330	45		
3							SS-03			260	23		
4							SS-04			300	12		
5		-2.59 2.59	ALLUVIUM GRAVEL and SAND, some silt, brown, loose to dense.				SS-05			350	8		
6							SS-06			270	8	GS W = 5.4	
7							SS-07			260	8		
8							SS-08			140	8		
9							SS-09			310	15		
10							SS-10			410	36		
11		-7.32 7.32	End of Borehole at 7.32m										

Remarks:

Type of boring:

Contractor:

Drilling equipment:

Borehole

Lantech Drilling Services

CME75 Trackmount, Solid Stem

Augers

Field staff: T. Dobson, MSc., EIT, GIT

Verified by: T. Dobson, MSc., EIT, GIT

Page 1 of 1

Vertical Scale = 1 : 45

EQ-09-Ge-66A R.1 04.03.2009

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Negotkuk First Nation

BOREHOLE REPORT

Project n°: **02308072.001**
Borehole n°: **BH24-02**
Start Date: **2024-09-25**

Project: **Negotkuk WWTF Improvements**

Location: **Negotkuk First Nation**

Coordinates (m):	North	7532334.947 (Y)
	East	2406738.053 (X)
	Elevation	86.01 (Z)
Bedrock:	m	End depth: 5.79 m

[illegible]

Remarks:

Type of boring:	Borehole
Contractor:	Lantech Drilling Services
Drilling equipment:	CME75 Trackmount, Solid Stem Augers

Field staff: **T. Dobson, MSc., EIT, GIT**

Verified by: **T. Dobson, MSc., EIT, GIT**

Page 1 of 1



Client:

Neqotkuk First Nation

BOREHOLE REPORT

Project n°: 02308072.001

Borehole n°: BH24-03

Start Date: 2024-09-25

Project: Neqotkuk WWTF Improvments

Location: Neqotkuk First Nation

Coordinates (m): North 7532340.385 (Y)

East 2406735.675 (X)

Elevation 86.05 (Z)

Bedrock: m End depth: 6.40 m

DEPTH - ft	DEPTH - m	STRATIGRAPHY			WELL DETAILS	WATER LEVEL (m)	SAMPLES					FIELD AND LABORATORY TESTS	
		ELEVATION - m DEPTH - m	SOIL OR BEDROCK DESCRIPTION	SYMBOLS			TYPE-NUMBER DUPLICATE	SUB-SAMPLE	CONDITION	RECOVERY (mm)	N-value or RQD	RESULTS	NATURAL WATER CONTENT AND LIMITS (%) Wp W WL UNDRAINED SHEAR STRENGTH (kPa) DYNAMIC PENETRATION STANDARD PENETRATION
		0.00 0.00	FILL SAND and GRAVEL, some silt, brown, compact to loose.										
1							SS-01			380	29		
2							SS-02			500	29		
3													
4													
5							SS-03			400	15		
6							SS-04	A		270	6		
7								B					
8		-2.59 2.59	ALLUVIUM GRAVEL and SAND, some silt, brown, loose to compact.										
9							SS-05			90	8		
10							SS-06			100	10		
11													
12													
13													
14													
15													
16		-4.73 4.73	SILT Sandy SILT, trace gravel, trace organic matter, brown, loose to dense.				SS-07	A		430	8		
17								B					
18							SS-08			230	9	MA W = 22.5	
19													
20							SS-09			440	40		
21													
22													
23													
24													
25													
26													
		-6.40 6.40	End of Borehole at 6.40m										

Remarks:

Type of boring:

Contractor:

Drilling equipment:

Borehole

Lantech Drilling Services

CME75 Trackmount, Solid Stem

Augers

Field staff: T. Dobson, MSc., EIT, GIT

Verified by: T. Dobson, MSc., EIT, GIT

Page 1 of 1

Vertical Scale = 1 : 45

EQ-09-Ge-66A R.1 04.03.2009

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Appendix C

Laboratory Test Results



eNGLOBE

Client: **Negotkuk First Nation**

Project: **Negotkuk WWTF Improvements**

Project No: 02308072.001

Location: **Negotkuk First Nation**

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

U.S. SIEVE SIZE IN MILLIMETRES

HYDROMETER

[illegible][illegible]

