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CONTRACT DOCUMENTS

City of Port Alberni

Wastewater Treatment Lagoon Upgrades
Construction Contract

June 2018

CANADA'S BEST MANAGED COMPANIES Platinum member

CONTRACT SPECIFICATIONS

FOR

CITY OF PORT ALBERNI

WASTEWATER TREATMENT LAGOON UPGRADES

CONSTRUCTION CONTRACT

JUNE 2018

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. K. D. WOO # 34152
June 28, 2018

Seal

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA S. DEE JR 25684
28 Jun 2018

Seal

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. Z. SALLY # 45124
28 JUN 2018

Seal

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA H. MASUDA # 44056
June 28/18.

Seal

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA K. A. NEAVE
June 28/2018

Seal

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA L. K. VALE
28/06/18

Seal

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA L. A. MACRAE # 33335
June 28/18

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature .....
Date .....

Prepared by Associated Engineering (B.C.) Ltd.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. G. BRUMPTON # 30001
June 28, 2018

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END OF DOCUMENT

Sealed bids marked "Bid for City of Port Alberni's Wastewater Treatment Lagoon Upgrades, Construction Contract" will be received at the offices of the City of Port Alberni, Planning and Development, 4850 Argyle Street, Port Alberni, BC V9Y 1V8, up to 2:00 p.m., local time, July 27, 2018.

The work includes upgrades to the existing lagoon, construction of a new treatment and screen buildings, demolition of existing structures, and any associated works of the City of Port Alberni's Wastewater Treatment Lagoon. Work also includes installation of Owner supplied equipment, including UV Disinfection system and aeration blowers. UV disinfection equipment supply, and aeration system supply and installation contracts will be novated into general contract.

Contract Documents may be examined at the offices of the City of Port Alberni, Planning and Development.

Contract Documents will be available for downloading from BC Bid on or after July 3, 2018.

Technical inquiries by bidders are to be directed to Scott Smith (City Planner, City of Port Alberni), and Hugo Masuda, P.Eng. (Project Engineer, Associated Engineering) at the contact information below. Addenda will be in written form and posted to BC Bid. All addenda become part of the Contract document and must be considered when responding to this invitation to Bid. It is the sole responsibility of the Bidder to check for Addenda on BC Bid. Bidders are strongly encouraged to subscribe to BC Bid's email notification service to receive notices of Addenda. Verbal answers are binding only when confirmed by written addenda.

A Bidders' Briefing is scheduled for Friday, July 13, 2018 at 10:30 am. It is in the best interest of the Bidder to attend this briefing.

Bids must be accompanied by the specified Bid Bond payable to the City of Port Alberni.

The lowest or any bid will not necessarily be accepted.

Scott Smith, City Planner
Planning and Development
City of Port Alberni
Scott_smith@portalberni.ca
250-720-2808
4850 Argyle Street
Port Alberni, BC V9Y 1V8

Hugo Masuda, P.Eng.
Project Engineer
masudah@ae.ca
236-317-2213
Associated Engineering
500 – 2889 East 12th Avenue
Vancouver, BC V5M 4T5

Part 1 General

1.1 DEFINITIONS

.1 Definitions

.1 "**Bid Closing Time**" means the time and date stipulated for receipt of bids in Article 1.3.1.1 of this Section as may be amended by addendum

.2 "**Bid Documents**" means the bid documents obtained in accordance with Article 1.3.1.1 of these Instructions to Bidders and comprising all of the documents and drawings listed in the Table of Contents thereof and any addenda that may be issued thereto.

.3 "**Bid Form**" means Section 00 41 00 of the Bid Documents and the supplements thereto.

.4 "**Bidder**" means any holder of Bid Documents.

.5 "**Total Bid**" means the amount entered by the Bidder into the Bid Form as may be adjusted as provided for by Articles 1.9.7.1 and 1.9.7.4 of this Section.

.2 Additional Definitions

.1 The definitions set out in Section 00 72 00 - General Conditions are incorporated into and form part of this Section 00 21 13 - Instructions to Bidders.

1.2 LIMITATION OF LIABILITY

.1 The Bidder agrees that the Owner's sole obligation, in return for the Bidder's preparation and submission of its bid, is to give consideration to the bid in accordance with the Contract Documents. The Bidder hereby waives any claim for damages or costs of any nature against the Owner and the Engineer (including, without limitation, the cost of preparing and submitting the bid, and any anticipated profits and contributions to overhead) arising out of the Owner's use of its discretion under the Contract Documents and the Engineer's advice to the Owner.

1.3 INVITATION

.1 Bid Call

.1 Offers signed under seal, executed, and dated will be received by the City of Port Alberni, located at 4850 Argyle Street, Port Alberni, BC, V9Y 1V8 before 2 pm local time on July 27, 2018.

.2 Offers received after the Bid Closing Time will be returned to the Bidder unopened.

.3 Offers will be opened privately shortly after the Bid Closing Time.

1.4 INTENT

.1 The intent of this bid process is to obtain an offer to perform work to complete a supply, installation and any other associated works for the upgrades at the City of Port Alberni Wastewater Lagoon Facility located on Shoemaker Bay road (former Catalyst lagoon located at 49° 15' 3.9024" N 124° 49' 24.8520" W) for a Lump Sum Price contract, in

accordance with the Contract Documents. Refer to Section 01 11 00 - Summary of Work for a description of work required and conditions under which work will be carried out.

1.5 CONTRACT/BID DOCUMENTS

.1 Availability

.1 Bid Documents shall be obtained at BC Bid on or after July 3, 2018.

.2 General Contractors obtaining Bid Documents must provide contact information (fax number, phone number, email address, mailing address) when obtaining Bid Documents. Provide contact information to the persons listed in the Invitation to Bid. Accurate and complete contact information is required for distribution of addenda, if any.

.3 Bid documents irregularly obtained from sources other than those provided for in Article 1.5.1.1 ("unofficial bid documents") are used entirely at the risk of the Person who holds them. Neither Engineer nor Owner undertakes to provide information or addenda to Persons holding unofficial bid documents. Any use which a Person makes of unofficial bid documents or any reliance on or decisions to be made based on them, are the responsibility of such Persons. Engineer and Owner accept no responsibility for damages, if any, suffered by any Person as a result of decisions made or actions based on unofficial bid documents. Bids received from Persons holding unofficial bid documents may be declared informal at the sole and unfettered discretion of the Owner and if so declared will be rejected.

.4 Bid Documents are made available only for the purpose of obtaining offers for this project. Their use does not confer a license or grant for other purposes.

.5 Refer to Section 00 30 00 - Information Available to Bidders for identification of information available to Bidders.

.2 Examination

.1 Upon receipt of Bid Documents, verify that documents are complete. Notify Engineer should the documents be incomplete.

.2 Immediately notify Engineer upon finding discrepancies or omissions in Bid Documents.

.3 Queries/Addenda

.1 Direct questions to Scott Smith, telephone 250-720-2808, email Scott_smith@portalberni.ca, and Hugo Masuda, P.Eng., telephone 236-317-2213, email masudah@ae.ca

.2 Addenda will be in written form and may be issued during the bidding period. All addenda become part of the Contract Documents. Include costs in the Total Bid.

.3 Verbal answers are only binding when confirmed by addendum.

.4 Clarifications requested by Bidders must be in writing not less than five (5) Business Days before Bid Closing Time. The reply will be in the form of an addendum, a copy of which will be forwarded to known Bidders.

.4 Proposed Substitutions

.1 Base Total Bid on use of specified products.

.2 Products other than those specified will be considered only if information is provided on the Document 00 43 25 - Substitution List in the Supplements to Bid Form.

.3 The submission shall provide sufficient information to enable Engineer to determine acceptability of such products.

.4 Provide complete information on required revisions to other work to accommodate each substitution. The dollar amount of additions to or reductions from the Total Bid, including revisions to other work, is to be shown on the Substitution List.

.5 Unless substitutions are submitted in this manner and subsequently accepted, provide products as specified.

.6 Approval to submit substitutions prior to submission of bids is not required.

.7 No ruling on a proposed substitution will be made prior to bid submission.

.8 Submit additional documentation supporting the proposed substitution(s) with the Bid Form.

1.6 SITE ASSESSMENT

.1 Site Examination

.1 Visit the Project Site and surrounding area before submitting a bid.

.2 A visit to the Project Site has been arranged for Bidders as follows: Friday, July 13, 2018. Bidders unable to attend the bidder's briefing may schedule alternate times to visit the project site by contacting the Owner and Engineer.

.2 Bidders Briefing

.1 A briefing for Bidders has been scheduled for 10:30 am, Wednesday July 11, 2018, at the location of the existing electrical building at the former Catalyst lagoon.

.2 All general contract Bidders are invited.

.3 Representatives of Owner and Engineer will be in attendance.

.4 Material changes to the Bid Documents arising from the briefing will be recorded in an Addendum and issued to known Bidders.

1.7 QUALIFICATIONS

.1 Bidder's Qualifications

.1 Submit completed Document 00 45 13 - Bidders' Qualification form with the Bid Form.

.2 Subcontractors

.1 Indicate on Document 00 43 36 - Subcontract List in the Supplements to Bid Form the names of all subcontractors proposed to be employed on the Work.

.2 Owner reserves the right to object to any of the subcontractors listed in Document 00 43 36 – Subcontract List and such objection may be valid cause for

rejection of the bid. If Owner objects to a listed subcontractor then Owner will permit Bidder, within 5 days of such Notice, to propose a substitute subcontractor acceptable to Owner provided that there is no resulting adjustment in the Total Bid or the Contract Time. Bidder is not required to make such a substitution and, if Owner objects to a listed subcontractor, rather than propose a substitute subcontractor, Bidder may by Notice request that Owner rejects its bid and Owner will agree to that request. In that event, Owner shall return that Bidder's Bid Deposit.

1.8 BID SUBMISSION

.1 Bid Ineligibility

.1 Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain unbalanced prices, arithmetical errors, or irregularities of any kind, may, at the discretion of Owner, be declared informal. If so declared, the bid will be rejected.

.2 Bids with Bid Form, Supplements to Bid Form, Bid Bond or enclosures which are improperly prepared may, at the discretion of Owner, be declared informal. If so declared, the bid will be rejected.

.3 Bids that fail to include bonding or insurance requirements may be declared informal. If so declared, the bid will be rejected.

.2 Submissions

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

.2 Submit one copy of the executed offer on the Bid Form provided, signed with original signature(s), and corporate sealed where applicable, together with the required Bid Bond and Supplements to Bid Form in a closed opaque envelope, clearly identified with Bidder's name, project name and Owner's name on the outside. The second copy of the Bid Form is provided for Bidder's records.

.3 Do not submit Bid Documents with Bid Form.

.4 Bids received by fax or email shall be rejected.

.3 Bid Modifications

.1 Written amendments to the submitted offer shall be permitted if received in hard copy at the office where bids are being opened prior to Bid Closing Time, provided that bid amendments are endorsed by the same party or parties who signed and sealed the offer.

.2 The onus is on Bidder to ensure timely receipt of bid modifications. Owner makes no assurances regarding availability of fax communication lines or equipment. To be considered, fax transmissions of bid modifications must be received in full prior to Bid Closing Time.

.3 An amendment that expressly or by inference discloses Bidder's Total Bid or other material element of the bid, such that in the opinion of Owner the confidentiality of the bid is breached, shall be valid cause for Owner, at their sole discretion, to reject the bid.

.4 Amendments submitted via fax email shall not be permitted.

.4 Bid Withdrawal

.1 Bidder shall be permitted to withdraw bid without prejudice, provided a request, in writing or by fax, signed by the same person or persons who signed the Bid Form, is received at the office designated in the Bid Documents before Bid Closing Time. Error on the part of Bidder in preparing the bid confers no right to the withdrawal of the bid after it has been opened.

1.9 BID ENCLOSURES/REQUIREMENTS

.1 Bid Security

.1 Bids shall be accompanied by a Bid Bond in an amount not less than 10 percent of the Total Bid.

.2 Endorse the Bid Bond in the name of City of Port Alberni as obligee, signed and sealed by the principal (Contractor) and surety.

.3 Use standard surety industry CCDC prescribed Bid Bond form. Bid Bond form CCDC 220 is included as a sample in Document 00 43 24.

.4 The Bid Deposit will be returned after execution of the Contract by the accepted Bidder.

.5 If no contract is awarded, all Bid Deposits will be returned.

.6 If the accepted Bidder fails for any reason to execute Section 00 52 00 - Contract Agreement or to provide the surety bonds stipulated in Section 00 72 00 - General Conditions or the insurance stipulated in Section 00 73 16 – Insurance within the time agreed to in the Bid Form, and such extension of time as may be granted by Owner, the accepted Bidder or the accepted Bidder's surety shall pay to the Owner the amount of the difference in money between the Total Bid and the amount for which Owner may legally contract with another party to perform the work, if the latter amount be in excess of the former.

.2 Surety Company

.1 Bid Bond and Consent of Surety must be issued by a surety company licensed to conduct business in the province or territory where the work is located.

.3 Performance Assurance

.1 The accepted Bidder shall provide Performance and Labour and Materials Payment Bonds as described in the Section 00 72 00 - General Conditions.

.4 Cost of Bonds

.1 Include the cost of bonds in the Total Bid.

.5 Insurance

.1 Provide a signed "Undertaking of Insurance", on a standard form provided by the insurance company, stating their intention to provide insurance to Bidder in accordance with the insurance requirements of the Contract Documents.

.6 Bid Form Requirements

.1 Fill in prices where indicated on Bid Form.

.2 In the event of a discrepancy between unit prices and extension, unit prices will govern and Engineer will correct extensions accordingly.

.3 In the event of a discrepancy between the sum of prices and Total Bid, prices will govern and Engineer will correct Total Bid accordingly.

.4 Include in price(s) bid supply of all materials except those specified to be supplied by others, all supervision, labour and equipment, and a provision for sales taxes, duties, overhead and profit. Total Bid shall represent the entire cost to Owner for the completed works as specified and shown on the drawings, exclusive only of GST/HST payable by Owner.

.5 The amount of GST or HST payable by Owner on goods and services provided under this Contract is in addition to the Total Bid and is to be shown on a separate line on the Bid Form.

.6 Bid analysis will be based on the Total Bid price, exclusive of GST/HST.

.7 Bidder, in submitting an offer, agrees to complete the Work by the date indicated in the Bid Form.

.7 Bid Signing

.1 The Bid Form shall be executed by Bidder as follows:

.1 Sole Proprietorship: signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature.

.2 Partnership: signature of all partners in the presence of a witness who will also sign. Insert the word partner under each signature.

.3 Limited Company: signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal.

.4 Joint Venture: each party of the joint venture shall execute the bid under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

.8 Supplements to Bid Form to be submitted with bid:

.1 Document 00 43 23 - Alternatives. Identify the cost variations to the bid price(s) applicable to the work described in Section 01 23 00 - Alternatives.

.2 Document 00 43 24 - Bid Bond.

.3 Document 00 43 25 - Substitution List. List substitute products and resulting price variations proposed. Base Total Bid on specified products.

.4 Document 00 43 43 - Force Account Rates. List all personnel and equipment hourly rates likely to be used on the project. These rates will form the basis for payment for force account work carried out in accordance with Section 00 72 00 - General Conditions.

.5 Document 00 45 13 - Bidders' Qualification. Complete in all details and submit with the Bid Form.

.6 Document 00 43 44 - Fair Wage Declaration.

.9 Supplements to Bid Form for post-bid Submission

.1 Following bid submission, upon request from Engineer, Bidders under consideration for contract award are required to complete the following Supplements to Bid Form within two (2) Business Days of receipt of the request:

.1 Document 00 43 36 - Subcontract List. List the names of all subcontractors. Identify portion(s) of the work to be performed by each subcontractor.

.2 Document 00 43 27 - Lump Sum Price Breakdown. Provide an accurate and balanced breakdown of lump sum price(s) to be used for calculating progress payments and for cost accounting purposes.

.3 Document 00 43 44 - Equipment Suppliers List. Indicate the manufacturer or product brand name of each item listed, and the name of the supplier or distributor from whom each item will be purchased.

.2 Document 00 43 83 - Construction Schedule. Provide the requested schedule information to demonstrate ability to plan work and respond to critical deadlines.

1.10 ASSIGNMENT OF SUPPLY CONTRACTS

.1 The City of Port Alberni has entered into the following supply contracts

.1 UV Disinfection Equipment

.2 Aeration System Supply and Installation

.2 A copy of these Request for Proposals are appended to these Bid Documents. The Request for Proposal specifies that the resulting contract would be assigned to the General Contractor for the General Construction Contract.

.3 The successful Bidder hereunder will be required to enter into a tripartite Assignmnet and Novation Agreement with the above noted suppliers and the City of Port Alberni, in the for set out in Section 005261 and 005261a of these documents. Following this, the successful Bidder will then undertake all obligations and responsibilities as the “Owner” and “General Contractor” for the above noted supply contract.

.4 Equipment off-loading, storage, installation, start-up, testing, commissioning, administration and expediting of the assigned supply contract will be the responsibility of the successful Bidder. The costs for this work and the cost for the supply contract shall be included in the Total Bid Price.

1.11 OFFER ACCEPTANCE/REJECTION

.1 Duration of Offer

.1 Bids shall remain open to acceptance and shall be irrevocable for a period of sixty (60) days after the bid closing date.

.2 Acceptance of Offer

.1 Owner reserves the right to accept any offer, waive defects in any offer, or reject any or all offers.

.2 After acceptance of an offer by Owner, Owner will issue a written Notice of Award to accepted Bidder.

Part 2 Products

NOT USED.

Part 3 Execution

NOT USED.

END OF DOCUMENT

Part 1 General

1.1 GEOTECHNICAL REPORT

.1 The geotechnical report bound with these documents has been prepared for Owner by an independent specialist consultant. While the data contained therein is believed to be accurate, any opinions or recommendations are solely those of the authors of the geotechnical report. Bidders must form their own conclusions from the data and shall make no claim at any time that any opinion or recommendation is incorrect or misleading. Neither Owner nor Engineer accepts responsibility for the contents of this report nor for the suggestions or recommendations contained therein, except for recommendations, if any, which have been specifically incorporated into the Specifications.

1.2 GROUND IMPROVEMENTS DESIGN

.1 The ground improvements design drawings and specifications are appended to these documents in Appendix A.

1.3 HAZARDOUS MATERIALS SURVEY

.1 The hazardous materials survey bound with these documents has been prepared for the Owner by an independent specialist consultant, and provides information relevant to the demolition of the existing electrical building. While the data contained therein is believed to be accurate, any opinions or recommendations are solely those of the authors of the report. Bidders must form their own conclusions from the data and shall make no claim at any time that any opinion or recommendation is incorrect or misleading. Neither Owner nor Engineer accepts responsibility for the contents of this report nor for the suggestions or recommendations contained therein, except for recommendations, if any, which have been specifically incorporated into the Specifications.

1.4 EXISTING BUILDING RECORD DRAWINGS

.1 The record drawings for the existing electrical building at the former Catalyst lagoon are included for the information of bidders. While the information contained on these drawings is believed to be accurate, bidders must field confirm the information contained on the drawings and form their own conclusions from the information on the drawings. Neither the Owner or Engineer accepts responsibility for the contents of the drawings.

1.5 OWNER SUPPLIED EQUIPMENT

.1 The City of Port Alberni has entered into equipment supply agreements for the supply of the UV Disinfection Equipment, and supply and installation of the aeration system (including blowers to be installed by General Contractor). Vendor proposals for this equipment are included in the appendices.

Part 2 Products

NOT USED

Part 3 Execution

NOT USED

END OF DOCUMENT

CITY OF PORT ALBERNI
WASTEWATER LAGOON FACILITY UPGRADES
GENERAL CONTRACT

TO: Scott Smith
City Planner
Planning and Development
City of Port Alberni
4850 Argyle Street
Port Alberni, BC V9Y 1V8

The undersigned Bidder, having carefully examined the Contract Documents and locality of the proposed work, and having full knowledge of the work required and the materials to be furnished and used, hereby agrees to provide all necessary materials, supervision, labour and equipment and perform and complete all work, and fulfill everything as set forth and in strict accordance with the Contract Documents and Addenda numbered [1]_____ for the sum of:

Lump Sum Price:	[2]	$
Contingency Allowance		$150,000.00
Cash Allowance		$7,500.00
TOTAL BID: (excluding GST)	[2]	$
Goods and Services Tax:	[2]	$

[1] Bidder to fill in each Addendum No. received, e.g., 1, 2, 3, etc. as applicable.
[2] To be completed by Bidder.

The undersigned also agrees:

1 that Owner is in no way obligated to accept this bid;

2 that Owner may, at Owner's discretion, award to other than the low Bidder;

3 that, if the Bid Form is improperly completed or incomplete, Owner shall have the right to disqualify and/or reject this bid;

4 that this bid is made without knowledge of the bid prices to be submitted for this work by any other company, firm, or person;

5 that this bid is made without any connection or arrangement with any other company, firm, or person submitting a bid for this work;

6 that this bid is made without any undisclosed connection or arrangement with any other company, firm, or person having an interest in this bid or in the proposed Contract;

7 that this bid is irrevocable for sixty (60) days after the closing date for receipt of bids and that the Owner may, at any time within such period, accept this bid whether any other bid has previously been accepted or not and whether Notice of Award of a contract has been given or not;

8 to deposit with Owner a Performance Bond and Labour and Material Payment Bond on the forms provided in these documents and for the amount specified in the General Conditions and the specified insurance endorsement certificates and execute the Contract Agreement in accordance with the time periods specified in the General Conditions, such time periods being extended only on the written approval of Owner;

9 to commence and proceed actively with the work promptly following receipt of the Notice to Proceed, and to complete all work under the Contract by August 31, 2019, subject to the provisions of the General Conditions for extension of Contract Time;

10 to compensate Owner in accordance with the Contract Documents if the work is not completed within the Contract Time;

11 to do all extra work not reasonably inferable from the specifications or drawings, but called for in writing by Engineer and to accept as full compensation therefor payment in accordance with the provisions of the General Conditions;

12 that payment for the work done will be made at the bid price(s) which shall be compensation in full for the work done under the terms of the Contract, exclusive of GST payable by Owner;

13 that, in preparing this bid, the Bidder has drawn their own conclusions from the data contained in the geotechnical report bound with these documents and has not relied on the opinions or the recommendations of the authors of the geotechnical report; and

14 agree to join in an assignment and Novation Agreement in the form set out in Section 00 52 61 as soon as the contract between the Owner and the Contractor has been signed.

SUPPLEMENTS TO BID FORM

The following Supplements to Bid Form are included with and form a part of our Bid. We understand that the information provided on these forms will be used by the Owner during Bid analysis.

00 43 23 - Alternatives
00 43 24 - Bid Bond
00 43 25 - Substitution List
00 43 27 - Lump Sum Price Breakdown
00 43 43 - Force Account Rates
00 43 83 - Construction Schedule
00 45 13 - Bidder's Qualifications

The following Supplements to Bid Form are not being submitted with our bid. These forms will be completed and submitted upon request. We understand that the information provided on these forms may be used by the Owner during bid analysis.

00 43 36 - Subcontract List
00 43 44 - Equipment Suppliers List
00 43 83 - Construction Schedule

This bid is executed under seal at _____this _____ day of _____, 20__.

_____
Name of Firm

_____
Address

_____

For Individual or Partnership:
SIGNED, SEALED AND DELIVERED by:

_____ _____
Bidder (please print) Signature
in the presence of:

_____
Title

_____
Name

_____
Address

_____
City/Province/PC Seal

_____
Occupation

For Limited Company or Corporation:
The Corporate Seal of:

_____
Bidder (please print)
was hereunto affixed in the presence of:

_____
Authorized Signing Officer Seal
Title

_____
Authorized Signing Officer
Title

NOTE: If the bid is by joint venture, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF DOCUMENT

Supplement to Bid Form

We, the undersigned Surety Company, do hereby consent and agree to become bound as guarantor in a Performance Bond and Labour and Material Payment Bond each in the amount of fifty percent (50%) of the total bid for the fulfilment of the Contract, with

……..
as principal for the works specified in the Contract Documents entitled

……..
which Contract may be awarded within sixty (60) days from the closing date of bids to

…….
at the price(s) set forth in the Bid Form. The Bonds shall be issued in the form and manner specified within the Contract Documents. We hereby further declare that our Company is licensed to conduct business in the province or territory wherein the work is located and has a net worth greater than the amount of the required guarantee.

Surety Company

Signature for Surety Company

Title

Place ……

Date ……

END OF DOCUMENT

Supplement to Bid Form

1. Provide the Variation of Total Bid Price for Alternatives for the following:

   .1 Provide variation of Total Bid Price for Alternative to utilize deep soil mixing as ground improvement method under treatment building as described in Section 01 23 00 – Alternatives.

   Total Bid Price Variation is $_____.

END OF DOCUMENT

Supplement to Bid Form

Use CCDC standard form 220, an example of which follows.

BID BOND

No…… $.....

KNOW ALL MEN BY THESE PRESENTS THAT .....

..... as Principal

hereinafter called the Principal, and .....

a corporation created and existing under the laws of .....

and duly authorized to transact the business of Suretyship in .....

as Surety, hereinafter called the Surety, are held and firmly bound unto .....

..... as Obligee

hereinafter called the Obligee, in the amount of .....

..... Dollars ($)

lawful money of Canada, for the payment of which sum, well and truly to be made, the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a written tender to the Obligee, dated the .....

day of……, 20…… for .....

.....

.....

.....

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION is such that if the aforesaid Principal shall have the tender accepted within sixty (60) days from the closing date of tender and the said Principal will, within the time required, enter into a formal contract and give the specified security to secure the performance of the terms and conditions of the Contract, then this obligation shall be null and void. Otherwise the Principal and the Surety will pay unto the Obligee the difference in money between the amount of the bid of the said Principal and the amount for which the Obligee legally contracts with another party to perform the work if the latter amount be in excess of the former.

The Principal and the Surety shall not be liable for a greater sum than the specified penalty of this bond.

Any suit under this bond must be instituted before the expiration of six months from the date of this Bond.

IN WITNESS WHEREOF, the Principal and the Surety have Signed and Sealed this Bond this .....

…… day of ……, 20.....

SIGNED and SEALED
in the presence of

(
(
(
(……(Seal)
Principal
(
(
(
(……(Seal)
Surety

Supplement to Bid Form

We propose using the following equipment and/or materials as substitutes for those specified and shown on the drawings. Should any of these proposed substitutes be accepted, we will adjust our Total Bid in accordance with the price variations shown below. These prices will represent the total cost difference to the Owner for supply and installation of the proposed substitute products in lieu of those specified.

Item	Product Brand Name or Manufacturer	Supplier	Price Variation

END OF DOCUMENT

Supplement to Bid Form

We certify that the following is an accurate and balanced breakdown of our lump sum price(s). Work required, but not specifically mentioned, is included in the item with which it is most closely associated.

Item	Description	Unit	Quantity	Unit Price	Extension	Total
Phase 1 - Screening Facility						
1.1	General Requirements (Divisions 0 and 1)					
1.1.2	Mobilization/Demobilization	L.S.	1			
1.1.3	Startup and Commissioning	L.S.	1			
1.1.4	O&M Manuals	L.S.	1			
1.1.5	As-Built Drawings	L.S.	1			
1.2	Ground Improvements – Compaction Piles	L.S.	1			
1.3	Civil/Sitework					
1.3.1	Clearing, Grubbing	m^2	1110			
1.3.2	Organics Stripping and Off-Site Disposal	m^3	222			
1.3.3	Site Grading - Imported Fill Type A or Type B	m^3	376			
1.3.4	200 mm Thick Granular Base	m^2	188			
1.4	Concrete (Division 3)	L.S.	1			
1.5	Masonry - (Division 04)	L.S.	1			
1.6	Metal Fabrications - (Division 5)	L.S.	1			
1.7	Roofing - Division 7	L.S.	1			
1.8	Architectural (Divisions 8 and 9)	L.S.	1			
1.9	Process Mechanical (Division 40)	L.S.	1			
1.10	Screen & Compactor Supply & Installation (Division 46)	L.S.	1			
1.11	Building Mechanical (Divisions 21, 22 and 23)	L.S.	1			
1.12	Electrical, Instrumentation and Controls (Division 26)	L.S.	1			
Subtotal – Phase 1						**$_____**

Item	Description	Unit	Quantity	Unit Price	Extension	Total
Phase 2 – Treatment and Lagoon Upgrades						
1.0 General Requirements (Divisions 0 and 1)						
1.1	General Requirements (Divisions 0 and 1)					
1.1.1	Mobilization/Demobilization	L.S.	1			
1.1.2	Startup and Commissioning	L.S.	1			
1.1.3	O&M Manuals	L.S.	1			
1.1.4	As-Built Drawings	L.S.	1			
2.0 Treatment Building						
2.1	Ground Improvements – Compaction Piles	L.S.	1			
2.2	Civil					
2.2.1	Clearing, Grubbing	m^2	1194			
2.2.2	Organics Stripping and Off-Site Disposal	m^3	239			
2.2.3	Excavation to Stockpile and On-Site Reuse	m^3	100			
2.2.4	S/E Berm Extensions - Isolation and Dewatering	LS	0			
2.2.5	S/E Berm Extensions - Organics Stripping and Off-Site Disposal	m^3	98			
2.2.6	S/E Berm Extensions – Removal and Disposal Unsuitable Material	m^3	81			
2.2.7	S/E Berm Extensions - 10 kg Riprap c/w Woven Geotextile	m^3	0			
2.2.8	S/E Berm Extensions - Imported Fill Type A or Type B	m^3	1100			
2.2.9	200 mm Thick Granular Base	m^2	1224			
2.2.10	100 mm HDPE DR26 c/w Riprap Outlet and Non-Woven Geotextile	m	26			
2.3	Concrete (Division 3)	L.S.	1			
2.4	Masonry - (Division 04)	L.S.	1			
2.5	Metal Fabrications - (Division 5)	L.S.	1			
2.6	Roofing - Division 7	L.S.	1			
2.7	Architectural (Divisions 8 and 9)	L.S.	1			
2.8	Process Mechanical (Division 40, including UV and Blower Equipment Installation)	L.S.	1			
2.9	Building Mechanical (Divisions 22 and 23)	L.S.	1			

Item	Description	Unit	Quantity	Unit Price	Extension	Total
2.10	Electrical, Instrumentation and Controls (Division 26)	L.S.	1			
3.0 Lagoon Upgrades						
3.1	New Berm - Preload	LS	1			
3.2	New Berm - Organics Stripping and Off-Site Disposal	m^3	107			
3.3	New Berm – Removal and Disposal Unsuitable Material	m^3	512			
3.4	New Berm - 10 kg Riprap c/w Woven Geotextile	m^3	2000			
3.5	New Berm - Imported Fill Type A or Type B	m^3	4910			
3.6	New Berm - 50 kg Riprap c/w Non-Woven Geotextile	m^3	230			
3.7	New Berm – 200 mm Thick Granular Base	m^2	920			
3.8	Splitter Box	LS	1			
3.9	Overflow Box Culverts	ea	8			
3.10	FRP pipe - Locate and Abandon	LS	1			
3.11	1050 mm HDPE DR26 - Supply and Install Buried	m	216			
3.12	1050 mm HDPE DR26 - Supply and Install on Bench and Cradle	m	218			
3.13	Steel Casing Pipe Bridge	LS	1			
3.14	Junction Chamber w/ Flow Meter Chamber - Preload	LS	1			
3.15	Junction Chamber w/ Flow Meter Chamber	LS	1			
3.16	Concrete Barriers	ea	48			
3.17	Pipe Bench - Excavation to Stockpile and On-Site Reuse	m^3	520			
3.18	Pipe Bench – Organics Stripping and Off-Site Disposal	m^3	552			
3.19	Pipe Bench – 150 mm Thick Clear Crush Bedding c/w Non-Woven Geotextile	m^3	60			
3.20	Pipe Bench - Imported Fill Type B c/w Non-Woven Geotextile	m^3	280			
3.21	Pipe Bench – 50 kg Riprap c/w Non-Woven Geotextile	m^3	1100			
3.22	Road Raise 20+210 to 20+240 – Organics Stripping and Off-Site Disposal	m^3	71			

Item	Description	Unit	Quantity	Unit Price	Extension	Total
3.23	Road Raise 20+210 to 20+240 – 200 mm Thick Granular Base	m^2	360			
3.24	Road Raise 20+210 to 20+240 – Imported Fill Type A or Type B	m^3	0			
3.25	Screening Building Connection	ea	2			
3.26	Perimeter Berm - Preload	LS	1			
3.27	Perimeter Berm - Raise Berm to 4.5 m El - Imported Fill Type A or Type B	m^3	55			
3.28	Perimeter Berm – 200 mm Thick Granular Base	m^2	600			
3.29	900 mm HDPE DR26 - Supply and Install Buried	m	303			
3.30	900 mm Effluent Valve Chamber	LS	1			
3.31	900 mm Effluent Flowmeter Chamber	LS	1			
3.32	250 mm HDPE DR26 - Supply and Install	m	176			
3.33	350 mm HDPE DR26 - Supply and Install	m	1155			
3.34	400 mm HDPE DR26 - Supply and Install	m	335			
3.35	450 mm HDPE DR26 - Supply and Install	m	415			
3.36	Tie into Existing FM - HDPE	ea	2			
3.37	Tie into Existing FM - PVC	ea	1			
3.38	Tie into Existing FM - AC	ea	3			
3.39	Manual Air Release Valves	ea	12			
3.40	100 mm HDPE DR17 - Supply and Install - 0 to 1 m depth	m	820			
3.41	Combination Air Valve	ea	1			
3.42	Revegetation and Seeding	m^2	3900			
4.0 Equipment Supply Contracts						
4.1	UV Disinfection Equipment	ea	1	$835,200	$835,200	
4.2	Lagoon Aeration Equipment	ea	1	$1,850,000	$1,850,000	
	Subtotal: Phase 2					**$_____**

END OF DOCUMENT

Supplement to Bid Form

It is our intention that the following work will, subject to Engineer's approval, be subcontracted to the firms indicated below. All other work will be performed by our own forces, except as authorized in writing by Engineer.

Trade	Name and Address of Subcontractor

END OF DOCUMENT

Supplement to Bid Form

SCHEDULE OF FORCE ACCOUNT RATES

The following personnel and equipment rates will form the basis of payment for force account work carried out in accordance with the General Conditions. The rates shown are all inclusive. Contractor overhead, small tool allowance and profit and, where applicable, subcontractor overhead and profit, are included in the rates. (Add additional pages, if necessary.)

GROUND IMPROVEMENTS

(i) In the case of additions, unit prices shall be provided as appropriate to account for:

1. **Primary Deep Ground Improvement Method**

a. Add/delete Installed Piers/Piles (w/o remobilization) $____ /linear metre up to 5 m

b. Add/delete Installed Piers/Piles (w/o remobilization) $____ /linear metre over 5 m

c. Add for pre-drilling (including drill rig remobilization) $____/linear metre

d. Removal of Obstructions $____/hour

e. Additional Mobilizations $____ Each

2. **Alternative Deep Soil-Cement Mixing Method (DMM)**

a. Add/delete Installed area (w/o remobilization) $____ /1 m^2/linear metre up to 5 m

b. Add/delete Installed area (w/o remobilization) $____ /1 m^2/linear metre over 5 m

c. Removal of Obstructions $____/hour

Additional Mobilizations $____ Each

PERSONNEL

List by Occupation	Hourly Rate	Overtime Rate

List by Occupation	Hourly Rate	Overtime Rate

EQUIPMENT
(Complete with Operator)

Description	Hourly Rate	Model and Size

END OF DOCUMENT

Supplement to Bid Form

The following is a list of suppliers from whom we intend to purchase various items of material indicated, together with the product brand name or the name of the manufacturer of each.

We will alter neither products nor suppliers from those listed below without the written authorization of the Engineer.

Item	Product Brand Name or Manufacturer	Supplier
Screening Equipment		

END OF DOCUMENT

Supplement to Bid Form

We provide the following information relative to the Construction Schedule in order that Owner may assess our ability to plan the work and respond to critical deadlines.

Item	Schedule						

END OF DOCUMENT

Supplement to Bid Form

We provide the following information in order that Owner may judge our ability to fulfil the Contract requirements.

1. The average number of workers we will employ and maintain on the project is _____.

2. The name of the superintendent we propose to place on the project and his previous experience on this type of construction is as follows:

Superintendent Name:			
Project Name and Value ($)	**Owner**	**Contact Name**	**Phone Number**

3. The project, owner and contact person for similar work:

Project Name and Value ($)	**Owner**	**Contact Name**	**Phone Number**

Project Name and Value ($)	Owner	Contact Name	Phone Number

END OF DOCUMENT

THIS AGREEMENT made this _____ day of _____ in the year 20__ by and between the City of Port Alberni, herein called "Owner," and _____, herein called "Contractor".

WITNESSETH: That Contractor and Owner undertake and agree as follows:

ARTICLE 1.

Contractor shall:

1. Provide all necessary materials, labour, supervision and equipment, and perform all work and fulfill everything as set forth and in strict accordance with the Contract Documents and Addenda numbered ___ for the project entitled "City of Port Alberni, Wastewater Treatment Lagoon Upgrades, Construction Contract" which have been prepared by Associated Engineering (B.C.) Ltd., acting as and hereby entitled Engineer; and

2. Commence to proceed actively with the work of the Contract promptly following receipt of the Notice to Proceed, and achieve Total Performance of the Work by August 31, 2019, subject to the provisions for the extension of Contract Time stipulated in the General Conditions.

ARTICLE 2.

Owner will pay to Contractor, as full compensation for the performance and fulfilment of this Contract, the sum or sums of money specified herein in the manner and at the times specified in the Contract Documents.

ARTICLE 3.

All of the Contract Documents, including but not limited to the Invitation to Bid, Instructions to Bidders, Information Available to Bidders, Bid Form, Supplements to Bid Form, Bonds, Insurance, General Conditions, Supplementary Conditions, Special Provisions, Addenda, Appendices, Specifications and Drawings, whether annexed hereto or contained in a separate volume, are incorporated herein and form a part of this Agreement as fully to all intents and purposes as though recited in full herein, and the whole shall constitute the Contract between the parties, and it shall enure to the benefit of and be binding upon them and their successors, executors, administrators, and assigns.

ARTICLE 4.

No implied contract of any kind whatsoever, by or on behalf of Owner, shall arise or be implied from anything contained in this Contract or from any position or situation of the parties at any time, it being understood and agreed that the express contracts, covenants, and agreements contained herein and made by the parties hereto are and shall be the only contracts, covenants, and agreements on which any rights against Owner may be founded.

ARTICLE 5.

Subject to Article 3, this Agreement shall supersede all communications, negotiations, and agreements, either written or verbal, made between the parties hereto in respect of matters pertaining to this Agreement prior to the execution and delivery hereof.

ARTICLE 6.

Any Notice to be given by either Party pursuant to this Agreement, or Engineer, shall be in writing and delivered personally, by commercial courier or transmitted by fax to the following addresses and fax numbers, as applicable:

Contractor at:	
Address:	
Fax:	Email:
Owner at:	
Address: City of Port Alberni, 4850 Argyle Street, Port Alberni, BC V9Y 1V8	
Fax:	Email: scott_smith@portalberni.ca
Engineer at:	
Address: 500 – 2889 East 12th Avenue, Vancouver, BC V5M 4T5	
Fax: (604) 291-6163	Email: brumptonc@ae.ca

A Notice shall be deemed to have been given and received on the date on which it was delivered or transmitted, if delivered or transmitted on a Business Day during the regular business hours of the recipient. If it is delivered or transmitted on a day that is not a Business Day or outside the regular business hours of the recipient, the Notice shall be deemed to have been delivered or transmitted on the following Business Day.

A Party may change its address for receipt of Notices at any time by giving Notice of the change to the other Party and Engineer in accordance with this provision. Engineer may change its address for receipt of Notices at any time by giving Notice of the change to the Parties in accordance with this provision. Such changed address for receipt of Notices will be effective five (5) Business Days after receipt of the Notice by the recipient.

Email may be used for day-to-day communication between the Parties and others working on the Project, but email shall not be used for the delivery of a Notice which is required to be given by this Agreement.

IN WITNESS WHEREOF the parties hereto have executed this Agreement the day and year above first written.

For Individual or Partnership:
SIGNED, SEALED AND DELIVERED by:

Contractor (please print) | Signature

in the presence of:

Title

Name

Address

City/Prov/PC | Seal

Occupation

For Limited Company:

The Corporate Seal of:

Contractor (please print)

was hereunto affixed in the presence of:

Authorized Signing Officer | Title | Seal

Authorized Signing Officer | Title

NOTE: If Contractor is a joint venture, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

For Corporate Owner:

The Corporate Seal of:

Owner (please print full corporate name)

was hereunto affixed in the presence of:

Authorized Signing Officer Title Seal

Authorized Signing Officer Title

For Individual Owner:

Owner (please print) Signature

Signature of Witness

Address of Witness

Occupation

END OF DOCUMENT

NOVATION AGREEMENT

BETWEEN:

(OWNER)

AND:

(CONTRACTOR)

AND:

(SUPPLIER)

WHEREAS:

A. Owner entered into a Contract with Supplier dated June 28, 2018, for the supply of UV Disinfection System (Supply Contract), which is annexed hereto as Appendix "D";

B. It is a requirement of the Supply Contract that the Supplier enter into a Novation Agreement with the General Contractor selected by the Owner;

C. Owner entered into a contract with Contractor dated [____], for City of Port Alberni Wastewater Lagoon Facility Upgrades (Construction Contract);

D. It is a requirement of the Construction Contract that the Contractor enter into a Novation Agreement with Supplier so that Supplier becomes a subcontractor to Contractor;

NOW THEREFORE in consideration of the premises and of the mutual agreements hereinafter contained the parties agree as follows;

1. The Contractor and Supplier agree to be bound by the terms of the Supply Contract, annexed hereto as Appendix "A", with the Contractor assuming all the rights and obligations of the Owner as set out therein.

2. Supplier retains all the rights and obligations set out in the Supply Contract and henceforth accepts the Contractor in place of the Owner.

3. Supplier agrees that henceforth it is a subcontractor to the Contractor in respect of the Construction Contract.

4. Supplier hereby releases the Owner from all of the Owner's obligations under the Supply Contract and from all claims of every nature whatsoever arising therefrom, excepting only those claims, if any, already notified to the Owner in writing, and acknowledges that it will henceforth look only to the Contractor for the discharge of the Owner's obligations thereunder and that only the Contractor may exercise the rights of the Owner thereunder.

5. Henceforth, the terms and conditions of the Construction Contract insofar as they can apply to a subcontract shall govern the relations between the Contractor and the Supplier; provided nevertheless, that if any term of the Construction Contract is inconsistent with any payment provision or Special Condition or Special Provision in the Supply Contract such payment provision, Special Condition or Special Provision of the Supply Contract shall prevail.

6. The Owner and Supplier agree that the Supply Contract between them has been terminated.

7. It is agreed that as of the date hereof $ 835,578 is owing to the Supplier under the Supply Contract.

IN WITNESS WHEREOF the parties have hereunto affixed their hands and seals this _____ day of _____ , 20 _____ .

For Corporate Owner:

The Corporate Seal of:

_____ _____

Owner (please print full corporate name) Seal

was hereunto affixed in the presence of:

_____ _____

Authorized Signing Officer Title

_____ _____

Authorized Signing Officer Title

For Individual Owner:

_____ _____

Owner (please print) Signature

_____

Signature of Witness

_____

Address of Witness

_____

Occupation

For Individual or Partnership:
SIGNED, SEALED AND DELIVERED by:

Contractor (please print) | Signature

in the presence of:

Title

Name

Address

City/Prov/PC | Seal

Occupation

For Limited Company:

The Corporate Seal of:

Contractor (please print)

was hereunto affixed in the presence of:

Authorized Signing Officer | Title | Seal

Authorized Signing Officer | Title

NOTE: If Contractor is a joint venture, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

For Individual or Partnership:
SIGNED, SEALED AND DELIVERED by:

Supplier (please print)

Signature

in the presence of:

Title

Name

Address

City/Prov/PC

Seal

Occupation

For Limited Company:

The Corporate Seal of:

Supplier (please print)

was hereunto affixed in the presence of:

Authorized Signing Officer Title

Seal

Authorized Signing Officer Title

NOTE: If Supplier is a joint venture, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF DOCUMENT

NOVATION AGREEMENT

BETWEEN:

(OWNER)

AND:

(CONTRACTOR)

AND:

(SUPPLIER)

WHEREAS:

A. Owner entered into a Contract with Supplier dated June 28, 2018, for the supply of the lagoon aeration system (Supply Contract), which is annexed hereto as Appendix "E";

B. It is a requirement of the Supply Contract that the Supplier enter into a Novation Agreement with the General Contractor selected by the Owner;

C. Owner entered into a contract with Contractor dated [____], for City of Port Alberni Wastewater Lagoon Facility Upgrades (Construction Contract);

D. It is a requirement of the Construction Contract that the Contractor enter into a Novation Agreement with Supplier so that Supplier becomes a subcontractor to Contractor;

NOW THEREFORE in consideration of the premises and of the mutual agreements hereinafter contained the parties agree as follows;

1. The Contractor and Supplier agree to be bound by the terms of the Supply Contract, annexed hereto as Appendix "A", with the Contractor assuming all the rights and obligations of the Owner as set out therein.

2. Supplier retains all the rights and obligations set out in the Supply Contract and henceforth accepts the Contractor in place of the Owner.

3. Supplier agrees that henceforth it is a subcontractor to the Contractor in respect of the Construction Contract.

4. Supplier hereby releases the Owner from all of the Owner's obligations under the Supply Contract and from all claims of every nature whatsoever arising therefrom, excepting only those claims, if any, already notified to the Owner in writing, and acknowledges that it will henceforth look only to the Contractor for the discharge of the Owner's obligations thereunder and that only the Contractor may exercise the rights of the Owner thereunder.

5. Henceforth, the terms and conditions of the Construction Contract insofar as they can apply to a subcontract shall govern the relations between the Contractor and the Supplier; provided nevertheless, that if any term of the Construction Contract is inconsistent with any payment provision or Special Condition or Special Provision in the Supply Contract such payment provision, Special Condition or Special Provision of the Supply Contract shall prevail.

6. The Owner and Supplier agree that the Supply Contract between them has been terminated.

7. It is agreed that as of the date hereof $ 1,837,000 is owing to the Supplier under the Supply Contract.

IN WITNESS WHEREOF the parties have hereunto affixed their hands and seals this _____ day of _____ , 20 _____ .

For Corporate Owner:

The Corporate Seal of:

_____ _____
Owner (please print full corporate name) Seal

was hereunto affixed in the presence of:

_____ _____
Authorized Signing Officer Title

_____ _____
Authorized Signing Officer Title

For Individual Owner:

_____ _____
Owner (please print) Signature

_____
Signature of Witness

_____
Address of Witness

_____
Occupation

For Individual or Partnership:
SIGNED, SEALED AND DELIVERED by:

Contractor (please print)	Signature
in the presence of:	Title
Name	
Address	
City/Prov/PC	Seal
Occupation	

For Limited Company:

The Corporate Seal of:

Contractor (please print)

was hereunto affixed in the presence of:

Authorized Signing Officer	Title	Seal
Authorized Signing Officer	Title	

NOTE: If Contractor is a joint venture, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

For Individual or Partnership:
SIGNED, SEALED AND DELIVERED by:

Supplier (please print)

Signature

in the presence of:

Title

Name

Address

City/Prov/PC

Seal

Occupation

For Limited Company:

The Corporate Seal of:

Supplier (please print)

was hereunto affixed in the presence of:

Authorized Signing Officer Title

Seal

Authorized Signing Officer Title

NOTE: If Supplier is a joint venture, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF DOCUMENT

Use CCDC standard form 221, an example of which follows.

PERFORMANCE BOND

No……. $ .....

KNOW ALL MEN BY THESE PRESENTS THAT .....

..... as Principal

hereinafter called the Principal, and .....

a corporation created and existing under the laws of .....

and duly authorized to transact the business of Suretyship in .....

as Surety, hereinafter called the Surety, are held and firmly bound unto .....

..... as Obligee

hereinafter called the Obligee, in the amount of .....

…….. Dollars ($ .....)

lawful money of Canada, for the payment of which sum, well and truly to be made, the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a written tender to the Obligee, dated the .....

day of ……, 20……. for .....

.....

.....

.....

in accordance with the Contract Documents submitted therefor which are by reference made part hereof and are hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION is such that if the Principal shall promptly and faithfully perform the Contract then this obligation shall be null and void; otherwise it shall remain in full force and affect.

Whenever the Principal shall be, and declared by the Obligee to be, in default under the Contract, the Obligee having performed the Obligee's obligations thereunder, the Surety shall promptly remedy the default, or shall promptly:

(1) complete the Contract in accordance with its terms and conditions, or

(2) obtain a bid of bids for submission to Obligee for completing the Contract in accordance with its terms and conditions, and upon determination by the Obligee and the Surety of the lowest responsible bidder, arrange for a contract between such bidder and the Obligee and make available as work progresses (even though there should be a default, or a succession of defaults, under the contract or contracts of completion, arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of Contract price", as used in this paragraph, shall mean the total amount payable by the Obligee to the Principal under the Contract, less the amount properly paid by the Obligee to the Principal.

Any suit under this Bond must be instituted before the expiration of two (2) years from the date on which the final payment under the Contract falls due.

The Surety shall not be liable for a greater sum than the specified penalty of the Bond.

No right of action shall accrue on this Bond, to or for the use of, any person or corporation other than the Obligee named herein, or the heirs, executors, administrators or successors of the Obligee.

IN WITNESS WHEREOF, the Principal and the Surety have Signed and Sealed this Bond this .....

…….. day of ……., 20….

SIGNED and SEALED
in the presence of

(
(
(
(…….(Seal)
Principal

(
(
(
(……...(Seal)
Surety

Use CCDC standard form 222, an example of which follows.

LABOUR AND MATERIAL PAYMENT BOND
(TRUSTEE FORM)

No……. $.....

Note: This Bond is issued simultaneously with another Bond in favour of the Obligee conditioned for the full and faithful performance of the Contract.

KNOW ALL MEN BY THESE PRESENTS THAT .....

..... as Principal

hereinafter called the Principal, and .....

a corporation created and existing under the laws of .....

and duly authorized to transact the business of Suretyship in .....

as Surety, hereinafter called the Surety are, subject to the conditions hereinafter contained, held and firmly bound unto .....

..... as Trustee

hereinafter called the Obligee, for the use and benefit of the Claimants, their and each of their heirs, executors, administrators, successors and assigns, in the amount of .....

…… Dollars ($.....)

lawful money of Canada, for the payment of which sum well and truly to be made the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a written tender to the Obligee, dated the .....

day of …….., 20 …… for .....

.....

.....

.....

which Contract Documents are by reference made a part hereof, and are hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION is such that, if the Principal shall make payments to all Claimants for all labour and material used or reasonably required for use in the performance of the Contract, then this obligation shall be null and void; other wise it shall remain in full force and affect, subject however to the following conditions:

1. A Claimant for the purpose of this Bond is defined as one having a direct contract with the Principal for labour, material, or both, used or reasonably required for use in the performance of the Contract, labour and material being construed that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment directly applicable to the Contract provided that a person, firm or corporation who rents equipment to the Principal to be used in the performance of the Contract under a contract which provides that all or any part of the rent is to be applied towards the purchase price thereof, shall only be a Claimant to the extent of the prevailing industrial rental value of such equipment for the period during which the equipment was used in the performance of the Contract. The prevailing industrial rental value of equipment shall be determined, insofar as it is practical to do so, in accordance with and in the manner provided for in the latest revised edition of the publication of the Canadian Construction Association titled “Rental Rates on Construction Equipment” published prior to the period during which the equipment was used in the performance of the Contract.

2. The Principal and the Surety hereby jointly and severally agree with the Obligee, as Trustee, that every Claimant who has not been paid as provided for under the terms of his contract with the Principal, before the expiration of a period of ninety (90) days after the date on which the last of such Claimant’s work or labour was done or performed or materials were furnished by such Claimant, may as a beneficiary of the trust herein provided for, sue on this Bond, prosecute to final judgment for such sum or sums as may be justly due to such Claimant under the terms of a contract with the Principal and have execution thereon. Provided that the Obligee is not obliged to do or take any act, action or proceeding against the Surety on behalf of the Claimants, or any of them, to enforce the provisions of this Bond. If any act, action or proceeding is taken either in the name of the Obligee or by joining the Obligee as a party to such proceeding, then such act, action or proceeding shall be taken on the understanding and basis that the Claimants or any of them, who take such act, action or proceeding, shall indemnify and save harmless the Obligee against all costs, charges and expenses or liabilities incurred thereon and any loss or damage resulting to the Obligee by reason thereof. Provided still further that, subject to the foregoing terms and conditions, the Claimants, or any of them, may use the name of the Obligee to sue on and enforce the provisions of this Bond.

3. No suit or action shall be commenced hereunder by any Claimant:

   (a) unless such Claimant shall have given written notice within the time limits hereinafter set forth to each of the Principal, the Surety and the Obligee, stating with substantial accuracy the amount claimed. Such notice shall be served by mailing the same by registered mail to the Principal, the Surety and the Obligee, at any place where an office is regularly maintained for the transaction of business by such persons or served in any manner in which legal process may be served in the Province or other part of Canada in which the subject matter of the Contract is located. Such notice shall be given:

(1) in respect of any claim for the amount or any portion thereof, required to be held back from the Claimant by the Principal under either the terms of the Claimant's contract with the Principal, or under the Builders' (Mechanics') Liens Legislation applicable to the Claimant's contract with the Principal, whichever is the greater, within one hundred and twenty (120) days after such Claimant should have been paid in full under the Claimant's contract with the Principal;

(2) in respect of any claim other than for the holdback, or portion thereof, referred to above, within one hundred and twenty (120) days after the date upon which such Claimant did, or performed, the last of the work or labour or furnished the last of the materials for which such claim is made under the Claimant's contract with the Principal;

(b) after the expiration of one (1) year following the date on which the Principal ceased work on the Contract, including work performed under the guarantees provided in the Contract;

(c) other than in a Court of competent jurisdiction in the Province or District of Canada in which the subject matter of the Contract, or any part thereof, is situated and not elsewhere, and the parties hereto agree to submit to the jurisdiction of the Court.

4. The Surety agrees not to take advantage of Article 1959 of the Civil Code of the Province of Quebec in the event that, by an act or an omission of the Claimant, the Surety can no longer be subrogated in the rights, hypothecs and privileges of said Claimant.

5. Any material change in the contract between the Principal and the Obligee shall not prejudice the rights or interest of any Claimant under this Bond, who is not instrumental in bringing about or has not caused such change.

6. The amount of this Bond shall be reduced by, and to the extent of any payment or payments made in good faith, and in accordance with the provisions hereof, inclusive of the payment by the Surety of Builders' (Mechanics') Liens which may be filed of record against the subject matter of the Contract, whether or not claim for such lien be presented under and against this Bond.

7. The Surety shall not be liable for a greater sum than the specified penalty of this bond.

IN WITNESS WHEREOF, the Principal and the Surety have Signed and Sealed this Bond this .....

day of ……, 20……

SIGNED and SEALED
in the presence of

(
(
(
(……(Seal)
Principal

(
(
(
(……(Seal)
Surety

Use standard two-sided form, which follows. [Include ICBC forms APV-47 and APV-29 for owned and non-owned automobiles for all contracts in the Province of British Columbia.]

CERTIFICATE OF INSURANCE

ISSUED TO:-

PROJECT:- DESCRIPTION:-

LOCATION:-

This is to certify that insurances as described herein, have been arranged through this office for the Insured named below on whose behalf this Certificate is executed and we hereby certify that such insurances are in full force and effect as of this date, but only with respect to the type(s) of insurance for which a policy number, policy period, and limits of liability or amount is shown.

INSURED:-

SCHEDULE OF INSURANCE			
TYPE OF INSURANCE	**COMPANY AND POLICY NUMBER**	**EFFECTIVE & EXPIRY DATES OF POLICY**	**LIMIT OF LIABILITY/AMOUNT**
COMPREHENSIVE GENERAL LIABILITY		EFFECTIVE	BODILY INJURY
		EXPIRY	$ EACH PERSON
			$ EACH ACCIDENT
			$ AGGREGATE PRODUCTS
			PROPERTY DAMAGE
			$ EACH ACCIDENT
			$ AGGREGATE PRODUCTS
			BODILY INJURY & PROPERTY DAMAGE
			$ INCLUSIVE
		WRAP UP ☐	$ AGGREGATE PRODUCTS
EMPLOYERS LIABILITY		EFFECTIVE	$ EACH PERSON
		EXPIRY	$ EACH ACCIDENT
AUTOMOBILE LIABILITY OWNED/LEASED VEHICLES		EFFECTIVE	BODILY INJURY
		EXPIRY	$ EACH PERSON
			$ EACH ACCIDENT
			PROPERTY DAMAGE
			$ EACH ACCIDENT
			BODILY INJURY & PROPERTY DAMAGE
			$ INCLUSIVE
AUTOMOBILE LIABILITY NON-OWNED VEHICLES		EFFECTIVE	BODILY INJURY
		EXPIRY	$ EACH PERSON
			$ EACH ACCIDENT
			PROPERTY DAMAGE
			$ EACH ACCIDENT
			BODILY INJURY & PROPERTY DAMAGE
			$ INCLUSIVE
UMBRELLA LIABILITY		EFFECTIVE	$ LIMITS
		EXPIRY	EXCESS OF $
BUILDERS RISK/ INSTALLATION FLOATER		EFFECTIVE	$ SITE
		EXPIRY	$ OTHER LOCATION
		WRAP UP ☐	$ TRANSIT
CONTRACTORS		EFFECTIVE	$
EQUIPMENT		EXPIRY	
WORKERS' COMPENSATION		EFFECTIVE	AS REQUIRED BY THE ORDINANCE(S)
		EXPIRY	OF THE
OTHER			

PARTICULARS OF INSURANCE

GENERAL LIABILITY

- ☐ Premises Property and Operations
- ☐ Products and Completed Operations
- ☐ Blanket Contractual (all written agreements)
- ☐ Tenants Fire Legal Liability
- ☐ Owners and Contractors Protective
- ☐ Occurrence Bodily Injury and Property Damage
- ☐ Broad Form Property Damage
- ☐ Contingent Employers Liability
- ☐ Personal Injury
- ☐ Sudden and Accidental Pollution Liability
- ☐ Non-Owned Automobile Liability
- ☐ Severability of Interest or Cross Liability
- ☐ Exclusions pertaining to Blasting, Collapse, Underpinning, deleted
- ☐ Provides Coverage for Claims arising from Use of Machinery and Equipment attached to licensed construction machinery on Project Site
- ☐ Employees as Additional Insured
- ☐ Owner as Additional Insured
- ☐ Engineer as Additional Insured
- ☐ Waiver of Subrogation against Additional Insureds
- ☐ 30 Days Notice of Cancellation
- ☐
- ☐
- ☐

CONTINGENT EMPLOYERS LIABILITY

- ☐ 30 Days Notice of Cancellation
- ☐

AUTOMOBILE

- ☐ 15 Days Notice of Cancellation
- ☐

MARINE/AIRCRAFT

- ☐ 30 Days Notice of Cancellation

MARINE/AIRCRAFT/CARGO

- ☐ 30 Days Notice of Cancellation
- ☐

BUILDERS RISK/INSTALLATION FLOATER

- ☐ All Risk Form
- ☐ Fire, Extended Coverages, Riot, Vandalism or Malicious Acts
- ☐ Difference in Conditions
- ☐ Flood Included
- ☐ Earthquake Included
- ☐ Excludes Faulty Workmanship, Faulty Construction or Faulty Design but not loss resulting therefrom
- ☐ Covers Transit by Land
- ☐ Covers Boiler Explosion during Installation, Temporary Operation and Testing
- ☐ Covers Owner as Additional Named Insured
- ☐ Grants Permission for Occupancy prior to completion
- ☐ Waiver of Subrogation Against Additional Insureds
- ☐ 30 Days Notice of Cancellation
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

CONTRACTORS EQUIPMENT

- ☐ Subrogation Waived Against Owner
- ☐ Subrogation Waived Against Owner, Construction or Project Manager, Architects and Engineers
- ☐ 30 Days Notice of Cancellation
- ☐
- ☐

NON-OWNED AUTOMOBILE

- ☐ 15 Days Notice of Cancellation
- ☐

OTHERS

- ☐
- ☐
- ☐
- ☐

☒ **INDICATES THAT THE COVERAGE/ENDORSEMENT INDICATED IS INCLUDED**

REMARKS (STATE DEDUCTIBLE IF ANY)

TERMS AND CONDITIONS

This Certificate is issued for convenience only. All of the terms and conditions of the Policies referred to are contained in the original document which are not modified or amended by this Certificate.

In the event of cancellation or material change of the Policies referred to herein, the Insurer and/or the undersigned will provide written notice as indicated above.

DATED _____

_____
Authorized to sign on behalf of Insurers

PART 1 CONTRACT DOCUMENTS

GC 1. DEFINITIONS

In this Contract, the following definitions shall apply:

"Abnormal Weather" means adverse temperature, precipitation, wind or other adverse weather condition which, in any two (2) week period, differs from the statistical average for that condition in that period by more than one standard deviation, calculated based on relevant data available from Environment Canada, covering the twenty (20) year period immediately preceding the Notice of Award.

"**Business Day**" means any day other than a Saturday, Sunday or statutory holiday recognized in the province or territory wherein the Project Site is located.

"**Certificate of Insurance**" means a document issued by an insurance company or authorised broker to certify the extent, period and limits of insurance coverage under specific conditions granted to listed Persons.

"**Certificate of Substantial Performance**" means a certificate issued by the Engineer stating that Substantial Performance of the Work has been achieved.

"**Certificate of Total Performance**" means a certificate issued by the Engineer stating that Total Performance of the Work has been achieved.

"**Change**" means an increase or addition to, a reduction or deletion from or an extension of the Work or the Construction Schedule, or the replacement of a proposed subcontractor or supplier, which results in a material change to the Contract Time or Contract Price.

"**Change Directive**" means a written instruction signed by the Owner and issued by the Engineer to the Contractor directing the Contractor to proceed with a Change despite the absence of an agreement as to adjustment of the Contract Price or Contract Time, or both, as applicable.

"**Change Order**" means a written record of a Change prepared by the Engineer and signed by the Owner, the Engineer and the Contractor stating their agreement to a Change, and setting out a description of the Work covered by the Change Order, the price or method of valuation of the Work and the change in the Contract Price or adjustment of the Contract Time, or both, as applicable.

"**Claim**" means a written demand for adjustment of the Contract Price or Contract Time made by either Party against the other Party.

"**Confidential Information**" means all information that is acquired by, or becomes known to, the Contractor or any of its Personnel, or Subcontractors as a result of, directly or indirectly, performing the Work, or otherwise being involved in the Project and which is in the nature of one of the following categories of information:

(a) all information with respect to the Owner's operations, the Project and this Contract; or

(b) all personal information as defined in the Freedom of Information and Protection of Privacy legislation in the jurisdiction in which the Work is performed.

"**Consequential Damages**" means all damages except direct damages, including any one or more of: loss of profits or anticipated profits, loss of business opportunity, loss of revenue and loss of reputation.

"**Construction Equipment**" means all tools, machinery and equipment whether operated or not operated, which are required for preparing, fabricating, conveying, erecting or otherwise performing the Work but are not incorporated into the Work.

"**Construction Schedule**" means the schedule for the Work which is prepared by the Contractor and approved by the Owner and the Engineer in accordance with GC 25 CONSTRUCTION SCHEDULE.

"**Construction Safety Plan**" means the plan developed by the Contractor to address safety on the Project Site, and anywhere else that the Work is performed.

"**Contemplated Change Notice**" means a written notification authorized and issued by or on behalf of the Owner, providing Notice and Specifications or Drawings, or both, to the Contractor and others of a contemplated Change and requesting a quotation for adjustments of Contract Price and Contract Time that would result from the Change.

"**Contract Documents**" or "**Contract**" means the complete set of documents, Specifications, Drawings, and addenda incorporated therein, as listed in the "Table of Contents" of the Contract and any amendments thereto agreed upon between the Parties, including all Site Instructions, Specifications, Drawings, Change Orders and Change Directives.

"**Contract Price**" means, if the Contract is on the basis of a stipulated or lump sum, the lump sum price stated in Section 00 41 00 – Bid Form, as may be adjusted by Change Orders or Change Directives. If the Contract calls for payments on a unit price basis whether including lump sums or not, Contract Price shall mean the product of the units of Work actually performed and the appropriate unit prices plus the total of the lump sums prices all as stated in Section 00 41 00 – Bid Form, and all as may be adjusted by Change Orders or Change Directives.

"**Contract Time**" means the time stipulated in Article 1 of Section 00 52 00 - Contract Agreement as the period between the date of the Notice of Award and achievement of Total Performance of the Work, as may be adjusted by Change Orders or Change Directives.

"**Contractor**" means the Contractor named in Section 00 52 00 - Contract Agreement.

"**Deficiencies**" means one or more defects or deficiencies in the Work or Materials, including Work omitted or not performed as provided for in this Contract.

"**Dispute**" means any difference between the Contractor and the Owner as to the interpretation, application or administration of the Contract or any failure by the Owner and the Contractor to agree where the Contract Documents call for agreement.

"**Drawings**" means the graphic and pictorial drawings, sketches and representations, whether electronic or paper-based, prepared to represent the Work and issued by the Engineer, including plans, elevations, sections, details, schedules, and diagrams.

"**Engineer**" means Associated Engineering acting through a delegate duly appointed to act on its behalf, or such other engineer, architect or Person as may from time to time be duly authorized and appointed in writing by the Owner.

"Field Instruction" means a written directive by the Engineer for immediate action by the Contractor to correct or remedy observed deficiencies in compliance with the safety or environmental requirements of the Contract.

"**Force Account**" means the method of calculating payment the Contractor shall receive for the Work performed as set out in GC 56 FORCE ACCOUNT WORK.

"**Governmental Authority**" means any federal, provincial, first nation or municipal government, official, administrative, regulatory, or legislative authority, commission, tribunal or court or any of the respective agencies or departments thereof having jurisdiction over any aspect of the Project, the Work, this Contract, or any matters arising thereunder.

"**Law**" means the common law and all applicable decrees, statutes, laws, by-laws, rules, orders, codes, directives and regulations in effect from time to time and made or issued by any Governmental Authority having jurisdiction over any aspect of the Project, the Work, this Contract, the Owner, the Contractor and the Subcontractors, and includes any applicable replacement, amendment or supplementary legislation, and any applicable regulations, and further includes the OH&S Legislation.

"**Lien Act**" means the applicable provincial or territorial lien legislation, including regulations enacted pursuant to that lien statute, at the Project Site, current at the date of the Notice to Proceed and as may be revised during the Contract Time.

"**Materials**" means materials, supplies, machinery, equipment and fixtures which are or which are to be permanently incorporated into the Work, but excludes Construction Equipment.

"**Major Lien Fund Holdback**" means the total of lien holdbacks from progress payments for Work performed before Substantial Performance of the Work.

"**Milestone Date**" means any date or dates specified in the Contract Documents for completion of specified portions of the Work, including the dates of Substantial Performance of the Work and Total Performance of the Work.

"**Minor Lien Fund Holdback**" means the total of lien holdbacks from progress payments for Work performed after Substantial Performance of the Work.

"**Notice**" means a notice made in writing and delivered to one of the Parties or the Engineer at the address, or any replacement address, stipulated for and in the method required for, delivery as set out in Article 6 of Section 00 52 00 - Contract Agreement.

"**Notice of Award**" has the meaning set out in Section 00 41 00 - Bid Form.

"**Notice to Proceed**" has the meaning set out in Section 00 41 00 - Bid Form.

"**OH&S Legislation**" means, collectively, all of the applicable decrees, statutes, laws, by-laws, rules, orders, codes, directives and regulations concerning occupational health and safety, which may be in force, from time to time at the Project Site.

"**Other Contractors**" means any other contractors or consultants which are retained directly by the Owner for other work at the Project Site, other than the Contractor, and includes the Owner's own forces.

"**Owner**" means the Person identified as such in Section 00 52 00 - Contract Agreement and includes any authorized representative of the Owner.

"**Party**" means one of the parties to this Contract and Parties means the Owner and the Contractor, collectively, as the case may be.

"**Payment Certificate**" has the meaning set out in GC 37 PROGRESS PAYMENTS.

"**Person**" means any one of an individual, partnership, limited liability partnership, limited liability company, corporation, sole proprietorship, trust, unincorporated organization, association, society, or Governmental authority.

"**Personnel**" means, without limitation:

(a) in relation to any Party and its affiliates, elected officials, directors, officers, employees, contract personnel, non-employed representatives, contractors, consultants and agents, including those who are assigned or seconded to the Project; and

(b) in relation to any other Person, each of their respective elected officials, directors, officers, employees, contract personnel, non-employed representatives, contractors, consultants and agents, including those who are assigned or seconded to the Project.

"**Pre-contractual Statement**" means any communication or correspondence, including any agreement, undertaking, representation, warranty, promise, assurance, arrangement or draft of any nature whatsoever, whether or not in writing, relating to the subject matter of the Contract and which is not repeated in the Contract, made by any Person at any time before the date of the Contract Agreement.

"**Prime Contractor For Safety**" means "Prime Contractor", "Constructor", "Principal Contractor", or such other position of similar import as the case may be according to the location of the Project Site, as is defined in the OH&S Legislation.

"**Project**" means the project identified in Article 1 of Section 00 52 00 - Contract Agreement.

"**Project Record Drawings**" means a dedicated set of Drawings reserved and annotated by the Contractor on an ongoing basis during the performance of the Work for the purpose of recording differences between the built Work and Drawings.

"**Project Site**" means the designated location of the Work on the Project as identified in the Contract Documents, or, if not identified in the Contract Documents, as identified by the Owner by Notice to the Contractor, from time to time.

"**Project Takeover**" means the turnover by the Contractor and the takeover by the Owner of part, or all of, the Project, which may occur in phases, or not, as determined in the sole discretion of the Owner, and which shall occur when all of the prerequisites identified in this Contract have been completed by the Contractor, certified by the Engineer and accepted in writing by the Owner.

"**Project Takeover Date**" means the date that Project Takeover occurs in relation to a part, or all, of the Project.

"**Quantities**" means the quantities for the Work performed, measured in accordance with GC 39 QUANTITIES.

"**Records**" means the records of the Contractor and its Subcontractors relating to the Contract, the Project or the performance of the Work, and which include, paper and electronic copies, as the case may be, of:

(a) original invoices and accounts;

(b) records of account for all Work performed, itemizing the names and positions of Personnel, the hours worked by each, the type of services performed and the hourly rate charged, together with copies of all subcontracts and invoices for expenses;

(c) records of account for all amounts claimed related to termination or suspension, itemizing the names and positions of Personnel, the hours worked by each, the type of services performed and the hourly rate charged, together with copies of all subcontracts; and

(d) correspondence, minutes of meetings, notes, reports, incident reports and all other documentation including information relating to the Contractor's compliance with the Law and the Contract and the use of Confidential Information.

"**Shop Drawings**" means one or more Drawings, diagrams, illustrations, photographs, schedules, performance charts, technical brochures, samples, models and other data which are to be provided by or through the Contractor or the Subcontractors to illustrate details of a portion of the Work.

"**Site Instruction**" means an instruction, not involving any adjustment to the Contract Price or Contract Time, in the form of Specifications, Drawings, schedules, samples, models or written instructions issued by the Engineer to supplement the Contract Documents as required for the performance of the Work.

"**Specifications**" means those documents, whenever issued by the Engineer, setting out the requirements and standards for Materials, equipment, systems, workmanship and the services necessary for the proper performance of the Work or any part thereof.

"**Subcontractor**" means a Person who performs part of the Work, including the Supply of Materials, and either: (a) has a direct contract with the Contractor or (b) has no direct contract with the Contractor but is at any tier below the Contractor.

"**Substantial Performance of the Work**" means that the Work is substantially complete or substantially performed as defined in the Lien Act, the Work or a substantial part of it is ready for use or is being used in the way that was intended for the purpose intended, and the Engineer has issued a certificate verifying that, in the opinion of the Engineer, Substantial Performance of the Work has been achieved.

"**Superintendent**" means the Contractor's senior representative at the Project Site.

"**Supplier**" means a Person having a direct contract with the Contractor to Supply Materials not worked to a special design for the Work.

"**Supply**" means supply and pay for.

"**Surety**" means the Person who has supplied the performance and labour and material bonds for the Contract.

"**Temporary Work**" means temporary supports, structures, facilities, services and other temporary items, excluding Construction Equipment that is required for performing the Work but is not incorporated into the Work.

"**Total Performance of the Work** " means the Work, with the exception of Warranty Work, has been fully completed, including rectification of all known Deficiencies, and the Engineer has issued a certificate verifying that, in the opinion of the Engineer, Total Performance of the Work has been achieved.

"**Toxic or Hazardous Substances**" means any solid, liquid, gaseous, thermal or electromagnetic irritant or contaminant and includes all pollutants and hazardous substances or wastes whether or not defined in any Law.

"**Warranty Period**" means that period of time set out in GC 63 WARRANTY during which the Contractor is obligated to warrant the Work.

"**Warranty Work**" means the Work to remedy, correct or rectify any Deficiencies, including any Work required to access the Deficiencies and any Work required to make good the Deficiencies and any other Work or work performed by Other Contractors that is destroyed, disturbed or negatively affected by the performance of the Work to remedy, correct or rectify any Deficiencies, which shall be performed by the Contractor.

"**Work**" means and includes anything and everything required to be done for the fulfilment and completion of the Contract.

"**Workers Compensation Legislation**" means the applicable workers compensation legislation at the Project Site, current at the date of the Notice to Proceed and as may be revised during the Contract Time.

"**Working Day**" means any day that there is construction activity at the Project Site or any Business Day that construction activity is reasonably possible.

GC 2. INTERPRETATION AND GENERAL PROVISIONS

.1 Wherever this Contract requires an action to be performed or an obligation to be undertaken, unless otherwise specified, such action or obligation shall be performed in a prompt and commercially reasonable manner by the Party taking the action or fulfilling its obligation.

.2 This Contract supersedes all prior negotiations and Pre-contractual Statements, relating in any manner to the subject matter of this Contract, including any bid documents that are not expressly listed in the Table of Contents of the Contract Documents.

.3 A Party shall have no right of action against any other Party arising out of or in connection with any Pre-contractual Statement except to the extent that it is repeated in the Contract.

.4 This Contract may only be amended by a document in writing signed by the Parties.

.5 Wherever the term "including" is used, or any derivative thereof, it shall be read to mean "including, but not limited to" or an equivalent phrase for a derivative, as the case may be, if the context so permits such a construction.

.6 Wherever the singular or masculine or neuter is used it will be interpreted as meaning the plural or feminine or body politic or corporate, and *vice versa*, as the context requires.

.7 Documents comprising this Contract are complementary, and what is required by any one shall be as binding as if required by all.

.8 Words and abbreviations that have customary technical or trade meanings are used in this Contract in accordance with such recognized meanings.

.9 The failure of Owner, the Engineer or the Contractor at any time to require the performance of any provision or requirement of this Contract shall not affect the right of that Party to require the subsequent performance of that provision or requirement.

.10 All amounts referred to in this Contract are in Canadian dollars, unless otherwise indicated.

.11 In the calculation of time, the first day shall be excluded and the last day shall be included.

.12 If a court of competent jurisdiction determines that any provision of this Contract is invalid or unenforceable, such determination shall not affect the validity or enforceability of the remaining provisions of this Contract.

.13 The Parties have each had the opportunity of obtaining legal advice and accordingly any rule of construction to the effect that any ambiguity is to be resolved against the drafting Party shall not apply in the interpretation of this Contract.

GC 3. LAW OF THE CONTRACT AND ATTORNMENT

.1 This Contract shall be governed by the Laws of the province or territory where the Project Site is located and the Parties agree to attorn to the exclusive jurisdiction of the Courts of that province or territory.

GC 4. PRECEDENCE OF DOCUMENT FOR INTERPRETATION

.1 In case of any inconsistency or conflict between the provisions of the Contract Documents, the provisions of such documents and addenda thereto shall take precedence and govern in the following order:

1. Contract Agreement
2. Supplementary Conditions
3. General Conditions
4. Specifications
5. Drawings
6. Executed Bid Form
7. Instructions to Bidders
8. Invitation to Bid
9. All other documents

.2 Figured dimensions on a Drawing take precedence over measurements scaled from the Drawing.

.3 Large-scale Drawings take precedence over those of smaller scale.

.4 Supplementary Drawings and Specifications supersede their antecedents.

.5 In case of conflict between figured dimensions on a Drawing and the dimensions of a specified product, the dimensions of the specified product shall govern.

.6 If compliance with two or more standards or specifications is specified and the standards or specifications establish different or conflicting requirements, the Contractor shall comply with the most stringent requirement.

.7 Documents of a later date shall govern over a similar type of document of an earlier date.

GC 5. USE OF THE CONTRACT DOCUMENTS

.1 The intent of the Contract Documents is that the Contractor shall Supply, directly or through a Subcontractor, all labour, Materials, related services, equipment or other matters or things necessary for the Contractor to perform the Work.

.2 All Work described in the Specifications and not shown on the Drawings and all Work shown on the Drawings and not described in the Specifications shall be performed by the Contractor as if included in both.

.3 The Contractor shall review the Contract Documents provided by the Owner or the Engineer and shall promptly provide Notice to the Engineer of any of the following that the Contractor discovers or becomes aware of:

(a) any errors, inconsistencies, omissions or ambiguities in the Contract Documents;

(b) doubt as to the meaning or intent of any part of the Contract Documents;

(c) any variance between the content of the Contract Documents and the Law; or

(d) modifications required to be made to the Contract Documents as a result of revisions made to the Law.

.4 If the Contractor does discover any conditions described in GC 5.3, the Contractor shall not proceed with the Work affected until the Contractor has received clarification of or revisions to the Contract Documents from the Engineer.

.5 If Notice is given by the Contractor in accordance with GC 5.3 and clarifications or revisions to the Contract Documents are required, the Engineer shall revise the Contract Documents and any Change shall be dealt with in accordance with PART 11 CHANGES AND CONCEALED OR UNKNOWN CONDITIONS.

.6 If the Contractor fails to provide Notice as required in GC 5.3 or proceeds with the Work before receiving clarification of or revisions to the Contract Documents from the Engineer as provided for in GC 5.5, the Contractor shall be responsible for and shall bear the costs, expenses, and damages attributable to any such failure, or of proceeding in such manner.

.7 Unless otherwise expressly agreed to in writing by the Owner, nothing contained in the Contract Documents shall create any contractual relationship between:

(a) the Owner or its Personnel and any Subcontractor or its Personnel, or other Persons engaged in the performance of the Work; or

(b) the Engineer or its Personnel and the Contractor, or any Subcontractor, or their respective Personnel, or other Persons engaged by them in the performance of the Work.

GC 6. NO WAIVER

.1 No action or failure to act by the Owner, the Engineer or the Contractor shall constitute a waiver of any right or duty afforded or imposed on any of them under this Contract, and such action or failure to act shall not constitute an approval of, or acquiescence in, any breach of this Contract, except as may be expressly provided for or required by this Contract or otherwise agreed in writing by the Parties.

GC 7. NO ASSIGNMENT WITHOUT CONSENT

.1 Neither Party to this Contract shall assign their respective rights or responsibilities, or any portion thereof, without the prior written consent of the other Party.

GC 8. SURVIVAL

.1 Any provision of this Contract which expressly states or naturally implies that it survives the termination, cancellation, completion, suspension or expiration of this Contract, including any other provision that is necessary for the interpretation or enforcement of the same, shall continue as valid and enforceable notwithstanding any such termination, cancellation, completion, suspension or expiration.

PART 2 INSURANCE, WORKERS' COMPENSATION AND BONDS

GC 9. INSURANCE

.1 The Contractor shall obtain and continuously carry, while the Work is being performed and while any remedial or Warranty Work is being undertaken, at the Contractor's own expense and cost, the insurance coverage as specified in Section 00 73 16 – Insurance, unless otherwise indicated in writing by the Owner. The Owner reserves the right to supplement or add insurance coverage from time to time as may be required, by Change Order.

.2 The insurance maintained by the Owner or the Contractor shall in no manner limit the Contractor's obligations to indemnify or otherwise perform the obligations required of it pursuant to the terms of this Contract.

.3 Prior to commencing the Work, the Contractor shall provide the Owner with Certificates of Insurance in a form acceptable to the Owner and evidence the insurance coverage is in accordance with the requirements of the Contract.

.4 Deductibles, if any, which are applicable to the specified insurance, shall be borne by the Contractor.

GC 10. WORKERS' COMPENSATION

.1 The Contractor shall ensure all of its and the Subcontractors' respective Personnel, agents, representatives and visitors attending at the Project Site are registered for workers' compensation coverage. The Contractor shall indemnify and save harmless the Owner for any and all claims incurred by the Owner as a result of the Contractor failing to comply with GC 10.

.2 The Contractor shall at all times pay or cause to be paid any assessment or contribution required to be paid pursuant to the Workers Compensation Legislation applicable to the Project Site. If the Contractor fails to do so, the Owner, in addition to any of its other rights under this Contract, may retain the amount of the assessment or contribution from any payment then due, or to become due, to the Contractor under this Contract.

.3 At any time during the term of this Contract, when requested by the Owner, the Contractor shall provide evidence of compliance by the Contractor and Subcontractors with the obligations under GC 10. As minimum, the Contractor shall provide evidence, satisfactory to the Engineer, of compliance with the requirements of the Workers Compensation Legislation including payments due thereunder at the following times:

(a) prior to commencing the Work;

(b) as a condition of receiving a Certificate of Substantial Performance ; and

(c) as a condition of receiving a Certificate of Total Performance.

.4 If at any time the performance of the Work is stopped because the Contractor unreasonably fails or refuses to comply with a regulation or order issued pursuant to the Workers Compensation Legislation, then such failure or refusal shall be considered a default under this Contract and the provisions of GC 49 OWNER'S RIGHT TO TERMINATE FOR DEFAULT shall apply.

GC 11. BONDS

.1 The Contractor shall, prior to commencement of the Work, pay for and provide to the Owner:

(a) a performance bond, in the amount of 50% of Contract Price, covering the performance of this Contract, including any warranty requirements; and

(b) a labour and material payment bond, in the amount of 50% of Contract Price.

.2 The Owner shall not be obligated to make any payment to the Contractor until such time as the bonds specified in GC 11.1 have been delivered to the Owner by the Contractor.

.3 The bonds specified in GC 11.1 shall be:

(a) in the form which is in accordance with the latest edition of the CCDC approved bond forms;

(b) issued by a duly licensed surety company authorized to transact the business of suretyship in the province or territory of the Project Site;

(c) acceptable to the Owner; and

(d) maintained in good standing until the fulfillment of the Contract.

PART 3 GENERAL PROVISIONS

GC 12. EXECUTION OF THE CONTRACT AGREEMENT

.1 The Contractor shall deliver the following documents to the Engineer within ten (10) Business Days of the date of the Notice of Award:

(a) Certificates of Insurance in accordance with GC 9 INSURANCE;

(b) evidence of compliance with the requirements of the Workers Compensation Legislation including payments due thereunder in accordance with GC 10 WORKERS' COMPENSATION;

(c) bonds in accordance with GC 11 BONDS; and

(d) draft Construction Schedule in accordance with GC 25 CONSTRUCTION SCHEDULE.

.2 The Engineer shall deliver the Contract Documents, in a form ready for signing, and the Notice to Proceed to the Contractor within five (5) Business Days after receipt of the documents from the Contractor provided for in GC12.1 that are satisfactory and in strict compliance with the Contract Documents.

.3 The Contractor shall sign the Contract Documents and return them to the Engineer within five (5) Business Days after receiving them and the Engineer shall forward them to the Owner for signing.

.4 The Owner shall sign the Contract Documents and return them to the Engineer within fifteen (15) Business Days after receiving them and the Engineer shall deliver the Contractor's copies to the Contractor.

GC 13. CONDUCT OF THE WORK

.1 The Contractor shall perform the Work in strict accordance with the Contract Documents and in a professional, competent and safe manner with good workmanship which performance meets or exceeds the standards for construction on projects of a similar nature and locality.

.2 The Contractor shall perform the Work diligently and take all measures necessary to ensure that the Construction Schedule is met.

.3 The Contractor represents that it is highly knowledgeable and experienced in the type of work described in the Contract Documents. The Contractor is being retained by the Owner specifically because of its knowledge and expertise in that regard.

.4 The Contractor shall in all respects be an independent contractor.

.5 The Contractor shall not, in the performance of the Work, engage in practices which conflict with the Owner's interest including, without limitation, disclosing information about the Owner's business or operations; withholding information that could adversely affect the business interests or operations of the Owner; accepting gifts from or offering gifts to the Owner's Personnel that may lead to a perceived obligation; or engaging in any activity that would contravene any Law. The Contractor shall inform the Owner, immediately and in writing, of any potential conflict of interest that may arise.

.6 The Contractor shall cooperate and work with any Other Contractors, who are appointed by the Owner from time to time.

.7 The Contractor shall perform the Work in such manner as to cause a minimum of interference with the Owner's operations and the operations of Other Contractors. The Contractor and the Owner shall cooperate fully with each other, Other Contractors and all other parties with whom the Contractor and the Owner may be involved during the performance of the Work.

GC 14. ACTIVITIES

.1 The Owner will provide the Project Site. Where Work is to be performed on lands owned by others, the Owner will obtain the necessary easements or rights-of-way. Delay in providing the Project Site, or in obtaining easements or rights-of-way which, in the opinion of the Engineer, delays the Work will be deemed cause for extension of the Contract Time and the provisions of GC 47 DELAY shall apply.

.2 The Contractor shall not enter on the Project Site until the Owner or the Engineer has issued the Notice to Proceed.

.3 The Contractor shall ensure that all permits, licenses and building occupancy permits for the Project which are required by the Contract Documents to be obtained by the Contractor are obtained in a timely manner and in accordance with the Construction Schedule.

.4 The Contractor shall, by personal inspection, examination, calculations or tests, or by any other means, satisfy himself with respect to the local conditions to be encountered and the Quantities, quality, and practicability of the Work and of his methods of procedure.

.5 The Contractor shall be responsible for all ordering, scheduling and planning required to complete the Work in a timely manner. Without prejudice to Contractor's obligation to perform on time, the Contractor shall give the Engineer prompt Notice in writing if any delay is foreseen for any reason.

.6 The Contractor shall monitor its progress in performing the Work and report regularly to the Engineer in a format acceptable to the Engineer, which shall include:

(a) actual progress reports, with itemization of Work complete, in progress and scheduled for the next period and the Materials delivered to the Project Site;

(b) forecasts for progress and labour deployment;

(c) identification of any portions of the Work which have, or have the potential to be, delayed and the mitigation efforts being deployed by the Contractor to address such delay or potential delay;

(d) lost time incident reports; and

(e) other reports which may be requested by the Engineer from time to time.