Appendix B – Sludge Survey Report

December 10th, 2020

Ken Moulton
Tobique First Nation, NB
13094 Route 105
Tobique (NB) E7H 3Y4

Subject: Wastewater Lagoon Bathymetry Survey
O/Ref.: 2003252

Dear Mr. Moulton:

BATHYMETRIC SURVEY – SUMMARY REPORT

As requested, Crandall, a division of Englobe Corp. [Crandall], surveyed the wastewater treatment lagoon at Tobique First Nation on October 15, 2020. The survey was conducted using a manned flat bottom boat with integrated 200 kHz echo sounders and GPS units. The equipment recorded position (NAD83 Datum in Latitude and Longitude projection) and water depth (to an accuracy of approximately 5cm) at a rate of approximately once per second. The water surface elevation was surveyed, and all depth information is presented as a geodetic elevation. Figure 1 in Appendix A shows the contours of the top of sludge surveyed. Figure 2 in Appendix A shows a 3D map of the sludge accumulated in the lagoon. Aerial images were taken to create an orthomosaic of the site to provide a current aerial view, which are shown in Figure 1 and Figure 3.

1 METHODOLOGY

Bottom depths were measured using a manned flat bottom boat, equipped with a GPS units and 200 kHz echo sounder. The water level in the lagoon was surveyed with a level, relative to the top of the inlet manhole, with a geodetic elevation of 84.93m. The geodetic elevation was provided by Wayne Hodges Surveying Ltd. and based on CGVD28 datum.

The design bottom elevation of the lagoon was calculated by subtracting the manual depth readings from the surveyed water level. The manual readings were measured by pushing a survey rod through the sludge to the hard bottom at several locations throughout the lagoon. The water's edge of the lagoon was obtained from aerial photographs taken with a drone on the date of the survey.

The lagoon design engineer, NATECH Environmental, provided us with design drawings for comparison with our surveyed data. The elevations surveyed were not consistent with the 1993 lagoon drawings that were issued 'For Approval'. Table 1 below listed the discrepancies.

Table 1. Surveyed elevation vs. 1993 design drawings Issued 'For Approval'

Parameter	Oct 15, 2020 Surveyed Elevation	1993 Design Elevation	Difference
Top of Inlet Manhole	84.93 m	83.9 m	1.13 m
Invert of Outlet (of Inlet MH)	83.53 m	82.7 m	0.83 m
Water Elevation	83.08 m	82.5 m	0.58 m
Bottom of Lagoon	79.28 m	78.65 m	0.63 m

2 RESULTS

2.1 WASTEWATER LAGOON

The water level in the lagoon was surveyed to be 83.08 m on October 15, 2020. The hard bottom of the lagoon was measured to be 79.28m. The top of the inlet manhole was surveyed with an elevation of 84.93. The surveyed bottom contours of the lagoon are plotted on Figure 1.

The following observations were noted:

1. There is very little sludge accumulation on the outlet side of the baffle.
2. There is an average of approximately 0.4m of sludge on the inlet side of the baffle with up to 1.4m of sludge near the inlet pipe.
3. Side slopes of the lagoon appear to be 2.5 : 1
4. There were two lines of aerators on the inlet side of the baffle that were not operating on the day of the survey. One of those lines appears to have a break in the line on the western side of the lagoon next to the berm.
5. Holes were observed on the upper portion of the lagoon liner.
6. Photos of the pond taken on the day of the survey are shown Figure 4.
7. The accumulation of sludge is approximately 2,000 m³ or 8% of the lagoon capacity, almost entirely accumulated on the inlet side of the baffle.

Table 2. Tobique Lagoon Summary

Parameter	Units	Value
Lagoon Length	m	120
Lagoon Width	m	70
Water Surface Area	m ²	8,370
Bottom Surface Area	m ²	5,100
Depth	m	3.8
Design Volume (at 83.08m)	m ³	25,777
Current Surveyed Volume (at WL 83.08 m)	m ³	23,796
Total Sludge Volume on October 15, 2020	m ³	1,981
Total Sludge Volume	%	8%

We trust the enclosed is to your satisfaction. If, however, additional information should be required, please don't hesitate to contact us.