.7 The Owner shall make reasonable efforts to provide the Contractor with the necessary information regarding the Project which the Owner has available. It shall be the Contractor's responsibility to:

(a) advise the Engineer if any further or additional information is required; and

(b) obtain and assemble adequate information to permit the Work to be completed in a proper and expeditious manner as required by and in accordance with the Contract Documents and the Construction Schedule.

PART 4 ADMINISTRATION OF THE CONTRACT

GC 15. AUTHORITY OF THE ENGINEER

.1 The Engineer shall have authority to act on behalf of the Owner only to the extent provided for in this Contract or as the Owner may authorize, from time to time, but only to the extent that such authorization is communicated to the Contractor by Notice from the Owner.

.2 The duties, responsibilities, and limitations of authority of the Engineer shall only be modified or extended by a Notice issued by the Owner to the Contractor.

GC 16. ROLE AND RESPONSIBILITY OF THE ENGINEER

.1 The Engineer shall, to the extent specifically provided for in this Contract, be a representative of the Owner during the performance of the Work until the date of the Total Performance of the Work and the completion of the Warranty Work. The Engineer's instructions to the Contractor shall be forwarded directly from the Engineer, or alternatively through the Owner, as may be determined appropriate by the Owner from time to time.

.2 The Engineer shall visit the Project Site at intervals appropriate to the progress of the Work to observe the progress and quality of the Work and to determine if the Work is proceeding in general conformity with this Contract.

.3 The Engineer may provide at the Project Site one or more Personnel to assist in carrying out the Engineer's responsibilities.

.4 Based upon the Engineer's observations and evaluation of the Contractor's applications for payment, the Engineer shall make an assessment as to the amounts owing to the Contractor under this Contract and shall issue Payment Certificates as provided for in PART 7 PAYMENT AND ALLOWANCES.

.5 The Engineer shall not be responsible for, and shall not have control, charge, or supervision of construction means, methods, techniques, sequences, or procedures, quality assurance or safety or environmental protection programs and other programs required in connection with the Work in accordance with applicable Law or general construction practice.

.6 The Engineer shall not be responsible for the Contractor's failure to carry out its obligations in accordance with the Contract Documents. The Engineer shall not have control over, charge of, or be responsible for the acts or omissions of the Contractor or any Person for whom the Contractor is responsible at Law.

.7 The Engineer shall be, in the first instance, the interpreter of the requirements of this Contract and shall make determinations as to the performance under the Contract by the Owner and the Contractor and the Subcontractors. Interpretations and determinations of the Engineer shall be consistent with the intent of the Contract Documents.

.8 Claims, Disputes, and other matters in question relating to the performance of the Work or the interpretation of the Contract Documents, shall be referred initially by Notice to the Engineer for the Engineer's interpretation and determination. The Engineer's interpretation and determinations shall be given by Notice to both the Owner and the Contractor.

.9 The Engineer shall have authority to reject work which, in the Engineer's opinion, does not conform to the requirements of this Contract. Whenever the Engineer considers it necessary or advisable, the Engineer shall 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 Engineer to act, nor any decision either to exercise or not exercise such authority, shall give rise to any duty or responsibility of the Engineer to the Contractor.

.10 During the progress of the Work, the Engineer may issue Site Instructions to the Contractor. The Contractor shall comply with the Site Instructions with reasonable promptness or in accordance with a schedule for implementation of such Site Instructions agreed to by the Engineer and the Contractor.

.11 The Engineer may issue Field Instructions requiring the Contractor's immediate action to effect, maintain or restore compliance of the Work with the safety or environmental requirements of the Contract.

.12 The Engineer shall review and take appropriate action upon the Contractor's submittals such as Shop Drawings and samples, as provided in the GC31 SHOP DRAWINGS.

.13 The Engineer shall prepare Change Orders, Change Directives, Contemplated Change Notices and Site Instructions as provided in PART 11 CHANGES AND CONCEALED OR UNKNOWN CONDITIONS. Neither a Change Order nor a Change Directive shall constitute a Change unless signed by the Owner.

.14 The Engineer shall conduct reviews of the Work to verify Substantial Performance of the Work and Total Performance of the Work as provided in GC 40 SUBSTANTIAL PERFORMANCE OF THE WORK and GC 42 TOTAL PERFORMANCE OF THE WORK AND FINAL PAYMENT.

.15 The Engineer shall make reasonable efforts to promptly review and take appropriate action with respect to documents submitted by the Contractor, including written warranties and related documents, and upon the Owner's request, shall establish a process for the Owner's review of some or all such documents.

.16 In the event that the Contractor believes that the Engineer is not promptly reviewing or taking appropriate action with respect to any samples or documents submitted by the Contractor, the Contractor shall, within five (5) Business Days of such event occurring, provide Notice to the Engineer and the Owner setting out which samples or documents have not been promptly reviewed or in relation to which the Engineer has not taken appropriate action and the effect of such conduct. If the Contractor does not provide such Notice within the specified time, the Contractor shall have no Claim against the Owner for any reason relating to the conduct of the Engineer with respect to the review of samples or documents submitted by the Contractor.

GC 17. REVIEW AND INSPECTION OF THE WORK

.1 The Owner and the Engineer shall have access to the Work at all times provided they follow the Contractor's safety requirements.

.2 The Contractor shall Supply sufficient, safe, and proper facilities at all times for the review and inspection of the Work by the Owner, the Engineer and Governmental Authorities. If parts of the Work are in preparation at locations other than the Project Site, the Owner and the Engineer shall be given access to such parts of the Work.

.3 The Owner may review the Project Site at any time to observe whether the Contractor is fulfilling its responsibilities as Prime Contractor for Safety and under the OH&S Legislation. Reviews may include: Project Site conditions, work processes, procedures and documentation of Project Site safety related activities. Observed infractions or possible infractions will be reported to the Engineer and the Contractor for further investigation and action by the Contractor.

.4 If any portion of the Work is designated for tests, inspections or approvals in the Contract Documents, or by the Engineer, or by Law, the Contractor shall give the Engineer Notice of not less than two (2) Business Days of when the Work will be ready for review and inspection. The Contractor shall arrange for, and shall give the Engineer reasonable Notice of, the date and time of inspections by all Governmental Authorities.

.5 The Contractor shall promptly deliver to the Engineer two copies of any certificates and inspection reports relating to the Work, or any portion thereof.

.6 Within ten (10) Business Days of the commencement of the Work, the Owner and the Engineer, in conjunction with the Contractor, shall jointly develop a schedule of items of Work which are designated for special tests, inspections, or approvals.

.7 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 re-perform all covering Work, all at the Contractor's expense, regardless of the outcome of the tests.

.8 The Engineer may order any portion or portions of the Work to be examined to confirm the Work is in accordance with the requirements of this Contract. If the Engineer provides Notice to the Contractor that the Work is not in accordance with the requirements of this Contract, the Contractor shall correct the Work and pay the cost of examination, correction and restoration. If, on such examination, the Work has been completed in accordance with the requirements of this Contract, the Owner shall be responsible for the cost of examination and restoration, except as provided for in GC 17.7.

.9 Neither the failure of the Engineer, or an inspection agency appointed by the Owner or the Engineer, to carry out any reviews or inspections, nor errors or omissions in the performance of such reviews and inspections by the Engineer, or an appointed inspection agency, shall relieve the Contractor from responsibility that the Work, or any portion thereof, is performed in accordance with this Contract.

.10 The Contractor shall continuously monitor and inspect the Work of the Subcontractors for Deficiencies and ensure that all such Deficiencies are promptly corrected.

.11 The Contractor shall implement and follow a quality assurance program with respect to the performance of the Work, and shall ensure the compliance of the Subcontractors with its quality assurance program, to ensure that the quality of the Work meets or exceeds the standards of performance and quality required by this Contract.

GC 18. DEFICIENCIES

.1 At all times during the performance of the Work, the Contractor shall promptly remedy, correct and rectify any Deficiencies, whether or not the Deficiencies have been incorporated in the Work, and whether or not the Deficiencies are the result of poor workmanship, use of defective Materials, or vandalism, theft or damage through carelessness, negligence, inadequate security or protection or other act or omission of the Contractor or any Person for whom the Contractor is responsible at Law.

.2 The Contractor shall remedy, correct and rectify, as required to ensure the timely performance of the Work in accordance with the Construction Schedule, any and all:

(a) Deficiencies in a manner acceptable to the Engineer and the Owner; and

(b) Work, or other work, that is destroyed or damaged as a result of the Deficiencies or the remedying or correction thereof.

.3 If, in the opinion of the Owner, it is not expedient to correct any Deficiency as provided for in this Contract, after consultation with the Engineer and Contractor, the Owner may require the Contractor to deduct from the amount otherwise due to the Contractor the difference in value between the Work as performed and that called for by this Contract. If the Owner and the Contractor do not agree on the difference in value, they shall refer the matter for determination in accordance with PART 12 DISPUTE RESOLUTION.

.4 In the event that the Contractor does not remedy, correct or rectify the Deficiencies as required herein, the Owner may, upon expiry of ten (10) Business Days after giving Notice to the Contractor, take such steps as may be necessary to remedy, correct or rectify the Deficiencies in the Work or other work which is damaged or destroyed as a result of the Deficiencies or the

remedying or correction thereof. In such event, the Contractor shall promptly pay the Owner for costs incurred by the Owner for remedying, correction or rectification of those Deficiencies, including both the Work or other work, if any, destroyed or damaged, or any alterations necessitated by the Contractor failing to remedy, correct or rectify the Deficiencies and any claims incurred by the Owner in so doing may be set-off against any monies due from the Owner to the Contractor.

PART 5 EXECUTION OF THE WORK

GC 19. CONTROL OF THE WORK

.1 The Contractor shall have total control of the Work and shall effectively control, direct and supervise the Work so as to ensure conformity with the Contract Documents and compliance with all Law.

.2 The Contractor shall be solely responsible for construction means, methods, techniques, sequences, procedures and safety and coordination of the various parts of the Work.

.3 Without limiting the generality of the foregoing, the Contractor is responsible for the coordination of the various parts of the Work so that no part is left in an unfinished or incomplete condition, unless otherwise required or specified by the Engineer to be unfinished or uncompleted.

.4 Prior to commencing any of the Work, the Contractor shall verify all measurements, dimensions, and levels necessary for the proper, timely and complete performance of all aspects of the Work. Where measurements, dimensions or levels are not included in the Contract Documents or exact locations or requirements are not apparent, the Contractor shall immediately provide Notice to the Engineer identifying the lack of information and shall obtain instructions from the Engineer prior to proceeding with any part of the Work affected thereby.

GC 20. ELECTRONIC INFORMATION

.1 At the Contractor’s request and at the Owner’s option, the Engineer may provide the Contractor with electronic copies of the Drawings, design digital terrain model, building information model or other such information.

.2 If the Engineer does provide such information, it is provided "as is" and at the Contractor's request, without warranty of any kind, whether express or implied. All implied warranties, including, without limitation, implied warranties of accuracy, completeness, merchantability, fitness for a particular purpose, and non-infringement, are hereby expressly disclaimed.

.3 Under no circumstances will the Owner or the Engineer be liable to any Person for any direct, indirect, special, incidental, or other damages including Consequential Damages and, without limitation, any loss of programs or information, based on any use of this information or any information referenced therein, even if the Owner or the Engineer has been specifically advised of the possibility of such damages.

GC 21. LAYOUT OF THE WORK

.1 The Engineer shall establish reference points for construction which are necessary for the Contractor to proceed with the Work.

.2 The Contractor shall preserve and protect the established reference points and shall not modify or relocate the established reference points without the approval of the Engineer.

.3 Unless otherwise stated in the Contract Documents, the Contractor shall be responsible for:

(a) laying out the Work;

(b) Supply of stakes, markers and related tools and equipment.

.4 Regardless of the layout methodology, the Contractor shall verify the accuracy of the proposed location of the elements of the Work as indicated by the layout, prior to their construction, by measurements to legal property lines and existing physical features at the Project Site.

GC 22. CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS

.1 The Owner reserves the right to award separate contracts for work at the Project Site to Other Contractors and to perform work with its own forces.

.2 The Contractor shall cooperate and work with any Other Contractors, who are appointed by the Owner from time to time.

.3 When separate contracts are awarded by the Owner to Other Contractors for work at the Project Site, the Owner shall:

(a) provide for the coordination of the activities and work of Other Contractors with the Work;

(b) provide Notice to the Contractor as to whether the Contractor will be Prime Contractor for Safety in relation to some, or all of the work that is performed by Other Contractors; and

(c) where the Contractor is Prime Contractor for Safety for the area of the Project Site where work is to be performed by Other Contractors, contractually require that those Other Contractors adhere to the work rules and procedures established by the Contractor to ensure safety and the protection of Persons and the Work.

.4 When separate contracts are awarded for work at the Project Site or when work is performed at the Project Site by the Owner's own forces, the Contractor shall:

(a) provide the Other Contractors with a reasonable opportunity to bring onto the Project Site and store their respective materials and to use their construction equipment and temporary work to execute their respective work;

(b) coordinate and schedule the Work with the work of Other Contractors;

(c) connect such other work with the Work as specified or shown in the Contract Documents;

(d) participate and assist with Other Contractors and the Owner in reviewing and coordinating the construction schedules of those Other Contractors; and

(e) where part of the Work is affected by, or depends upon for its proper execution, the work of Other Contractors, promptly provide Notice to the Engineer, prior to proceeding with that part of the Work, of any apparent deficiencies in such work. Failure by the Contractor to promptly provide Notice will invalidate any Claims of the Contractor against the Owner by reason of the deficiencies in the work of Other Contractors.

.5 When a Change is required as a result of :

(a) assignment of Prime Contractor for Safety status by the Owner with respect to Other Contractors; or

(b) coordination of, interference or damage to the work of Other Contractors; or

(c) connection of the work of Other Contractors with the Work,

the Changes will be dealt with in accordance with PART 11 CHANGES AND CONCEALED OR UNKNOWN CONDITIONS.

GC 23. SUSPENSION OF WORK BY OWNER

.1 The Owner may at any time suspend the Work or delay commencement thereof, or any portion thereof, provided he gives the Contractor ten (10) Business Days' Notice of suspension or delayed commencement. The Contractor shall resume Work upon Notice from the Owner within ten (10) Business Days after the date set forth in such Notice to resume Work.

.2 In the event that the Owner chooses to delay the commencement of the Work or any portion thereof or implement a temporary suspension:

(a) the Contract Time shall be adjusted by the Owner to account for the period of delay or suspension affecting the Work and any seasonal impact on the Work directly resulting from the delay or suspension; and

(b) the Owner shall reimburse the Contractor for direct and provable costs and expenses incurred by the Contractor necessitated by such delay or suspension of the Work or portion thereof, but the Contractor shall not recover from the Owner payment for any loss of profits or any other form of damages.

.3 If the delay or suspension of the Work lasts more than forty-five (45) Business Days, the Contractor may, at its option and on ten (10) Business Days' Notice, terminate the Contract as provided for in GC 50 CONTRACTOR'S RIGHT TO TERMINATE FOR DEFAULT. The Contractor shall not be permitted to terminate the Contract when only a portion of the Work is delayed or suspended.

.4 A suspension of the Work because of seasonal climatic conditions, whether ordered by the Owner or the Engineer or not, shall not be deemed to be a suspension of the Work within the meaning of GC 23.

.5 Except as provided by GC 23, the Owner shall not be liable in any way to the Contractor in relation to a suspension or delayed commencement of the Work, or any portion of the Work, and

under no circumstances shall the Owner be liable for Consequential Damages as a result of suspension or delayed commencement of the Work pursuant to GC 23.

GC 24. TEMPORARY SUPPORTS, STRUCTURES AND FACILITIES

.1 The Contractor shall have the sole responsibility for the design, erection, operation, maintenance and removal of Temporary Work and the design and execution of construction methods required in its use.

.2 The Contractor shall engage and pay for professional engineer(s) registered and in good standing in the province or territory where the Project Site is located and skilled in the appropriate disciplines to perform those functions referred to in GC 24.1 where:

(a) required by the Law or by the Contract Documents; and

(b) in all cases where such Temporary Work and its method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.

.3 Despite any other provision of this Contract, where the Contract Documents include designs for Temporary Work or specify a method of construction in whole or in part, such Temporary Work 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.

.4 At least fifteen (15) Business Days before construction or location of Temporary Work the Contractor shall submit representative designs and sketches of Temporary Work to the Engineer as provided for in GC 31 SHOP DRAWINGS. The Engineer shall review the Temporary Work drawings and sketches for compatibility with the Work and for possibilities of impediments to the operations of Other Contractors and the safe passage of the public.

GC 25. CONSTRUCTION SCHEDULE

.1 The Contractor shall:

(a) within ten (10) Business Days of award of this Contract, prepare a draft Construction Schedule including all of the construction phases of the Work that shall incorporate:
  (i) the sequence and timing of the required major Project decisions;
  (ii) the timing of major activities of the Work and sufficient detail of the critical events and their inter-relationship to demonstrate that the Work will be performed in conformity with the Contract Time; and

(b) within the time referred to in GC 25.1(a) deliver to the Engineer the draft Construction Schedule and:
  (i) at a time agreed to by the Engineer, make a presentation of the draft Construction schedule to the Engineer;
  (ii) where the draft Construction Schedule cannot be approved by the Engineer without revision, the Contractor shall promptly revise the draft Construction Schedule and deliver and re-present it to the Engineer repeating the process until

the draft Construction Schedule is approved and becomes the Construction Schedule;

(iii) break-down the Construction Schedule into phases of the Work and show the Milestone Dates for the various phases;

(iv) use the Construction Schedule as the baseline schedule which will be identified and compared to all subsequent schedule revisions and updates;

(v) at least monthly, or as more frequently requested by the Engineer:

1. provide proposed updates to the Construction Schedule, which updates shall include:
   a. a twenty (20) Business Day forecast of the planned progress of the Work;
   b. adjustments resulting from Change Orders and Change Directives; and
   c. identification of potential variances between the Construction Schedule and probable completion dates for all elements of the Work;
2. review all schedules for Work not started or completed and when required prepare and plan for mitigation measures and submit the mitigation plan in writing to the Engineer for review.

.2 Approval by the Engineer of the Construction Schedule shall not diminish or lessen the Contractor's obligations and responsibilities under this Contract, including the obligation to meet the Milestone Dates and achieve the Total Performance of the Work within the Contract Time.

.3 The time for performance of the Work shall commence on the date specified in the Notice to Proceed, or if not so specified, on the date that the Notice to Proceed is issued.

GC 26. SAFETY

.1 Unless expressly directed otherwise pursuant to GC 22 CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS, the Contractor shall be solely responsible for construction safety at the Project Site and in performing the Work, and for the Contractor's compliance and that of the Subcontractors with all Law and practices relating to health and safety. The Contractor shall be responsible for initiating, maintaining and supervising all safety programs, including the preparation of applicable hazard assessments, in connection with the performance of the Work.

.2 The Owner delegates and the Contractor accepts the role and responsibilities of the Prime Contractor for Safety for the entire Project Site until the Project Takeover Date of the entire Work. A partial takeover of the Project by the Owner shall not affect this delegation, unless Notice of a Change in the designation of the Contractor as Prime Contractor for Safety is provided by the Owner to the Contractor, in which case, the Contractor shall follow the directions of the Owner as set out in the Notice.

.3 In the event of any occurrence, circumstance or condition that caused, or has the potential to cause, injury or damage to any Person, property, reputation, security or the environment, the Contractor shall:

(a) immediately verbally notify the Owner and the Engineer of the same and follow up with prompt Notice providing details of the occurrence, circumstance or condition;

(b) keep the Owner and the Engineer informed and provide copies of all relevant documentation to the Owner and the Engineer of all developments, including medical status and anticipated recovery of any individuals involved, investigations by any Governmental Authority, reports prepared by or submitted by the Contractor or any Subcontractor and the laying of any charges;

(c) cooperate and ensure the cooperation of all Subcontractors with investigations, whether instigated by the Owner or any Governmental Authority, and provide copies of any investigations undertaken by the Contractor to the Owner; and

(d) prepare a corrective action plan in a time period agreed to by the Owner and the Engineer and provide a copy to the Owner and the Engineer.

.4 The Owner may, acting reasonably but at its sole and absolute discretion, for reasons of health and safety, cause parts of, or all of, the Work or Project to be stopped, or the Contractor or any of the Subcontractors to be removed or excluded from the Project Site. Such action shall not relieve the Contractor from its obligations under this Contract or otherwise affect the Contract Price, the Contract Time or give rise to any Claim by the Contractor against the Owner.

GC 27. SUPERINTENDENT AND KEY PERSONNEL

.1 The Contractor shall assign to the Project the Superintendent identified in Section 00 45 13 – Bidder's Qualifications. The Superintendent shall remain assigned to the Project up to and including the achievement of Substantial Performance of the Work and shall dedicate substantially all of their full working time and attention to the Project. The Contractor shall ensure that the Superintendent is available at no additional cost for consultation and to provide direction during the correction of Deficiencies and performance of any Warranty Work. The Superintendent shall not be removed, re-assigned to another project or have their role changed on the Project without the prior written consent of the Engineer, unless such individual leaves the employment of the Contractor.

.2 The Superintendent shall represent the Contractor at the Project Site until all Deficiencies noted at the time of Substantial Performance of the Work have been corrected to the satisfaction of the Engineer. Notices and Site Instructions given to the Superintendent shall be held to have been received by the Contractor.

.3 The Engineer, may, with reasonable cause at any time during the performance of the Work, by Notice to the Contractor, require the replacement of the Superintendent identified in Section 00 45 13 – Bidder's Qualifications or other supervisory Personnel assigned to the Work. Upon receipt of the Notice, the Contractor shall immediately make arrangements to appoint a replacement acceptable to the Engineer.

GC 28. SUBCONTRACTORS

.1 The Contractor shall:

(a) enter into written subcontracts with Subcontractors to require them to perform their Work as provided in the Contract Documents;

(b) ensure that the relevant portions of this Contract are incorporated into and form part of, the subcontracts entered into between the Contractor and its Subcontractors, including:

(i) provisions equivalent to those set out in PART 10 TERMINATION so that in the event of any kind of termination or delay the Contractor is only required to pay its Subcontractors for those types of costs and expenses that the Owner is required to pay the Contractor and the Contractor shall indemnify the Owner from any other claim by any of its Subcontractors; and

(ii) an obligation for Subcontractors to protect the Work, the Owner's property, property on or adjacent to the Project Site and Materials stored off the Project Site on terms equal to, or more favourable, than the terms set out in PART 6 PROTECTION OF PERSONS AND PROPERTY AND TOXIC OR HAZARDOUS SUBSTANCES.

.2 The Contractor shall employ only those Subcontractors listed in Section 00 43 36 – Subcontract List or others as approved in writing by the Engineer and shall not change or employ additional Subcontractors without the approval of the Engineer and the Owner, which approval shall not be unreasonably withheld. Such changes in Subcontractors shall not result in an adjustment to the Contract Price or Contract Time.

.3 The Owner, through the Engineer, may at any time during the performance of the Work object to the use of a Subcontractor and give Notice to the Contractor to employ a different Subcontractor that is satisfactory to the Owner.

.4 If the Owner requires the Contractor to change a proposed Subcontractor or Supplier pursuant to GC 28.3 for any reason other than reasonable cause, the Contract Price or Contract Time, or both as the case may be, shall be adjusted by the differences, if any, occasioned by such required Change.

.5 Unless a Subcontractor is specified in the Contract Documents, the Contractor shall not be required to engage as a Subcontractor, a Person to whom the Contractor reasonably objects.

.6 If a Subcontractor provides the Engineer with a copy of the relevant executed subcontract agreement, then the Owner, through the Engineer, may provide to a Subcontractor information as to the percentage of the Subcontractor's Work which has been certified for payment. The Owner and the Engineer shall inform the Contractor of any such communications.

GC 29. LABOUR AND MATERIALS

.1 The Contractor shall Supply all services, labour, Materials, tools, Construction Equipment, Temporary Work, water, heat, light, power, transportation, and other facilities and services, including temporary access, access roads, parking areas, laydown areas and utilities, necessary for the performance of the Work.

.2 Materials Supplied shall be new, fit for the purposes intended by the Owner and otherwise of the quality as depicted in and required by the Contract Documents. Materials that are not specified shall be of a quality consistent with those specified and their use confirmed in advance as being acceptable to the Engineer.

.3 Materials that are used in the performance of the Work, for construction or incorporation into parts of the Work that will be in contact with partially treated or potable water, including water retaining structures and piping, shall be compatible with potable water in accordance with all applicable health and environmental regulations. This shall include, but not be limited to, all sealants, waterproofing agents, form release agents, concrete accessories, and valve and pipe coatings and linings.

.4 Until such time as the Materials are incorporated into the Work, the Contractor shall be responsible for the safe and secure storage and preservation of Materials on the Project Site, or elsewhere if located off of the Project Site, so as to avoid damage, destruction, contamination, alteration, waste or spoilage to the Materials, injury to Persons, damage or destruction to property or delay to the Project resulting from such Materials.

.5 The Contractor shall maintain good order and discipline among the Contractor's Personnel, and the Subcontractor's Personnel engaged in the performance of the Work, and shall not employ, or permit to be employed, any Subcontractor not skilled in the tasks assigned.

GC 30. DOCUMENTS AT THE SITE

.1 The Contractor shall keep at least two (2) copies of current Contract Documents, permits, licenses, authorizations, submittals, reports, the Construction Safety Plan, together with documentation applicable to safety procedures and compliance with the OH&S Legislation and Workers Compensation Legislation, and minutes of meetings for the Work at the Project Site, in good order and available for review by the Owner and the Engineer.

.2 The Contractor shall ensure that record Drawings, Project Record Drawings, maintenance manuals, operating instructions, and such similar construction documents, are properly completed and handed over to the Engineer in a timely manner, or as otherwise required by the Owner. The Contractor shall not achieve Total Performance of the Work until all record Drawings, Project Record Drawings, maintenance manuals, operating instructions and such similar construction documents are complete and delivered to the Engineer.

.3 The Contractor shall ensure that all manufacturers' maintenance manuals, service agreements, warranties and guarantees are in order, and shall prepare a register of the same and deliver the register and the documents to the Engineer in a timely manner, or as otherwise required by the Owner, and in any event, before Total Performance of the Work.

GC 31. SHOP DRAWINGS

.1 In consultation with the Engineer, the Contractor shall establish and implement procedures for timely receipt, processing and review of Shop Drawings and samples. Upon request of the Engineer, the Contractor shall prepare a target schedule of dates for submission, review and return of Shop Drawings for the consideration of the Engineer.

.2 The Contractor shall Supply Shop Drawings as described in the Contract Documents or as the Engineer may reasonably request.

.3 The Contractor shall review all Shop Drawings prior to submission to the Engineer and shall represent by its review that:

(a) the Contractor has determined and verified all field measurements and field construction conditions and shall ensure that any Subcontractor submitting Shop Drawings has also determined and verified all field measurements and field construction conditions, Material requirements, catalogue numbers, and similar data; and

(b) the Contractor and the Subcontractor have checked and coordinated all Shop Drawings with the requirements of the Work and the requirements of the Contract Documents.

.4 The Contractor shall confirm this review of each of the Shop Drawings by stamp, date, and signature of the individual responsible. Shop Drawings not reviewed, stamped and signed by the Contractor may be rejected by the Engineer.

.5 The Contractor shall submit Shop Drawings to the Engineer to review in an orderly sequence, in accordance with any schedule that may be agreed to for the submission of Shop Drawings and sufficiently in advance of the need for reviewed Shop Drawings, so as not to cause any delay to the Construction Schedule or to the work of Other Contractors. At the time of submission, the Contractor shall provide Notice to the Engineer of any deviations in the Shop Drawings from the requirements of the Contract Documents.

.6 Upon the Engineer's request, the Contractor shall revise and resubmit Shop Drawings which the Engineer rejects as inconsistent with the Contract Documents. The Contractor shall provide Notice to the Engineer of any revisions made to resubmitted Drawings other than those requested by the Engineer.

.7 If the Contractor Supplies the Shop Drawings in accordance with the schedule agreed upon, the Engineer shall review and return Shop Drawings in accordance with the schedule agreed upon, or otherwise with reasonable promptness. In the event that the Contractor believes that the Engineer is not promptly reviewing Shop Drawings submitted by the Contractor, the Contractor shall, within five (5) Business Days of such event occurring, provide Notice to the Engineer and the Owner setting out which Shop Drawings have not been promptly reviewed and the effect of such conduct. If the Contractor does not provide such Notice within the specified time, the Contractor shall have no Claim against the Owner for any reason relating to the conduct of the Engineer with respect to review of Shop Drawings.

.8 The Engineer's review of Shop Drawings is for general conformity to the design concept, and for general arrangement only, and shall not relieve the Contractor of responsibility for errors or omissions in the Shop Drawings or for meeting all requirements of this Contract.

.9 The Engineer's authority to review Shop Drawings shall be for the benefit of the Owner and such authority shall not give rise to any duty or responsibility of the Engineer or the Owner to the Contractor, Subcontractors or their Personnel or other Persons performing any of the Work.

.10 Shop Drawings that require approval of any Governmental Authority shall be submitted to such Governmental Authority by the Contractor for approval, prior to submission to the Engineer, so as not to adversely impact the Construction Schedule.

GC 32. STEWARDSHIP OF THE PROJECT SITE

.1 The Contractor shall confine Construction Equipment, Temporary Work, storage of Materials, waste products and debris and operations of Personnel and Subcontractors to limits indicated by Law, ordinances, permits or the Contract Documents, as applicable, and shall not unreasonably encumber or obstruct the Work or the Project Site.

.2 The Contractor shall not load, or permit to be loaded, any part of the Work with a weight or force or in any other manner that will endanger the safety of the Work or any Persons.

.3 The Contractor shall maintain the Work and the Project Site in a tidy condition free from the accumulation of waste products and debris, other than that resulting from the operations of the Owner or Other Contractors.

.4 The Contractor shall remove waste products and debris, other than that resulting from the operations of the Owner or Other Contractors, and shall leave the Work and the Project Site clean and suitable for occupancy on each applicable Project Takeover Date. The Contractor shall remove tools, Construction Equipment, and equipment not required for the performance of the remaining Work.

.5 In the event that any products or debris resulting from the operations of the Owner or Other Contractors affects the Work or safety on the Project Site, the Contractor shall immediately verbally inform the Engineer and the Owner and provide Notice to the same of such condition within one (1) Business Day thereafter.

.6 Prior to application for the final Payment Certificate, the Contractor shall remove tools, Construction Equipment, Temporary Work, and waste products and debris, other than that resulting from the work undertaken by the Owner or the Other Contractors.

PART 6 PROTECTION OF PERSONS AND PROPERTY AND TOXIC OR HAZARDOUS SUBSTANCES

GC 33. PROTECTION OF WORK AND PROPERTY

.1 In performing the Work the Contractor shall protect the Work and the Owner's property and any other Person's property from damage. The Contractor shall at the Contractor's own expense make good any such damage which arises as the result of the Contractor's operations.

.2 At no additional cost to the Owner and as part of the Work, the Contractor shall provide all safety devices, signage and supervision at the Project Site that are necessary to protect Personnel and the public.

.3 Before commencing any Work at the Project Site the Contractor shall:

(a) expose and determine conclusively the location in the field of all underground utilities and structures indicated on the Contract Documents as being at the Project Site;

(b) consult with all utility corporations that provide electricity, communication, gas or other utility services in the area of the Project Site, to expose and conclusively determine the location of all underground utilities;

(c) expose and conclusively determine the location of any other utilities or underground structures that are reasonably apparent or inferable in an inspection of the Project Site; and

(d) survey and record the location, in three dimensions, of underground structures exposed in accordance with GC 33.3; and

(e) provide the information obtained under GC 33.3 (d) to the Engineer.

.4 If any underground utility or structure located under GC 33.3 is in conflict with the Work as indicated on the Drawings, immediately provide Notice to the Engineer. If the resolution of the conflict requires a Change that increases or decreases the Contract Price or the Contract Time, then the provisions of GC 57 CONCEALED OR UNKNOWN CONDITIONS shall apply.

.5 The Contractor shall pay the costs to repair any underground utility or structure that the Contractor damages in the performance of the Work which the Contractor was required to locate under GC 33.3.

.6 If, in the performance of the Work the Contractor causes damage to an underground utility or structure:

(a) which was unknown or unforeseeable to the Contractor at the time of the damage; and

(b) that the Contractor was not required to locate pursuant to GC 33.3,

then such event may be considered a concealed or unknown condition and the provisions of GC 57 CONCEALED OR UNKNOWN CONDITIONS shall apply.

.7 Unless the Owner provides Notice to the Contractor stating otherwise, in the event of a shutdown or suspension of the Work, the Contractor shall continue to be responsible for the care, protection, security and maintenance of the Work during the period of the shutdown or suspension.

.8 The Contractor shall provide, at no additional cost to the Owner, adequate site security at all times during the performance of the Work. The Owner shall not be responsible for the costs of any theft, damage, alteration, loss or replacement.

GC 34. TOXIC OR HAZARDOUS SUBSTANCES

.1 Unless otherwise specified in the Contract Documents the Contractor shall assume that the Owner has elected not to conduct tests or investigations for Toxic or Hazardous Substances at the Project Site.

.2 Subject to the provisions of GC 34, the Owner bears the risk that the Contractor will encounter Toxic or Hazardous Substances at the Project Site.

.3 The Contractor has no obligation or duty to conduct tests or investigations for Toxic or Hazardous Substances at the Project Site unless the Engineer gives written directions regarding Toxic or Hazardous Substances that are discovered or suspected at the Project Site.

.4 If, in the performance of the Work the Contractor encounters any materials at the Project Site that the Contractor knows or suspects may be Toxic or Hazardous Substances then the Contractor shall immediately:

(a) stop the Work, or portion of the Work, and take such steps as required so that such materials are contained and not disturbed; and

(b) give written Notice to the Engineer, the Owner and all other parties as required by Law.

.5 If the Engineer observes any materials at the Project Site that the Engineer knows or suspects may be Toxic or Hazardous Substances then the Engineer shall immediately give written Notice to the Owner and the Contractor, and the Contractor shall immediately stop the Work or portion of the Work as required by GC 34.4.

.6 If materials are encountered that are or are suspected to be Toxic or Hazardous Substances and Notice is given either by the Contractor pursuant to GC 34.4, or by the Engineer pursuant to GC 34.5, then the Engineer shall after consulting with the Contractor give the Contractor written directions specifying what, if any, measures are to be taken on account of such materials so as to reasonably permit the Contractor to proceed with the Work. The Contractor shall strictly comply with any such directions.

.7 The Work shall be performed in full compliance with all Laws applicable to any Toxic or Hazardous Substances encountered at the Project Site.

.8 Any adjustment that the Contractor is required to make to the performance of the Work on account of suspected or confirmed Toxic or Hazardous Substances encountered by the Contractor at the Project Site and that were not identified in the Contract Documents shall be considered a concealed or unknown condition and the provisions of GC 57 CONCEALED OR UNKNOWN CONDITIONS shall apply.

.9 Unless stated otherwise in the Contract Documents, the remediation, treatment or removal of any Toxic or Hazardous Substances shall be a Change and the provisions of Part 11 CHANGES AND CONCEALED OR UNKNOWN CONDITIONS shall apply.

.10 Provided that the Contractor strictly complies with the requirements of GC 34 then the Owner shall indemnify the Contractor against any costs, expenses and damages that the Contractor is required by Law to pay to any third party (excluding Subcontractors) as a direct result of encountering any Toxic or Hazardous Substances in the performance of the Work at the Project Site.

.11 If the Contractor fails to notice any materials that a competent contractor reasonably experienced in the Work would have noticed were Toxic or Hazardous Substances, or fails to comply with a direction given by the Engineer pursuant to GC 34.5, then the Contractor shall:

(a) pay all reasonable additional costs the Owner is required by Law to incur to deal with any Toxic or Hazardous Substances that have been disturbed or permitted to escape as a direct result of such failure; and

(b) indemnify the Owner from any and all additional costs, expenses and damages that the Owner is required by Law to pay to any third party as a direct result of such failure.

.12 The Contractor shall not bring to the Project Site any Toxic or Hazardous Substances and the Contractor shall indemnify the Owner from any costs, expenses and damages the Owner is required by Law to pay as a result of the Contractor bringing any Toxic or Hazardous Substances to the Project Site.

.13 Nothing in GC 34 shall be interpreted to prohibit or prevent the Contractor from bringing to the Project Site any Toxic or Hazardous Substances such as fuel oil, or other materials that the Contractor is specifically, or by necessary and reasonable implication, permitted or required to bring onto the Project Site in order to perform the Work as required by the Contract Documents.

.14 In the event that Toxic or Hazardous Substances are used or placed in the Work or onto the Project Site by the Contractor, or any Person for whom the Contractor is responsible at Law, the Contractor shall take the necessary steps to ensure that no Person suffers injury, sickness, or death, and that no property is damaged or destroyed as a result of exposure to, or the presence of, such Toxic or Hazardous Substances.

PART 7 PAYMENT AND ALLOWANCES

GC 35. GENERAL PROVISIONS RELATING TO PAYMENT

.1 Payments shall be made to the Contractor in accordance with this PART 7 PAYMENT AND ALLOWANCES and, as applicable, Section 00 52 00 - Contract Agreement.

.2 No payment by the Owner under this Contract, or partial or entire use or occupancy of the Work by the Owner shall constitute an acceptance of any portion of the Work which is not in accordance with the requirements of the Contract.

GC 36. FINANCIAL INFORMATION REQUIRED OF THE CONTRACTOR

.1 At the request of the Owner, from time to time, the Contractor shall provide to the Owner, in writing, such financial or corporate information as may be reasonably required by the Owner, to establish or confirm the ability of the Contractor to perform its obligations pursuant to this Contract.

.2 The Contractor shall keep the Owner apprised of any material or significant changes in the ownership or financial position of the Contractor which take place or are to take place during the term of this Contract or which may in any manner adversely impact on the Contractor's ability to perform its obligations in a timely, competent or complete manner.

GC 37. PROGRESS PAYMENTS

.1 Within five (5) Business Days after the end of a calendar month the Engineer shall prepare and issue to the Owner a Payment Certificate for the period ending the last calendar day of the month.

.2 The Payment Certificate shall set out as of the end of last calendar day of the preceding month:

(a) the total value of the Work completed and the Materials incorporated into the Work;

(b) the total Quantities, or the percent complete for each pay item;

(c) all holdback amounts if any;

(d) the total amount owing by the Owner to the Contractor;

(e) any liquidated damages or other deductions; and

(f) set offs permitted by the Contract Documents.

.3 The Engineer shall not finalize a Payment Certificate without consulting with the Superintendent about the Quantities and amounts to be included in a Payment Certificate.

.4 The period referred to in GC 37.1 for the issuance of the Payment Certificate may be extended by any time that the Contractor takes to provide the consultation to the Engineer, or to provide any supporting documentation the Engineer requires to finalize the Payment Certificate.

.5 If the Engineer does not agree with the Superintendent regarding any aspect of the Payment Certificate then the Engineer shall without delay:

(a) prior to issuing the Payment Certificate, fully advise the Superintendent of the reasons for the disagreement; and then

(b) issue the Payment Certificate to the Owner, with a copy to the Contractor, in the amounts the Engineer determines are correct.

.6 The Contractor shall provide to the Engineer all documentation as required by the Contract Documents in support of the completed portion of the Work and Materials covered by the Payment Certificate including inspection reports, invoices, weigh tickets and daily Force Account records.

.7 If requested in writing by the Engineer the Contractor shall, as a precondition to the issuance of the Payment Certificate, provide a sworn declaration in a form acceptable to the Engineer that all amounts relating to the Work, due and owing to third parties, including all Subcontractors and Suppliers, as of the end of the month previous to that covered by the Payment Certificate, have been paid.

.8 Except for materials or products which are identified in the Contract Documents as being “Supply Only”, payments shall not be made for materials or products purchased by the Contractor but not fully incorporated into the Work at the Project Site.

.9 Subject to GC 44 WITHHOLDING OF PAYMENT AND SET OFF, the Owner shall make payment to the Contractor of amounts due by the Owner no later than twenty (20) Business Days after the receipt by the Owner of the Payment Certificate as issued by the Engineer.

.10 All Payment Certificates issued by the Engineer shall be to the best of the Engineer's knowledge, information, and belief.

.11 The monthly progress Payment Certificates shall not bind the Owner or Engineer in any manner in the preparation of subsequent Payment Certificates or the final progress Payment Certificate, but shall be construed and held to be approximate only. By issuing any Payment Certificate, the Engineer does not assume any of the responsibility of the Contractor with respect to the correctness or completeness of the Work, including the Contractor's responsibility to ensure that the Work has been completed in accordance with the Contract Documents.

GC 38. PROGRESS PAYMENT HOLDBACKS

.1 The Owner shall:

(a) hold back 10%, or other percentage as required by the Lien Act, of any amounts net of value-added taxes due to the Contractor, including those amounts due for payment for Work performed after Substantial Performance of the Work; and

(b) if the Project Site is a highway, Indian reserve or other lands that cannot be liened, then, notwithstanding that a lien cannot be registered against the Project Site, hold back the percentage that would have been required if the Lien Act did apply of any amounts due to the Contractor as a lien holdback, on the same conditions as though such holdback was a requirement of the Lien Act, including making payment from such holdback directly to Subcontractors.

.2 In addition to other holdbacks as provided by the Contract Documents, the Owner may hold back from payments otherwise due to the Contractor amounts as determined by the Engineer pursuant to GC 44 WITHHOLDING OF PAYMENT AND SET OFF, on account of deficient or defective Work already paid for. This holdback may be held, without interest, until such deficiency or defect is remedied.

.3 If after Substantial Performance of the Work is achieved the Contractor is unable to complete any portion of the Work because of climatic or other conditions beyond the Contractor's reasonable control then the Owner may hold back from payments otherwise due to the Contractor the amount, as estimated by the Engineer, by which the cost to have others complete the Work exceeds the Contract Prices for such completion work.

.4 The Contractor shall assist the Owner to establish a holdback account pursuant to the Lien Act, if required to be established under the Lien Act, at a savings institution acceptable to the Owner, including preparing and completing any and all documents and forms as the savings institution may require. Any Notice issued by the Contractor upon the Owner's failure to pay into the holdback account the amount the Owner is required to retain under the Lien Act shall be given in writing to the Engineer.

GC 39. QUANTITIES

.1 The estimate of Quantities shown in the Section 00 41 00 - Bid Form serves only to provide a basis for comparing bids and no representations have been made by either Owner or Engineer that the actual Quantities will even approximately correspond therewith.

.2 The Owner has the right to increase or decrease the Quantities in any or all items and to eliminate items entirely from the Work.

.3 Where there is a discrepancy between the measurement or calculations made by or for the Contractor to establish the Quantities and the measurement or calculations made by the Engineer to establish the Quantities, the Quantities shall be deemed to be the measurement made by the Engineer.

.4 Where the Quantities are disputed by the Contractor, upon request of the Contractor, the Parties will exchange their data, surveys and other information as the same relates to the measurements and calculations.

.5 If after reviewing the Engineer's data, surveys and other information the Contractor still disputes the Quantities, the Contractor may dispute the Quantities by providing Notice to the Engineer, within ten (10) Business Days of the Engineer providing its data, surveys and other information to the Contractor, stating:

(a) that it disagrees with the Quantities; and

(b) its measurements and calculation of the Quantities.

.6 If Notice is provided by the Contractor as set out in GC 39.5, the Parties shall take the necessary steps to have the Dispute resolved in accordance with PART 12 DISPUTE RESOLUTION. In the event that the Contractor does not provide Notice to the Engineer as set out in GC 39.5, the Contractor shall be deemed to have waived all of its rights to dispute the Quantities.

GC 40. SUBSTANTIAL PERFORMANCE OF THE WORK

.1 The Engineer shall be the payment certifier responsible for payment certification as required by the Lien Act for the Contractor. The Contractor shall be the Person responsible for payment certification as required by the Lien Act for all Subcontractors.

.2 When the Contractor considers that it has achieved Substantial Performance of the Work, the Contractor shall prepare and submit to the Engineer:

(a) a written application from the Contractor for a Certificate of Substantial Performance; and

(b) written confirmation that upon payment in the amount applied for, that the Contractor has no further Claim against the Owner for the Work, for any reason, except to the extent of any Claims for which the Contractor has previously provided Notice to the Owner and the Engineer.

.3 The Engineer will, no later than six (6) Business Days after the receipt of a written application from the Contractor for a Certificate of Substantial Performance make an inspection and assessment of the Work to verify the validity of the application. The Engineer will prepare and issue a comprehensive list of items to be completed or corrected, and either:

(a) issue the Certificate of Substantial Performance, or

(b) if the Engineer determines that Substantial Performance of the Work has not been achieved, consult with the Contractor and advise the Contractor of the Work required to achieve Substantial Performance of the Work.

.4 Failure to include an item on the comprehensive list of items described in GC 40.3 does not alter the responsibility of the Contractor to complete the Work or remedy, correct or rectify any Deficiencies.

.5 If the Engineer determines that Substantial Performance of the Work has not been achieved, the Owner may deduct the cost of the inspection and assessment by the Engineer from payments otherwise due to the Contractor.

.6 The Contractor may, after performing the required Work, re-apply for the Certificate of Substantial Performance, and the provisions of GC 40 shall apply to the re-application.

.7 The Engineer shall include the date of Substantial Performance of the Work in the Certificate of Substantial Performance.

.8 The Contractor shall promptly post a copy of the Certificate of Substantial Performance at a prominent and visible location at the Project Site.

GC 41. RELEASE OF MAJOR LIEN FUND HOLDBACK

.1 Upon the expiry of the statutory time for filing liens under the Lien Act, the Contractor shall submit the following documents to the Engineer:

(a) an application for payment of the holdback amount;

(b) a sworn declaration in a form acceptable to the Engineer to state that all accounts for labour, subcontracts, Materials, 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; and

(c) documents satisfactory to the Engineer showing compliance with the applicable Workers Compensation Legislation at the Project Site including payments due thereunder.

.2 After the receipt of an application for payment from the Contractor and the accompanying documents as provided in GC 41.1, the Engineer will issue a Payment Certificate for payment of the holdback amount.

.3 The Owner shall pay any lien holdback as required by the Lien Act, or on such other date as required by Law, but the Owner may set off from the holdback payment the amounts for any Deficiencies or filed liens as provided in GC 44 WITHHOLDING OF PAYMENT AND SET OFF.

GC 42. TOTAL PERFORMANCE OF THE WORK AND FINAL PAYMENT

.1 When the Contractor considers that it has achieved Total Performance of the Work, the Contractor shall prepare and submit to the Engineer:

(a) a written application from the Contractor for a Certificate of Total Performance; and

(b) written confirmation that upon payment in the amount applied for, that the Contractor has no further Claim against the Owner for the Work, for any reason, except to the extent of any Claims for which the Contractor has previously provided Notice to the Owner and the Engineer.

.2 The Engineer will, no later than six (6) Business Days after the receipt of a written application from the Contractor for a Certificate of Total Performance make an inspection and assessment of the Work to verify the validity of the application, and either:

(a) issue the Certificate of Total Performance, or

(b) if the Engineer determines that Total Performance of the Work has not been achieved, the Engineer will prepare and issue a comprehensive list of items to be completed or corrected to achieve Total Performance of the Work.

.3 Failure to include an item on the comprehensive list of items described in GC 42.2(b) does not alter the responsibility of the Contractor to complete the Work or remedy, correct or rectify any Deficiencies.

.4 If the Engineer determines that Total Performance of the Work has not been achieved, the Owner may deduct the cost of the inspection and assessment by the Engineer from payments otherwise due to the Contractor.

.5 The Contractor may, after performing the required Work, re-apply for the Certificate of Total Performance, and the provisions of GC 42 shall apply to the re-application.

.6 The Engineer shall include the date of Total Performance of the Work in the Certificate of Total Performance.

.7 No later than ten (10) Business Days after issuance of the Certificate of Total Performance, the Engineer shall issue to the Contractor, a draft Payment Certificate for final payment, for the Contractor's review and agreement. If after reviewing the Engineer's Payment Certificate the Contractor disputes the Quantities or the payment amount, the provisions of GC 39 QUANTITIES will apply.

.8 If after reviewing the Engineer's Payment Certificate the Contractor agrees with the Quantities and the payment amount, then no later than five (5) Business Days after receipt from the Contractor of Notice that the Contractor agrees with the Payment Certificate for final payment, the Engineer shall issue to the Owner, a Payment Certificate for final payment in the amount that the Engineer determines to be properly due.

.9 Subject to GC 44 WITHHOLDING OF PAYMENT AND SET OFF, the Owner shall make payment to the Contractor of amounts certified as due by the Engineer, no later than twenty (20)

Business Days after receipt of the Engineer's Payment Certificate for final payment and attainment of all of the following conditions:

(a) Total Performance of the Work has been achieved by the Contractor, verified by the Engineer and approved by the Owner;

(b) the period designated for the release of holdback pursuant to the Lien Act from the date of Substantial Performance of the Work has expired;

(c) no liens have been registered arising from the Work;

(d) there are no claims that have been made against the Owner by any Person other than the Contractor, arising from the performance of the Work.

GC 43. RELEASE OF MINOR LIEN FUND HOLDBACK

.1 Upon the expiry of the statutory time for filing liens under the Lien Act, the Contractor shall submit the following documents to the Engineer:

(a) an application for payment of the holdback amount;

(b) a sworn declaration in a form acceptable to the Engineer to state that all accounts for labour, subcontracts, Materials, Construction Equipment, and other indebtedness which may have been incurred by the Contractor in the Total 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; and

(c) documents satisfactory to the Engineer showing compliance with the applicable Workers Compensation Legislation at the Project Site including payments due thereunder.

.2 After the receipt of an application for payment from the Contractor and the accompanying documents as provided in GC 43.1, the Engineer will issue a Payment Certificate for payment of the holdback amount.

.3 The Owner shall pay any lien holdback as required by the Lien Act, or on such other date as required by Law, but the Owner may set off from the holdback payment the amounts for any Deficiencies or filed liens as provided in GC 44 WITHHOLDING OF PAYMENT AND SET OFF.

GC 44. WITHHOLDING OF PAYMENT AND SET OFF

.1 Subject to GC 44.2, if for any reason there are any Deficiencies, any portion of the Work that is not performed or there is any claim by a third party made against the Owner arising from the Work, the Owner may withhold from payment to the Contractor such amounts as the Engineer determines are sufficient and reasonable to cover the cost of rectification, completion or resolution, until the Deficiencies are rectified, the Work is completed or such claim is resolved.

.2 The cost of rectifying Deficiencies or completing Work not performed shall be estimated by the Engineer and a value equivalent to twice that amount shall be withheld from any payment.

Subject to any other right the Owner may have, the holdback amount shall be paid to the Contractor after proper rectification of all the Deficiencies and completion of all Work.

.3 In preparing the estimate referred to in GC 44.2, the Engineer shall not be bound by the Contractor's unit prices and shall estimate the cost of rectifying Deficiencies or completing Work using his sole judgement of the influence of prevailing circumstances.

.4 Notwithstanding any other provision of this Contract, the Owner shall be entitled to withhold and set-off against any monies otherwise due and payable to the Contractor under this Contract, any sums which the Owner is permitted to withhold either pursuant to this Contract or to any other agreement between the Owner and the Contractor, howsoever arising.

GC 45. PROGRESSIVE RELEASE OF HOLDBACK TO SUBCONTRACTORS AND SUPPLIERS

.1 Where provided by the Lien Act and if the Contractor has certified that the work of a Subcontractor or Supplier is substantially or totally performed, upon application by the Contractor accompanied by the documents listed in GC 45.2 and expiry of the statutory time for filing liens under the Lien Act the Owner shall pay the Contractor the holdback amount retained for such subcontract work, or for the Materials supplied by such Supplier.

.2 Applications to the Engineer by the Contractor for progressive release of holdback to Subcontractors or Suppliers shall be accompanied by the following documents:

(a) A Certificate of Substantial or Total Performance of the subcontract work or supply contract, as the case may be, prepared by the Contractor in a form acceptable to the Engineer;

(b) a sworn declaration in a form acceptable to the Engineer to state that all accounts for labour, subcontracts, Materials, Construction Equipment, and other indebtedness which may have been incurred by the Subcontractor or Supplier, as the case may be, in the Substantial or Total Performance of the subcontract work, or the supply contract, as the case may be, and for which the Owner or Contractor 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;

(c) documents satisfactory to the Engineer showing compliance by the Subcontractor or Supplier, as the case may be, with the applicable Workers Compensation Legislation at the Project Site including payments due thereunder; and

(d) written confirmation that upon payment in the amount applied for, that the Subcontractor or Supplier, as the case may be, has no further Claim against the Contractor for subcontract work or Materials for any reason, except to the extent of any claims for which the Subcontractor or Supplier has previously provided Notice to the Contractor.

.3 After the receipt of an application for payment from the Contractor and the accompanying documents as provided in GC 45.2, the Engineer will issue a Payment Certificate for payment of the holdback amount.

.4 The Owner shall pay any lien holdback as required by the Lien Act, or on such other date as required by Law, or thirty (30) Business Days after receipt of the documents listed in GC 45.2 that are satisfactory to the Engineer, whichever is the latest.

.5 Progressive release of holdback to Subcontractors and Suppliers as provided for in GC 45 shall not affect the Warranty Period. The Warranty Period for the Work shall commence as provided for in GC 63 WARRANTY.

PART 8 TAXES AND DUTIES

GC 46. RESPONSIBILITY FOR TAXES AND DUTIES

.1 The Contract Price includes all customs duties and taxes, except Goods and Services Tax (GST) or Harmonized Sales Tax (HST), in effect at the time of the execution of this Contract.

.2 The Contractor shall be responsible to pay all taxes.

.3 The amount of GST or HST payable by the Owner on goods and services provided under this Contract is in addition to the Contract Price and is to be shown on a separate line on Payment Certificates.

.4 If the Owner is exempt from GST or HST, a Certificate of Exemption will be issued to the Contractor following issuance of the Notice of Award.

.5 The Contract Price shall include any tax rebates which may be applicable under current legislation. Upon request by the Contractor, the Owner shall provide certificates, in support of the Contractor's rebate submission to a Governmental Authority. The Owner shall not be liable to compensate the Contractor for any tax rebates that are denied by Governmental Authorities.

.6 In the event that new or additional duties or taxes in respect of the Work are applicable or required by the Law after this Contract is executed, the Contract Price shall be adjusted to include such new or additional taxes and duties, if applicable.

PART 9 TIMELY CONSTRUCTION

GC 47. DELAY

.1 Subject to the limitations and requirements expressly stated in GC 47, and the Contractor's obligation to mitigate the impact of any delay, if the Contractor is delayed in the performance of the Work:

(a) due to an action or omission of the Owner, the Engineer or any Person for whom the Owner is responsible at Law;

(b) by a "stop work" or similar order issued by a court or Governmental Authority, and providing that such order was not issued as the result of an act or fault of the Contractor or any Person for whom the Contractor is responsible at Law;

(c) where Changes to the Work are made as provided for in PART 11 CHANGES AND CONCEALED OR UNKNOWN CONDITIONS;

(d) where the Work is suspended or delayed in commencement as provided for in GC 23 SUSPENSION OF WORK BY OWNER;

(e) where the Work is delayed on account of the Owner not providing the Project Site, or not obtaining easements or rights-of-way;

(f) where the Work is delayed on account of conditions which could not have been foreseen or which were beyond the control of the Contractor and which were not the result of fault or negligence of the Contractor or any Person for whom the Contractor is responsible at Law;

(g) where the Work is delayed on account of Abnormal Weather;

(h) where the Engineer causes delay in providing Drawings or necessary information;

(i) where, in the opinion of the Engineer, the Contractor is entitled to an extension of Contract Time;

(j) where strikes, lockouts, or labour disputes prevent or substantially interfere with the progress of the Work,

then provided the Engineer determines that there is no concurrent delay that has been caused by the Contractor or any Person for whom the Contractor is responsible at Law, the Contract Time shall be extended for such reasonable time as is appropriate to account for the delay directly associated with the causes set out above, but not including concurrent delays caused by the Contractor or any Person for whom the Contractor is responsible at Law, as the Engineer, in the first instance, determines, or as may be subsequently determined in accordance with PART 12 DISPUTE RESOLUTION.

.2 No extension of the Contract Time shall be made and no adjustment in the Contract Price shall be made for any delay except for a delay described in GC 47.1 and then only if the Contractor provides Notice, in accordance with GC 47.4, of such a Claim to the Engineer within five (5) Business Days after the occurrence of the event which has caused the delay.

.3 Except as expressly provided within these General Conditions, the granting of an extension of Contract Time pursuant to GC 47 shall not give the Contractor grounds to make any Claims whatsoever for additional payment, except on the grounds set out in GC 47.1 items (b), (c), (d) or (e).

.4 The Notice prescribed by GC 47.2 must:

(a) contain sufficient detail to provide the Engineer with the opportunity to identify the cause of the delay and to take steps to mitigate the impact of such delay;

(b) be provided by the Contractor to the Engineer with respect to each and every event of delay; and

(c) be provided as a separate Notice.

.5 Knowledge by the Owner or the Engineer of any delay, or the impact of any delay, shall not constitute a waiver of the requirement for the Contractor to provide Notice in accordance with GC 47.2.

.6 The failure to provide separate express Notice in strict compliance with GC 47 shall be deemed to be prejudicial to the Owner and shall prohibit the Contractor from claiming, or being entitled to, any Claim for adjustment to the Contract Time or Contract Price with respect to such delay or any impact of such delay.

.7 In the event of a delay the Contractor shall take all reasonable measures to minimize the effects and the costs of the delay and this obligation shall be taken into account in the determination of the Contractor's entitlement to an extension of the Contract Time and reimbursement of delay costs, if any.

.8 The Owner shall not be liable for any penalties or claims by third parties incurred or suffered by the Contractor and under no circumstances shall the Owner be liable for Consequential Damages, as a result of delay pursuant to GC 47.

.9 If the Contractor is delayed in the performance of the Work by its own acts or omissions or those of its Personnel or Subcontractors, then the Contractor will not be entitled to any time extension or additional payment as a result of such delay.

.10 No extension of Contract Time shall be made and no adjustment in the Contract Price shall be made for any delay Claim that is based on the concept of the cumulative effect of multiple Changes.

GC 48. LATE COMPLETION

.1 The Contractor acknowledges that if the Contractor fails to complete the Work within the Contract Time or fails to meet a specified Milestone Date for any part of the Work, the Owner will incur additional administrative and overhead costs and will be required to pay additional compensation to the Engineer (collectively "Additional Overhead"). The Contractor agrees that in the event the Contractor fails to complete the Work within the Contract Time or fails to meet a specified Milestone Date for any part of the Work, the Owner may deduct from any monies owing to the Contractor for the Work, as a genuine pre-estimate of the Owner's Additional Overhead, the amount specified in the Supplementary General Conditions for each Working Day the Work or any portion of the Work remains incomplete after the applicable Contract Time or Milestone Date.

.2 The rights set out in GC 48.1 are in addition to any other rights the Owner may have and are in no way exclusive.

.3 No bonus will be allowed by the Owner for completion of the Work in less than the Contract Time.

PART 10 TERMINATION

GC 49. OWNER'S RIGHT TO TERMINATE FOR DEFAULT

.1 If the Contractor is unable to pay its lawful debts as they come due, is adjudged bankrupt, makes a proposal pursuant to the *Companies' Creditors Arrangement Act*, commits or threatens to do any act of bankruptcy, commits or seeks to liquidate or is involved in any similar action under any Law relating to bankruptcy or insolvency, the Owner may, without prejudice to any other right or remedy it has, terminate this Contract by giving the Contractor, trustee, monitor or receiver Notice that this Contract will be terminated immediately and that the applicable provisions of GC 49 apply.

.2 If the Contractor neglects to proceed with, undertake or complete any aspect of the Work promptly or properly, or otherwise fails to comply with the requirements of this Contract, the Owner may, without prejudice to any other right or remedy the Owner may have, give Notice to the Contractor that the Contractor is in default of the Contractor's contractual obligations and instruct the Contractor to correct the default within five (5) Business Days immediately following the receipt of the Notice.

.3 If the default cannot be corrected within the five (5) Business Days specified, the Contractor shall be in compliance with the Owner's instructions if the Contractor:

(a) commences the correction of the default in a manner acceptable to the Owner, within a different time agreed to by the Owner;

(b) provides the Owner with a written plan and schedule acceptable to the Owner for such correction; and

(c) corrects the default in accordance with such schedule.

.4 If the Contractor fails to correct the default in accordance with GC 49.2 or as subsequently agreed upon pursuant to GC 49.3, without prejudice to any other right or remedy the Owner may have, the Owner may, without further Notice to the Contractor, do one or both of the following:

(a) immediately correct such default and deduct the cost thereof, including any costs incurred by the Owner, from any payment then or thereafter due to the Contractor, provided that the Engineer has certified such cost as due to the Owner; or

(b) immediately terminate the Work, in whole or in part, or terminate this Contract, in whole or in part.

.5 In the event of default under GC 49, the Owner shall have the option, to be exercised in its absolute discretion, to terminate the right of the Contractor to perform all or any part or parts of the Work and permit the Contractor to continue to perform the rest of the Work.

.6 If the Owner terminates the Work, in whole or in part, or terminates this Contract, in whole or in part, whether pursuant to GC 49.1, GC 49.4 or GC 49.5, or otherwise:

(a) the Owner shall be entitled to take possession of the Work and Materials, and use the Construction Equipment and Temporary Work at the Project Site, subject to the rights of

third parties, and finish the Work by whatever method the Owner may consider proper or expedient;

(b) the Owner shall be entitled to withhold further payment to the Contractor until the total cost of construction of the Work and all backcharges to the Contractor are known; and

(c) in addition to any other amount that may be owing under this Contract, the Contractor shall be liable to the Owner for the amount by which the following items added together exceed the Contract Price:
  (i) the total cost of construction of the Work;
  (ii) a reasonable allowance or amount, as determined by the Engineer, to cover the cost of Warranty Work;
  (iii) a reasonable allowance or amount, as determined by the Engineer, to compensate the Engineer;
  (iv) the costs and expenses both external and internal and including actual legal fees, disbursements and taxes incurred by the Owner for its additional services related to the termination of the Work, in whole or in part, or termination of this Contract, in whole or in part.

.7 In the event that the Owner terminates the Work in part or terminates this Contract in part, the Owner shall be entitled to apply GC 49.6 with an appropriate adjustment for the portion of the Work involved and the portion of the Contract Price attributable to that portion of the Work.

.8 The Owner shall not be liable for those costs incurred by the Contractor as a result of the termination.

.9 The Owner shall not be liable for any penalties or claims by third parties incurred or suffered by the Contractor and under no circumstances shall be liable for Consequential Damages as a result of termination pursuant to GC 49 and the Contractor shall indemnify and hold the Owner and its Personnel, including the Engineer, harmless from and against any such penalties or claims.

GC 50. CONTRACTOR'S RIGHT TO TERMINATE FOR DEFAULT

.1 If the Owner is adjudged bankrupt, makes a proposal pursuant to the *Companies' Creditors Arrangement Act*, commits or threatens to do any act of bankruptcy, commits or seeks to liquidate or is involved in any similar action under any Law relating to bankruptcy or insolvency, the Contractor may, without prejudice to any other right or remedy it has, terminate this Contract by giving the Owner, trustee, monitor or receiver Notice that this Contract will be terminated immediately and that the applicable provisions of GC 50 apply.

.2 If the Work is stopped or otherwise delayed for a period of forty-five (45) Business Days or more as provided for in GC 23 SUSPENSION OF WORK BY OWNER or under an order or decision of a court or decision of another Governmental Authority, and providing that such order was not issued as the result of an act or fault of the Contractor or any Person for whom the Contractor is responsible at Law, the Contractor may terminate the Work without prejudice to any other right or remedy the Contractor may have, by giving the Owner Notice five (5) Business Days prior to such termination. The Contractor shall not be permitted to terminate the Contract when only a portion of the Work that is incomplete is delayed or suspended until forty-five (45) Business days after the Work, except for that portion which is suspended or delayed, is substantially completed.

.3 The Contractor shall provide Notice to the Owner, with a copy to the Engineer, if the Owner is in default of its contractual obligations to pay the Contractor when due the amounts certified by the Engineer or awarded by a court of competent jurisdiction. The Notice shall state that if the default is not corrected in the thirty (30) Business Days immediately following the receipt of the Notice, the Contractor may, without prejudice to any other right or remedy it may have, stop the Work or terminate this Contract.

.4 If the Contractor terminates this Contract under the conditions set out in GC 50.1 or GC 50.2, the Contractor shall be entitled to be paid for all of the Work that has been properly performed in accordance with this Contract to the date of termination and which has not been paid for or reimbursed to that date, and such other costs and expenses that the Contractor may have sustained as a direct result of the Owner's default which the Engineer considers to be reasonable and which are supported by auditable documentation, but shall not be entitled to any claims for Consequential Damages.

.5 The Owner shall not be liable for any penalties or claims incurred or suffered by the Contractor and under no circumstances shall be liable for Consequential Damages as a result of termination pursuant to GC 50 and the Contractor shall indemnify and hold the Owner and its Personnel, including the Engineer, harmless from and against any such penalties or claims.

GC 51. TERMINATION FOR CONVENIENCE

.1 The Owner, in its sole discretion, shall have the right, which may be exercised at any time, to terminate all or a portion of the Work or this Contract, without reason or cause, by giving not less than twenty (20) Business Days' Notice to the Contractor.

.2 If the Work or this Contract is terminated by the Owner pursuant to GC 51.1, the Contractor shall be entitled to:

(a) the portion of the Contract Price owed but unpaid to the date of termination, computed in accordance with this Contract; and

(b) reasonable costs incurred by the Contractor in terminating the Work or this Contract, including the cost of materials that cannot reasonably be returned to their Supplier and any return-to-supplier costs.

.3 If the Work or this Contract is terminated by the Owner pursuant to GC 51, the Owner shall not be liable to the Contractor for any claims or Consequential Damages or any amounts other than as stated in GC 51.2, as applicable, except as expressly provided for herein, and the Contractor shall indemnify and hold harmless the Owner, its Personnel, including the Engineer, from any such claims for amounts not provided for in GC 51.

GC 52. OBLIGATIONS ON TERMINATION

.1 If the Owner terminates the Work, in whole or in part, or terminates this Contract, in whole or in part, whether pursuant to GC 49.1, GC 49.4 or GC 49.5 OWNER'S RIGHT TO TERMINATE FOR DEFAULT, or otherwise, the Contractor shall:

(a) subject always to considerations of safety and of the environment, immediately discontinue performance of the Work, except to the extent as may be necessary to carry

out such discontinuance, and ensure that its operations and activities are brought to an orderly conclusion and that demobilization occurs in a proper and careful fashion with due attention being given to public safety and the protection of the Project and the Work;

(b) comply in full with the Owner's instructions regarding the termination;

(c) take such steps as may be necessary or desirable to minimize the costs to the Owner associated with the termination;

(d) promptly deliver to the Owner all of the deliverables and the Owner's Confidential Information and intellectual property, including the originals and all copies and all other documents required by the Owner;

(e) take all steps required by the Owner, to assign to and fully vest in the Owner the rights and benefits of the Contractor under all subcontracts with its Subcontractors and any licenses, warranties or guarantees for the Project; and

(f) assign to the Owner, or its nominee, as directed, rights and titles relating to all Materials for which the Contractor has been paid or will be paid through the termination process.

.2 The Contractor's obligations as to quality, correction, and warranty of the Work performed by the Contractor up to the date of termination shall continue in force after such termination. If Substantial Performance of the Work has not been reached by the date of termination, the Warranty Period shall nevertheless be deemed to commence from the date of Substantial Performance of the Work.

.3 Notwithstanding any other provision of this Contract, termination of this Contract in any manner by the Owner shall not limit, affect or invalidate in any manner:

(a) those provisions of this Contract for the benefit of the Owner which, expressly or by implication, are to operate or have effect after termination;

(b) any right of action the Owner may have as at the date of termination; or

(c) any other right or remedy the Owner may have as a consequence of the Contractor's default and the resulting termination of this Contract.

PART 11 CHANGES AND CONCEALED OR UNKNOWN CONDITIONS

GC 53. CHANGES

.1 The Owner, through the Engineer, without invalidating this Contract, may make Changes at any time.

.2 The Contractor shall not perform a Change without a written Change Order or Change Directive signed by the Owner and issued by the Engineer.

.3 The Contractor shall advise the Engineer of the effect a Contemplated Change Notice will have on the Contract Price and the Contract Time within five (5) Business Days of receipt of the Contemplated Change Notice, or within such other time period as may be agreed by the Parties.

.4 Where both additions and deletions are involved in a Change Order all calculations for profits and overhead shall be determined on a net basis for that Change Order.

.5 The Owner shall make the final determination as to whether any Change is to be implemented.

.6 It is intended in all matters related to Changes that the Owner, the Engineer and the Contractor shall act promptly so as not to adversely impact the Construction Schedule.

GC 54. CONTEMPLATED CHANGE NOTICES AND CHANGE ORDERS

.1 When a Change is proposed or required, the Engineer shall provide a Contemplated Change Notice describing the proposed Change to the Contractor. If, due to exceptional circumstances, a Contemplated Change Notice cannot be issued by the Engineer, the Owner or the Engineer may issue a Change Directive as provided by GC 55 CHANGE DIRECTIVES.

.2 The method of determining the value of a Change shall be decided by the Engineer. The value of the Change shall be determined by one or more of the following methods:

(a) by unit prices or combinations of unit prices found in the "Schedule of Quantities and Prices" in Section 00 41 00 - Bid Form;

(b) by unit prices submitted by the Contractor and accepted by the Owner;

(c) by lump sum submitted by the Contractor and accepted by the Owner; and

(d) on a Force Account basis as specified in GC 56 FORCE ACCOUNT WORK.

.3 Within five (5) Business Days of receipt of the Contemplated Change Notice, or within such other time period as may be agreed by the Parties, the Contractor shall present, in a form acceptable to the Engineer, a method of proposed adjustment or an amount of proposed adjustment to the Contract Price, if any, and the adjustment in Contract Time, if any, for the proposed Change.

.4 Any written quotation for a Change submitted by the Contractor shall be interpreted:

(a) to represent the total adjustment to the Contract Price;

(b) to represent the total adjustment to the Contract Time;

(c) to include compensation for all costs related to the Change, including but not limited to costs for direct, indirect, office, overhead, surety, insurance and all other costs, mark-ups and profits; and

(d) to have considered all effects on the Contract Time and if there is no mention of Contract Time adjustment in the quotation to mean that the Contractor will implement and complete the Change without any adjustment to the Contract Time, in which case the Change will not extend the Contract Time or entitle the Contractor to additional compensation or damages of any nature whatsoever for any scheduling issues or acceleration.

.5 In the case of Changes proposed to be paid for in whole or in part by lump sum, the Contractor shall include a cost breakdown to substantiate or justify the Contract Price adjustment, in addition to any other documentation the Engineer or the Owner may require.

.6 In the case of Changes to be paid for in whole or in part by unit rates or Force Account plus a fixed or percentage fee, the form of presentation of costs and methods of measurement shall be agreed to by the Engineer and the Contractor before proceeding with the Change. The Contractor shall keep accurate documentation of Quantities and costs for Changes, and present an account of the cost of the Change to the Engineer.

.7 When the Engineer and the Owner agree to adjustments to the Contract Price or the Contract Time, or both, and the method to be used to determine the adjustments, a Change Order signed by the Engineer, the Owner and the Contractor shall be issued revising the Contract Price or the Contract Time, or both, as applicable. The value of Work performed as the result of a Change Order shall be included in Payment Certificate.

.8 Administration of Changes to be paid for in whole or in part by Force Account plus a fixed or percentage fee, shall be in the manner set out in GC 56 FORCE ACCOUNT.

.9 The Owner reserves the right to withdraw any Contemplated Change Notice without additional compensation to the Contractor if such withdrawal occurs prior to issuance of the Change Order.

GC 55. CHANGE DIRECTIVES

.1 If the Owner requires the Contractor to proceed with a Change prior to the Owner and the Contractor agreeing upon the adjustment in Contract Price and Contract Time, the Owner, through the Engineer, may issue a Change Directive.

.2 Upon receipt of a Change Directive, the Contractor shall proceed promptly with the Change and, in the case of an emergency identified in a Change Directive, proceed immediately with the Change.

.3 An adjustment in the Contract Price for a Change carried out by way of a Change Directive shall be determined on the basis of Force Account in accordance with GC 56 FORCE ACCOUNT WORK.

.4 If the method of valuation, measurement or corresponding increase or decrease in the Contract Price and Contract Time cannot be promptly agreed upon then, the Engineer in the first instance, shall determine the method of valuation, measurement and corresponding increase or decrease in the Contract Price and the Contract Time subject to final determination in the manner set out in PART 12 DISPUTE RESOLUTION.

.5 In the case of a Dispute in the valuation of a Change Directive, and pending final determination of such value, the Engineer shall certify the value of Work performed in relation to the Change Directive in accordance with the Engineer's evaluation of the Change Directive, and shall include that amount in a progress Payment Certificate.

.6 If, at any time after the start of the Work directed by a Change Directive, the Owner and the Contractor reach agreement on the adjustment to the Contract Price and to the Contract Time, such agreement shall be recorded in a Change Order.

GC 56. FORCE ACCOUNT WORK

.1 Compensation for Work done on a Force Account basis, authorized by a Change Order or Change Directive issued by the Engineer, shall be calculated as follows:

(a) Labour - All classifications of labour not priced separately in the Bid Form will be paid for at rates actually paid by the Contractor. A payroll assessment of thirty percent (30%) of the hourly wage will be allowed to cover all costs including pension, holiday pay, payroll administration, insurance and similar benefits. Small tool allowance will be at the rate of four percent (4%) of gross cost of labour. The Contractor will be allowed a further ten percent (10%) mark-up on the total of the foregoing as the allowance for overhead and a further ten percent (10%) mark-up on the resulting subtotal as allowance for profit.

(b) Construction Equipment - The rates for equipment, vehicles and power tools shall include operator's wages, all maintenance and operating costs and Contractor's profit. No additional mark-up of Construction Equipment charges shall be allowed.

(c) Materials supplied by the Contractor shall be paid for at Supplier's invoice price plus an additional payment of ten percent (10%) of cost to cover handling and indirect overhead costs, plus ten percent (10%) of all costs including indirect overhead as profit.

(d) Construction Equipment rentals - The allowance to the Contractor for profit, superintendence, and all other expense related shall be ten percent (10%) of the rental agency's invoice to the Contractor for the rental of tools and miscellaneous equipment.

(e) For subcontract Work, the allowance to the Contractor for profit, superintendence, and all other expenses shall be ten percent (10%) of the Subcontractor's invoice for such Work performed.

.2 In the event that, in its sole discretion, Engineer deems that, any or all prices and rates for Force Account that are included in the Bid Form are not fair and reasonable compared with normal industry standards, Engineer may order recalculation of any or all prices and rates based on the Contractor’s actual costs, as provided for in GC 56.1 items (a) and (b).

.3 For the purposes of calculating Force Account rates as provided for in GC 56.1 items (a) to (e), upon request by Engineer, Contractor shall submit a detailed and verifiable statement of actual cost of labour, Construction Equipment, Materials and subcontracted Work. Pending receipt of such statements, Engineer shall apply normal industry-standard Force Account rates discounted by 20% to facilitate inclusion of interim payments for Force Account in Payment Certificates, on an ongoing basis.

.4 Subcontractor's Force Account invoices to the Contractor shall be calculated and submitted for review as described in GC 56.1 items (a) to (e), unless otherwise instructed by the Engineer.

.5 On a daily basis, the Contractor shall keep an accurate, complete and up-to-date record in a form satisfactory to the Engineer, showing on a shift-by-shift basis, all Contractor and Subcontractor labour, Construction Equipment and Materials to be paid by Force Account. Daily Force Account records shall be submitted by the Contractor to the Engineer for review within one (1) Business Day of the subject Work being performed. The submission to the Engineer or countersignature by the Engineer of daily Force Account records shall not at any time be deemed to be an admission that the Work is properly chargeable to Force Account.

.6 The Owner shall not be liable to pay for any Work based on Force Account for which the daily Force Account records were not prepared and submitted in accordance with GC 56.5.

GC 57. CONCEALED OR UNKNOWN CONDITIONS

.1 Subject to GC 57.2, should one Party discover conditions at the Project Site which:

(a) are subsurface or otherwise inaccessible and concealed physical conditions, which existed before the commencement of the Work, and which differ materially from those reasonably inferable from or indicated in the Contract Documents or studies, reports and other site data referenced therein; and

(b) materially affect the cost of the Work or the time required to perform the Work, then the discovering Party shall provide Notice to the other Party within one (1) Business Day of discovering such conditions and, in any case, before such conditions are disturbed.

.2 Physical conditions which are not visible but which are a logical extension, or part of a visible physical condition, and physical conditions which can be reasonably accessed for observation, shall not be considered as concealed for the purposes of GC 57.

.3 The Engineer shall promptly investigate and make a determination as to whether the conditions fit within the parameters described in GC 57.1.

.4 If the determination is that the conditions:

(a) fit within the parameters described in GC 57.1 and the performance of the Work with such conditions being present requires a Change that increases or decreases the Contract Price or the Contract Time, or both, then a Change Order or a Change Directive, as applicable, shall be issued to deal with the consequences of the conditions; or

(b) do not fit within the parameters described in GC 57.1 or do fit within the parameters described in GC 57.1 but do not cause an increase or decrease in the Contract Price or Contract Time, or both, the Engineer shall provide Notice of such determination to both the Owner and the Contractor.

.5 If either Party wishes to make a Claim that the Contract Time or Contract Price should be adjusted because of concealed or unknown conditions then such Party shall give the other Party and the Engineer Notice of such Claim immediately after that Party first becomes aware of the concealed or unknown condition. No adjustment of Contract Price or Contract Time shall be allowed for any Work undertaken prior to the delivery of such Notice.

.6 If either Party gives Notice of concealed or unknown conditions pursuant to GC 57.1, then as part of the Work the Contractor shall keep daily records in accordance with the requirements of GC 58 CLAIMS.

PART 12 DISPUTE RESOLUTION

GC 58. CLAIMS

.1 If the Contractor intends to make a Claim for an extension of Contract Time or 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 Engineer.

.2 Upon commencement of the event or series of events giving rise to a Claim, the Party intending to make the Claim shall:

(a) take all reasonable measures to mitigate any delay, loss or expense which may be incurred as a result of such event or series of events, and

(b) keep such records as may be necessary to support the Claim.

.3 The Party giving Notice of intent to make a Claim shall submit to the Engineer a detailed account of the amount claimed and the grounds upon which the Claim is based, within a reasonable time.

.4 Where the event or series of events giving rise to the Claim has a continuing effect, the detailed account submitted pursuant to GC 58.3 shall be considered to be an interim account and the Party making the Claim shall, at such intervals as the Engineer 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.

.5 The Engineer's findings, with respect to a Claim made by either Party, will be given by Notice in writing to both Parties within thirty (30) Business Days after receipt of the Claim by the Engineer, or within such other time period as may be agreed by the Parties.

.6 If such finding is not acceptable to either Party, the Claim shall be settled in accordance with this PART 12 DISPUTE RESOLUTION.

GC 59. APPLICABLE TO ALL DISPUTES

.1 In the event of a Dispute, the Contractor shall abide by the Engineer's decision with respect to the Dispute, proceed diligently with the Work without prejudice to the Contractor's right to advance any Claim it may wish to assert with respect to the Dispute and track all costs and impacts associated therewith.

.2 The Contractor shall not delay the Work or any portion of the Work, nor shall there be any extension of Contract Time solely on account of any Dispute Resolution pursuant to this PART 12 – DISPUTE RESOLUTION.

.3 Disputes between the Parties relating to or arising out of the Contract shall be settled in accordance with PART 12 DISPUTE RESOLUTION. No legal action shall be taken or maintained without these provisions having been complied with, except to the extent that such legal action is necessary to:

(a) preserve a right or commence a Claim that would otherwise be barred by statute or another agreement if such legal action is not commenced or maintained; or

(b) obtain injunctive relief.

GC 60. NEGOTIATION

.1 A Party seeking resolution of a Dispute shall commence the negotiation process by serving a Notice requiring negotiation of the Dispute on the other Party and the Engineer. The date of delivery, or deemed date of delivery, as the case may be, is referred to in PART 12 DISPUTE RESOLUTION as the "Negotiation Notice Date". The Notice shall describe the Dispute and reference any time or money claimed and reference all of the provisions of the Contract that are relied on in relation to the Dispute.

.2 The Parties shall meet in person for the purpose of negotiating a resolution of the Dispute within fifteen (15) Business Days of the Negotiation Notice Date. Failure to meet within this time period means that, subject to the Parties otherwise agreeing, the negotiation will be deemed complete and either Party can immediately commence mediation in accordance with GC 61 MEDIATION.

.3 Each of the Parties shall discuss the Dispute in a professional and amicable manner and negotiate in good faith. The Parties agree to use all reasonable efforts to resolve any Dispute, whether arising during the existence of this Contract or at any time after the expiration or termination of this Contract, which touches upon the validity, construction, meaning, performance or effect of this Contract or the rights or liabilities of the Parties or any matter arising out of, or in connection with this Contract.

.4 Disputes that are resolved by negotiation shall be formally concluded with a binding agreement between the Owner and the Contractor, executed within thirty (30) Business Days of the Negotiation Notice Date, stating the details of the resolution. Disputes that are not fully concluded in this manner will proceed to mediation, or otherwise, pursuant to GC 60.6.

.5 All meetings and communications during the negotiation are without prejudice and cannot be used in evidence in any proceeding. The Parties shall treat the negotiation as confidential and neither of the Parties shall disclose any part of the negotiation to any third party, except for the sole purpose of dealing with the Dispute.

.6 In the event that the Parties cannot resolve the Dispute within thirty (30) Business Days of the Negotiation Notice Date, then, subject to the Parties otherwise agreeing, the Parties shall participate in mediation in accordance with GC 61 MEDIATION.

GC 61. MEDIATION

.1 If the negotiation process provided for in GC 60 NEGOTIATION is initiated but a Dispute is not resolved within thirty (30) Business Days from the Negotiation Notice Date or the negotiation is

deemed complete pursuant to GC 60.2 NEGOTIATION either Party is entitled by Notice to the other Party to call for the appointment of an individual to act as a mediator. The date of delivery, or deemed date of delivery, as the case may be, is referred to in GC 61 as the "Mediation Notice Date".

.2 Within fifteen (15) Business Days of the Mediation Notice Date, the Parties shall jointly nominate a mediator. The cost of the mediator shall be shared equally between the Parties. The mediator will be instructed to render invoices at monthly intervals. The Owner shall fully pay the mediator for services rendered upon presentation of an invoice by the mediator and deduct the Contractor's share from payments otherwise due to the Contractor. In the event that there are no payments due to the Contractor, the Owner shall invoice the Contractor for the Contractor's share of the cost of the mediator.

.3 The Parties shall submit their positions relating to the Dispute in writing to the mediator and afford to the mediator access to all Records, documents and information the mediator may reasonably request. The Parties shall meet with the mediator at such reasonable times as may be required and shall, as facilitated by the mediator, negotiate in good faith to resolve the Dispute. All meetings and communications with or involving the mediator are without prejudice and cannot be used in evidence in any proceeding. The Parties shall treat the mediation as confidential and neither of the Parties shall disclose any part of the mediation to any third party, except for the sole purpose of dealing with the Dispute.

.4 If the Dispute has not been resolved within forty (40) Business Days of the Mediation Notice Date then, subject to the Parties otherwise agreeing, the mediation shall be deemed to have been concluded.

.5 Once the mediation is concluded, or deemed to be concluded, any Dispute not settled may be litigated in accordance with the Law.

PART 13 INDEMNIFICATIONS AND WARRANTY

GC 62. INDEMNIFICATIONS

.1 The Contractor shall at all times and without limitation, be fully liable for, and shall indemnify and save harmless the Owner and its Personnel, including the Engineer, from and against all liabilities, losses, injuries, costs, damages, legal fees, disbursements, fines, penalties, expenses, all manner of actions, causes of action, claims, demands and proceedings, all of whatever nature and kind, which any of the Owner and its Personnel may sustain, pay or incur or which may be brought or made against all or any of them, and whether or not incurred, in connection with any action or other proceedings or claims or demands made by third parties, relating to, or resulting from or arising out of all or any of the following:

(a) the misconduct, negligent action or negligent failure to act, as the case may be, of the Contractor or any of those Persons for whom the Contractor is responsible at Law (including, without limitation, any of its Personnel or Subcontractors);

(b) the costs of repairs, clean-up or restoration paid by the Owner and any fines levied against the Owner or the Contractor;

(c) any breach, violation or non-performance of any representation, warranty, obligation, covenant, condition or agreement in this Contract set forth and contained on the part of the Contractor to be fulfilled, kept, observed or performed, as the case may be;

(d) any damages to third parties caused by, resulting at any time from, arising out of or in consequence of the misconduct, negligent action or failure to act of the Contractor or any of those Persons for whom the Contractor is responsible at Law (including, without limitation, any of its Personnel or Subcontractors);

(e) any damages, costs, fines, expenses and penalties that the Owner is required to pay on account of the Contractor performing the Work in breach of any Workers Compensation Legislation order or regulation; or

(f) any damages, costs, fines, expenses and penalties arising out of or as a result of the Contractor's failure, or the failure of any Person for whom the Contractor is responsible at Law, to comply with the requirements of GC 34 TOXIC OR HAZARDOUS SUBSTANCES.

.2 The provisions in GC 62 are in addition to and shall not prejudice any other rights of the Owner at Law or in equity.

.3 The Owner shall indemnify and hold harmless the Contractor and its Personnel 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 a lack of or defect in title to the Project Site.

.4 If the Owner performs work at the Project Site at the same time as the Contractor is performing the Work, then the Owner shall indemnify and hold harmless the Contractor and its Personnel from and against claims, demands, losses, costs, damages, actions, suits or proceedings by third parties that arise out of or are attributable to, any act or omission or alleged act or omission of the Owner and its Personnel in the performance of that work.

GC 63. WARRANTY

.1 The Contractor warrants that the Work, including all workmanship, labour, Materials and equipment supplied by the Contractor, either directly or indirectly, and incorporated into the Work, shall comply in all respects with this Contract and shall be free from Deficiencies.

.2 Subject to GC 63.3, the Warranty Period with regard to the Work shall be the longer of:

(a) one year from the date of Substantial Performance of the Work, for any Materials or portions of the Work which are supplied or completed before Substantial Performance of the Work is attained, unless a longer period is specified in the Contract Documents for such Materials or portions of the Work;

(b) one year from the date of Total Performance of the Work, for any Materials or portions of the Work which are supplied or completed after Substantial Performance of the Work is attained, unless a longer period is specified in the Contract Documents for such Materials or portions of the Work;

(c) one year from the date of Total Performance of the Work if some Work is excluded from the Substantial Performance of the Work assessment, where permitted by the Lien Act in effect at the Project Site, because a portion of the Work cannot be completed expeditiously for reasons beyond the control of the Contractor; and

(d) where a period longer than that described in GC 63.2(a) or GC 63.2(b) is specified in the Contract Documents, then that period specified in the Contract Documents shall apply from the date specified in the Contract Documents or, if no date is specified, from the date of Total Performance of the Work.