Yours very truly,



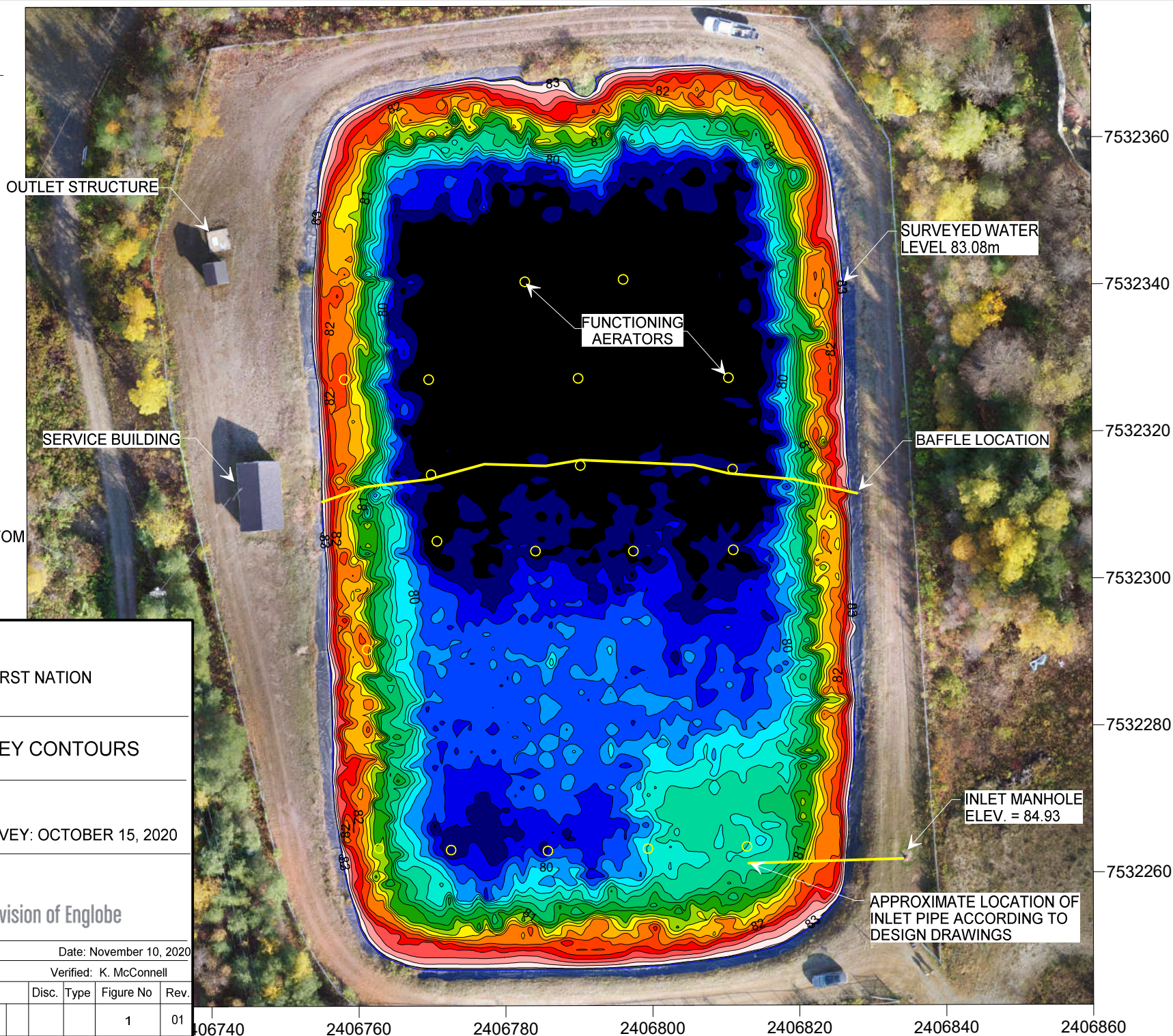
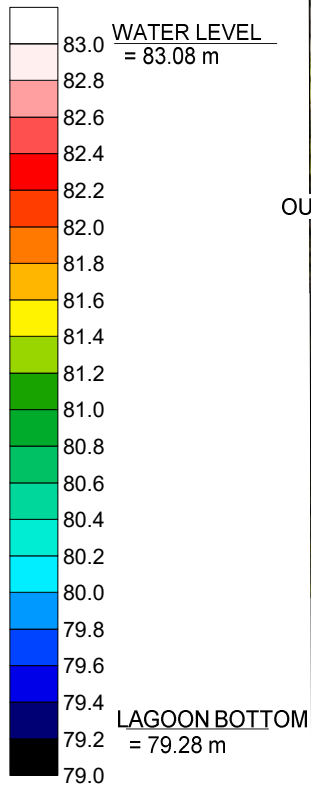
Kyle K. McConnell, EIT
Civil Engineer



Teresa Jones
Technician

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Appendix A:



CLIENT

TOBIQUE FIRST NATION

LAGOON SURVEY CONTOURS

SURVEY: OCTOBER 15, 2020



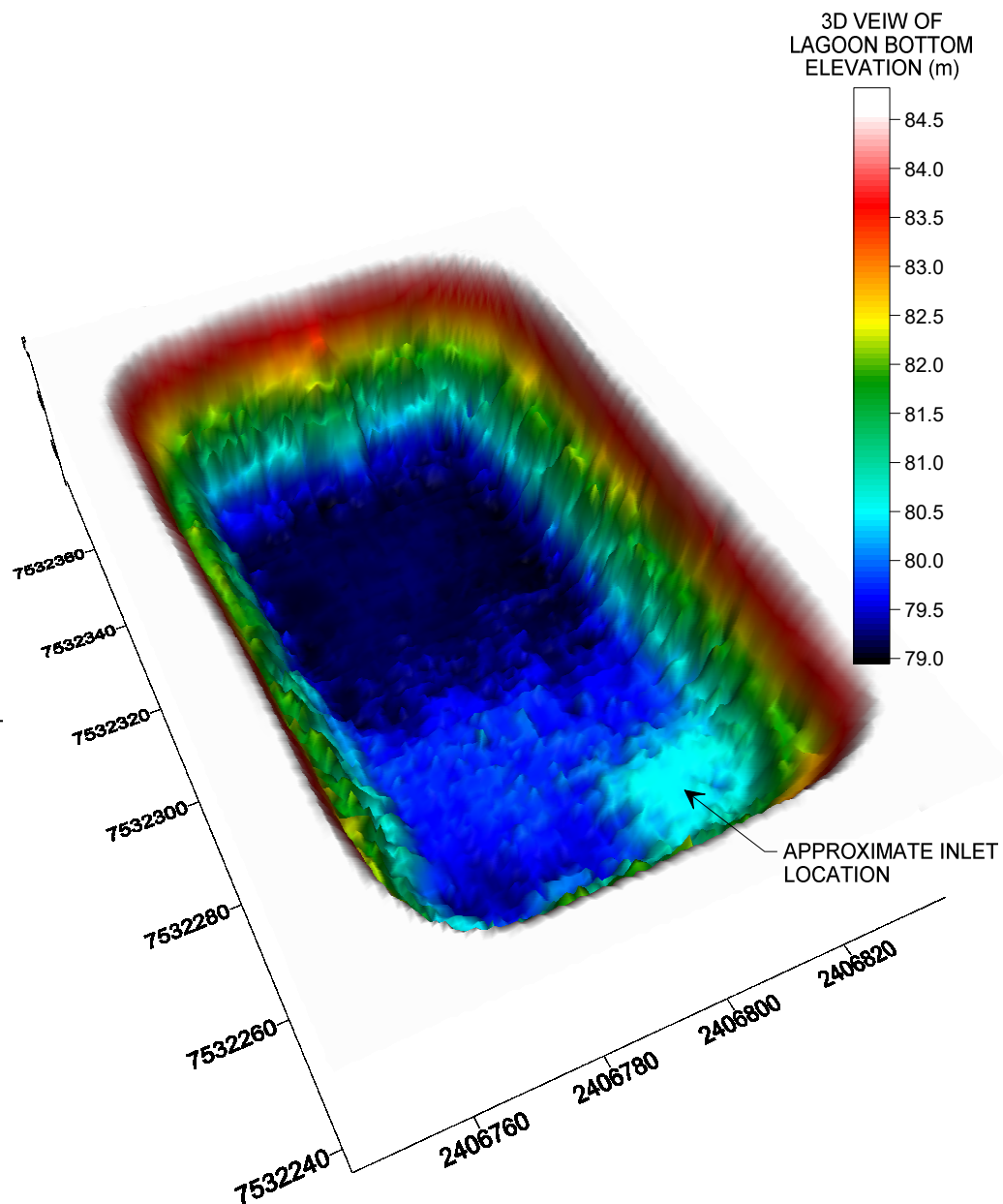
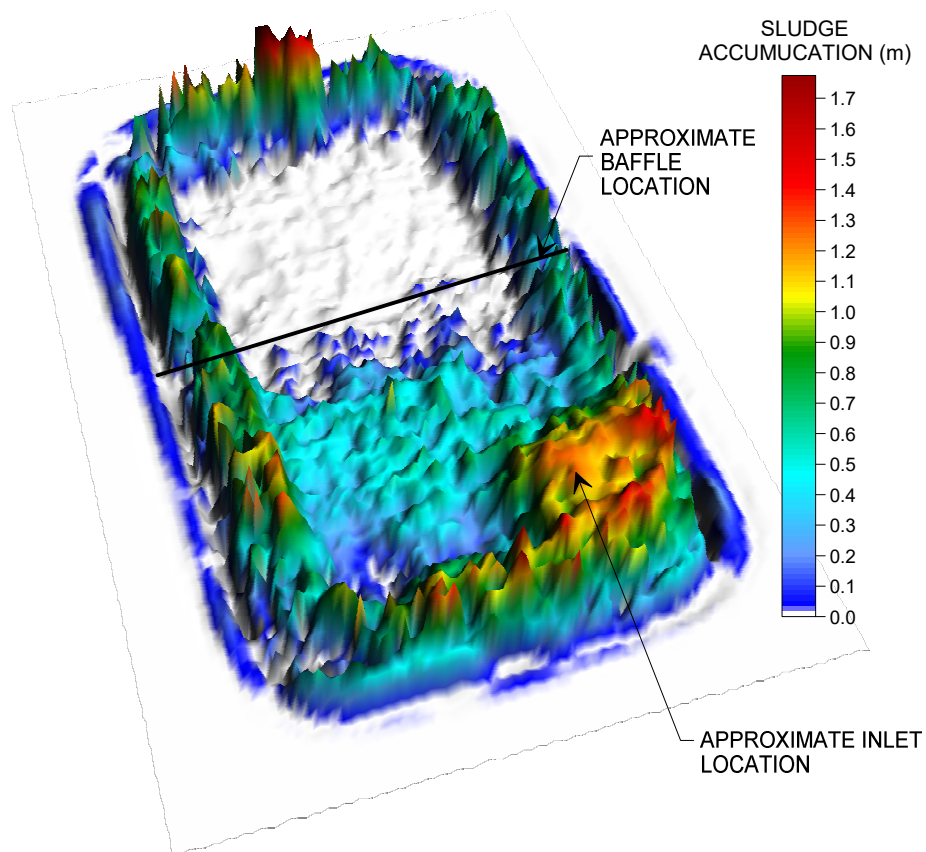
Project Manager: K. McConnell