.3 Where Warranty Work is performed, regardless of the initial Warranty Period, the Warranty Period shall recommence for that Warranty Work for the same period as initially contemplated commencing on the date of completion of the Warranty Work.

.4 The Contractor shall promptly perform the Warranty Work, at the Contractor's expense, for all Deficiencies which appear prior to and during the Warranty Period for which the Contractor is provided Notice by the Owner or the Engineer no later than thirty (30) Business Days after the end of the Warranty Period.

.5 All Warranty Work carried out by the Contractor shall be performed during periods of time acceptable to the Owner.

.6 The Contractor shall ensure that any Warranty Work which is of an emergency nature, as reasonably determined by the Owner, is performed immediately upon receipt of Notice from the Owner or the Engineer.

PART 14 CONFIDENTIALITY AND FREEDOM OF INFORMATION

GC 64. CONFIDENTIALITY

.1 The Contractor shall:

(a) hold, and shall take all reasonable steps to ensure that any Person employed, engaged or contracted by it holds all Confidential Information in strict confidence;

(b) not use, and shall take reasonable steps to ensure that any Person employed, engaged or contracted by it does not use any Confidential Information other than to perform the Work;

(c) not disclose, and shall take reasonable steps to ensure that any Person employed, engaged or contracted by it does not disclose, any Confidential Information to anyone other than those Persons engaged to perform the Work and then only to the extent that such Confidential Information is directly required to be disclosed in order to properly perform the Work; and

(d) not disclose, and shall take reasonable steps to ensure that any Person employed, engaged or contracted by it does not disclose any Confidential Information to any third party at any time during or subsequent to the duration of this Contract.

.2 The obligations set forth in GC 64.1 apply to any and all Confidential Information except that which:

(a) is required to be disclosed by applicable Law; or

(b) subject to the applicable Law, is in the public domain or is provided to its financial and legal advisors in confidence.

.3 The Contractor agrees that it shall not include any reference to the Owner, the Work or the Project in any advertisement, public announcement or statement, or promotional materials without the prior written consent being obtained from the Owner.

PART 15 INTELLECTUAL PROPERTY AND TITLE TO THE WORK

GC 65. INTELLECTUAL PROPERTY

.1 The Contract Documents and models provided by the Engineer in any format are to be used only with respect to the Project and are not to be used for other work and are not to be copied or altered in any manner without the prior written authorization of the Engineer and the Owner.

.2 The Contractor shall indemnify and hold harmless the Owner, its Personnel, agents and consultants, including the Engineer, from any and all claims arising out of or as a result of an infringement or an alleged infringement of a copyright, or a trademark, patent or invention used or incorporated into the Work by the Contractor, the Subcontractors, or any Person for whom the Contractor is responsible for at Law.

.3 Subject to any limitations of liability expressly provided for in this Contract and any Law, the Owner shall, to the extent it can provide an indemnity in accordance with the Law, indemnify the Contractor against claims arising out of or as a result of an infringement or an alleged infringement of a patent relating to a model, plan, equipment or design which was provided to the Contractor by the Owner as part of the Contract Documents.

GC 66. BUILDERS LIENS AND TITLE TO THE WORK

.1 The Contractor shall remove or cause to be removed all affidavits of claim of lien, claims of lien or liens filed or registered against the lands and premises on which the Work is being performed or has been performed which claim of lien or liens arise out of anything done or to be done under the Contract. Such removal shall be effected by the Contractor forthwith upon demand by the Owner or the Engineer. Upon receiving satisfactory security for its costs and a suitable indemnity, the Owner will authorize the Contractor to apply to the Court in the name of the Owner to have the affidavits of claim of lien, claims of lien or liens removed from the title to the lands upon payment into Court.

.2 Notwithstanding anything elsewhere contained in the Contract Documents, the Contractor shall indemnify and hold harmless the Owner against and from all demands, damages, costs, losses and actions arising in any way out of claims of lien or liens which arise out of anything done or to be done under the Contract.

.3 The obligations imposed on the Contractor by the provisions of GC 66 shall not extend to claims of lien or liens properly filed by the Contractor himself.

.4 The Contractor warrants that title to all of the Work and other matters or things produced for the benefit of the Owner shall be free of all claims.

.5 Title to all Materials shall, unless otherwise agreed in writing, vest in the Owner absolutely upon delivery to the Project Site or upon payment therefore, whichever shall first happen. All Materials shall remain at the risk of the Contractor until incorporated in the Work and Total Performance of the Work is achieved. Title to any Materials which are rejected by the Engineer or are ordered by him to be removed from the Project Site for any reason shall revest in the Contractor immediately upon receipt of Notice of rejection or order for removal.

.6 The Contractor warrants that Materials delivered to the Project Site shall:

(a) not be removed from the Project Site or changed except with the prior written authorization of the Owner; and

(b) at all times be kept secure.

GC 67. RECORDS

.1 The Contractor shall:

(a) maintain full Records of the estimated and actual costs of the Work together with all tender calls, quotations, contracts, correspondence, invoices, receipts and vouchers relating thereto. The Contractor shall maintain daily Records of the time, materials and equipment employed on the Work. Daily Records shall allocate the time, materials and equipment spent on each activity performed in a day to a description of that activity;

(b) preserve the Records for the Work during the term of the Contract and for a period of at least 3 years after Total Performance of the Work;

(c) make all Records and material referred to in GC 67.1(a) available to audit and inspection by the Owner and by Persons acting on behalf of the Owner when requested;

(d) allow any of the Persons referred to in GC 67.1(c) to make copies of and to take extracts from any of the Records and material referred to in GC 67.1(a); and

(e) provide any Person referred to in GC 67.1(c) with information that may be required from time to time in connection with such Records and material.

END OF DOCUMENT

MODIFICATIONS TO GENERAL CONDITIONS

The General Conditions are hereby revised as follows:

GC 29, LABOUR AND MATERIALS

Add GC 29.6 as follows:

Under the provisions of the Collective Agreement Article 31.02 (b) (between the City and C.U.P.E. Local 118) contracted employees engaged by the City of Port Alberni are to "receive wages and conditions of employment at least equal to the terms" of the current C.U.P.E Collective Agreement. Contractor's shall list all current wage rates in the "Contractor's Questionnaire" included in this tender package.

The City may request a random check of wages paid to employees. Failure to adhere to the confirmed wage rates may be considered to be a breach of contract.

The City may withhold funds equal to the value of wages not paid and require confirmation that the situation has been rectified.

Fill out Contractor's Questionnaire at the end of this Section.

GC 48. LATE COMPLETION

Add GC 48.4 as follows:

.4 The pre-estimate of the Owner's additional costs pursuant to GC 48.1 shall be $1,000 per Working Day.

GC 63. WARRANTY

Delete all references to one (1) year Warranty Period and replace with two (2) year Warranty Period.

ADDITIONAL GENERAL CONDITIONS

The following General Conditions are hereby added:

GC69. EARLY USE OF THE WORK BY OWNER

.1 At the Owner's sole discretion and upon Notice to the Contractor, the Owner may take early possession of and use any completed or partially completed portions of the Work before Substantial Performance of the Work has been achieved. Such early possession and use by the Owner shall not constitute an acceptance of any portion of the Work which is not in accordance with the requirements of the Contract.

.2 If early use of particular completed or partially completed portions of the Work is expressly provided for in the Contract Documents then the Contractor will not be entitled to any adjustments of Contract Time or Contract Price as a result of such early use in accordance with those provisions.

.3 If early use of particular completed or partially completed portions of the Work is not expressly provided for in the Contract Documents, early possession or use of those portions of the Work shall be considered a Change and the provisions of GC 53 CHANGES shall apply.

.4 In the event that the Owner takes early possession of and uses any completed or partially completed portions of the Work before Substantial Performance of the Work has been achieved, then the Warranty Period for the portions of the Work that are under early possession or use by the Owner shall commence on the date the early possession and use commences.

.5 Despite the provisions of GC 69.3, under no circumstances shall possession and use of completed or partially completed portions of the Work be considered a Change if such possession and use commences after the expiry of the Contract Time. The Owner shall not be liable for any costs incurred by the Contractor after expiry of the Contract Time as a result of the Owner's possession and use of completed or partially completed portions of the Work.

Add the following:

GC70. CANADIAN ANTI-SPAM LEGISLATION

.1 In accordance with Canadian anti-spam legislation, each Party consents to contacting the other Party and its personnel through electronic messages relating to the Project. Following completion of the Project, either Party may withdraw consent by contacting the other Party.

Add the following:

GC71. PROFESSIONALISM

.1 The Contractor agrees that it and its sub-contractors and employees agree to comply with the following code of conduct:

(a) Carry out their responsibilities in a professional and competent manner.
(b) Continue to improve their knowledge, competence, skills, and professional ability.
(c) Be aware of and abide by the British Columbia Human Rights Code.
(d) Note engage in any action or conduct or make any comment, gesture, or contact which a reasonable person would regard as likely to cause offence or humiliation to anyone, whether in the workplace or any other location.
(e) Act, and be perceived by the public to act, in a fair and impartial manner in the performance of their duties or provisions of services.
(f) Note make any public comments that denigrate, disparage, or are disrespectful of the Owner, employees, and elected officials, and refrain from making negative comments about the credibility of the Owner employees, and elected officials.
(g) Conduct themselves in a friendly, courteous, and professional manner when dealing with the public.
(h) Refrain from engaging in any other practice that could unfavourably reflect upon the Owner as identified solely by the Owner.

END OF DOCUMENT

Declaration of Wages Paid to Employees

The City of Port Alberni (the City) has a contractual obligation to CUPE Local 118 (the union representing the City's workers) that requires all contractors to pay their employees who are performing work for the City, a minimum of the same hourly rate as the City's workers are paid for performing similar work.

Prior to being awarded a contract to undertake work on behalf of the City, or being engaged to work for the City on an as and when basis, all contractors are required to sign this declaration certifying that they will pay to their employees hourly wages equal to or greater than those identified in the table below, when those employees perform work similar to the positions noted below.

I, _____(name), certify that I am an authorized representative of _____ (the Contractor). As such, I certify that as a condition of being awarded Contract # _____, or providing as and when required work for the City, the hourly wages paid by the Contractor to employees of the Contractor who perform work for the City, will be equal to or greater than those hourly wages identified in the table below, for performing work similar to the noted positions .

POSITIONS & RATES OF PAY		
POSITION	CITY OF PORT ALBERNI WAGE (2018)	CONTRACTOR-PAID WAGE (include where applicable or note as N/A)
Sidewalk Watch	17.73	
Van Driver	22.38	
Maintenance Assistant (Janitorial)	24.58	
Maintenance (Janitorial)	25.84	
Labourer	26.91	
Truck Driver	28.56	
Solid Waste Collector	29.63	
Equipment Operator (General)	29.63	
Sweeper Operator	30.18	
Flail Mower Operator	30.18	
Loader Operator	30.71	
Backhoe Operator	32.34	
Concrete Formsetter / Finisher	32.34	
Grader Operator	32.34	
Excavator Operator	32.91	
Engineering Technician	33.43	
Gardener	34.50	
Mechanic	34.50	
Carpenter	34.50	

On behalf of the Contractor I hereby authorize the City to withhold up to 10% of the total value of the contract until such time as the City is satisfied that the Contractor has complied fully with the commitment noted above. If the City requests payroll records pertaining to the contract (or as and when work) the Contractor will provide such records as requested.

Signed for the Contractor _____ Date: _____

Signed for the City _____ Date: _____

Date of Revision: January 8, 2018

Without limiting any of Contractor's obligations or liabilities under the Contract Documents, Contractor shall, and shall cause its Subcontractors to, obtain and continuously carry, while Work is being performed and, unless otherwise specified in this Section, while any remedial or warranty work is being undertaken, at Contractor's own expense and cost, the following insurance coverage with minimum limits not less than those stated:

Commercial General Liability Insurance

Commercial General Liability Insurance, in a form acceptable to Owner, with limits of not less than $5,000,000.00 inclusive per occurrence for bodily injury, death and damage to property, including loss of use thereof.

Commercial General Liability policy shall include the following:

a. Additional Insured: Owner and Engineer are added as additional insured, but only with respect to liability arising out of the Contractor's performance of the Contract.
b. Bodily Injury and Property Damage to third parties arising out of the operations of the Contractor.
c. Products and Completed Operations: Coverage for bodily injury or property damage arising out of goods or products manufactured, sold, handled, or distributed by the Contractor and/or arising out of operations that have been completed by the Contractor.
d. Personal Injury: While not limited to, the coverage must include Violation of Privacy, Libel and Slander, False Arrest, Detention or Imprisonment and Defamation of Character.
e. Cross Liability/Separation of Insureds: Without increasing the limit of liability, the policy must protect all insured parties to the full extent of coverage provided. Further, the policy must apply to each Insured in the same manner and to the same extent as if a separate policy had been issued to each.
f. Blanket Contractual Liability: The policy must, on a blanket basis or by specific reference to the Contract, extend to assumed liabilities with respect to contractual provisions.
g. Employees must be included as Additional Insured.
h. Employers' Liability (or confirmation that all employees are covered by Worker's compensation (WSIB) or similar program)
i. Broad Form Property Damage including Completed Operations: Expands the Property Damage coverage to include certain losses that would otherwise be excluded by the standard care, custody or control exclusion found in a standard policy.
j. Notice of Cancellation: The Insurer will provide the Owner thirty (30) days written notice of policy cancellation.
l. Owners' or Contractors' Protective Liability: Covers the damages that the Contractor becomes legally obligated to pay arising out of the operations of a subcontractor.
m. Non-Owned Automobile Liability - Coverage for suits against the Contractor resulting from the use of hired or non-owned vehicles.
o. All Risks Tenants Legal Liability - to protect the Contractor for liabilities arising out of its occupancy of leased premises.
p. Sudden and Accidental Pollution Liability (minimum 120 hours): To protect the Contractor for liabilities arising from damages caused by accidental pollution incidents.

Automobile Insurance (Owned and Non-Owned)

Automobile Liability Insurance in an amount usual for a contract of this nature, but for not less than $2,000,000 per accident or occurrence., covering death and damage to property, effective for all licensed vehicles owned, leased, rented or used by Contractor.

The policy shall include the following:

a. Third Party Liability - $2,000,000 Minimum Limit per Accident or Occurrence
b. Accident Benefits - all jurisdictional statutes
c. Uninsured Motorist Protection
d. Notice of Cancellation: The Insurer will endeavour to provide the Contracting Authority thirty (30) days written notice of cancellation

Contractors' Equipment Insurance

"All-Risk" Contractors' Equipment Insurance to the full insurable value of construction machinery and equipment used by Contractor in the performance of Work, including boiler insurance for temporary boilers and pressure vessels as applicable.

Builders Risk Insurance

"All-Risks" Course of Construction Insurance in the joint names of Contractor, Owner and Engineer, with the subcontractors as unnamed insureds, insuring not less than one hundred and ten percent (110%) of the sum of the amount of the Contract Price and the full value of materials provided by the Owner for incorporation into Work, with a deductible not exceeding $5000.00. Such coverage to contain sublimits for materials in transit and materials stored at unnamed locations. Builders Risk Insurance shall be obtained and carried until Total Performance of the Work.

All policies of insurance shall be in a form acceptable to Owner and shall not allow subrogation claims by the insurer against Owner or Engineer.

All policies of insurance that Contractor is required to obtain will be considered as primary insurances in relation to insurances held by Owner or Engineer without any right of contribution from any policies of insurance held by Owner or Engineer.

All policies of insurance shall provide that at least 30 days prior written notice be given to Owner in the event of cancellation or amendment restricting coverage.

Prior to commencing Work, Contractor shall provide Owner with Certificates of Insurance in a form acceptable to Owner, and with a letter from the insurer stating that the insurance provided complies with the requirements of the Contract.

Deductibles, if any, which are applicable to the insurance specified herein, shall be borne by Contractor.

The specified limits of insurance and coverages in no way define or limit the obligation of Contractor to indemnify Owner in the event of loss.

Owner makes no representation or warranty with respect to the extent or adequacy of the insurance protection afforded by the insurance policies that are specified in this section. Contractor shall be fully responsible to determine additional insurance coverages that may be necessary and advisable for protection of Contractor or to fulfil Contractor's obligations under this Contract.

END OF DOCUMENT

Part 1 General

1.1 PROJECT COORDINATION

.1 Coordinate progress of the Work, progress schedules, submittals, use of site, temporary utilities, construction facilities and controls, with the Engineer and the Owner's Project Manager.

.2 It is the Contractor's responsibility to lead and provide overall Project Management of the Work in close collaboration and coordination with Owner's Project Manager, the City's operations staff, and the Engineer.

.3 The Contractor's Project Manager shall be the single point of contact through whom the Contractor shall communicate with the Owner. The Contractor's Project Manager shall be responsible for the overall management and coordination of the Work and for maintaining close contact with the Owner's Project Manager.

.4 The Contractor shall provide a detailed Project Management Plan including the following:

- .1 A detailed work program and schedule.
- .2 A worker Health and Safety Plan with sufficient details of how the Contractor plans to handle confined spaces, fall protection, and specific hazards of the work site.
- .3 A Communications Management Plan for coordination of activities with the City, especially any issues affecting plant access, operations, staff and the public including a report on a monthly basis at a minimum.
- .4 A Risk Management Plan including risk identification, analysis, planning and risk monitoring and control.
- .5 A Quality Management Plan including quality objectives, quality planning, quality assurance and quality control processes.

.5 Coordinate with the Owner's Project Manager to perform the work and provide effective communication that enables the City's staff to coordinate their operations activities. Where collaboration with the City's staff is required to undertake the work, ensure that each party clearly understands their roles and responsibilities.

1.2 HOURS OF WORK

.1 Perform Work in conformity with all municipal bylaws with respect to noise control, hours of work, night work and holiday work.

.2 Obtain written permission of Engineer before undertaking holiday work or night work.

1.3 RELICS AND ANTIQUITIES

.1 Relics and antiquities and items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found on site

or in buildings to be demolished, remain property of Owner. Protect such articles and request directives from Engineer.

.2 Notify Engineer immediately if evidence of archaeological finds is encountered and await Engineer's written instructions before proceeding with work in area.

.3 Owner may choose to arrange for archeological monitoring by a third party of excavated material during certain portions of the work. Where Owner identifies portions of the work that would require archeological monitoring, Contractor to coordinate construction activities with Owner and archeologist to allow archeological sampling and inspections.

1.4 CUTTING AND PATCHING

.1 Approvals

.1 Submit written request in advance of cutting or alteration which affects:

.1 Structural integrity of any element of Project.

.2 Integrity of weather-exposed or moisture-resistant elements.

.3 Efficiency, maintenance, or safety of any operational element.

.4 Visual qualities of sight-exposed elements.

.5 Work of Owner or separate contractor.

.2 Inspection

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.3 Execution

.1 Perform cutting, fitting, and patching including excavation and fill, to complete the Work.

.2 Remove and replace defective and non-conforming work.

.3 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical work.

.4 Perform Work to avoid damage to other work.

.5 Prepare proper surfaces to receive patching and finishing.

.6 Perform cutting and patching for weather-exposed and moisture-resistant elements and sight-exposed surfaces equivalent to original or better.

.7 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed.

.8 Restore work with new products in accordance with Contract Documents.

.9 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.10 At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated material as specified in the Contract Documents, full thickness of construction element.

.11 Refinish surfaces to match adjacent finishes; for continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

1.5 SCHEDULE

.1 Schedules Required

.1 Construction Progress Schedule.

.2 Submittal Schedule for Shop Drawings, Product Data and Samples.

.3 Cash Allowance Schedule for purchasing products.

.2 Refer to GC25 – Construction Schedule in Section 00 72 00 – General Conditions.

.3 Submission

.1 Refer to Section 01 33 00 – Submittals.

1.6 BASIC PRODUCT REQUIREMENTS

.1 Product and Material Quality

.1 Products, materials, equipment and articles (referred to as Products throughout specifications) incorporated in Work shall be new, not damaged or defective, and conforming with specifications for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Defective Products, 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.

.2 Storage, Handling and Protection

.1 Handle and store Products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact.

.3 Store products subject to damage from weather in weatherproof enclosures.

.3 Manufacturer's Instructions

.1 Unless otherwise indicated in specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify Engineer in writing, of conflicts between specifications and manufacturer's instructions, so that Engineer may establish course of action.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Engineer to require removal and reinstallation at no increase in Contract Amount.

.4 Workmanship

.1 Execute Work by workers experienced and skilled in respective duties for which they are employed. Immediately notify Engineer if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in their required duties. Engineer reserves the right to require the dismissal from site of workers deemed incompetent, careless, insubordinate or otherwise objectionable.

.5 Concealment

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Engineer if there is a contradictory situation. Install as directed by Engineer.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Title and Description of Work.

.2 Contract Method.

.3 Work by others.

.4 Future work.

.5 Work sequence.

.6 Hours of work.

.7 Contractor use of premises.

.8 Owner occupancy or partial Owner occupancy.

.9 Owner furnished items and/or pre-ordered products and/or pre-bid work.

.10 Documents provided.

.11 Supplementary drawings.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises general construction of the City of Port Alberni Wastewater Lagoon Upgrades, located at the former Catalyst treatment lagoon and further identified as the Work.

.2 The key components of the Work are generally described as follows (not listed in any particular order):

- .1 Project management and coordination.
- .2 Detailed field measurement of all relevant and applicable dimensions.
- .3 Demolition of the existing electrical building at the former Catalyst lagoon, including removal of adjacent concrete duct banks.
- .4 Demolition of existing infrastructure in berms, including removal of electrical cables and existing posts.
- .5 Tie-in to the existing six (6) pipes where they reach the existing City lagoon and extend to flowmeter chamber and junction chamber.
- .6 Site works for tie-in to existing force mains at existing City lagoon, including isolation and dewatering, for tie-ins to existing force mains.
- .7 Supply and install of flowmeter and junction chamber, and HDPE piping from the junction chamber to the new screen building.

.8 Construction of new Screen building, including supply and installation of fine screens/compactors, slides gates, stop logs and emergency bypass.

.9 Supply & install HDPE pipe from the screen building to the splitter box.

.10 Construction of a new berm that will split the former Catalyst lagoon into two cells. The berm will run across the existing lagoon from the new Treatment building to the dividing berm east of the Screen building. The berm will include the splitter box, and will also include several overflow culverts between the two cells.

.11 All required isolation and dewatering in the former Catalyst lagoon to allow construction of the new berm.

.12 Emergency overflow, repurposing the existing outlet structure of the former Catalyst lagoon into an emergency overflow including supply and install of new bar screen and stop logs.

.13 Repair of pipe penetration into existing outlet structure under cash allowance.

.14 Installation of electrical cabling and junction boxes on floating pump station platforms. Supply and installation of floating pump station by others.

.15 Construction of new Treatment building, including installation of UV disinfection equipment.

.16 Ground improvements for the new treatment building and screen building.

.17 Supply, fabrication and installation of all process piping, storm sewer, sanitary sewer and plumbing including valves and appurtenances.

.18 Installation of new blowers. Supply and installation of discharge (steel portion) piping, tie into vendor supplied aeration system.

.19 Supply and installation of HDPE effluent pipe from treatment building to tie-in point of marine outfall.

.20 Upgrading of the existing berms around the former Catalyst lagoon, increasing berm height in areas where significant settlement has occurred.

.21 Supply and installation of electrical, instrumentation and controls systems including new transformer and genset. Extend overhead power to plant from existing location to the new Treatment building.

.22 Extend water supply to the new Screen and Treatment buildings.

.23 Supply, fabrication and installation of heating and ventilation systems.

.24 Construction of access roads.

.25 Startup and commissioning including any testing requirements.

.26 Restoration, clean-up and landscaping.

.27 Other related work and/or matters including, but not limited to construction of access roads, pedestrian and traffic control, compliance with safety requirements.

.3 Construct the Work under a single lump sum contract.

1.3 WORK BY OTHERS

.1 Work of Project executed during Work of this Contract, and which is specifically excluded from this Contract:

.1 Construction of marine outfall, including pipe and diffuser installation.

.2 Work of Project which will be executed after completion of Work of this Contract, and which is specifically excluded from this Contract:

.1 Decommissioning of the existing City lagoon, including desludging and draining of lagoon and removal of portions of the City lagoon berms.

.2 Installation of six (6) HDPE force mains into their permanent alignment.

1.4 HOURS OF WORK

.1 Perform Work in conformity with all municipal bylaws with respect to noise control, hours of work, night work and holiday work.

.2 Obtain written permission of Engineer before undertaking holiday work or night work.

1.5 CONTRACTOR USE OF PREMISES

.1 Contractor must coordinate work on site with the owner and owner's Project Manager and Engineer.

.2 Ascertain boundaries of Site within which work must be confined.

.3 Obtain written authorization from Owner to enter private lands which are the subject of easements or rights-of-way obtained by Owner.

.4 Ascertain and abide by conditions pertaining to use of easements or rights-of-way.

.5 Assume full responsibility for protection and safekeeping of products under this Contract.

.6 Obtain and pay for use of additional storage, access or work areas needed for operations under this Contract.

.7 Limit use of premises for Work, for storage, and for access, to allow:

.1 Owner occupancy.

.2 Work by other contractors.

.8 Coordinate use of premises under direction of Owner.

.9 Prior to final inspection, obtain and submit to Engineer written signed releases from all owners of lands affected by easements or rights-of-way, confirming that properties have been left in an acceptable condition and that owners have no further claims in this respect. Engineer will supply release form.

1.6 OWNER OCCUPANCY

.1 Owner will occupy premises during entire construction period for execution of normal operations.

.2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.7 PRE-ORDERED PRODUCTS

.1 Owner has pre-bid work with suppliers for specific products and work, to expedite the Work and for other purposes in Owner's interests.

.2 On execution of Contract Agreement, Contractor shall execute a novation agreement included in the Contract Documents with the selected equipment suppliers.

.3 Contractor responsibility for purchase, handling, and installation for pre-ordered products is same as for other Contractor-furnished products.

.4 Schedule of Pre-ordered Products & Pre-bid Work

.1 Lagoon aeration system including blowers.

.2 UV reactors.

.5 Retain a copy/copies of the necessary shop drawings for inclusion in the O & M manuals, as specified in Contract Documents.

1.8 OWNER SUPPLIED EQUIPMENT

.1 The following items are being procured by Owner:

.1 Effluent pump stations, including pumps and floating platforms.

1.9 DRAWINGS AND SPECIFICATIONS FURNISHED

.1 Owner Responsibilities:

.1 Provide 2 copies of drawings and specifications to Contractor.

.2 Provide printed pdf copy of drawings and specifications to Contractor.

.2 Contractor Responsibilities:

.1 Pay for additional copies of drawings and specifications if required.

.2 Maintain at Site one complete set of drawings and specifications. Make available to Engineer at any time.

1.10 SUPPLEMENTARY DRAWINGS

.1 Engineer may furnish supplementary drawings to assist proper execution of work. Such drawings will be issued for clarification only and will have same meaning and intent as if included with plans referred to in Contract Documents.

Part 2 Products

Not Used

Part 3 Execution

NOT USED

END OF SECTION

1 General

1.1 CONTINUITY OF OPERATIONS

.1 The City of Port Alberni treats municipal wastewater in the existing City lagoon. Wastewater flows to the lagoon through six pipes as shown on the drawings. Wastewater flow comes from four pump stations and two gravity lines. Work of this contract must not interrupt wastewater flow, except for planned, short duration shutdowns.

.2 Pump stations may not be shut down for durations longer than 4 hours at a time. Shutdowns must be scheduled for low flow periods (over night) during dry weather.

.3 Upon completion and commissioning of the new lagoon, the existing City lagoon will be decommissioned under a separate contract.

.4 The work of this contract requires a controlled and staged start-up and commissioning approach for the new lagoon to ensure continuous wastewater treatment. Therefore, the work of this contract will potentially require temporary operational regimes.

.5 Coordination and cooperation with City staff and Engineer, and the marine outfall contractor is required.

.6 The work sequences and tie-in procedures specified in this Section should enable the Contractor to perform construction activities concurrently with City operation activities. The Contractor may propose alternative work sequences or procedures that maintain system operation, for the approval of the Engineer.

.7 Ensure that access is maintained for all operation and maintenance requirements of the existing systems at all times, housekeeping is maintained at the highest possible level to minimize interference, and the existing facilities are maintained.

.8 Complete all tie-ins to existing facilities in the shortest practical time frame to minimize interferences. Scheduling must reflect this priority.

.9 Some shutdowns may have to take place during other than normal working hours, i.e. nighttime and/or weekends.

1.2 SHUTDOWN AND TIE-IN PLAN

.1 Prepare a detailed plan for any shutdown, tie-in, or construction activity which will potentially affect existing City operations, describing temporary provisions, the length of time required to complete, and the necessary personnel and equipment which the Contractor will provide in order to prevent supply interruption to the distribution system.

.2 Prepare and submit the shutdown or tie-in plan to the Engineer prior to conducting a scheduled shutdown or tie-in. Allow sufficient time for review by the Engineer and City, followed by a meeting to be held between the Engineer, City operations personnel, and the Contractor to discuss activities and responsibilities relating to the shutdown or tie-in and potential limitations and requirements not addressed in the plan.

.3 Force main tie-in location is located in a tidal channel adjacent to the lagoon. Contractor to submit construction plan for exposing the existing pipes and completing tie-in. Plan to include methods of channel isolation, dewatering, and equipment access, and how methods meet environmental regulations. Prepare plan and complete work as per Section 014100. Engineer and Owner will use this construction plan as part of the permit application to regulatory agencies for the work.

1.3 SUBMITTALS FOR REVIEW

.1 In accordance with Section 01 33 00 - Submittals, submit electronic printed pdf copy of a detailed shutdown or tie-in plan and schedule no later than four weeks prior to the scheduled shutdown or tie-in. No shutdown, tie-in or outage will be allowed without approval by the Engineer of the appropriate plan. Coordinate the shutdown or tie-in with the Construction Schedule.

.2 Submit tie-in construction plan a minimum of 6 months prior to scheduled work, to allow for permit application with regulatory authorities.

2 Products

Not Used

3 Execution

3.1 WORK SEQUENCE REQUIREMENTS

.1 Construct Work in stages to accommodate Owner's continued use of existing wastewater lagoon during construction.

.2 Coordinate with Construction Schedule and with Owner Occupancy during construction.

.3 Maintain fire access/control.

.4 The sequences of work detailed are not intended to dictate the exact method of carrying out the work, only the sequence that shall be followed to ensure that the impact on operations is minimized. The Contractor is solely responsible to devise construction schedules to meet operation and contract requirements, and in recognition of construction conditions (i.e. weather conditions, seasonal conditions).

.5 Contractor should schedule a 6 month period for preload materials to be in place. Timing of preload materials will be as directed by Engineer, based on results of settling plate monitoring.

.6 The suggested work construction sequences are prepared, based on the Engineer's understanding of the site limitations, supply requirements and construction problems. Irrespectively, neither the Engineer nor the Owner shall be held responsible in case of any delay in completion of the project on grounds of the suggested sequences.

Item	Description
.1	Construct new berm in center of lagoon at beginning of project, including provisions for temporary preloading as shown on the drawings. Placement of preload in other areas of the project as shown on the drawings. This work can happen concurrently with demolition and ground improvements.
.2	Demolition of existing electrical building.
.3	Installation of ground improvements at treatment building and screen building locations.
.4	Construction of remaining components of the work, including screen and treatment buildings, lagoon piping installation, and related electrical and mechanical works.
.5	Removal of preload material, and installation of components in preload areas including flowmeter and junction chambers, and piping from screen building to splitter box.
.6	After all systems at the new lagoon have been successfully commissioned, Contractor may perform tie-ins to existing incoming sanitary sewer force mains.

END OF SECTION

Part 1 General

1.1 CASH ALLOWANCES

.1 Include, in Contract Amount, cash allowances stated herein.

.2 Cash allowances, unless otherwise specified, cover the net cost to Contractor and Subcontractors of services, products, construction machinery and equipment, freight, handling, unloading, storage installation and other authorized expenses incurred in performing Work.

.3 Contract Amount, and not the cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.

.4 Contract Amount will be adjusted by written order to provide for an excess or deficit to each cash allowance.

.5 Where costs under a cash allowance exceed the amount of the allowance, Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in GC 56 – Force account Work.

.6 Progress payments on account of work authorized under cash allowances will be included in Engineer's monthly progress payment certificate.

.7 A schedule shall be prepared jointly by Engineer and Contractor to show when items called for under cash allowances must be authorized by Engineer for ordering purposes so that the progress of Work will not be delayed.

.8 The amount of each allowance, for Work specified in the respective specification Sections:

.1 Drawing 2972-00-D-561: include the stipulated sum of $7,500 for the repair of pipe wall penetration into emergency overflow structure.

.2 Include the stipulated sum of $50,000 for the unloading and installation of the two effluent pump stations, including pumps, flowing platforms and related components.

1.2 CONTINGENCY ALLOWANCE

.1 Include in Contract Amount a contingency allowance as shown in Bid Form.

.2 Expenditures under the contingency allowance will be authorized and evaluated in accordance with the procedures provided in GC 53 – Changes, GC 54 – Contemplated Change Notices and Change Orders and GC 55 – Change Directives.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Referenced specification Sections contain pertinent requirements for materials and methods to achieve work described herein.

.2 Coordinate pertinent related work and modify surrounding work as required to complete project under each alternative designated.

1.2 ALTERNATIVES

.1 State in Bid Form variation in bid price for Alternatives described below and listed in Bid Form.

.2 Alternative No. 1:

.1 Ground improvements for Screen and Treatment Building using Deep Soil Mixing in lieu of compaction piles as described in Appendix A.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 MEASUREMENT FOR PAYMENT

.1 For lump sum price item, Engineer will calculate payment based on tendered price and Engineer's estimate of percentage of work item completed, unless otherwise described in clauses below.

.2 Clearing and Grubbing

.1 Measurement shall be based on square meters cleared and grubbed within limits indicated on drawings, if required.

.2 Payment for clearing and grubbing items shall include removal and disposal off-site of all branches, stumps, timbers and vegetation remains per Section 31 11 00 – Clearing and Grubbing, and all incidentals.

.3 Organics Stripping and Off-Site Disposal

.1 Measurement for organics stripping, removal and disposal off site of soft or unsuitable subgrade material will be made by loose truck box volume as determined by the Site Inspector.

.2 Payment includes excavation, removal and off-site disposal of unsuitable material as determined by the Geotechnical Engineer, and all incidentals. Contractor will determine suitable disposal locations in accordance with municipal, provincial, and federal regulations. Specified backfill and compaction for replacement material, where required, will be as shown in the drawings and paid under other items, per Section 31 14 13 – Soil Stripping and Stockpiling.

.4 Excavation to Stockpile and On-Site Reuse

.1 Payment will be based on the unit price per cubic meter for common excavation.

.2 Measurement for payment will be based on cross-sections at sufficient and equal intervals taken by the Contractor and verified by the Site Inspector in areas of excavation. Initial cross-sections will be taken after clearing and grubbing and stripping of unsuitable organic material, immediately prior to excavation. Final cross-sections will be taken upon completion of excavation to subgrade levels required prior to placing of other materials over the excavated surface.

.3 Payment includes excavation, hauling and double-hauling, stockpiling on site as determined by the Contractor and generally indicated on the Contract Drawings, placement and compaction of the suitable re-used native materials as shown on the Contract Drawings, per Section 31 00 00 – Earthwork, and all incidentals.

.5 Imported Fill Type A or Type B

.1 Measurement for payment of imported fill will be based on cubic metres of material incorporated into the work, based on cross-sections at sufficient and equal intervals taken by the Contractor and verified by the Site Inspector in areas of fill. Initial cross-sections will be taken after completion of excavation to subgrade levels required prior to placement of fill materials. Final cross-sections will be taken upon completion and compaction of the fill per Contract Drawings.

.2 Payment includes supply, placement and compaction as shown on the Contract Drawings per Section 31 00 00 - Earthwork. Underlying non-woven geotextile per Section 31 32 19 - Geotextile where required by Contract Drawings in new berm or berm extensions will be incidental to this item.

.6 10 kg Riprap

.1 Measurement for payment of 10 kg riprap fill will be based on cubic metres of material incorporated into the work, to the design limits shown on the Contract Drawings, and agreed to by the Site Inspector. Payment for 10 kg riprap above the elevation limit shown in the Contract Drawings will require approval from the Site Inspector. Weigh tickets will be provided to the Site Inspector as loads are delivered to the site and incorporated into the work.

.2 Payment includes supply and installation of material per Section 31 37 00 – Riprap and 31 00 00 - Earthwork, isolation and dewatering per Section 31 00 00 - Earthwork, and underlying woven geotextile per Section 31 32 19 - Geotextile, and all other incidentals.

.7 Removal and Disposal Unsuitable Material

.1 Measurement for removal and off-site disposal of unsuitable subgrade material will be made by loose truck box volume.

.2 Payment includes excavation, dredging if required, and off-site disposal per Section 31 00 00 - Earthwork, and all other incidentals.

.8 50 kg Riprap

.1 Measurement for machine placed graded riprap will be in cubic metres of material incorporated into the work based on measured actual quantity placed, to the design limits and thicknesses shown on the Contract Drawings. Rip-rap placed beyond the designed limit will be deducted from the measurement for payment. Measurement for such deduction will be by the most equitable volume measurement. Weigh tickets will be provided to the Site Inspector as loads are delivered to the site.

.2 Payment includes supply and installation of riprap per Section 31 37 00 – Riprap and includes non-woven geotextile as shown on the Contract Drawings and per Section 31 32 19 - Geotextile, and all other incidentals.

.9 HDPE DR26 Supply and Install Buried

.1 Payment for sanitary sewage force mains buried installation will be made at the unit price, separately for various sections consistent with pipe diameters, materials, trench details, and backfill requirements shown on the Contract Drawings.

.2 Measurement will be based on lineal m of installed pipe approved by the Site Inspector, along the centreline of main.

.3 Payment will include stripping, trench excavation, protection of existing infrastructure, supply and installation of all pipe and fittings, anchor blocks, cut-off walls, related materials, bolts, flexible restraints, adapters, tie-rods, unshrinkable fill, imported or native backfill as shown on the Contract Drawings, cleaning and pressure and leakage testing, flushing, outlet riprap and geotextile, all surface restoration as shown on the Contract Drawings, and all incidentals.

.10 HDPE DR26 Supply and Install Benched

.1 Payment for sanitary sewage force mains benched installation will be made at the unit price, separately for various sections consistent with pipe diameters, materials, details, shown on the Contract Drawings.

.2 Measurement will be based on lineal m of installed pipe approved by Site Inspector, along centreline of main.

.3 Payment will include supply and installation of all pipe, bedding, geotextile, related materials, pipe cradle, unistruts and related hardware, concrete and reinforcement, bolts, flexible restraints, adapters, tie-rods, as shown on the Contract Drawings, cleaning and pressure and leakage testing, flushing, all surface restoration as shown on the Contract Drawings, and all incidentals.

.11 HDPE DR21 Supply and Install

.1 Payment for DR 21 sanitary sewage force mains installation will be made at the unit price, separately for various sections consistent with pipe diameters, materials, installation details, and backfill requirements shown on the Contract Drawings.

.2 Measurement will be based on lineal m of installed pipe approved by the Site Inspector, along centreline of main.

.3 Payment will include stripping, trench excavation, protection of existing infrastructure, supply and installation of all pipe and fittings, related materials, flexible restraints, adapters, tie-in into valves downstream of new junction flow meter chamber, placement on side slope within lagoon effluent, securing and anchoring force mains along lagoon shoulder, unshrinkable fill, imported or native backfill as shown on the Contract Drawings, cleaning and pressure and leakage testing, flushing, all surface restoration as shown on the Contract Drawings, and all incidentals.

.12 Steel Casing Pipe Bridge

.1 Payment will be made at the lump sum price, including labour, equipment, and materials, for the supply and installation of steel casing pipe bridge, unistruts and related hardware, casing spacers, anchor rods as shown on the Contract Drawings, and all incidentals required for this item.

.13 Preload

.1 Payment for preload will be made at the lump sum price.

.2 Payment includes supply and installation of preload fill where required beyond final design grade, to the specifications indicated, supply and installation of settlement gages, construction and maintenance of vehicle access, survey instrumentation and monitoring to the required frequency and accuracy, and removal and disposal of preload fill and preload materials not required for and interfering with the installation of final structure, and restoration of areas in preload footprint outside of footprint of permanent works. Preload to be installed per the Contract Drawings. Location and protection of existing utilities and infrastructure, site preparation, isolation and dewatering, erosion and sediment control, is incidental hereto.

.3 50% of payment will be made once the preload has been completely placed per the Contract Drawings. 50% of payment will be made following the preload period once the materials have been removed and disposed.

.14 200mm Thick Granular Base

.1 Measurement for payment for Granular Base will be based on square metres of placed and compacted material incorporated into the work per the Contract Drawings, measured by the Contractor and verified by the Site Inspector.

.2 Payment includes supply, installation, stockpiling, double handling, and compaction and all incidentals. Payment for areas outside of the designed limit will be deducted from the measurement of placed and compacted area.

.15 Overflow Box culverts

.1 Payment for Overflow Box Culverts will be made at the unit price for labour, equipment, and materials for the supply and installation of precast concrete box culverts with size, material, location, and requirements as shown on the Contract Drawings.

.2 Payment includes where necessary, trenching, excavation, supply of precast sections, bedding, backfill, benching, shop drawings, cleaning, and all incidentals.

.16 Splitter Box

.1 Payment for Splitter Box will be made at the lump sum price.

.2 Payment includes labour, equipment, and materials for the supply and installation of a precast concrete box structure with size, material, location, hatch, stop logs, pipe connections, and requirements as shown on the Contract Drawings. Payment includes where necessary, trenching, excavation, sub-excavation, supply of precast structures, bedding, backfill, benching, shop drawings, cleaning and all incidentals.

.3 Payment will be progressed based on tendered price and Site Inspector's estimate of percentage of work completed.

.17 Concrete Barriers

.1 Payment for concrete barriers will be made at the unit price and will be based on exact number of barriers supplied per the Contract Drawings.

.2 Payment includes supply of precast barriers and placement to the specifications of Section 03 41 00 Plant-Precast Structural Concrete and at locations as shown on the Contract Drawings or as determined in the field by Engineer. Any stockpiling or storage and double handling on site will be incidental to this item.

.18 Protect and Abandon FRP Pipe

.1 Payment will be made at the lump sum price, including locating of existing pipeline, trenching, excavation, cutting, supply and installation of blind flange, hardware, and all incidentals, as shown on the Contract Drawings.

.2 Payment will be progressed based on tendered price and Site Inspector's estimate of percentage of work completed.

.19 Junction Chamber

.1 Payment will be made at the lump sum price, including all labour, equipment, and materials for the complete supply and installation of the junction chamber as shown on the Contract Drawings.

.2 Payment includes excavation, sub-excavation, dewatering, concrete vault, all components inside and part of chamber, connection to outgoing pipes, connection to incoming pipes up to upstream valve towards junction flow meter chamber, grouting, bedding, backfilling, HDPE lining, watertight joints, compaction of backfill, ground improvements, and all work incidental hereto.

.20 Junction Flow Meter Chamber

.1 Payment will be made at the lump sum price, including all labour, equipment, and materials for the complete supply and installation of the junction flow meter chamber as shown on the Contract Drawings.

.2 Payment includes excavation, sub-excavation, dewatering, box manhole, all components inside and part of chamber and all components up to junction chamber and upstream valve, including valves and flexible couplings upstream and downstream of chamber, sump drain system including outlet and riprap, grouting, bedding, backfill, compaction of backfill, and all work incidental hereto.

.21 Effluent Flow Meter Chamber

.1 Payment will be made at the lump sum price, including all labour, equipment, and materials for the complete supply and installation of the effluent flow meter chamber as shown on the Contract Drawings.

.2 Payment includes excavation, sub-excavation, dewatering, box manhole, all components inside and part of chamber and up to flexible connections to incoming and outgoing pipes, benching, grouting, bedding, backfill, compaction of backfill, and all work incidental hereto.

.22 Effluent Air Valve Chamber

.1 Payment will be made at the lump sum price, including all labour, equipment, and materials for the complete supply and installation of the effluent air valve chamber as shown on the Contract Drawings.

.2 Payment includes excavation, sub-excavation, dewatering, box manhole, all components inside and part of chamber and up to flexible connections to incoming and outgoing pipes, sump drain system including rock pit, grouting, bedding, backfill, compaction of backfill, and all work incidental hereto,

.23 Water Main

.1 Payment for water mains will be made at the unit price per linear metre.

.2 Measurement will be made horizontally along the centreline of the installed pipe from centre-to-centre of fittings or to the end of the pipe, whichever is applicable.

.3 This price shall include all labour, equipment and materials for the supply and installation of the pipe and fittings, including: trench excavation, disposal of surplus excavated material, supply and installation of all pipe, related materials, bolts, gaskets, tie-rods, boulder disposal, dewatering, bracing and sheeting,

insulated pipe, aluminum jacket where identified, thrust blocks, estuary crossing including steel casing. tie in into existing combination air valve on the main water supply line, tie in into new Screening and UV Treatment Buildings, bedding, backfilling, compaction of backfill, disinfection, cleaning, pressure and leakage testing, flushing, all surface restoration as specified, and all work incidental thereto.

.24 Combination Air Valve

.1 Payment for combination air valves, grade rings, frames and covers will be made at the unit price for each as shown in the Bid Form.

.2 Price is to include materials and labour to install combination air valves, grade rings, frames and covers, including excavation, dewatering, bracing and sheeting, backfilling with select native material, and all work incidental thereto.

.25 Forcemain Tie-In HDPE/PVC/AC

.1 Payment for tie ins will be made at the unit price per each tie in connection, separately for various sections consistent with pipe material and requirements shown on the Contract Drawings.

.2 Measurement will be made for each connection completed.

.3 This price shall include all labour, equipment and materials for the supply and installation of the pipe and fittings required to complete the tie in into the existing HDPE/PVC/AC forcemain, including: excavation, boulder disposal, dewatering, bracing and sheeting, and all work incidental thereto.

.26 Manual Air Release Valves

.1 Payment for manual air release valves will be made at the unit price per each manual air release valve.

.2 This price shall include all labour, equipment and materials for the supply and installation of the valve, fittings, service saddle, HDPE DR 17 outlet pipe and all other work incidental thereto.

.27 Revegetation Seeding

.1 Payment for revegetation seeding will be made at the unit price per square metre of area restored as shown in the Contract Drawings and described in Section 31 00 00 - Earthwork and 01 57 01 – Environmental Protection.

.2 Payment will include the necessary equipment, labour and materials for the supply and application of hydraulic mulch, grass seed, and warranty and maintenance for one year from Total Performance. Payment includes any necessary erosion control blankets, pegging down, and maintenance as required by the hydraulic seeding supplier and other incidentals.

.3 Measurement for payment will only be made for surface actually seeded and approved by Site Inspector. Areas of overseeding onto existing grass or sod or unapproved by Site Inspector will not be measured for payment.

.28 Ground Improvements

.1 Measurement of payment for alternative ground improvement methods is based upon the total densified area, approximately 900 m^2 at the UV building and

approximately 500 m^2 at the screener building for an approximate total of 1400 m^2. Area is to be measured relative to center of perimeter piers or piles.

.2 The area of improved ground accepted by the Geotechnical Engineer of Record will be paid per approval.

1.2 PROGRESS PAYMENTS

.1 Refer to GC 37 – PROGRESS PAYMENTS

1.3 CHANGES

.1 Refer to GC 53 - CHANGES.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 ENGINEER TO ADMINISTER

.1 Engineer will administer preconstruction meeting and progress meetings to be held at intervals of approximately once per month.

.2 Contractor's superintendent, and senior representatives of major Subcontractors, to attend all meetings.

.3 Representatives of Contractor, Subcontractor and suppliers attending meetings shall be qualified and authorized to act on behalf of the party each represents.

.4 Contractor to provide physical space for meetings.

1.2 PRECONSTRUCTION MEETING

.1 Within 10 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Owner, Engineer, Contractor, and major Subcontractors will be in attendance.

.3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.

.4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.

.5 Agenda to include the following:

.1 Appointment of official representative of participants in the Work.
.2 Schedule of Work, progress scheduling.
.3 Schedule of submission of shop drawings, samples, colour chips.
.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
.5 Delivery schedule of specified equipment.
.6 Site security.
.7 Contemplated change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
.8 Force account procedures.
.9 Owner provided Products.
.10 Record drawings.
.11 Maintenance manuals.
.12 Take-over procedures, acceptance, warranties.
.13 Monthly progress claims, administrative procedures, photographs, holdbacks.
.14 Appointment of inspection and testing agencies or firms.

.15 Insurance.

.16 Safety issues.

1.3 PROGRESS MEETINGS

.1 During course of Work and weeks prior to project completion, schedule progress meetings monthly.

.2 Contractor, major Subcontractors involved in Work, Engineer and Owner are to be in attendance.

.3 Notify parties minimum 5 days prior to meetings.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 5 days after meeting.

.5 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revisions to construction schedule.

.8 Progress, schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Pending changes and substitutions.

.12 Review proposed changes for effect on construction schedule and on completion date.

.13 Safety issues.

.14 Other business.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 REQUIREMENTS INCLUDED

.1 Construction schedule

.2 Shop drawings and product data

.3 Samples

.4 Operating and maintenance manuals

.5 Record drawings

.6 Progress photographs

.7 Certificates

1.2 ADMINISTRATIVE

.1 Provide to Engineer for review the submittals specified. Submit with reasonable promptness and in an 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 and no claim for extension by reason of such default will be allowed.

.2 At Engineer's request, prepare and submit schedule fixing the dates for submission and return of shop drawings, product data or samples.

.3 Do not proceed with Work affected by the submittal until review is complete.

.4 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being examined and shall be considered rejected.

.5 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents and stating reasons for deviation.

.6 Verify that field measurements and affected adjacent Work are coordinated.

.7 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer review of submittals.

.8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.

.9 Keep one reviewed copy of each submission on Site.

1.3 CONSTRUCTION SCHEDULE

.1 Prepare schedule in the form of a horizontal bar chart.

.2 Provide a separate bar for each trade or operation. Show proposed progress of all activities for main work items and subtrades of Contract. Where applicable, indicate labour, construction crews, plant and equipment to be employed. Show delivery dates of major pieces of equipment.

.3 Provide horizontal time scale identifying the first work day of each week.

.4 Submit three 3 copies of initial schedules within ten 10 days after award of Contract.

.5 Engineer will review schedule and return reviewed copy within five 5 days after receipt.

.6 Resubmit finalized schedule within 7 days after return of reviewed copy.

.7 Distribute copies of the finalized schedule to:

.1 Job site office
.2 Subcontractors
.3 Engineer
.4 Owner
.5 Other concerned parties

.8 Instruct recipients to report to Contractor, within 10 days, any problems anticipated by the timetable shown in the schedule.

.9 Revise and resubmit schedule and work plan within 5 days after notification by Engineer that previously reviewed schedule is not being met. Show changes in operations proposed to complete construction work within Contract Time.

.10 If, during course of work, Contract Time is extended, correct construction schedule and work plan to show revised commencement and completion dates of affected parts of work.

.11 No progress payment will be approved until receipt of a schedule acceptable to Engineer.

1.4 WORK PLAN

.1 Provide Work Plan for each key activity, as requested by Engineer, to show construction methods. Relate Work Plan to activities shown on Construction Schedule and requirements of Section

1.5 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 Detail all shop drawings using the metric system. Prepare to a drafting standard equivalent to Contract drawings.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, wiring diagrams, panel layouts with bills of material, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Adjustments made on shop drawings by Engineer are not intended to change the Contract Amount. If adjustments affect the value of Work, state such in writing to Engineer prior to proceeding with Work.

.5 Make such changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of any revisions other than those requested.

.6 Engineer will supply a Shop Drawing Review Stamp. Stamp all transparencies and copies of shop drawings submitted for review.

.7 Fill in the following information on the Shop Drawing Review Stamp on each shop drawing prior to submitting the drawing to Engineer:

.1 Associated Engineering Job. No. -- "2017-2972"

.2 Drawing Number -- (see description in next paragraph)

.3 Date of submission.

.8 Apply the following drawing numbers to Shop Drawings on this work:

.1 Civil Shop Drawings:
C-1001
C-1002
C-(etc.)

.2 Architectural Shop Drawings:
A-1001
A-1002
A-(etc.)

.3 Structural Shop Drawings:
S-1001
S-1002
S-(etc.)

.4 Mechanical Shop Drawings:
M-1001
M-1002
M-(etc.)

.5 Electrical Shop Drawings:
E-1001
E-1002
E-(etc.)

.6 Instrumentation Shop Drawings:
I-1001
I-1002
I-(etc.)

.7 General Shop Drawings and drawings not covered by the above discipline categories:
G-1001
G-1002
G-(etc.)

.9 Maintain a complete Shop Drawing Record showing the review status of all shop drawings on the work. Provide Engineer with a copy of this record on a monthly basis or as requested by Engineer.

.10 Submittal submissions:

.1 Submit shop drawings and other submittals to Engineer for review with a Submittal Transmittal Form as provided by Engineer or in a form acceptable to Engineer.

.2 One original hard copy or an electronic file of the Submittal Transmittal Form (at Contractor's choice) will be provided to Contractor by Engineer. An example of the form is annexed to this Section. Make photocopies of the form as needed for use on the project.

.3 For each submittal or submittal package, type or print the appropriate information on the form to fully describe the submittal(s) being sent for review.

.4 Number each transmittal form in sequential order, for record and tracking purposes.

.5 Sign the form in the space provided to acknowledge Contractor review of the submittal(s).

.6 Retain one photocopy of the form for filing and record purposes.

.7 Forward the form and the accompanying submittal(s) to Engineer.

.11 Submissions shall include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Apply shop drawing stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of 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 Relationship to adjacent work.

.12 Submit electronic PDF copies of product data sheets or brochures for requirements requested in specification Sections and as Engineer may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

.13 Submit electronic PDF of shop drawings for each requirement requested in specification Sections and as Engineer may reasonably request.

.14 Submittals will be returned with one or more of the following notations. Take action as noted:

.1 "REVIEWED" - Make and distribute additional copies as required for execution of Work.

.2 "REVISE & RESUBMIT" - Make the necessary revisions and resubmit revised drawings for review. Show the drawing number of the first such revised drawing and show the latest revision number applicable to the drawing by adding a suffix to the drawing number as - "REV. 1", "REV. 2", etc.

.3 “REVIEWED AS NOTED” – This notation indicates when Engineer has provided notations on the shop drawings that must be incorporated into the goods or work. Make and distribute additional copies as required for execution of the work.

.4 "NOT REVIEWED" - This notation indicates when Engineer has not reviewed the drawing. It may also be used in combination with the notation to revise and resubmit the drawing where Engineer lacks sufficient information to complete the review and requires to resubmit the drawing for review after revision.

.5 Drawings will be marked "REVIEWED" together with the notation to "REVISE & RESUBMIT" when Engineer requires Contractor to resubmit a revised drawing showing corrections made as a result of Engineer's notations on the shop drawings. This procedure will not relieve Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of Contract.

.15 Use only those shop drawings on the work that bear the "REVIEWED" notation.

.16 Do not revise shop drawings marked "REVIEWED" unless resubmitted to Engineer for further review.

.17 Where more than one type of shop drawing has been specified for one item, e.g., wiring diagrams, layout details, and dimensional drawings, the shop drawings shall be submitted together, to enable Engineer to review the drawings as a package.

.18 Catalogue pages or drawings applicable to an entire family or range of equipment will not be accepted as shop drawings unless they are clearly marked to show the pertinent data for the particular materials.

.19 Manufacturers' catalogues, manuals, or price lists will not be accepted as shop drawings. Such materials may be used as supplemental information to the shop drawings.

.20 Indicate the tag number of instruments and valves and clearly show the features and details applicable to the equipment being supplied.

.21 Determine which shop drawings have, in addition to those drawings specifically mentioned in the Contract, design elements requiring the seal of a Professional Engineer registered in the Province or Territory where the work is located, in accordance with the applicable provincial or federal engineering acts or other governing legislation. Seal such drawings before submitting them for review. Submit for review engineering calculations signed by the registered Professional Engineer responsible for the shop drawing design elements.

.22 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, electronic PDF copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through the same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.23 Owner may deduct, from payments due to Contractor, costs of additional engineering work incurred if correct shop drawings are not submitted after one review by Engineer.

.24 Review by Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Engineer approves the detail design inherent in the shop drawings, responsibility for which remains with Contractor, and such review does not relieve Contractor of the responsibility for errors or omissions in the shop drawings or of the responsibility for meeting all requirements of the Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at the job-site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.

1.6 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples as to origin and intended use in Work.

.2 Deliver samples prepaid to Engineer's site office.

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

.4 Adjustments made on samples by Engineer are not intended to change Contract Amount. If adjustments affect the value of Work, state such in writing to Engineer prior to proceeding with Work.

.5 Make changes in samples which Engineer may require, consistent with Contract Documents.

1.7 OPERATING AND MAINTENANCE MANUALS

.1 Submit operating and maintenance manuals to Engineer, per Section 01 78 23.

1.8 RECORD DRAWINGS

.1 Submit record drawings to Engineer, per Section 01 78 39, upon completion of Work and prior to final inspection.

1.9 PROGRESS PHOTOGRAPHS

.1 On commencement of Work and at weekly intervals thereafter, supply Engineer with clear digital photographs of different views to indicate progress of Work. Take photographs from locations selected by Engineer. Clarity of the submitted photographs must be that the Engineer can discern the necessary details indicating progress of the Work. Photos shall be a minimum of 8 MB, in JPEG format, and shall be submitted via an FTP site, or similar.

.2 On completion of the Work, or at time designated by Engineer provide digital photographs of various interior and exterior views selected by Engineer.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

SHOP DRAWING / SUBMITTAL TRANSMITTAL

Submittal Description: _____ File Number: _____

Submittal Number: _____

Specification Section: _____

ENGINEER	CONTRACTOR
Associated Engineering	
Attention: Christian Brumpton	Attention:
Associated Engineering Project No.: 2017-2972	Contractor Project No.:

Routing:					
	Date Sent		**Contractor to Engineer**		Date Received
	Date Sent		**Engineer to Contractor**		Date Received

Owner:		**Contract:**	
Project:		**Contract Number:**	

Enclosed are the following ___ Submittals for Review ___ Submittals for Information ___ O&M Manual Data

Remarks: _____

CONTRACTOR			ENGINEER			
Item	**Copies Submitted**	**Description (Drawing Number, Revision Number, Title, Item Description)**	**Copies Returned**	**Review Action[1]**	**Reviewer Initials**	**Comments Attached**

[1] Review Action: **REV** = Reviewed; **RAR** = Revise and Resubmit; **NR** = Not Reviewed

Contractor certification (certify either A or B):

A. We have verified that the material or equipment covered by this submittal meets all specified requirements, including coordination with all related work.

B. We have verified that the material or equipment covered by this submittal meets all specified requirements except for the noted deviations. (Record deviations below or on attachments. Be specific.)

Item Number **Deviation**

_____ _____

_____ _____

_____ _____

Certified by: _____

Contractor's Signature

SHOP DRAWING / SUBMITTAL TRANSMITTAL

Submittal Description: _____ File Number: _____

Submittal Number: _____

Specification Section: _____

ENGINEER	CONTRACTOR
Associated Engineering	
Attention: Christian Brumpton	Attention:
Associated Engineering Project No.: 2017-2972	Contractor Project No.:

Routing:					
	Date Sent		**Contractor to Engineer**		Date Received
	Date Sent		**Engineer to Contractor**		Date Received

Owner:		**Contract:**	
Project:		**Contract Number:**	

Enclosed are the following ___ Submittals for Review ___ Submittals for Information ___ O&M Manual Data

Remarks: _____

CONTRACTOR			ENGINEER			
Item	**Copies Submitted**	**Description (Drawing Number, Revision Number, Title, Item Description)**	**Copies Returned**	**Review Action[1]**	**Reviewer Initials**	**Comments Attached**

[1] Review Action: **REV** = Reviewed; **RAR** = Revise and Resubmit; **NR** = Not Reviewed

Contractor certification (certify either A or B):

G A. We have verified that the material or equipment covered by this submittal meets all specified requirements, including coordination with all related work.

G B. We have verified that the material or equipment covered by this submittal meets all specified requirements except for the noted deviations. (Record deviations below or on attachments. Be specific.)

Item Number	**Deviation**

Certified by: _____

Contractor's Signature

Part 1 General

1.1 RELICS AND ANTIQUITIES

.1 Relics and antiquities and items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found on site or in buildings to be demolished, remain property of Owner. Protect such articles and request directives from Engineer.

.2 Notify Engineer immediately if evidence of archeological finds is encountered and await his written instructions before proceeding with work in area.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 REQUIREMENTS INCLUDED

.1 Regulations affecting the Work imposed by:

- .1 BC Ministry of Environment
- .2 BC Hydro and Power Authority
- .3 Fisheries and Oceans Canada
- .4 Navigation Protection Act
- .5 Environment Canada
- .6 National Building Code
- .7 BC Building Code
- .8 Occupational Health and Safety
- .9 Municipal by-laws and servicing standards
- .10 Municipal utilities
- .11 Regional Water and Sewer Commission

1.2 COMPLIANCE WITH REGULATIONS

.1 Ascertain requirements and regulations of authorities listed above.

.2 Comply with all such requirements and regulations as applicable to the Work.

.3 Requirements set out in this Section are for guidance and information and are not necessarily complete.

1.3 PERMITS

.1 Notwithstanding the provisions of GC 14 - Activities, Owner will obtain all construction permits required for the Work.

1.4 WORK IN VICINITY OF OVERHEAD POWER LINES

.1 Request power company to relocate, de-energize or guard any energized conductor where construction equipment may operate within 3 m of conductor.

.2 Obtain power company approval prior to operating any equipment within 3 m of energized conductor.

.3 Where practical, avoid storage of metallic pipe sections under high voltage overhead power lines.

.4 If pipe sections must be stored under power lines, protect personnel from effects of induced currents by grounding pipe sections at two (2) locations with AWG #2 copper ground conductors and grounding rods.

.5 Complete and submit WCB Form 30M33 prior to commencement of work.

1.5 WORK IN WATERCOURSE

.1 Comply with the following requirements for all work within the normal high water wetted perimeter of the channel.

.1 Restrict all work within the wetted perimeter to the minimum necessary to construct the Works, and to the period required by regulatory agencies.

.2 Avoid operating machinery and equipment within the wetted perimeter of the river. Undertake all work in a manner that will minimize the release of sediment into the water.

.3 Riprap and other materials placed within the normal high-water wetted perimeter of the river to be clean and free of silt, overburden, debris, and other substances deleterious to aquatic life.

.4 Restrict removal and disturbance of topsoil, forest cover, and vegetation adjacent to the river to the minimum necessary to construct the Works.

.5 Remove all temporary works, including falsework, shoring, cofferdams, temporary bridges, access ramps, and protective works, from the Site. Reinstate river channel to the condition and configuration that existed prior to construction.

.6 Alter or suspend pertinent operations immediately at the request of a fisheries officer.

.7 Submit proposals for review at least 2 weeks prior to any operation within the normal high-water wetted perimeter. Include methods intended to isolate activities from the river and means whereby the release of sediment and unacceptable discharges into the river will be controlled.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 LATEST EDITIONS

.1 All references to specifications, standards, or methods of technical associations refer to the latest adopted revision, including all amendments, in effect on the date of submission of bids, except where a date or issue is specifically noted.

1.2 ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air-Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWMAC	Architectural Woodworkers Manufacturers Association of Canada
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
CAN	Canadian National Standard
CBM	Certified Ballast Manufacturers
CBTIC	Clay Brick and Tile Institute of Canada
CEC	Canadian Electrical Code
CEMA	Canadian Electrical Manufacturers Association
CGA	Canadian Gas Association
CGRA	Canadian Good Roads Association
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CITC	Canadian Institute of Timber Construction
CLA	Canadian Lumbermen Association
CMAA	Crane Manufacturers Association of America
CMHC	Canada Mortgage and Housing Corporation
CPCA	Canadian Painting Contractors Association
CPCI	Canadian Prestressed Concrete Institute
CRCA	Canadian Roofing Contractors Association
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSSBI	Canadian Sheet Steel Building Institute
CUA	Canadian Underwriters Association
CWB	Canadian Welding Bureau
CWC	Canadian Wood Council

CSPI	Corrugated Steel Pipe Institute
EEI	Edison Electric Institute
EEMAC	Electrical and Electronic Manufacturers of Canada
FFPC	Federal Fire Prevention Committee
FM	Factory Mutual Engineering Corporation
IAO	Insurers' Advisory Organization
IBRM	Institute of Boiler and Radiator Manufacturers
IEC	International Electrotechnical Commission
IEE	Institution of Electrical Engineers (U.K.)
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IGMAC	Insulated Glass Manufacturers Association of Canada
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Standardization Organization
LEMA	Lighting Equipment Manufacturers Association
LTIC	Laminated Timber Institute of Canada
MMA	Millwork Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NBC	National Building Code of Canada
NEC	National Electrical Code
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NLGA	National Lumber Grade Authority
OECI	Overhead Electrical Crane Institute
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PMBC	Plywood Manufacturers Association of British Columbia
RCABC	Roofing Contractors Association of British Columbia
RLM	RLM Standards Institute
RTAC	Road and Transportation Association of Canada
SAE	Society of Automotive Engineers
SBI	Steel Boilers Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters' Laboratories of Canada
USFG	United States Federal Government
WCB	Workers' Compensation Board
WCLIB	West Coast Lumber Inspection Bureau

1.3 CONFORMANCE

.1 Conform to these standards, in whole or in part as specifically requested in Specifications.

.2 If there is question as to whether any product or system is in conformance with applicable standards, Engineer reserves the right to have such products or systems tested to prove or disprove conformance.

.3 The cost for such testing will be born by Owner in the event of conformance with Contract Documents or by Contractor in the event of non-conformance.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 INSPECTION

.1 Refer to GC 17 – Review and Inspection of Work.

1.2 TESTING LABORATORY SERVICES

.1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by Engineer are specified under various sections.

.2 Engineer will appoint and pay for services of testing laboratory except for the following:

- .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
- .2 Inspection and testing performed exclusively for Contractor's convenience.
- .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
- .4 Mill tests and certificates of compliance.
- .5 Tests specified to be carried out by Contractor under the supervision of Engineer.
- .6 Concrete testing as indicated in Section 03 30 00 – Cast-in-Place Concrete.

.3 Where tests or inspections by designated testing laboratory reveal work not in accordance with contract requirements, Contractor shall pay costs for additional tests or inspections as Engineer may require to verify acceptability of corrected work.

.4 Contractor's Responsibilities:

- .1 Furnish labour and facilities to:
  - .1 Provide access to work to be inspected and tested.
  - .2 Facilitate inspections and tests.
  - .3 Make good work disturbed by inspection and test.
  - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .2 Notify Engineer sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Engineer.

1.3 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, offsite manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.4 PROCEDURES

.1 Notify the appropriate agency and Engineer in advance of the requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 REJECTED WORK

.1 Refer to GC 18 - Deficiencies.

1.6 REPORTS

.1 Submit 1 hard copy and one printed pdf copy of inspection and test reports promptly to Engineer.

.2 Provide copies to Subcontractor of work being inspected/tested or manufacturer/ fabricator of material being inspected/tested.

1.7 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

.2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by the Law of the Place of Work shall be appraised by Engineer and may be authorized as recoverable.

1.8 MOCKUPS

.1 Prepare mock-ups for Work specifically requested in the specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in locations acceptable to Engineer.

.3 Prepare mock-ups for Engineer review with reasonable promptness and in an orderly sequence, so as not to cause any delay in the Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 Engineer will assist in preparing a schedule to establish the dates for preparation, if requested to do so.

.6 Remove mock-ups at conclusion of Work or when acceptable to Engineer.

1.9 MILL TESTS

.1 Submit mill test certificates as required of the specification Sections.

1.10 EQUIPMENT/SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

.2 Refer to individual specification sections for definitive requirements.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 INSTALLATION/REMOVAL

.1 Provide temporary utilities in order to execute the work expeditiously.

.2 Make necessary applications to authorities having jurisdiction, obtain required permits, and pay all fees and related charges.

.3 Remove from site all such work after use.

.4 Restore site to clean, sanitary condition.

1.2 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as required by local health authorities.

.3 Keep area and premises in sanitary condition.

.4 Disinfect facilities frequently.

.5 Remove contaminated soil and material and replace with fresh, clean material.

.6 Dispose of sanitary wastes, in accordance with the applicable regulations, and subject to approval of Engineer.

.7 Provide all sanitary supplies required for use by Contractor's work force and staff of Engineer.

.8 Prohibit the committing of nuisance. Promptly discharge any employee violating such provision.

1.3 POWER

.1 Arrange, pay for including monthly usage charges and maintain temporary electrical power supply in accordance with governing regulations and ordinances.

.2 Install temporary facilities for power such as pole lines and underground cables to approval of local power supply authority.

.3 Locate temporary power at designated location, or at an acceptable location subject to approval of Engineer.

.4 Electrical power and lighting systems installed under this Contract may be used for construction requirements with prior approval of Engineer provided that guarantees are not affected. Make good damage. Replace lamps which have been used over period of 3 months.

.5 Potential sources of temporary construction power include the following:

.1 City SCADA building at existing lagoon. Contractor to coordinate with City and would be responsible for all cabling required to provide power to construction area.

.2 Electrical supply from Catalyst mill. Contractor to coordinate with Catalyst paper, and make arrangements as required. Likely tie-in point would be existing manhole in the berm.

1.4 WATER SUPPLY

.1 Arrange, pay for and maintain temporary water supply in accordance with governing regulations and ordinances.

.2 Water supply is available on site and will be provided for construction usage at no cost.

.3 Permanent water supply system installed under this Contract may be used for construction requirements with prior approval of Engineer provided that guarantees are not affected. Make good damage.

.4 Locate temporary water supply at a location acceptable to Engineer.

1.5 TELEPHONE

.1 Provide and pay for (including monthly rental charges) temporary telephones necessary for own use and use of Engineer and Owner.

.2 Pay for all long-distance telephone calls except those made by Engineer and Owner.

1.6 MAINTENANCE OF PUBLIC UTILITIES

.1 Arrange Work to avoid interruption of utilities serving the public. Pay for damage.

.2 Where interruption of public utilities is unavoidable, obtain prior approval for interruption from responsible authority.

.3 As required by utility authority, establish and pay for temporary relocation of utility during construction.

.4 Comply with utility authority requirements in giving notice to users prior to interruption of service.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 INSTALLATION/REMOVAL

.1 Provide lockable temporary field offices and sheds as required during construction in locations directed by Engineer.

.2 Remove promptly from Site all such facilities after use.

1.2 CONTRACTOR'S SITE OFFICE

.1 Provide office heated to 22°C, lighted to 750 Lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table and telephone, pay telephone not acceptable.

1.3 SITE DOCUMENTS

.1 Maintain the following documents and materials on-site, in Contractor's Site Office, at all times:

- .1 Contract Documents including Drawings.
- .2 Work Orders and Change Orders.
- .3 Shop Drawings.
- .4 Delivery Schedules.
- .5 Progress Estimates.
- .6 As-Built Drawings.

.2 Maintain documents in order and make available for viewing by Engineer at all times.

1.4 ENGINEER'S SITE OFFICE

.1 Provide temporary office for Engineer.

.2 Inside dimensions minimum 3.6 m long x 3 m wide x 2.4 m high, with floor 0.3 m above grade, complete with 2 50% opening windows and one lockable door.

.3 Insulate building and provide electric heating system to maintain 22°C inside temperature at -20°C outside temperature.

.4 Finish inside walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish floor with 19 mm thick plywood.

.5 Install electrical lighting system to provide minimum 750 lx using surface mounted, shielded commercial fixtures with 10% upward light component.

.6 Arrange and pay (including monthly rentals) for telephone and internet access in Engineer’s office for Engineer’s exclusive use. Long distance calls placed on this phone will be paid by Engineer.

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

.8 Equip office with 1 x 2 m table, one (1) drafting table, four (4) chairs, 6m of shelving 300mm wide, one 3 drawer filing cabinet, one (1) plan rack and one (1) coat rack and shelf.

.9 Maintain in clean condition.

1.5 STORAGE SHEDS

.1 Provide adequate weathertight sheds with raised floors, for storage of materials, tools and equipment which are subject to damage by weather.

.2 Provided heated storage structures.

.3 Maintain storage sheds in a neat, clean condition.

1.6 FIRST AID FACILITIES

.1 Provide and maintain on Site, in a clean orderly condition, completely equipped First-Aid facilities readily accessible at all times to Contractor's employees. Facilities and staffing to be in accordance with OH&S Legislation.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 INSTALLATION/REMOVAL

.1 Provide temporary access and parking areas as required.

.2 Remove from Site all such work after use.

1.2 ACCESS ROADS

.1 Provide and maintain adequate access to Site.

.2 Build and maintain temporary roads where indicated or directed and provide snow removal during period of work.

.3 If authorized to use existing roads for access to Site, maintain such roads for duration of Contract and make good damage resulting from contractors' use of roads.

.4 Prior to final inspection, obtain and submit to Engineer written signed releases from owners of all roads used for Site access, verifying that roads have been adequately restored and left in a satisfactory condition.

.5 Trim loads of trucks hauling excavated material, cement, sand, stone, gravel, debris or other loose material before leaving the site, and ensure that the bodies of such vehicles are tight so that no spillage of loads occurs.

.6 Vehicles larger than a pick-up truck must use the following route to access the site, to avoid nearby residential areas:

- .1 Pacific Rim Highway to McCoy Lake Rd.
- .2 McCoy Lake Rd. tro Woodward Rd.
- .3 Woodward Rd. to Trill Pit Rd.
- .4 Trill Pit Rd. to Stirling Arm Rd
- .5 Stirling Arm Road to Shoemaker Road, follow Shoemaker to Lagoon access.

1.3 ACCESS TO UTILITY INSTALLATIONS

.1 Do not obstruct hydrants, valve or control pit covers, valve boxes, curb stop boxes, fire or police call boxes, and all other utility controls, warning systems, and appurtenances.

.2 Provide and pay for bridges, walks, or other temporary facilities necessary to ensure that these controls or warning systems are free for use in their normal manner at all times during construction.

1.4 CONSTRUCTION PARKING

.1 Parking will be permitted on Site provided it does not disrupt the performance of Work.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 INSTALLATION/REMOVAL

.1 Provide temporary barriers and enclosures as required to protect against injury and damage.

.2 Remove from Site all such work after use.

1.2 HOARDING

.1 Erect hoarding where indicated on drawings to protect the public, workers, public and private property from injury or damage.

.2 Provide hoarding with chain link fence 2 m high, protecting public and private property from injury or damage. Provide lockable gates within hoarding for access to site by workers and vehicles.

.3 Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to building.

1.3 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard railings and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.2 Provide as required by governing authorities.

1.4 TREE AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties where indicated.

.2 Wrap in burlap trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m.

.3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict tree removal to areas indicated or designated by Engineer.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 CONSTRUCTION CLEANING

.1 Maintain the Work in tidy condition, free from the accumulation of waste products and debris, other than that caused by Owner or other contractors.

.2 Remove waste material and debris from the site and deposit in waste container at the end of each working day.

.3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

.4 Promptly clean up any spillage that occurs on site roads, access roads or public roads, or other areas where construction vehicles are travelling.

.5 If Contractor is negligent in maintaining cleanliness of roads, Owner will arrange for cleaning to be done at Contractor's expense.

1.2 FIRES

.1 Fires and burning of rubbish on site is not permitted.

1.3 DISPOSAL OF WASTES

.1 Do not bury, or permit to be buried, rubbish and waste materials on site unless approved by Engineer.

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

.3 Remove from Site wastes and materials specified or designated by Engineer to be disposed of. Dispose of these wastes and materials at designated landfill or recycling facility.

1.4 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from surface and ground water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.4 Maintain existing drainage facilities affected by Work in good operating condition at all times during construction.

1.5 WORK ADJACENT TO WATERWAYS

.1 Do not operate construction equipment in waterways unless specifically authorized to do so.

.2 Do not use waterway beds for borrow material without Engineer's approval.

.3 Do not dump excavated fill, waste material, debris, or other extraneous material in waterways under any circumstances.

.4 Design and construct temporary crossings to minimize erosion to waterways.

.5 Do not skid logs or construction materials across waterways.

.6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.7 Do not blast under water or within 100 m of indicated spawning beds.

1.6 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 Control emissions from equipment and plant to requirements of authorities having jurisdiction.

.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.7 MATERIALS TO BE SALVAGED

.1 Remove, clean, deliver, unload and neatly stockpile at designated areas, materials which are specified or designated by Engineer to be salvaged.

.2 Repair or replace at Contractor's expense salvaged materials damaged during removal, unloading or in transit.

1.8 BLASTING

.1 Obtain Owner's approval for blasting. Owner, in granting approval, does not assume any responsibility for Contractor's methods or for injury, loss of life or damage resulting therefrom.

.2 Obtain insurance coverage for blasting operations prior to commencing such operations.

.3 Repair or pay for any damage resulting from blasting operations.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 GENERAL

.1 All works shall be undertaken in accordance with:

.1 Any permits or approvals granted for the Project.

.2 'Land Development Guidelines for the Protection of Aquatic Habitat' developed by Fisheries and Oceans Canada (DFO) and the Ministry of Environment (http://www.dfo-mpo.gc.ca/Library/165353.pdf)

.3 Standards and Best Practices for Instream Works' developed by the Ministry of Water, Land and Air Protection (https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/standards-guidelines/best-management-practices/iswstdsbpsmarch2004.pdf).

.4 Measures to Avoid Harm to Fish and Fish Habitat found on the DFO website, paying particular attention to advice related to Timing, Contaminant and Spill Management, Erosion and Sediment Control, Shoreline Re-vegetation and Stabilization and Operation of Machinery (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html)

.2 Environmental Protection measures will incorporate mitigation measures outlined in the Wastewater Treatment Plant Expansion Construction and Operations Environmental Impact Study, February 2018, prepared by Associated Engineering (AE) for the City of Port Alberni and provided as part of the tender (see Appendix X.)

1.2 PERMITS AND APPROVALS

.1 The Owner is responsible for submitting a DFO Project Review for the construction phase.

.2 The Contractor will be responsible for obtaining all other permits required for the Project by environmental agencies or recommended by the Contractor's Environmental Monitor, including but not limited to fish salvage permits. The Contractor must comply with the provisions of all permits and approvals applicable for the Project.

1.3 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

.1 The Contractor shall provide a CEMP prepared and/or signed and accepted by a Qualified Environmental Professional (QEP), which describes in detail the approach to be taken in addressing environmental issues associated with the Project and the correlation of the CEMP to the project schedule. The plan must be based on recommendations and mitigations presented in AE's Environmental Impact Study (see Appendix X) and be inclusive of all elements required to complete the Work, providing construction procedures as they relate to the protection of the environment.

1.4 ENVIRONMENTAL MONITORING

.1 The Contractor shall retain an Environmental Monitor. This person shall be an appropriately QEP. Environmental monitoring will be conducted by the QEP daily during environmentally sensitive works (e.g., vegetation clearing and in-stream works), and weekly during non-critical works. The QEP shall provide the Contractor and the Owner

with bi-weekly environmental monitoring reports documenting construction activities, implemented mitigation measures, any environmental issues observed, and recommended corrective actions.

1.5 TEMPORARY EROSION AND SEDIMENT CONTROLS

.1 The Contractor will submit a Sediment and Erosion Control Plan as a separate document or as part of the Contractor's CEMP. The Contractor will not commence with the Work until the Erosion and Sediment Control Plan is approved by the Engineer." The standards for sediment and erosion control outlined in the "Land Development Guidelines for the Protection of Aquatic Habitat" must be adhered to.

.2 All work must be undertaken and completed in such a manner as to prevent the release of silt, sediment or sediment-laden water, raw concrete or concrete leachate, or any other deleterious substances into the Somass River and Somass Estuary.

.3 Construction and excavation wastes, overburden, soil, or other substances deleterious to aquatic life must be disposed of or placed in such a manner so as to prevent their entry into any the Somass River and Somass Estuary.

.4 Any fill used for this project must be free of contaminants and must be placed so that it will not gain entry into the Somass River and Somass Estuary.

1.6 SPILL PREVENTION AND EMERGENCY RESPONSE

.1 The Contractor will submit a comprehensive Spill Prevention and Emergency Response Plan prior to construction to be included in the CEMP. The plan will specify the measures to prevent introduction of deleterious substances.

1.7 INSTREAM WORKS

.1 All work in and/or around the estuary (i.e. tidal waterbodies) must be undertaken and completed during the period of July 1 to September 15 and November 15 to February 15 or as approved by DFO.

.2 All in-stream work must be conducted during favourable weather and low flow conditions (i.e., low tide). The Contractor will make suitable preparations for inclement weather so as not to allow sediment to enter the Somass River and estuary to the satisfaction of the Environmental Monitor.

.3 Upon commencement of in-stream works, the Work must be pursued continuously to completion, without delay, and as quickly as practicable.

.4 All in-stream work must be undertaken and completed in isolation of all flowing water. Generally, this is to be accomplished by completely isolating the working area and diverting flows around the working area. The intake must be screened to prevent potential entrainment or impingement of fish.

.5 Prior to in-stream work, the Contractor shall retain a QEP to secure a fish collection permit from DFO and complete a fish salvage of the isolated work area.

1.8 WATER QUALITY

.1 The Contractor is responsible for planning, scheduling and performing this Work in such a manner that the quality of water flowing from and through the Site is within provincial and federal water quality guidelines for the protection of aquatic life, and will take

immediate action to correct any deficiency in water quality, as outlined in an Erosion Sediment Control Plan. The Contractor is responsible for maintaining conditions which protect the environment not only during active construction on the Site, but also during periods when the Contractor has suspended its construction activity for any reason.

1.9 VEGETATION PROTECTION

.1 Delineate the work area using a physical barrier (e.g. snow fencing) to limit clearing and grubbing to areas in the Project area footprint and areas required to complete construction activities.

.2 Restrict fill placement to only those areas where this is required to complete construction activities.

.3 Identify areas of invasive plants within the limits of construction, remove with root structures and dispose of off-site. Soil near these identified areas will be contaminated (seeds, roots), and cannot be transported to another location to prevent spread.

.4 The Contractor shall retain a QEP to prepare a Species at Risk Management and Restoration Plan incorporating the guidelines provided in AE's Environmental Impact Study (see Appendix X) to outline translocations, seeding, restoration site plan, and follow up monitoring.

.5 The Contractor shall retain a QEP to inventory rare plants (i.e., Vancouver Island beggarticks, Oregon ash, Virginia cherry) within the site just prior to the start of construction. This should include documentation of the numbers of plants and/or the areas that could be disturbed, as well as a photography and video log. Use this information to prepare a Species at Risk Management and Restoration Plan to focus on invasive control, existing population protection and translocation (of identified individuals or groups) to other areas identified as suitable within the site, and a follow up monitoring program.

1.10 BREEDING BIRDS

.1 The Breeding Bird Nesting Window is mid-March to mid-August of any given year when birds are nesting. No clearing of vegetation is permitted during this critical bird breeding period unless the Contractor's QEP performs a bird nest survey. If nests of species named in the BC Wildlife Act (i.e., great blue heron or various raptors including eagles, peregrine falcon and osprey) are identified in the vicinity of the Project area prior to construction, these must be protected year-round and cannot be disturbed. A QEP will identify and mark any active nests and provide guidance for protection.

1.11 SURVEYS AND SALVAGES

.1 The Contractor will be responsible for pre-construction surveys and salvages (e.g. pre-clearing bird nest survey, rare plant inventories, fish salvage) by a QEP as required by the Project's permits and approvals, best management practices, and recommended by the Contractor's Environmental Monitor. If required, the surveys and salvages shall be considered incidental to the Work and no additional payment will be made. The Contractor will be required to schedule the Work accordingly.

1.12 CLEARING AND GRUBBING

.1 Limit clearing and grubbing to the toe of the berms and designated laydown areas within the construction limits as shown on the drawings or as indicated by the Engineer.

.2 Retain all Oregon ash (*Fraxinus latifolia*), Virginia cherry (*Prunus virginiana*), arbutus (*Arbutus menziesii*), and patches of Vancouver Island beggarticks (*Bidens amplissima*) to the extent possible, as identified and flagged by the QEP.

.3 All topsoil (organic soil) is not required to be removed, and shall be directed in the field by the Engineer.

.4 If approved by the Engineer, any stripped topsoil may be stockpiled in an approved location for re-use on the final surface dyke slopes. Any stockpiled topsoil materials shall be covered and secured with polyethylene sheets. Any stripped materials not approved by the Engineer for re-use shall be disposed of off-site at an approved site.

1.13 WATER DETENTION AND TREATMENT FACILITIES

.1 The extent of water detention and treatment facilities required by the Contractor to meet its responsibilities for protection of the aquatic environment while carrying out the Work will depend on a number of factors, including but not limited to the methods and schedule chosen by the Contractor for performing the Work, and the weather or other Site conditions encountered during the Work.

.2 Where facilities for water detention or treatment are shown on the Drawings, or otherwise required as part of the Work, they have been designed only for conditions which will apply after the completion of the Work. Unless otherwise stated elsewhere in the Special Provisions or on the Drawings, such facilities may be used by the Contractor for runoff detention and treatment while carrying out the Work, subject to the Contract Administrator's approval and subject to the Contractor's discretion as to their effectiveness for this purpose.

.3 Whether intentionally so used or not, these facilities will be restored by the Contractor prior to completion of the Work to the lines and grades specified in the Contract Documents.

.4 Whatever further water treatment facilities may be necessary will be provided, maintained and removed by the Contractor.

1.14 SITE RESTORATION

.1 Re-establish Vancouver Island beggarticks along any disturbed perimeter berms of the lagoons. This can be accomplished by seed harvesting on existing plants in September and October (if possible with Project timing), or by obtaining seeds from Saanich Native Plants (http://www.saanichnativeplants.com).

.2 A suitable hydroseed mix shall be obtained from Saanich Native Plants and if possible, include Vancouver Island beggarticks.

.3 Seed mix rate shall be 100 kg/ha.

.4 Fertilizer shall be 300 kg/ha 16-32-6 (92% Urea Coated).

.5 Guar Gum tackifier at the rate of 50 kg/ha.

.6 .6 Wood fibre mulch at the rate of 1500 kg/ha.

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 SIGN

.1 Provide and erect, within three (3) weeks of Contract award, a project sign in a location designated by Engineer.

.2 Construct sign 1.2 x 2.4 m, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.

.3 Indicate on sign, the names of project, Owner, Engineer and Contractor, of a design style established by Engineer.

.4 Maintain sign in good condition for the duration of Work. Clean periodically.

.5 No other signs or advertisements, other than warning signs, are permitted on site.