Date: November 10, 2020

Prepared: T. Jones

Verified: K. McConnell

Department	Project	Otp	Disc.	Type	Figure No	Rev.
	2003252				1	01



CLIENT

TOBIQUE FIRST NATION

LAGOON 3D SLUDGE
ACCUMULATION

SURVEY: OCTOBER 15, 2020



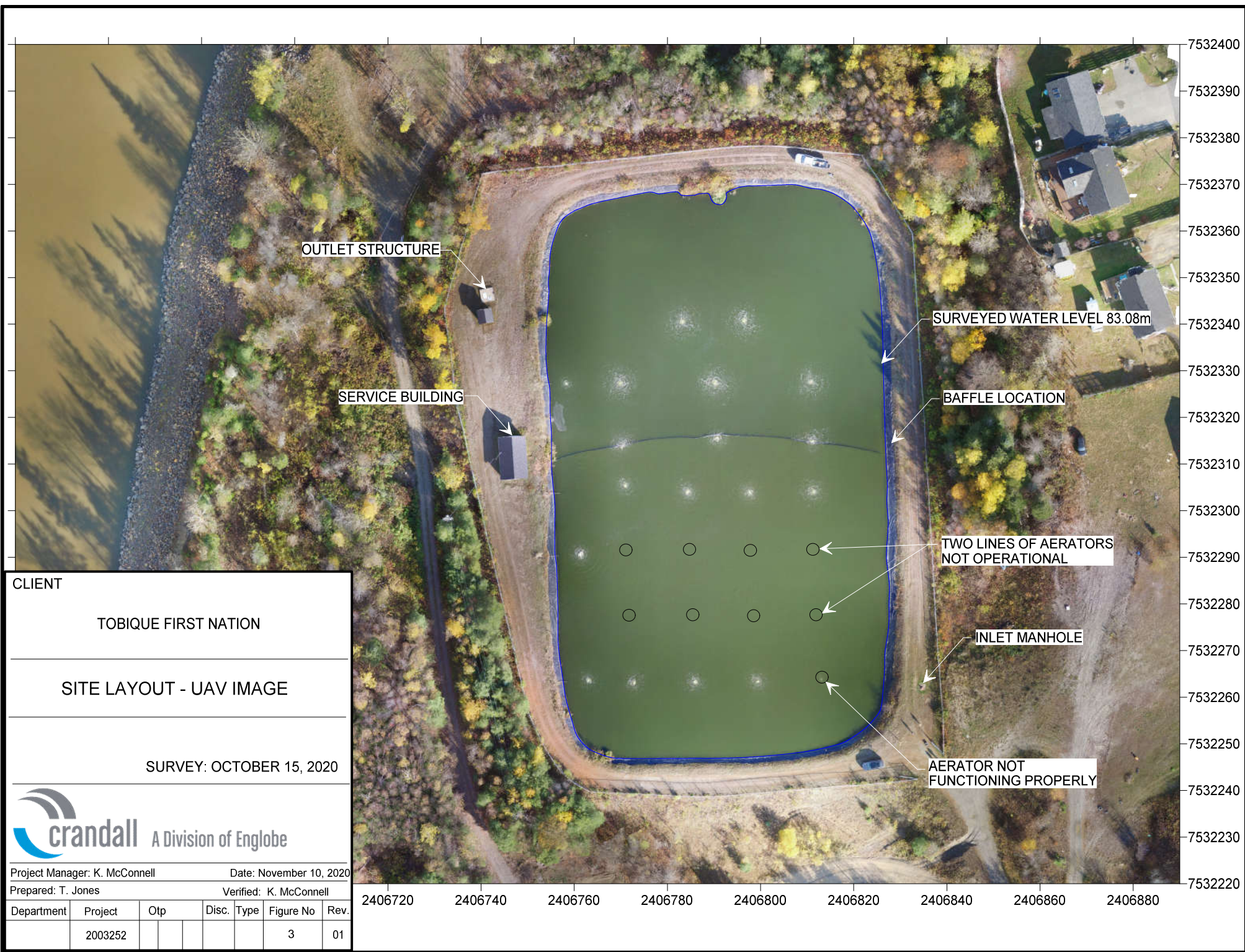
Project Manager: K. McConnell

Date: November 10, 2020

Prepared: T. Jones

Verified: K. McConnell

Department	Project	Otp	Disc.	Type	Figure No	Rev.
	2003252				2	01



CLIENT

TOBIQUE FIRST NATION

SITE LAYOUT - UAV IMAGE

SURVEY: OCTOBER 15, 2020



Project Manager: K. McConnell			Date: November 10, 2020				
Prepared: T. Jones			Verified: K. McConnell				
Department	Project	Otp	Disc.	Type	Figure No	Rev.	
	2003252				3	01	



Inlet manhole



Berm of Lagoon

CLIENT

TOBIQUE FIRST NATION

SITE PHOTOS

SURVEY: OCTOBER 15, 2020



Project Manager: K. McConnell Date: November 10, 2020

Prepared: T. Jones Verified: K. McConnell

Department	Project	Otp	Disc.	Type	Figure No	Rev.
	2003252				4	01



Hole in Lagoon Liner