.6 Upon completion of construction or within ten (10) working days of being so notified by Engineer, remove the Construction Sign and restore site of sign to satisfaction of Engineer.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 QUALITY

.1 Products, materials, equipment and articles (referred to as Products throughout the specifications) incorporated in Work shall be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Defective Products, whenever identified prior to the completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to the quality or fitness of Products, the decision rests strictly with the Engineer based upon the requirements of the Contract Documents.

.4 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.

.5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.2 AVAILABILITY

.1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Products are foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In the event of failure to notify Engineer at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Engineer reserves the right to substitute more readily available products of similar character, at no increase in Contract Amount.

1.3 STORAGE, HANDLING AND PROTECTION

.1 Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 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.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 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.

.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged Products and to the satisfaction of Engineer.

1.4 TRANSPORTATION

.1 Pay costs of transportation of Products required in the performance of Work.

.2 Transportation cost of Products supplied by Owner will be paid for by Owner. Unload, handle and store such Products.

1.5 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification Section.

.4 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.6 QUANTITIES

.1 Schedules of piping, fittings, reinforcing, or other materials indicating quantity and/or dimension, which are shown on the drawings or in the specifications, are intended only to assist Contractor with quantity takeoff. Quantities and dimensions shown therein are not guaranteed to be accurate and must be checked by Contractor prior to placing an order for such materials.

.2 Claims for additional payment resulting from variations between quantities shown on the schedules and those actually installed will not be accepted.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 MOBILIZATION

.1 Mobilization shall consist of preparatory work and operations including, but not limited to, those necessary to the movement of personnel, equipment, supplies and incidentals to Site; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on Site.

1.2 DEMOBILIZATION

.1 Demobilization shall consist of cleanup work and operations including, but not limited to, those necessary to the removal of personnel, equipment, and incidentals from Site.

1.3 PAYMENT

.1 Any amount of the lump sum price for mobilization and demobilization that exceeds 5% of the Total Bid shall be paid upon completion of the contract and removal of equipment and cleanup of the work areas to the satisfaction of Engineer.

.2 Payment for that portion of the lump sum price for mobilization and demobilization that is less than or equal to 5% of the Total Bid will be made as follows:

.1 75% will be paid on the first progress payment certificate due after Contractor has established their operations and facilities and submitted the following documents in a form acceptable to the Engineer:

.1 Construction Environmental Management Plan

.2 Project Management Plan

.2 The remaining 25% will be paid upon completion of the contract and removal of equipment and cleanup of the work areas to the satisfaction of Engineer.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittals.

.2 Submit site specific Health and Safety Program: Within 14 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Program 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 Submit Construction Safety Checklists after completion.

.4 Submit copies of all reports or directives issued by Federal and/or Provincial health and safety inspector(s).

.5 Submit copies of incident and accident reports.

.6 Submit on site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

.7 Submit Material Safety Data Sheets (MSDS).

.8 Submit personnel training requirements including names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.

.9 Submit, and post at the Work site, the emergency numbers for police, fire and ambulance for the locale of the Work, as well as the names and after hours numbers for key site personnel related to health, safety or security of the site.

1.2 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

.2 Submit hazard assessment report to Engineer.

1.3 MEETINGS

.1 Attend health and safety pre-construction meeting.

.2 Arrange for "tool box" safety meetings and submit reports.

1.4 REGULATORY REQUIREMENTS

.1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

1.5 GENERAL REQUIREMENTS

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

.2 Correct deficiencies and re submit Health and Safety Program when so requested by Engineer.

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 Program.

1.7 COMPLIANCE REQUIREMENTS

.1 Comply with OH&S Legislation

1.8 UNFORSEEN HAZARDS

.1 Should any unforeseen or peculiar safety related factor, hazard, or condition become evident during performance of Work, immediately stop work and follow procedures in place for employee's right to refuse work in accordance with the OH&S Legislation. Advise Engineer verbally and in writing.

1.9 CORRECTION OF NON COMPLIANCE

.1 Immediately address health and safety non compliance issues identified by Engineer or designated safety inspector.

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

.3 Be aware that Engineer may stop Work if non compliance of health and safety regulations is not corrected.

1.10 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.

.2 Stop Work when necessary or advisable for reasons of health and safety.

.3 Be aware that Engineer or designated safety inspector may stop Work when deemed necessary or advisable for reasons of health and safety.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, acceptable to Owner.

1.2 SURVEY REFERENCE POINTS AND LEGAL SURVEY MARKERS

.1 Existing base horizontal and vertical control points are designated on drawings.

.2 Locate, confirm and protect control points and legal survey markers prior to starting site work. Preserve permanent reference points during construction.

.3 Make no changes or relocations without prior written notice to Engineer.

.4 Report to Engineer when a reference point or legal survey marker is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.5 Require surveyor to replace control points in accordance with original survey control.

.6 Require surveyor to replace legal survey markers lost or destroyed as a result of construction activities.

1.3 SURVEY REQUIREMENTS

.1 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out, by instrumentation.

.3 Stake for grading, fill and topsoil placement and landscaping features.

.4 Stake slopes and berms.

.5 Establish pipe invert elevations.

.6 Stake batter boards for foundations.

.7 Establish foundation column locations and floor elevations.

.8 Establish lines and levels for mechanical and electrical work.

.9 Establish initial elevations of settling plates in preload areas. Survey elevations of settling plates on a weekly basis.

.10 Provide competent worker(s) to assist Engineer with checking of layout, measurement of quantities, and compilation of record data. Reserve worker(s) for this purpose and make available as required by Engineer.

1.4 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

1.5 SUBMITTALS

.1 Submit name and address of Surveyor to Engineer.

.2 On request of Engineer, submit documentation to verify accuracy of field engineering work.

.3 Submit certificate signed by Surveyor certifying that elevations and locations of completed Work are in conformance, or nonconformance with Contract Documents.

1.6 SUBSURFACE CONDITIONS

.1 Promptly notify Engineer in writing if subsurface conditions at Site differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 After prompt investigation, should Engineer determine that the conditions do differ materially, instructions will be issued for changes in Work as provided in GC 53 - Changes.

1.7 ENGINEER'S ASSISTANT AND STAKES

.1 Provide Engineer with all stakes, batter boards, straight edges, and other materials, with the exception of technical instruments and apparatus, required by Engineer to set out lines and levels for Work.

.2 Supply Engineer with competent worker(s), as required, to assist in the setting of lines and levels for Work.

1.8 EXISTING SURVEY MARKERS

.1 Replace legal survey markers, disturbed or removed by the construction operation, that existed at a horizontal distance of 1.5 m or more from the centreline of pipe being installed. If it is necessary to remove or disturb existing legal survey markers that are within 1.5 m of the pipe centreline, notify Engineer before such removal or disturbance and replacement will be at Owner's expense.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting and patching means acceptance of existing conditions.

.4 Provide temporary structural supports to ensure structural integrity of surroundings.

.5 Provide devices and methods to protect other portions of project from damage.

.6 Provide protection from elements for areas which may be exposed by uncovering work.

.7 Maintain excavations free of water.

1.2 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify Engineer, in writing, of conflicts between the specifications and manufacturer's instructions, so that Engineer may establish the course of action.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Engineer to require removal and re-installation at no increase in Contract Amount.

1.3 WORKMANSHIP

.1 General:

.1 Execute work by workers experienced and skilled in the respective duties for which they are employed. Notify Engineer immediately if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in their required duties. Engineer reserves the right to require the dismissal from the site, of workers deemed incompetent, careless, insubordinate or otherwise objectionable.

.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with Engineer, whose decision is final.

.2 Co-Ordination:

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for co-ordination and placement of openings, sleeves and accessories.

.3 Protection of Work in Progress:

.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by Engineer, at no increase in Contract Amount.

.2 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Engineer.

.4 Remedial Work:

.1 Refer to Section 00 72 00 - General Conditions and Section 00 73 00 - Supplementary Conditions.

.2 Perform remedial work required to repair or replace the parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.3 Perform remedial work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Work.

.5 Location of Fixtures:

.1 Consider the location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Engineer of a conflicting installation. Install as directed.

.6 Concealment:

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Engineer if there is a contradictory situation. Install as directed by Engineer.

1.4 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with a minimum of disturbance to Work, and/or and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authority having jurisdiction, stake and record location of capped service.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 MATERIALS

.1 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.2 FINAL CLEANING

.1 In preparation for Certificate of Completion or Total Performance of the project, perform final cleaning.

.2 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.3 Remove waste products and debris other than that caused by Owner or other Contractors.

.4 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.5 Clean roofs, downspouts, and drainage systems.

.6 Remove grease, dust dirt, stains, labels, fingerprints, and other foreign materials, from interior and exterior finished surfaces including glass and other polished surfaces.

.7 Clean lighting reflectors, lenses, and other lighting surfaces.

.8 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.9 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.10 Broom clean paved surfaces; rake clean other surfaces of grounds.

.11 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.12 Remove snow and ice from access to building.

.13 Inspect valve boxes, manholes and hydrants to check for debris and proper operation.

.14 Operate valves, including those existing prior to construction, to ensure that no damage has occurred or debris accumulated, due to cleanup activities.

Part 2 Products

Not Used

Part 3 Execution

Not used

END OF SECTION

Part 1 General

1.1 START-UP

.1 Test, adjust, balance and put into trial operation all mechanical, electrical, and control works and equipment.

1.2 DOCUMENTATION

.1 Prepare Construction Completion Certificate (CCC) upon completion of each system, which defines each system and its terminal points.

.2 Submit each CCC to Engineer for approval.

.3 Final Completion is subject to the acceptance of the CCC for each system, but acceptance of the CCC is not to be construed as acceptance of the system.

.4 Include complete records on testing, adjusting, and balance, such as pre-commissioning, pressure testing and alignment records, in the CCC.

.5 Contractor responsibilities under CCC:

.1 Certify that system is prepared and ready for commissioning and operation.

.2 Assume responsibility for commissioning and initial operation.

1.3 ADJUSTING

.1 Make adjustments to equipment and other works, as necessary to place the Work into operation.

.2 Trial operate all units. Check mechanical operation. Check for overload and undue vibration. Make necessary adjustments.

.3 Dowel equipment as directed by Engineer.

.4 Loop check pneumatic lines to determine correct operation of controllers, control valves, and appurtenances.

.5 Blow down instrument pneumatic supply and signal lines prior to connection and leak testing.

.6 Adjust the setpoints of field mounted pressure, level and temperature switches.

Part 2 Products

Not Used

Part 3 Execution

Not used

END OF SECTION

01 75 01.01 EQUIPMENT INSTALLATION CERTIFICATION FORM:

Contract No: _____ Specification Section: _____

Equipment Tag # _____ Equipment Description: _____

_____

Contractor: _____

Vendor of Equipment Item: _____

The undersigned vendor of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project specifications, has been provided and installed in accordance with the manufacturer's recommendations and that the equipment item may be started and field tested.

Comments: _____

_____

_____

_____

_____ _____

Date Vendor

_____

Signature of Authorized Representative

_____ _____

Date Contractor

_____

Signature of Authorized Representative

017501.02 PRE-COMMISSIONING CERTIFICATION FORM:

Contractor: _____ Contract No.: _____

Process System Name: _____

List each equipment item included in the process system. Attach marked Piping Schematics and/or P&ID indicating specific items and process system limits. Attach copies of the certified Field Performance Test Results.

Equipment Name (Including Item No.)	Equipment Model No.	Manufacturer

The Contractor certifies that the process system has been cleaned, flushed, pressure tested, disinfected, loop checked and that operational and performance testing of the process system has been successfully completed. The process system is made ready for commissioning and continuous operation as specified in Section 01 75 01.

The Contractor shall carry the costs and be responsible for operation and maintenance of the process system throughout the commissioning stage. The Contractor may accept the assistance of the equipment manufacturer's representative, the Engineer relative to process considerations and by the Owner's operations and maintenance staff during commissioning.

This document is not to be construed as Substantial Completion or Notice of Acceptance.

Contractor's Pre-Commissioning Certification

_____

Contractor Signature of Authorized Representative Date

Acceptance of Contractor's Certification

Part 1 General

1.1 SECTION INCLUDES

.1 Requirements for placing Work in a state of readiness for acceptance by Owner.

.2 Section supplements, but does not supersede, specific requirements of other Sections.

1.2 DEFINITIONS

.1 Pre-Start-Up: Pre-start-up consists of the non-operating functions required to bring Work to a state of readiness for placing systems into service. It includes, but is not limited to; cleaning, leakage and pressure testing, cold alignment checks, disinfection, system flushing, lubrication of mechanical equipment, rotation checks and wiring loop checks. Contractor shall conduct inspections of all components and sub-components and shall arrange for inspections of equipment installations by qualified equipment manufacturers' representatives as required by Contract Documents. At this stage, deficiency lists are prepared and Contractor is to remedy outstanding incomplete or incorrect work in accordance with terms of Contract. Contractor shall obtain completed Equipment Installation Certification Forms for each specified piece of equipment and shall submit these to Engineer for review. Once Engineer is satisfied that each piece of equipment in a system or subsystem has been properly checked out and all apparent deficiencies have been remedied, a Green "Ready-to-Start" tag shall be placed on the equipment designating that the Pre-Start-Up Phase for that particular system is complete.

.2 Start-Up: Once each piece of equipment within a defined system carries a "Ready-to-Start" tag, then that individual system shall be started and tested. Both "Dry-Run" and "Wet-Run" tests are required. Contractor shall conduct performance tests of all equipment in conjunction with the manufacturers' representatives as required by the Contract Documents and under the witness of Engineer. Deficiencies that are uncovered shall be corrected and retesting shall be conducted as required. Start-Up Completion Certificates shall be prepared by Contractor certifying that the equipment or system is complete, successfully tested, started and ready for commissioning and continuous operation.

.3 Commissioning: Commissioning consists of placing all the various systems in Work into continuous operation in an orderly manner. Contractor is responsible for the commissioning activities and shall have equipment manufacturer representatives at the site, as well as qualified mechanical, electrical, control and instrumentation personnel. Contractor may be assisted by Engineer relative to process considerations and by Owner's operations and maintenance staff. Commissioning is considered to be complete when all systems have been operating continuously for a period of 80 hours without fault and in accordance with the specified performance requirements.

1.3 QUALITY CONTROL

.1 Appoint a professional engineer or qualified operations specialist as Testing and Commissioning Manager to manage, coordinate and supervise the Testing, Start-up and Commissioning Program. Qualifications to include minimum 5 years experience

managing testing, start-up and commissioning of mechanical, electrical, instrumentation, building systems and piping systems. Provide resume to Engineer for review prior to commencement of program.

.2 When specified in individual Sections of Contract Documents, require manufacturer or supplier to provide authorized representative(s).

.3 Testing:

.1 Provide all required testing equipment and ancillary equipment to verify specified performance.

.2 Calibrate all test equipment to plus or minus 2 percent of actual value at full scale.

.3 Employ recognized, industry standard calibration procedures or as specified in individual Sections.

.4 Submit calibration plans and results to Engineer.

.4 Attend and participate in Pre-start-up, Start-up and Commissioning workshops with Engineer and Owner representatives.

1.4 SAFETY

.1 Ensure all requisite safety equipment, devices, detectors, materials and procedures are in place, tested and operational before commencing.

.2 Conform to requirements of all regulatory authorities having jurisdiction.

.3 Maintain communications with fire, police, environmental and health authorities.

1.5 ENVIRONMENTAL PROTECTION

.1 Comply with all requirements of federal, provincial and local jurisdictions having authority.

1.6 PRE-START-UP

.1 Prepare Pre-start-up Equipment Checkout Listing which includes all Process Mechanical, Commodity-retaining Structures, Building Mechanical, Instrumentation and Controls and Electrical Equipment. Group listing into logical systems or sub-systems for orderly progression of activities during start-up.

.2 Identify all pieces of equipment by Tag Numbers.

.3 To extent practical, remove all scaffolding, debris, planks tools and other construction-related material.

.4 Remove all sand, silt, dirt and debris from tanks, channels, chambers, instrumentation and control panels and electrical panels and vacuum clean.

.5 Clean all surfaces of tanks and conduits, including walls, roofs, floors and columns with high pressure water jets or as specified in individual Sections.

.6 Clean interior of all pipes and fluid-carrying equipment, including pumps and inspect with Engineer present.

.7 Conduct leakage and pressure tests in accordance with individual Sections.

.8 Conduct disinfection procedures in accordance with requirements of individual Sections.

.9 Provide Checkout Tag for each piece of equipment.

.10 Checkout Tags to be filled in by each applicable trade verifying that all appropriate checks have been made, including but not limited to, cleaning, inspection, leakage testing, lubrication, rotation, calibration, adjustment and wire loop checks.

.11 Equipment Manufacturer's Representatives to inspect equipment in accordance with applicable individual Sections. Certify equipment has been properly installed and is ready to start.

.12 Contractor to submit Equipment Checkout Listing to Engineer. Equipment Checkout Listing to include the following:

.1 System description.
.2 Equipment Name and Tag Number of each component within System.
.3 Supplier's Name of each equipment component, complete with sign-off where applicable.
.4 Mechanical Trade sign-off (Blue and White Cards completed).
.5 Electrical/Instrumentation Trades sign-off (Red, Yellow and White Cards completed).
.6 Contractor sign-off (all cards completed).

.13 Attach the following to Equipment Checkout Listing:

.1 Manufacturer's Representatives' Installation Certification Form.
.2 Hydrostatic Test Certification Forms for Process Tanks.
.3 Pressure Test Certification Forms for Process Tanks.
.4 Disinfection Certification Forms where applicable.
.5 Instrumentation and Electrical Equipment Loop Check Forms.
.6 Instrumentation Calibration Forms.
.7 Listing of outstanding contract deficiencies for each system.

.14 Request, in writing, a Pre-Start-Up Inspection by Engineer. Once Engineer has conducted the Pre-Start-Up Inspection and is satisfied that each piece of equipment has been properly checked-out, a green "Ready-to-Start" tag will be attached to each piece of equipment in the system.

1.7 START-UP

.1 Conduct workshop with Owner's Representatives and Engineer to identify and integrate activities of all parties in start-up of Work. Prepare Start-up Plan which includes the following:

.1 Plan objectives.
.2 Facilities to be started.
.3 Sequence of events and start-up schedule.
.4 Responsibilities of each party.
.5 List of individuals involved complete with contact telephone numbers.
.6 English language description of each systems' intended means of operation.
.7 Initial operating conditions and parameters.
.8 Intended final operating conditions and parameters.
.9 Laboratory requirements and arrangements for outside testing services.
.10 Sampling and monitoring requirements.
.11 Contingency plans to respond to potential emergencies.
.12 Safety and environmental considerations.

.2 Develop Owner Training plan and implement.

.3 Provide Operating and Maintenance Manuals as required by individual Sections.

.4 Conduct Dry Run Tests for all equipment, witnessed by Engineer.

.5 Conduct Wet Run Tests for all equipment, witnessed by Engineer.

.6 Correct any deficiencies uncovered during testing.

.7 Provide Pre-Commissioning Certification Form.

1.8 COMMISSIONING

.1 Assemble Contractor's commissioning team to respond to requests for assistance by Engineer or Owner. Team to consist of representatives of Contractor and Contractor's mechanical, electrical and instrumentation staff or subcontractors, as appropriate.

.2 Contractor's representative to be at site during normal working hours for entire commissioning period. Contractor's commissioning team to be at site during normal working hours for the first 5 days of commissioning of each identified commissioning package and available within 4 hours' notice during remainder of each commissioning period. Contractor's representative and the commissioning team may be required to be at site outside of normal working hours during the commissioning period, at the discretion of Owner or Engineer and shall be available within four hours' notice.

.3 Remove and clean or replace as required all permanent and temporary filters and strainers in pipeline systems; replace HVAC filters; dewater and clean sumps and leave process systems clean and filled with clean water, unless otherwise directed by Engineer.

.4 Owner to commission Work in stages based on commissioning packages. Each commissioning package to consist of fully functional portions or groups of operationally tested systems capable of operating in concert to provide a complete service or function that is of value to Owner.

.5 Commissioning to be generally conducted in manual mode first, followed by automatic operation.

.6 Period of time for continuous automatic operation for acceptance of commissioning is 80 hours with all systems operating continuously without fault and all process, mechanical, control and electrical equipment free of vibration, overloading or overheating and functioning in accordance with specified rates, methods and performance.

.7 Failure of any part of Work during the period of continuous automatic operation will require restart of that portion or system of Work, following rectification of the fault or failure.

.8 If it is necessary to suspend start-up, commissioning or continuous operation during the commissioning period due to deficiencies or failure in any system, the full cost of interruption, call-back, testing and resumption of start-up, commissioning, or continuous operation shall be paid by Contractor.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 MANUAL

.1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of Divisions 02 to 49.

1.2 GENERAL

.1 Prepare three 3 copies of documentation including as-constructed shop drawings to instruct Owner's operations and maintenance staff in the operation and associated maintenance of each piece of equipment and system as supplied and installed.

.2 Submit the completed O & M Manuals before 90% of the work is approved for payment. No payment for any work will be made over 90% of the Contract value until completed O & M Manuals are received and accepted as satisfactory.

1.3 BINDERS

.1 Provide the material in 80 mm or 135 mm spine, 215 x 280 mm black, heavy-duty d-ring binders or approved alternative.

1.4 CONTENTS

.1 Arrange the material in volumes as described below. Provide a separate binder for each volume unless directed otherwise by Engineer. Where more than one binder is required to accommodate the documentation for a volume, increase or decrease the number of volumes and renumber as necessary.

Volume 1 - Operating Manual
Volume 2 - Architectural/Structural
Volume 3 - Mechanical Operations and Maintenance
Volume 4 - Electrical and Instrumentation Operations

.2 Permanently number each set.

.3 Letter the spine of the binder with the full identification title of the project and the front face with the following on the respective binders:

Full identification title of the project
Volume Number
Volume Title
City of Port Alberni
Number of Sets (e.g. 1 of 3)

.4 Engineer will prepare the manual content in Volume 1. All other Volumes are the responsibility of Contractor. Provide the binders and the dividing tabs to Engineer for the compilation of Volume 1.

.5 Arrange the binders according to the Construction Specifications Institute MASTERFORMAT - Master List of Sections, Titles and Numbers, utilizing laminated

mylar plastic divider tabs, colour coded according to section. Markings on the tabs are to be type written. Tab colours are to be as follows:

.1 Division – white

.2 Sections – orange

.3 Subsections – yellow

.6 Make up each binder as follows:

.1 Tab: Table of Contents - details the titles of various divisions of the manual in the binder.

.2 Tab: Introduction to manual - written explanation of the layout of the manual and intended use.

.7 Include separately the following:

.1 Consultant: name, address, telephone and FAX numbers, name of Project Manager.

.2 Contractor: name, address, telephone and FAX numbers, name of Project Manager.

.3 Major Sub-Contractors: name, address, telephone and FAX numbers of sub-contractors included in that binder.

.8 Provide the following for each respective discipline:

.1 Tab: Division number xx:

.2 Index - information in that division in order of appearance in the specification,

.3 List of sub-contractors and suppliers - name, address, and telephone and FAX numbers,

.4 Specification section cross reference, and

.5 Drawing List.

.9 Organize the various applicable sections under separate divider tabs labelled division/number as required by the project. A typical outline is as follows:

Tab: DIVISION 7 - THERMAL AND MOISTURE PROTECTION
07 11 13 - Bituminous Dampproofing
07 16 19 - Metal Oxide Waterproofing
07 18 00 - Traffic Coatings
07 19 00 - Water Repellents
07 21 13 - Board Insulation
07 21 16 - Blanket Insulation
07 21 23 - Loose-Fill Insulation
07 24 00 - Exterior Insulation and Finish Systems
07 26 00 - Vapour Retarders
07 31 29 - Wood Shingles and Shakes
07 61 00 - Sheet Metal Roofing
07 62 00 - Sheet Metal Flashing and Trim
07 72 33 - Roof Hatches
07 92 00 - Joint Sealing

.10 Provide the information given below, where applicable, for each system and major piece of equipment. Refer to each piece of equipment by its name and tag number. Where

manufacturer's literature covers several models or options, highlight the applicable information, using a non fading marker, and cross out redundant information.

.1 Index of information in that section in order of appearance;

.2 Description of system, components and technical data. Include interfaces, sequences, operations; characteristic changes for seasonal operation;

.3 Maintenance and operating instructions including:

- .1 Installation instructions
- .2 Procedure for starting
- .3 Proper adjustment
- .4 Test procedures
- .5 Procedure for operating
- .6 Procedure for shutdown
- .7 Safety precautions
- .8 List of electrical relay settings and control and alarm contact settings.

.4 Troubleshooting data;

.5 Preventative maintenance program complete with:

- .1 Suggested check list sheets
- .2 List of points to be greased or oiled
- .3 Recommended type, grade and temperature range of lubricants
- .4 List of wear points to be inspected and/or adjusted regularly.
- .5 Suggested schedule for lubrication and inspection

.6 Schematic, single line, and wiring diagrams;

.7 Valve tag list;

.8 Recommended spare parts list;

.9 Certification, guarantee, warranty;

.10 Service representatives - name, address and telephone number;

.11 Suppliers for replacement parts - name, address, and telephone numbers;

.12 Test results; witness testing and commissioning, reports;

.13 Test data for piping systems (degreasing, flushing, disinfection);

.14 Hydrostatic or air tests performance;

.15 Equipment alignment certificates;

.16 Balancing data for air and water systems;

.17 Inspection approval certificates for all types of systems; plumbing and piping, hot air and ventilating, electrical supervisory, etc.

.11 The material submitted in accordance with the contractual requirements for "As-Constructed Shop Drawings" is generally bulky and difficult to file in a binder. If requested by Engineer, provide copies of all "As-Constructed Shop Drawing" material in a single drawer legal size cardboard file cabinet. Arrange in accordance with the Construction Specifications Canada MASTERFORMAT. Identity any material located in the file cabinet as such in the appropriate location in the binders.

.12 At Engineer's discretion, provide the information in plastic map pockets in appropriate sections in the binders.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual specification sections.

.2 Supply special tools, wrenches, and accessories that are required for removing worn parts, making adjustments, and carrying out maintenance works.

.3 Deliver maintenance materials, special tools and spare parts as directed by Engineer.

.4 Prepare lists of maintenance materials special tools and spare parts for inclusion in operations and maintenance manuals.

1.2 MAINTENANCE MATERIALS

.1 Deliver specified items packaged to prevent damage.

.2 Identify, on carton or package, colour, room number, system or area, as applicable, where item is to be used.

1.3 SPECIAL TOOLS

.1 Assemble special tools as specified.

.2 Include following:

.1 Identification tag reference.
.2 Identification of equipment or system for which tools are applicable.

.3 Instruction on intended use of tool.

.4 Identify special tools to indicate equipment or system for which tools are intended.

1.4 SPARE PARTS

.1 Assemble spare parts as specified.

.2 Include the following:

.1 Part number.
.2 Identification of equipment or system for which parts are applicable.
.3 Installation instructions as applicable.
.4 Name and address of nearest supplier.

.3 Identify spare parts to indicate equipment or system for which parts are applicable.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 RECORD DRAWINGS

.1 Engineer will provide two sets of clean white prints and electronic full-size PDF copy for record drawing purposes.

.2 Identify drawings as "Project Record Copy".

.3 Maintain record drawings in new condition.

.4 Make record drawings available for inspection on-site by Engineer.

.5 Record neatly and accurately deviations from Contract Documents.

.6 Mark changes in red coloured ink.

.7 Record following information on one set of prints:

- .1 Depths of various elements of foundation in relation to geodetic datum.
- .2 Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvement.
- .3 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
- .4 Field changes of dimension and detail.
- .5 Changes made by Change Order or field direction.

.8 At completion of project and prior to final inspection, neatly transfer notations to second set of prints and submit both sets of record drawings to Engineer.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Procedures for demonstration and instruction of equipment and systems to Owner's personnel.

1.2 DESCRIPTION

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two (2) weeks prior to date of final inspection.

.2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.3 QUALITY CONTROL

.1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.4 SUBMITTALS

.1 Submit schedule of time and date for demonstration of each item of equipment and each system two (2) weeks prior to designated dates, for Engineer's approval.

.2 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.3 Give time and date of each demonstration, with list of persons present.

1.5 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation in accordance with Section 01 75 01 – Pre-start-up, Start-up and Commissioning.

.2 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 00 - Commissioning and equipment and systems are fully operational.

.3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.6 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

1.7 DEMONSTRATION AND INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.

.2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

.4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

1.8 TIME ALLOCATED FOR INSTRUCTIONS

.1 Ensure amount of time required for instruction of each item of equipment or system as follows, or as specified in individual Sections if greater than times below:

.1 Division 23 - Cooling and Ventilation Systems: 4 hours of instruction.

.2 Division 22 - Plumbing Systems: 4 hours of instruction.

.3 Division 26- Electrical and Control Systems: 8 hours of instruction.

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 START-UP AND ADJUSTMENT

.1 Test, adjust, balance and put into trial operation all mechanical, electrical, and control works and equipment prior to commissioning, as specified elsewhere in these documents.

1.2 DOCUMENTATION

.1 Refer to the Construction Completion Certificate (CCC) requirements specified elsewhere in these documents.

.2 Final Completion is subject to the acceptance of the CCC for each system, but acceptance of the CCC is not to be construed as acceptance of the system.

.3 Contractor responsibilities under CCC:

.1 Certify that system is prepared and ready for commissioning and operation.

.2 Assume responsibility for commissioning and initial operation.

1.3 COMMISSIONING

.1 The Commissioning Period is that period of time required to put the Work into continuous operation, to the satisfaction of Engineer.

.2 Give Engineer 48 hours prior notice before commencing commissioning procedures.

.3 Commission Work in an orderly fashion, system by system, where system is defined as an integral operating entity or loop.

.4 Provide sufficient trained and knowledgeable workers during the Commissioning Period to ensure smooth and orderly commissioning of Work.

.5 Make adjustments to equipment and other works, as necessary to place Work into operation.

.6 Trial operation:

.1 Trial operate all units.

.2 Check mechanical operation.

.3 Check for overload and undue vibration.

.4 Make necessary adjustments.

.7 Initial operation:

.1 Operate pumping units at design load.

.2 Check operation for alignment, clearance and rigidity.

.3 Make necessary adjustments.

.8 Alignments:

.1 Break open couplings between drivers and pumps after run-in period.

.2 Check alignments.

.3 Engineer to witness alignment checks and adjustments.

.9 Calibrate instrument primary elements, such as flow and pressure transmitters.

.10 Tune control loops to optimum performances by adjusting the action of pneumatic controllers.

.11 Make final adjustments to the setpoints of field mounted pressure, level and temperature switches.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Approved: 2017-07-21

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for the following:

- .1 Demolition and removal of the buildings and structures.
- .2 Demolition and removal of site improvements adjacent to a building or structure being demolished.
- .3 Demolition and removal of concrete foundation system.
- .4 Removing below grade construction including concrete duct banks and electrical cables.
- .5 Abandoning in place existing electrical ducts that do not conflict with new construction.
- .6 Disconnecting, capping or sealing, and abandoning in place site utilities.

.2 This section does not include for the removal of Hazardous Substances or asbestos abatement, or selective demolition of interior building components and finishes.

.3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; contractor representative is required to develop these details further by submitting a demolition plan prepared by a professional engineer.

1.2 REFERENCE STANDARDS

.1 Department of Justice Canada (Jus)

- .1 Canadian Environmental Assessment Act (CEAA), 2012.
- .2 Canadian Environmental Protection Act (CEPA), 2012.
  - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.
  - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
  - .4 Motor Vehicle Safety Act (MVSA), 1995
  - .5 Hazardous Substances Information Review Act, 1985

.2 National Fire Protection Association (NFPA)

- .1 NFPA 241-13, Standard for Safeguarding Construction, Alteration, and Demolition Operations

.3 National Research Council Canada (NRC)

- .1 National Building Code of Canada 2010 (NBC).

.4 Hazardous Building Material Survey and Record Drawings

- .1 Refer to hazardous building material survey report prepared by WSP, dated November 13, 2017.

.2 Refer to existing drawings of the electrical building, dated February 1970 and March 1989.

1.3 DEFINITIONS

.1 Demolition: rapid destruction of building following removal of Hazardous Substances.

.2 Hazardous Substances: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: asbestos PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

.3 Draft Construction Waste Management Plan (Draft CWM Plan): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill.

.1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project

.4 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of.

.5 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate with Owner for the material ownership as follows:

.1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner 's property, demolished materials shall become Contractor ’s property and shall be removed from Project site.

.2 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during demolition remain Owner 's property.

.2 Pre-Demolition Meetings:

.1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Engineer to:

.1 Verify project requirements.

.2 Verify existing site conditions adjacent to demolition work.

.3 Co-ordination with other construction subtrades.

.2 Hold project meetings every week.

.3 Ensure site supervisor, subcontractor representatives, and WMC attend.

.4 WMC must provide written report on status of waste diversion activity at each meeting.

.5 Engineer will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

.3 Scheduling:

.1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.

.1 In event of unforeseen delay notify Engineer in writing.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in the province of British Columbia as follows:

.1 Submit for review and approval demolition drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning.

.2 Submit in accordance with Section 01 33 00- Submittals

.3 WMC is responsible for fulfilment of reporting requirements.

.4 Schedule of Demolition Activities: Coordinate with Section 01 32 16.06- Construction Progress Schedule, and indicate the following:

.1 Detailed sequence of demolition and removal work, with starting and ending dates for each activity.

.2 Interruption of utility services.

.3 Coordination for shutoff, capping, and continuation of utility services.

.4 Locations of temporary partitions and means of egress.

.5 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction.

.6 Proposed Dust Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation.

.7 Inventory: Submit a list of items that have been removed and salvaged after demolition is complete.

.1 Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

.2 Pre-demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by demolition operations.

.2 Informational Submittals: Provide the following submittals when requested by the Engineer:

.1 Certificates: Submit Statement of Refrigerant Recovery as follows:

.1 Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and

that recovery was performed according to regulations of Authority Having Jurisdiction.

.2 Include name and address of technician and date refrigerant was recovered.

.2 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of Engineer, for work of similar complexity and extent.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Ensure Work is performed in compliance with applicable Provincial/Territorial and Municipal regulations.

.1 Comply with hauling and disposal regulations of Authority Having Jurisdiction.

.2 Standards: Comply with ANSI A10.6 and NFPA 241

.2 Regulatory Requirements: Perform work of this Section in accordance with the following:

.1 Federal Workers' Compensation Service and Provincial/Territorial Workers' Compensation Boards/Commissions.

.2 Government of Canada, Labour Program: Workplace Safety Provincial/Territorial Occupational Health and Safety Standards and Programs.

1.7 SITE CONDITIONS

.1 Environmental protection:

.1 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

.2 Fires and burning of waste or materials is not permitted on site.

.3 Do not bury rubbish waste materials.

.4 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.

.5 Ensure proper disposal procedures are maintained throughout project.

.2 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction as directed by Engineer.

.4 Protect trees, plants and foliage on site and adjacent properties where indicated.

.5 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.

.6 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

.7 Conduct structure demolition so Owner 's operations will not be disrupted:

.1 Provide not less than 72 hours' notice to Owner of activities that will affect operations.

.2 Maintain access to existing walkways, exits, and other adjacent occupied or used facilities:

.1 Do not close or obstruct walkways, exits, or other occupied or used facilities without written permission from Engineer and Authority Having Jurisdiction.

.8 Engineer assumes no responsibility for buildings and structures being demolished:

.1 Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

.2 Remove, protect and store salvaged items as directed by Engineer before structure demolition.

.3 Salvage items as identified by Engineer.

1.8 EXISTING CONDITIONS

.1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.

.2 Existing Hazardous Substances: Owner] has performed a hazardous substances assessment and identified materials requiring abatement as follows:

.1 Hazardous substances are as defined in the report prepared by WSP as per Section 1.2.

.2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.

Part 2 Products

2.1 EQUIPMENT

.1 Equipment and heavy machinery:

.1 On-road vehicles to: CEPA-SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations.

.2 Off-road vehicles to: EPA CFR 86.098.

.3 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

2.2 TEMPORARY SUPPORT STRUCTURES

.1 Design temporary support structures required for demolition work and underpinning and other foundation supports necessary for the project using a qualified professional engineer registered or licensed in Province of the Work.

Part 3 Execution

3.1 EXAMINATION

.1 Survey existing conditions and correlate with requirements indicated to determine extent of structure demolition required.

.2 Review Project Record Documents of existing construction provided as per Section 003000.

.3 Engineer does not guaranty that existing conditions are the same as those indicated in Project Record Documents.

.4 Inventory and record the condition of items being removed and salvaged.

.5 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.

.6 Promptly submit a written report to Engineer.

.7 Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during structure demolition operations.

.8 Verify that Hazardous Substances have been remediated before proceeding with structure demolition operations.

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: requirements of authorities having jurisdiction and sediment and erosion control plan, specific to site, that complies with EPA 832, whichever is more stringent.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.

.2 Protection of in-place conditions:

.1 Support affected structures and, if safety of structure being demolished adjacent structures or services appear to be endangered, take preventative measures, stop Work and immediately notify Engineer.

.2 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.

.3 Surface Preparation:

.1 Disconnect any electrical and telephone service lines entering buildings to be demolished.

.1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.

.2 Disconnect and cap mechanical services.

.1 Sewer and water lines: remove as directed by Engineer.

.2 Other underground services: remove and dispose of as indicated.

.3 Underground piping: remove and dispose as directed, and in accordance with CCME PN 1326, ULC/ORD-S660, ULC/ORD-C58.15, ULC/ORD-C58.19 .

.4 Do not disrupt active or energized utilities designated to remain undisturbed.

.5 Remove rodent and vermin as required by Engineer.

3.3 DEMOLITION

.1 Protect demolition work.

.2 Blasting operations not permitted during demolition.

.3 Remove contaminated or dangerous materials as 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.

.4 Prior to start of Work remove contaminated or hazardous materials from site and dispose of at designated disposal facilities in safe manner. Refer Existing Conditions in PART 1.

.5 Demolish structures.

.6 Crush concrete generated due to demolition of foundations to size suitable for recycling.

.1 Where possible, identify markets which will accept crushed material as aggregate.

.7 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.

.8 At end of each day's work, leave Work in safe and stable condition.

.1 Protect interiors of parts not to be demolished from exterior elements at all times.

.9 Demolish to minimize dusting. Keep materials wetted.

.10 Demolish masonry and concrete walls in pieces.

.11 Remove structural framing.

.12 Contain fibrous materials to minimize release of airborne fibres while being transported within facility.

.13 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.

.14 Use natural lighting to do Work where possible.

.1 Shut off lighting except those required for security purposes at end of each day.

3.4 SITE RESTORATION

.1 Below Grade Areas: Rough grade below grade areas ready for further excavation or new construction.

.2 Below Grade Areas: Completely fill below grade areas and voids resulting from structure demolition operations with satisfactory soil materials according to backfill requirements.

.3 Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes.

.4 Provide a smooth transition between adjacent existing grades and new grades.

3.5 REPAIRS

.1 General: Promptly repair damage to adjacent construction caused by structure demolition operations.

.2 Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

.3 Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.6 CLEANING

.1 Develop Construction Waste Management Plan related to Work of this Section.

.2 Waste Management: Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.3 Designate appropriate security resources / measures to prevent vandalism, damage and theft.

.4 Locate stockpiled materials convenient for use in new construction. Eliminate double handling wherever possible.

.5 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

.1 Label stockpiles, indicating material type and quantity.

.6 Separate from general waste stream each of following materials. Stockpile materials in neat and orderly fashion in location and as directed by Engineer for alternate disposal. Stockpile materials in accordance with applicable fire and safety regulations.

.7 Supply separate, clearly marked disposal bins for categories of waste material. NOTE: Specify materials to be reused in new construction.

.8 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.

.9 Transport material designated for alternate disposal using approved facilities in accordance with applicable regulations.

.10 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

.1 Disposal facilities must be those approved of.

.2 Written authorization from Engineer is required to deviate from disposal facilities.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)

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

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: in accordance with MMCD Division 01, convene pre-installation meeting one week prior to beginning of concrete works.

- .1 Ensure key personnel and site supervisor attend.
- .2 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in formwork liners and coatings and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Submit shop drawings for formwork and falsework, if applicable according to requirements as per below:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.
- .2 Prepare Shop Drawings in accordance with CSA S269.1 for formwork and falsework, if applicable.
- .3 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 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.

.5 Indicate sequence of erection and removal of formwork and falsework, if applicable.

.6 Include the following information on falsework Shop Drawings (if applicable):

.1 Longitudinal, lateral, vertical, dead, live and impact loads used in design.

.2 Safe bearing capacity of soil underneath mud sills.

.3 Maximum column, post and support loads.

.4 Deflection diagrams for beams with deflection of 10 mm or more.

.5 Deflection diagrams indicating initial and final elevation of deck surfaces, roofs and soffits.

.6 Grade of structural steel.

.7 Indicate steel posts, girders, beams, connections, bracing and welding, providing sufficient detail for safe performance of falsework.

.8 Fully detailed steel frame shoring.

.9 Species, grades and sizes of wood.

.10 Type and weight of equipment (moving or stationary) supported by falsework.

.11 Sequence, methods and rate of concrete placement.

.12 Proprietary equipment, adequately identified for checking purposes.

.13 Full details and locations of splices.

1.4 QUALITY CONTROL

.1 Quality Control: in accordance with Section 01 45 00 – Quality Control.

.2 Retain a professional engineer registered or licensed in Province of British Columbia, Canada, with experience in formwork and falsework (if applicable) design of comparable complexity and scope, to perform following services as part of Work of this Section:

.1 Design of formwork and falsework, if applicable.

.2 Review, stamp, and sign fabrication and erection Shop Drawings, design calculations and amendments.

.3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of Work is in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections a minimum of once per fortnight.

1.5 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect formwork from damages.

.3 Replace defective or damaged materials with new.

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 and CAN/CSA-S269.3.

.2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.

.2 Pan forms: removable, free of bends, dents, and residual concrete; having a high potential for reuse as indicated.

.3 Form ties:

.1 For concrete not designated 'Architectural': removable or snap-off metal ties, fixed or adjustable length, of a type that no metal will be within 40mm of the concrete surface when forms have been removed, and free of devices leaving holes minimum 25 mm diameter in concrete surface. Multiple strand ties are not permitted.

.2 For Architectural concrete; snap ties complete with plastic cones and light grey concrete plugs.

.4 Form liner:

.1 Plywood: medium density overlay Douglas Fir to CSA O121.

.5 Form release agent: Proprietary, non-volatile material not to stain concrete or impair subsequent application of finishes or coatings to surface of concrete, derived from agricultural sources, non-petroleum containing, non-toxic. Chemically active release agent containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms.

.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/falsework and ensure dimensions agree with drawings.

.2 Obtain Engineer’s approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1.

.5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.6 Do not place shores and mud sills on frozen ground.

.7 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.9 Align form joints and make watertight.

.1 Keep form joints to minimum.

.10 Locate horizontal form joints for exposed columns 1200 mm above finished floor elevation.

.11 Use 20 mm chamfer strips on external corners and 20 mm fillets at interior corners, joints, unless specified otherwise.

.12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.13 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.14 Line forms for following surfaces:

.1 Outer face of outside.

.2 Soffit of girders and underside of bridge decks if exposed.

.3 Exposed faces of abutments, wingwalls, piers and pylons: do not stagger joints of form lining material and align joints to obtain uniform pattern.

.4 Secure lining taut to formwork to prevent folds.

.5 Pull down lining over edges of formwork panels.

.6 Ensure lining is new and not reused material.

.7 Ensure lining is dry and free of oil when concrete is poured.

.8 Application of form release agents on formwork surface is prohibited where drainage lining is used.

.9 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.

.10 Cost of textile lining is included in price of concrete for corresponding portion of Work.

.15 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 3 days for footings and abutments.

.2 Remove formwork when concrete has reached 70% of its 28 day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.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 2400 mm apart.

.5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

.6 Time intervals given to be the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the air in contact with concrete is above 10°C and concrete has been damp or thoroughly sealed from evaporation and loss of moisture.

3.3 CLEANING

.1 Progress Cleaning: MMCD Division 03.

.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 and recycling in accordance with the project site waste management plan.

.1 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 American Concrete Institute (ACI)

.1 SP-66, ACI Detailing Manual.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A 1064/A 1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.3 CSA Group

.1 CSA-A23.1 /A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A23.3, Design of Concrete Structures.

.3 CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC, Reinforcing Steel Manual of Standard Practice.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: convene pre-installation meeting one week prior to beginning of concrete works.

.1 Ensure site supervisor and key personnel attend.

.2 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.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.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.

.2 Prepare reinforcement drawings in accordance with ACI SP-66.

.3 Indicate placing of reinforcement and:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Engineer, with identifying code marks to permit correct placement without reference to structural drawings.

.4 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

.1 Provide type B unless otherwise indicated.

.5 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 45 00 - Quality Control.

.2 Mill Test Report: upon request, submit to Engineer certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

.3 Upon request submit in writing to Engineer proposed source of reinforcement material.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Engineer.

.2 Reinforcing steel: billet steel, grade 400W, deformed bars to CSA-G30.18, unless indicated otherwise.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.

.4 Cold-drawn annealed steel wire ties: to CSA-G30.18.

.5 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2. Chairs to be plastic or plastic-coated steel.

.6 Tie wire: 1.5 mm diameter annealed wire.

.7 Mechanical splices: subject to approval of Engineer.

.8 Plain round bars: to CSA-G40.20/G40.21.

.9 Do not use materials with loose, scaly rust, dirt, oil, paint or other bond-breaking coatings.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and SP-66, ACI Detailing Manual.

.2 Obtain Engineer's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Engineer, 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 Engineer with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Inform Engineer of proposed source of supplied material.

Part 3 Execution

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Engineer.

.2 When field 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 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.

.4 Prior to placing concrete, obtain Engineer's approval of reinforcing material and placement.

.5 Notify the Engineer minimum 48h in advance to concrete pour to give sufficient time for rebar inspection.

.6 Maintain cover to reinforcement during concrete pour.

.7 Slab reinforcement to be supported at maximum 1200 mm each way. Tie every other bar intersection for slab top reinforcing at 300 mm or greater spacing.

.8 Protect projecting dowels from damage and cold bending.

3.3 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows:

.1 Reinforcing steel and welded wire fabric.

.2 Inspection and testing of reinforcing and reinforcing materials carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.

.1 Ensure testing laboratory certified to CSA A283.

.3 Ensure test results distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative, and Engineer.

.4 Departmental Representative will pay for costs of tests.

.5 Inspection or testing by Engineer not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 23 – Final Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

.4 ASTM C 881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

.5 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.6 ASTM C C1059/C1059M, Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

.7 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.8 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

.9 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.10 ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 CSA Group

.1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005),

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 and GUL - General use cement.

.2 MS and MSb - Moderate sulphate-resistant cement.

.3 MH, MHb and MHL - Moderate heat of hydration cement.

.4 HE, HEb and HEL - High early-strength cement.

.5 LH, LHb and LHL - Low heat of hydration cement.

.6 HS and HSb - High sulphate-resistant cement.

.2 Fly ash types:

.1 F - with CaO content maximum 8%.

.2 CI - with CaO content 15 to 20%.

.3 CH - with CaO minimum 20%.

.3 GGBFS - Ground, granulated blast-furnace slag.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: convene pre-installation meeting one week prior to beginning of concrete works.

.1 Ensure key personnel, site supervisor attend.

.2 Verify project requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals to be submitted to Engineer for review in accordance with Section 01330 - Submittals.

.2 Submit proposed mix design for each concrete type 2 weeks prior to commencement of work.

.1 Mix design shall specify the 28 or 56-day compressive strength, cement type, water cementing materials ratio, SCM content, maximum size aggregate, slump and air content. Mix design shall list all chemical admixtures.

.2 Recent test results for the proposed mix from at least five (5) separate sets of tests.

.1 28-day (or 56-day) compressive strength.

.2 Air content.

.3 Slump.

.3 Mix design to be signed and sealed by a qualified professional engineer registered in the Province of British Columbia and must include a letter confirming that:

.1 The proposed mix design will meet the requirements of this specification.

.2 The cement, supplementary cementing material, admixture, aggregates and water meet the requirements of this specification.

.3 Submit maximum heat of hydration for each watertight mix design, by testing concrete cylinders in insulated container. Monitor concrete temperature and ambient temperature during test.

.4 Submit proposed method of curing for watertight concrete. Watertight concrete refers to all concrete in the channels, submerged or partially submerged in liquid.

.5 Submit pour schedule with proposed locations of construction joints.

.6 Submit details of cold weather and hot weather protection.

.7 Submit quality control procedures.

.8 Submit manufacturer's data on floor hardener.

.9 Submit manufacturer's data on joint sealants.

.10 Submit method of crack repair.

1.5 QUALITY CONTROL

.1 Quality Control: in accordance with Section 01 45 00 – Quality Control.

.2 Provide Departmental Representative and Engineer, 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 meet specified requirements.

.3 At least 4 weeks prior to beginning Work, inform Departmental Representative and Engineer of source of fly ash.

.1 Changing source of fly ash without written approval of Engineer is prohibited.

.4 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative and Engineer on following items:

.1 Falsework erection.

.2 Hot weather concrete.

.3 Cold weather concrete.

.4 Curing.

.5 Finishes.

.6 Formwork removal.

.7 Joints.

.5 Quality Control Plan: provide written report to Departmental Representative Engineer verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.2 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Modifying maximum time limit without receipt of prior written agreement from Engineer or laboratory representative and concrete producer as described in CSA A23.1/A23.2. is prohibited.

.2 Deviations submitted for review by Engineer.

.3 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.7 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:

.1 Refer to CSA A23.1 Clause 7.4.1.5. Cold Weather Concreting.

.2 Maintain protection equipment, in readiness on Site.

.3 Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.

.4 Placing concrete upon or against surface at temperature below 5°C is prohibited.

.5 Maintain temperature of reinforcing bars and forms above 10°C prior to placing concrete.

.6 Maintain temperature of concrete when deposited in forms not less than 15°C and not higher than 25°C.

.7 Maintain temperature of concrete at surfaces at least 10°C for a minimum period of seven (7) days after placing and achieving minimum 75 percent of specified strength. Concrete temperature may then be lowered to ambient air temperature at a rate of 1.2°C per hour or 10°C per day.

.4 Hot weather protection:

.1 Refer to CSA A23.1 Clause 7.4.1.4 Hot Weather Concreting.

.2 Protect concrete from direct sunlight when ambient temperature above 27°C.

.3 Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.

.4 Monitor concrete temperatures. After concrete temperature has peaked, control rate of cooling to ambient air temperature at a rate of ½°C per hour to prevent cracking.

.5 Protect from drying. Keep concrete continuously moist during the curing period.

Part 2 Products

2.1 MATERIALS

.1 Portland Cement: GU.

.1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.

.2 Supplementary cementing materials: with minimum 20% fly ash replacement, by mass of total cementitious materials to CSA A3001.

.3 Water: to CSA A23.1.

.4 Aggregates: to CSA A23.1/A23.2.

.5 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: to ASTM C494. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.

.6 Curing compound: to CSA A23.1/A23.2.

.7 Waterstops: Hydrophilic waterstop or ribbed extruded PVC of sizes 100mm across containment curbs within building:

.1 Tensile strength: to ASTM D412.

.2 Elongation: to ASTM D412.

.3 Tear resistance: to ASTM D624.

.8 Protective coating on concrete:

.1 Liquid epoxy resin and liquid polyamine hardener on slab and walls within buildings within channels against liquid contents. Submit product data sheet for engineer to approve. Contractor to confirm coating systems will work with air contents specified for the concrete mix design. Acceptable products: Sikagard E.W.L., with Sikagard 75 EpoCem if reprofiling is required, or approved equal.

.2 Penetrating silane sealing slab surface sealant for exposed concrete, other than apron or exterior equipment pads. Submit product data sheet for engineer to approve. Contractor to confirm sealant system will work with air contents specified for the concrete mix design. Acceptable product: W. R. Meadows Intraguard, or equal.

.9 Joint Sealants:

.1 Joints Sealant: Sikaflex 2C SL Polyurethane Sealant primed with Sikaflex Primer 202. Sealant and primer by Sika Canada Inc., or as approved.

.2 Joint Sealant: Krystol T1 and T2 by Kryton International, or Xypex Patch and Plug and Xypex Concentrate by Xypex Chemical Corporation, for wet conditions.

2.2 MIXES

.1 Provide **watertight concrete mix No.1** to meet following hard state requirements:

.1 Durability and class of exposure: A-1.

.2 Compressive strength at 28/56 days of age: 35 MPa minimum.

.3 Intended application: Screen Building.

.4 Aggregate size: 20 mm.

.5 Admixture: air-entraining.

.6 Supplementary cementing materials: with minimum 30% fly ash replacement, by $kg/m^3$of total cementitious material.

.7 Water: 0.40.

.8 Air content category: 1.

.9 Volume stability: acceptable volume change range.

.10 Quality Plan: 01 45 00 - Quality Control.

.2 Provide **structural concrete mix No. 2** to meet following hard state requirement.

.1 Class of exposure: C-1.

.2 Compressive strength at 28 days of age: 35 MPa minimum.

.3 Intended application: UV and Screen Buildings Raft Slabs, exterior equipment space, aprons

.4 Aggregate: normal-density, maximum size 20 mm.

.5 Admixture: air-entraining.

.6 Supplementary cementing materials: with maximum 30 % fly ash replacement, by kg/$m^3$of total cementitious material.

.7 Water: 0.40.

.8 Air content category: 1.

.9 Slump: at time and point of discharge 40-80.

.10 Quality Plan: 01 45 00 - Quality Control.

.3 Provide **concrete mix No.4** to meet following hard state requirements:

.1 Durability and class of exposure: N.

.2 Compressive strength at 28 days of age: 20 MPa minimum.

.3 Intended application: Lean mix and thrust blocks.

.4 Aggregate size: 20 mm.

.5 Water: 0.50.

Part 3 Execution

3.1 PREPARATION

.1 Obtain Engineer's written approval before placing concrete.

.1 Provide 48 hours minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 Roughen all construction joints to minimum 6 mm amplitude with exposed aggregate finish by sandblasting or water blasting (minimum 35 MPa (5000 psi)) green concrete or other technique approved by Engineer.

.4 Minimum of 7 days to elapse between adjacent wall or slab pours.

.5 Pumping of concrete permitted only after approval of equipment and mix.

.6 Disturbing reinforcement and inserts during concrete placement is prohibited.

.7 Prior to placing of concrete obtain Engineer's approval of proposed method for protection of concrete during placing and curing.

.8 Protect previous Work from staining.

.9 Clean and remove stains prior to application for concrete finishes.

.10 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.

.11 In locations where new concrete dowelled to existing work, drill holes in existing concrete.

.1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.

.12 Do not place load upon new concrete until authorized by Departmental Representative Engineer.

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work to CSA A23.1/A23.2.

.2 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Engineer.

.2 Where approved by Engineer, 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 reviewed by Engineer.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Engineer before placing of concrete.

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Anchor bolts:

.1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.

.2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Engineer.

.1 Drilled holes: to manufacturers' recommendations.

.3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.4 Set bolts and fill holes with epoxy grout.

.5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

.4 Finishing and curing:

.1 Finish concrete to CSA A23.1/A23.2.

.1 Base Slab: Steel trowel finish floor for interior slab and broom finish floor for exterior slab. Trowel finishing tolerance 5 mm in 3.0 m.

.2 Apron: non-slip, broom finish.

.2 Do not sprinkle dry cement or dry cement sand mixture over concrete surfaces.

.3 Use procedures as noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface not damaged.

.4 Cure structural slab as follows:

.1 For a minimum of 7 days at a minimum temperature of 10°C by maintaining concrete surfaces continuously moist.

.2 Until concrete reaches 70% of specified 28-day strength as determined by field cured cylinders.

.3 Cure base slab concrete for minimum 14 days.

.5 Cure watertight concrete floor slabs, by one of the following methods:

.1 Ponding.

.2 Absorptive fabric covered with polyethylene and kept continuously moist.

.3 Continuous sprinkling is not an acceptable alternative.

.6 Cure watertight concrete walls as follows:

.1 Continuously soak top of wall.

.2 Loosen forms as soon as possible without damaging concrete.

.3 Maintain continuous supply of water to top of wall to keep inside of forms wet.

.7 Provide screed finish unless otherwise indicated.

.8 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.

.5 Repair honeycombed and defective concrete with method approved by Engineer.

3.3 CRACK REPAIR

.1 Visible cracks to be repaired by method approved by Engineer.

.2 Visible cracks in the walls within the zone of permanent backfill to be repaired by routing out cracks and installing Crystol T1 by Kryton or Xypex Concentrate by Xypex in accordance with manufacturer's instructions. Submit proposed method of repair to Engineer for approval prior to proceeding with repairs.

.3 Visible cracks in the slabs shall be repaired by epoxy injection. Contractor to submit procedure to Engineer for review two weeks prior to commencing with repair.

3.4 FIELD QUALITY CONTROL

.1 The Contractor will engage a Testing Laboratory to carry out concrete testing in accordance with CSA A23.1.

.2 A strength test will consist of 5 standard cylinders, one tested at 7 days, 2 at 28 days, and 2 at 56 days.

.3 Frequency of testing to CSA-A23.1 except minimum one strength test for each 50 m^3 of concrete.

.4 Take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.5 Take additional air content tests for concrete exposed to freezing and thawing in accordance with CSA A23.1, Clause 17.

.6 All testing costs will be paid for by the Contractor.

.7 Concrete failing to meet the requirements to be retested, strengthened or rejected in accordance with CSA A23.2. All additional testing, strengthening, and/or replacement to be at the Contractor's expense.

.8 The Engineer may monitor the mixing and handling of concrete, take additional strength and slump tests, and check all matters affecting quality control of the concrete. Extend full cooperation and assistance to the Engineer, including provision of access and samples for testing.

.9 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

.10 Inspection or testing by Engineer not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.5 CLEANING

.1 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.2 Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal.

.3 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION

Part 1 General

1.1 DESIGN REQUIREMENTS

.1 Design precast elements to CAN3-A23.3, CAN3-A23.4 and ASTM C1433 to carry handling stresses.

.2 Design precast elements to carry loads in accordance with ASTM C1433.

.3 Product requirements:

.1 Minimum internal dimensions: shown on the drawings.
.2 Minimum 28-day compressive strength: 35 MPa.
.3 Minimum concrete cover to reinforcing steel: 30 mm.
.4 Maximum crack width equal 0.2 mm.
.5 Maximum water/cementing material ratio: 0.40.
.6 Range in air content: 5% to 8%.
.7 Cement: Type HS.
.8 Provide openings and inserts as detailed on the drawings.
.9 Joints: to be made watertight using rubber rings equal to Butyl Mastic Joint Sealant or bituminous compound and Sikaflex 2C non-shrink, non-metallic grout or equal. Design connections/attachments of precast elements.

.4 Submit detailed design drawings for typical precast elements and connections to the Engineer for review prior to manufacture.

.5 Design connections/attachments of precast elements to load/forces specified by Engineer.

1.2 PERFORMANCE REQUIREMENTS

.1 Tolerance of precast elements to ASTM C1433.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 011000 – General Requirements, and in accordance with CAN3-A23.3 and CAN3-A23.4.

.2 Include the following items:

.1 Details of prestressed and non-prestressed members, reinforcement and their connections.
.2 Finishing schedules.
.3 Methods of handling and erection.
.4 Openings, sleeves, inserts and related reinforcement.
.5 Details of lining, anchoring of stop log frames, custom hatches and other custom details as shown in Contract Drawings.

.3 Ensure each drawing submitted bears stamp and signature of qualified professional engineer registered or licensed in province of British Columbia, Canada.

1.4 QUALIFICATIONS

.1 Precast concrete elements to be fabricated and erected by manufacturing plant certified by Canadian Standards Association in appropriate categories according to CSA-A251.

.2 Precast concrete manufacturer to be certified in accordance with CSA's certification procedures for precast concrete plants prior to submitting tender and to specifically verify as part of tender that plant is currently certified in appropriate category, Structural.

.3 Only precast elements fabricated in such certified plants to be acceptable to owner, and plant certification to be maintained for duration of fabrication, erection until warranty expires.

.4 Precast concrete elements to be fabricated by manufacturing plant certified by Ontario Concrete Pipe Association.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Precast concrete box sections.

.2 Precast concrete vault sections.

.3 Precast concrete barriers

.4 Manufacture units in accordance with ASTM C1433.

.5 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast on part of unit which will not be exposed.

.6 Provide hardware suitable for handling elements.

.7 Galvanize anchors and steel embedments after fabrication and touch up with zinc-rich primer after welding.

.8 Joints: make watertight using cement mortar or rubber gaskets to ASTM C443M, or combination of above.

.9 Mortar:

.1 Aggregate to CSA A82.56.

.2 Cement to CAN/CSA-A8.

.10 Lining

.1 Provide lining as shown in the Contract Drawings.

.11 Flexible Connectors

.1 All chambers to have resilient connectors between reinforced concrete manhole structures, pipes and laterals to ASTM C923M.

.2 Where flexible pipe penetrates domestic chambers, flexible gaskets shall be provided. Flexible gaskets will be factory installed as often as reasonably practical and field installed when necessary.

.3 Approved product: Kor-N-Seal or Press Seal.

.12 Ladder rungs to be:

.1 To conform to ASTM C497, ASTM C478M load test.

.2 20 mm cold rolled steel, hot dipped after bending to CSA G164, welded to reinforcing bars and cast with manhole sections or epoxy grouted into manhole walls.

.3 20 mm aluminum alloy #6351-T6 (CSA S157 and NBC 1977), complete with polyethylene anchor insulating sleeves and installed in 25 mm or 26 mm precast or drilled holes in manhole sections; embedment depth to meet ASTM C478 and ASTM C497 load and manufacturing requirements.

.4 Polypropylene encased steel ladder rungs: polypropylene ASTM D4101 steel core to be 1/2-inch dia grade 60 as per ASTM A615M.

.5 Minimum rung length 330 mm, minimum projection from structure wall 100 mm, maximum vertical spacing 300 mm.

.6 Distance from top of manhole cover to top rung to be maximum 500 mm where no handhold provided. Maximum distance may be extended to 660 mm where handhold provided.

.7 In compliance with all requirements of Worksafe BC.

.13 for valve chambers: cold rolled steel to CAN/CSA-G40.20, hot-dip galvanized after fabrication to CAN/CSA-G164 or aluminum alloy #6061-T6 to CAN3-S157 and NBC 1990.

.14 Precast concrete lids to H-20 loading conditions.

.15 Access Hatches:

.1 Hatch to be aluminum, MSU Type as shown on drawings.

.2 Hinge the hatch for easy opening with less than 225 N lifting force and provide a pad lock hasp with a box enclosure to prevent vandalizing of the lock.

.3 Apply 25 mm neoprene weather strip tape around perimeter of hatches to prevent rainwater access.

.4 Hatch to be suitable to be fully opened, secured, and locked in the open position.

.5 Hinges and hasp to be stainless steel.

Part 3 Execution

3.1 ERECTION

.1 Do precast concrete work in accordance with ASTM C1433.

.2 Install units as indicated on the Contract Drawings, true to alignment and grade, and not resting on pipe.

.3 Install precast units on in accordance with ground improvements, subgrade preparation, and preload requirements, where required, as directed by Geotechnical Engineer and shown on Contract Drawings.

.4 Install precast concrete barriers on firm, compacted, smooth ground, or undisturbed natural ground.

.5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab. Make each successive joint watertight with approved rubber ring gaskets.

.6 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.

.7 Plug lifting holes with mortar.

.8 Install aluminum hatch on top section to elevation indicated.

.9 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

.10 Protection, storage, and handling of precast concrete units to Manufacturer's recommendations.

3.2 CLEANING

.1 Obtain approval of cleaning methods from Engineer before cleaning soiled precast concrete surfaces.

.2 Clean units of debris and foreign materials. Remove fins and sharp projections.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group

.1 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.2 CAN/CSA-A179, Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A371, Masonry Construction for Buildings.

.2 International Masonry Industry All-Weather Council (IMIAC)

.1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings: Conduct pre-installation meeting one week prior to commencing work of this Section to:

.1 Verify project requirements, including mock-up requirements.

.2 Verify substrate conditions.

.3 Co-ordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Co-ordinate 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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.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.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.

.2 Submit shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

.4 Samples:

.1 Provide samples as follows:

.1 6 of each type of concrete masonry unit specified, including special shapes, supplemented with specific requirements in Section.

.2 2 samples of grout and mortar, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04 05 13 - Masonry Mortar and Grout.

.3 2 of each type of masonry accessory and flashing specified.

.4 2 of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19 - Masonry Anchorage and Reinforcing.

.5 Samples: used for testing and when accepted become standard for material used.

.5 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.

.6 Test and Evaluation Reports:

.1 Submit certified test reports in accordance with Section 01 33 00 - Submittals.

.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.

.7 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

.8 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:

.1 Verification of compliance of work with Contract.

.2 Site visit reports providing detailed review of installation of work, and installed work.

1.4 CLOSEOUT SUBMITTALS

.1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual.

1.5 EXTRA MATERIALS

.1 Submit manufacturer's instructions covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.6 QUALITY CONTROL

.1 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.

.2 Construct mock-up panel of exterior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, pointing, coursing, mortar and quality of work.

.3 Mock-up used:

.1 To judge quality of work, substrate preparation, operation of equipment and material application.

.2 For testing to determine compliance with performance requirements. Perform following tests:

.1 For clay units, in addition to requirements set out in referenced CSA and ASTM Standards include data indicating initial rate of absorption.

.4 Construct mock-up where directed by Engineer.

.5 Allow 48 hours for inspection of mock-up by Engineer before proceeding with work.

.6 When accepted by Engineer, mock-up to demonstrate minimum standard for this work. Mock-up may remain as part of finished work.

.7 Start work only upon receipt of written acceptance of mock-up by Engineer.

1.7 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 and 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 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

.5 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

.1 Ambient Conditions: assemble and erect components when temperatures are above 4°C.

.2 Weather Requirements: to CAN/CSA-A371.

.3 Cold weather requirements:

.1 To CAN/CSA-A371 with following requirements.

.1 Maintain temperature of mortar between 5°C and 50°C until batch is used.

.2 Maintain ambient temperature of masonry work and its constituent materials between 5°C and 50°C and protect site from wind chill.

.3 Maintain temperature of masonry above 0°C for minimum of 7 days, after mortar is installed.

.4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10°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 Refer to Section 04 22 00 - Concrete Unit Masonry.

Part 3 Execution

3.1 INSTALLERS

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

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 Engineer of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Engineer.

.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 prior to installation of concrete block.

.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 Exposed masonry:

.1 Remove chipped, cracked, and otherwise damaged units, in accordance with CAN/CSA-A165, in exposed masonry 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.

.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 Wetting of bricks:

.1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mm^2: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.

.2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

.6 Support of loads:

.1 Use 25 MPa 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; keep paper 25 mm back from faces of units.

.7 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. Do not use wedges.

.3 Built masonry to tie in with stabilizers, with provision for vertical movement.

.8 Loose steel lintels:

.1 Install loose steel lintels. Centre over opening width.

.9 Interface with other work:

.1 Cut openings in existing work as indicated.

.2 Openings in walls: reviewed Engineer.

.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 45 00 - Quality Control.

.2 Notify inspection agency minimum of 48 hours in advance of requirement for tests.

.2 Manufacturer's Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, and protection of its products, and submit written reports in acceptable format to verify compliance of work with Contract.

.2 Manufacturer's site services: provide manufacturer's site services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

.4 Obtain reports within 3 days of review and submit immediately to Engineer.

3.8 CLEANING

.1 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 approved by Engineer.

.3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.

.2 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 herein.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group

.1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A179, Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A371, Masonry Construction for Buildings.

.4 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.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.

.3 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00S - 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 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 Store and protect masonry mortar and grout packages from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.5 SITE CONDITIONS

.1 Ambient Conditions: maintain materials and surrounding air temperature to:

.1 Minimum 5°C prior to, during, and 48 hours after completion of masonry work.

.2 Maximum 32°C prior to, during, and 48 hours after completion of masonry work.

.2 Weather Requirements: CAN/CSA-A371.

Part 2 Products

2.1 MATERIALS

.1 Use same brands of materials and source of aggregate for entire project.

.2 Mortar and grout: CSA A179.

.3 Use aggregate passing 1.18 mm sieve where 6 mm thick joints are indicated.

.4 Colour: ground coloured natural aggregates or metallic oxide pigments.

.5 Mortar for exterior masonry above grade:

.1 Loadbearing: Type S based on Property specifications.

.6 Mortar for interior masonry:

.1 Loadbearing: Type S based on Property specifications.

.7 Following applies regardless of mortar types and uses specified above:

.1 Mortar for grouted reinforced masonry: Type S based on property specifications.

.2 Mortar for pointing: Type S based on proportion specifications.

.8 Coloured mortar: use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement.

.9 Non staining mortar: use non staining masonry cement for cementitious portion of specified mortar type.

.10 Grout following masonry components:

.1 All reinforced cores.

.2 Bond beams continuously.

.3 Other cores as indicated on drawings.

2.2 COLOUR ADDITIVES

.1 Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, to produce coloured mortar to match approved sample. Admixtures approved prior to use. Use in accordance with specific manufacturer's recommendations.

2.3 ADMIXTURES

.1 Water Repellent Agents: liquid.

2.4 MORTAR MIXES

.1 Colour and admixtures: Mix grout to semi fluid consistency.

.2 Coloured mortars: Incorporate colour and admixtures into mixes in accordance with manufacturer's instructions.

.3 Use clean mixer for coloured mortar.

.4 Pointing mortar: Pre-hydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour or more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

2.5 MORTAR MIXING

.1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to within 1% accuracy.

.2 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use.

.3 Maintain sand uniformly damp immediately before mixing process.

.4 Add mortar colour, admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.

.5 Using anti-freeze compounds including calcium chloride or chloride based compounds is prohibited.

.6 Adding air entraining admixture to mortar mix is prohibited.

.7 Use a batch type mixer in accordance with CAN/CSA-A179.

.8 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

.9 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.

.10 Use mortar within 2 hours after mixing at temperatures of 32°C, or 2-1/2 hours at temperatures under 5°C.

2.6 GROUT MIXES

.1 Bond Beams: grout mix 25 MPa strength at 28 days; 220-280 mm slump; mixed in accordance with CAN/CSA-A179.

.2 Lintels: grout mix 25 MPa strength at 28 days; 220-280 mm slump; in accordance with CAN/CSA-A179.

.3 Grout: Minimum compressive strength of 25 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA-A179.

2.7 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 fine grout.

.3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.

.4 Using calcium chloride or chloride based admixtures is prohibited.

2.8 MIX TESTS

.1 Testing Mortar Mix:

.1 Test mortar in accordance with CAN/CSA-A179, for mortar based on property specification. Test during construction for:

.1 Compressive strength.

.2 Consistency.

.3 Mortar aggregate ratio.

.4 Sand/cement ratio.

.5 Water content and water/cement ratio.

.6 Air content.

.7 Splitting tensile strength.

.2 Testing Grout Mix:

.1 Test grout in accordance with CAN/CSA-A179, for grout based on property specification. Test during construction for:

.1 Compressive strength.

.2 Sand/cement ratio.

.3 Water content and water/cement ratio.

.4 Slump.

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 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 Engineer.

3.2 PREPARATION

.1 Apply bonding agent to existing concrete surfaces.

.2 Plug clean-out holes with block masonry units. 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.

.2 Apply parging in uniform coating not less than total 10 mm thick.

3.4 MIXING

.1 Pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes.

.2 Clean mixing boards and mechanical mixing machine between batches.

.3 Mortar: weaker than units it is binding.

.4 Contractor to appoint one individual to mix mortar, for duration of project. In event that this individual is changed, mortar mixing must cease until new individual is trained, and mortar mix is tested.

3.5 MORTAR PLACEMENT

.1 Install mortar to manufacturer's instructions.

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.

3.7 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Test and evaluate mortar during construction in accordance with CAN/CSA-A179.

.2 Test and evaluate grout during construction to CAN/CSA-A179; test in conjunction with masonry unit sections specified.

.2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

3.8 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Remove droppings and splashings using clean sponge and water.

.3 Clean masonry with low pressure clean water and soft natural bristle brush.

.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 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)

- .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CAN/CSA-A179, Mortar and Grout for Unit Masonry.
- .3 CAN/CSA-A370, Connectors for Masonry.
- .4 CAN/CSA-A371, Masonry Construction for Buildings.
- .5 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
- .6 CSA S304, Design of Masonry Structures.
- .7 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.2 Reinforcing Steel Institute of Canada (RSIC)

- .1 Reinforcing Steel Manual of Standard Practice.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.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.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in province of British Columbia, Canada.
- .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 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.3 QUALITY CONTROL

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - 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 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

1.4 SITE MEASUREMENTS

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 Store and protect anchorage and reinforcing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Bar reinforcement: Steel to CAN/CSA-A371 and CSA G30.18, Grade 400W.

.2 Connectors: to CAN/CSA-A370 and CSA S304.1.

.3 Corrosion protection: to CSA S304.1, galvanized to CSA S304.1 and CAN/CSA-A370.

.4 Fasteners: installed post-construction:

.1 Screw Shields and Plugs: water-resistant.

.2 Bolts and Screws: size and type to suit application, locate where indicated.

.3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.

.4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.

.5 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.

.5 Ties: hot dip galvanized to CAN/CSA-A370 Table 5.2 steel finish.

.1 Corrugated to: CAN/CSA-A370.

.2 Unit ties, to CAN/CSA-A370: wire stainless steel, size to suit application.

.3 Adjustable Unit Ties: to CAN/CSA-A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations.

.4 Joint Reinforcement Ties: CSA A371 with corrosion protection to CSA S304 and CSA A370:

.1 Single Wythe Joint Reinforcement: ladder type:

.1 Steel wire, hot dip galvanized: to ASTM A641.

.2 Multiple Wythe Joint Reinforcement: ladder type: without moisture drip; adjustable:

.1 Steel wire, hot dip galvanized: to ASTM A641.

.6 Anchors: to CAN/CSA-A370:

.1 Conventional Anchors: type steel bolts with bent bar anchors, shape L, sized to suit application.

.2 Wedge Anchors: expansion anchors type wedge and bolt, sized to suit application.

.3 Sleeve Anchors: type sleeve and bolt, sized to suit application.

.4 Self-Contained Anchors: type double-glass/plastic vial system, with epoxy resin and hardener.

.5 Anchor Bolts: proprietary (patented) galvanized to CAN/CSA-A370 Table 5.2 uncoated finish.

.7 Conventional Bolts:

.1 Bolts: to ASTM A36, bar stock shop threaded.

.2 Plate anchors: steel to ASTM A36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.

.3 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A36 bar stock.

.8 Adhesive Anchors: proprietary systems, measure and mix system where epoxy materials are hand-measured and mixed in accordance with manufacturers' written instructions.

2.2 FABRICATION

.1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by Reinforcing Steel Institute of Canada.

.2 Fabricate connectors in accordance with CAN/CSA-A370.

.3 Obtain Engineer's approval for locations of reinforcement splices other than shown on placing drawings.

.4 Upon approval of Engineer, weld reinforcement in accordance with CSA W186.

.5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Engineer with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 5 weeks prior to commencing reinforcement work.

.2 Upon request, inform Engineer of proposed source of supplied material.

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 Engineer.

.2 Inform Engineer of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from Engineer.

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 concrete, obtain Engineer's approval of placement of reinforcement and connectors.

.3 Supply and install additional reinforcement to masonry as indicated.

3.4 BONDING AND TYING

.1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CAN/CSA-A371 and as indicated.

.2 Tie masonry veneer to backing in accordance with National Building Code of Canada (NBC), CSA S304.1, CAN/CSA-A371 and as indicated.

.3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370 and CAN/CSA-A371 and with manufacturer's instructions.

.1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371 and as indicated.

.2 Install horizontal joint reinforcement 400 mm on centre.

.3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 600 mm each side of opening.

.4 Place joint reinforcement continuous in first joint below top of walls.

.5 Lap joint reinforcement ends minimum 150 mm.

.6 Connect stack bonded unit 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.

.2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.

.3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

3.6 GROUTING

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

3.7 ANCHORS

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

3.8 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA S304.1 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 Engineer.

.2 When field bending authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars and connectors that have cracks or splits with undamaged bars.

3.11 FIELD QUALITY CONTROL

.1 Site inspections in accordance with Section 01 45 00 - Quality Control.

.2 Obtain Engineer approval of placement of reinforcement and connectors, prior to placing grout.

3.12 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.13 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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group

.1 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units.

.2 CAN/CSA-A371, Masonry Construction for Buildings.

.3 CSA S304.1, Design of Masonry Structures.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 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.

1.3 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - 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 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Construct mock-up panel of exterior concrete unit masonry construction 1200 x 1800 mm.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.

.2 Do not use brick tongs to move or handle masonry.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Do not double stack cubes of concrete unit masonry.

.3 Cover masonry units with non-staining waterproof membrane covering.

.4 Allow air circulation around units.

.5 Installation of wet or stained masonry units is prohibited.

.6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.

.7 Store and protect concrete unit masonry from nicks, scratches, and blemishes.

.8 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Standard concrete block units Type A: to CAN/CSA-A165 Series (CAN/CSA-A165.1).

.1 Classification: 20 (MPa).

.2 Dimensions Nominal: 200 mm wide x 200 mm high x 400 mm long.

.3 Special shapes: Provide corner offset blocks, 200x200x400 to suit corner layout. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

.4 Profile/Texture for Architectural Concrete Unit Masonry:

.1 Split faced: exterior.

.2 Running bond pattern.

.5 Colour:

.1 Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement. Color to be confirmed by Owner.

.2 Non staining mortar: use non staining masonry cement for cementitious portion of specified mortar type.

.6 Sealant: Polymer-modified acrylic penetrating sealant to provide resistance to dirt and moisture. Acceptable product: EnviroCoatings Canada Inc, Sealbond, or equal.

2.2 REINFORCEMENT

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

2.3 CONNECTORS

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

2.4 MORTAR MIXES

.1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.5 GROUT MIXES

.1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.6 CLEANING COMPOUNDS

.1 Use low VOC products.

.2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

.3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.7 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 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 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

.1 Concrete block units:

.1 Bond: running.

.2 Coursing height: 200 mm for one block and one joint.

.3 Jointing: concave where exposed or where paint or other finish coating is specified.

.2 Special Shapes:

.1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.

.2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

.3 End bearing: not less than as indicated on drawings.

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 12 - Masonry Mortar and Grout.

3.7 GROUT PLACEMENT

.1 Place grout in accordance with Section 04 05 12 - Masonry Mortar and Grout.

3.8 CONSTRUCTION

.1 Cull out masonry units, in accordance with CAN/CSA-A165 and reviewed 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 and interior 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.

3.9 REPAIR/RESTORATION

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.10 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: in accordance with Section 01 45 00 - Quality Control supplemented as follows:

.1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Departmental Representative in accordance with CSA S304.1.

.2 Notify inspection agency minimum of 48 hours in advance of requirement for tests.

.2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

3.11 CLEANING

.1 Progress Cleaning:

.1 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.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 23 – Final Cleaning.

3.12 PROTECTION

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

END OF SECTION

Approved: 2017-04-25

Part 1 General

1.1 REFERENCES

.1 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA)

- .1 CISC/CPMA 2-75, Quick-Drying, Primer for Use on Structural Steel.
- .2 CISC/CPMA 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel.

.2 Canadian Standards Association (CSA)

- .1 CSA G40.20 /G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA S16, Design of Steel Structures.
- .3 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.
- .4 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .5 CSA W55.3, Certificate of Companies for Resistance Welding of Steel and Aluminum.
- .6 CSA W59, Welded Steel Construction (Metal Arc Welding) Metric.

.3 The Master Painters Institute (MPI)

- .1 Architectural Painting Specification Manual - current edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for steel joist framing and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Colombia, Canada, who will be the supporting registered professional responsible for the design and field review of the design.
- .2 Indicate on erection drawings, relevant details such as joist mark, depth, spacing, bridging lines, bearing, anchorage and details.
- .3 Indicate particulars, on shop drawings, relative to joist geometry, framed openings, splicing details, bearing and anchorage. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.

.4 Delegated Design Submittals:

.1 Submit calculations and joist design drawings for typical joists, including any bridging or bottom chord extensions to engineer for approval and review minimum 4 weeks prior to fabrication and delivery.

1.3 QUALITY ASSURANCE

.1 Submit mill test reports minimum 4 weeks prior to fabrication of steel joists and accessories. Reports to show:

.1 Chemical and physical properties.

.2 Other details of steel incorporated into work.

.3 Certification by qualified metallurgists confirming that tests conform to requirements of CSA G40.20/G40.21.

.2 Submit affidavit prepared by fabricator of structural steel joists stating materials and products used in fabrication conform to this specification.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Basic 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 dry location and off ground 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 by manufacturer of packaging materials, crates, pallets, padding in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 SITE CONDITIONS

.1 Verify dimensions, openings, and roof top units or hatches sizes, and condition of existing work; report discrepancies and potential problem areas to Engineer for direction before commencing fabrication.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Design steel joists and bridging to carry loads and bracing indicated in the structural drawings shown to CSA S16 and CSA S136.

.2 Design joists and anchorages for uplift forces as engineered.

.3 Design for all components and primary and secondary elements including connections and bracing connected to steel joists.

.4 Design for BCBC 2012 load combinations for dead, live, snows, wind, seismic and superimposed loads are per structural drawings.

.5 Manufacture joists to consider load effects due to fabrication, erection and handling.

.6 Limit roof joist deflection due to specified live load to 240 maximum of span and deflection due to specified total load to 180 maximum of span.

2.2 MATERIALS

.1 Open web steel joists: to CSA S136 / CSA S16.

.2 Structural steel: to CSA S136 / CSA G40.20/G40.21.

.3 Welding materials: to CSA W59.

.4 Shop paint primer: to MPI - INT 5.1A / CISC/CPMA-2/ CISC/CPMA-1 / MPI - INT 5.1B.

.5 Shear studs: to CSA W59, Appendix H.

2.3 FABRICATION

.1 Fabricate steel joists and accessories as indicated in accordance with CSA S16 and CSA S136 and in accordance with approved shop drawings.

.2 Weld in accordance with CSA W59.

.3 Provide bottom chord extensions where indicated.

.4 Provide diagonal and horizontal bridgings and anchorages as required.

.5 Weld studs to top chords for attachment purposes, as required.

.6 Install shear studs in accordance with CSA W59.

2.4 SHOP PAINTING

.1 Clean, prepare and shop prime surfaces of steel joists to CSA S16.

.2 Clean members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces to SSPC SP1 brush blast.

.3 Apply one coat of CISC/CPMA 2 primer to steel surfaces to achieve dry film thickness of .065 mm to .080 mm maximum except:

.1 Surfaces encased in concrete.

.2 Surfaces to receive field installed stud shear connectors and steel decks.

.3 Surfaces and edges field welded.

.4 Faying surfaces of friction-type connections.

.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures minimum 5°C.

.5 Maintain dry condition and 5°C minimum temperature until paint thoroughly dry.

.6 Strip paint bolts, nuts, sharp edges and corners before prime coat dries.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for steel joist framing 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 ERECTION

.1 Do structural steel work: to CSA S16 and CSA S136.

.2 Do welding: in accordance with CSA W59.

.3 Ensure installers certified to CSA W47.1 for fusion welding and CSA W55.3 for resistance welding.

.4 Submit certification welded joints qualified by Canadian Welding Bureau.

.5 Erect steel joists and bridging as required to CSA S16 and in accordance with approved erection drawings.

.6 Complete installation of bridging and anchorages before placing construction loads on joists.

.7 Field cutting or altering joists or bridging not shown on shop drawings: to approval of Engineer.

.8 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.

3.3 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and work carried out by testing laboratory designated by Engineer.

.2 Testing laboratory to inspect representative joists for integrity, accuracy of fabrication and soundness of welds. Testing laboratory to also monitor test loading of joists used by manufacturer to verify design and check representative field connections. Engineer will determine extent of and identify inspections.

.3 Submit test report to Engineer within 7 days after completion of inspection.

.4 Contractor will pay costs of tests.

.5 Test shear studs to CSA W59.

3.4 FIELD PAINTING

.1 Paint: in accordance with Section 09 91 24 - Painting.

.2 Touch up damaged surfaces and surfaces without shop coat with CISC/CPMA-1 CISC/CPMA-2 MPI - INT 5.1B MPI - INT 5.1A in accordance with manufacturers' recommendations.

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.

.3 Waste Management: Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel joist framing installation.

END OF SECTION

Approved: 2010-06-30

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

- .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.3 CSA International

- .1 CSA S16, Design of Steel Structures.
- .2 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.
- .3 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .4 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .5 CSA W59, Welded Steel Construction, (Metal Arc Welding).

.4 Canadian Sheet Steel Building Institute (CSSBI)

- .1 CSSBI 10M, Standard for Steel Roof Deck.

.5 Submit in accordance with Section 01 33 00- Submittals.

.6 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for steel decking and include product characteristics, performance criteria, physical size, finish and limitations.

.7 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of British Columbia, Canada.
- .2 Submit design calculations if requested by Engineer.
- .3 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacing, projections, openings, reinforcement details and accessories.
- .4 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.
- .5 Low-Emitting Materials:
  - .1 Submit listing of paints and coatings used in building, comply with VOC and chemical component limits or restrictions requirements.

1.2 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, indoors, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect decking from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Design steel deck to CSSBI 10M, CSA S136, CSA S16, for whichever governs.

.2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.

.3 Deflection under specified live load not to exceed 1/240 of span, except that when plaster or gypsum board ceilings are hung directly from deck, live load deflection not to exceed 1/360 of span.

.4 Where vibration effects are to be controlled as indicated, dynamic characteristics of decking system to be designed to be in accordance with CSA S16.

.5 Fusion welds to CSA W47.1.

.6 British Columbia Building Code, BCBC.

2.2 MATERIALS

.1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 230 min, galvanneal steel with ZF75 coating, for interior surfaces not exposed to weather, galvanized finished.

.2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.

.3 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade 230 min, with ZF75, coating, regular spangle surface, not chemically treated for paint finish, for exterior surfaces exposed to weather.

.4 Acoustic insulation: fibrous glass 17.5 kg/m^3 density minimum profiled to suit deck flutes.

.5 Closures: in accordance with manufacturer's recommendations.

.6 Cover plates, cell closures, web stiffeners, edge strips and flashings: to be the same material and finish as steel deck. Metallic coating same as deck material. See architectural drawings for reference.

.7 Primer: zinc rich, ready mix to CAN/CGSB-1.181.

.1 VOC limit 250g/L maximum

.2 Sealants: VOC limit 250 g/L maximum.

.8 Shear studs: to CSA W59.

2.3 TYPES OF DECKING

.1 Steel roof deck: 38 mm profile, interlocking side laps.

2.4 WORK FURNISHED AND INCLUDED

.1 Steel roof deck

.2 Holes cut in deck

.3 Hole and edge reinforcing welded to deck

.4 Closures

.5 Metal upstands

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for steel decking 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 Structural steel work: in accordance with CSA S136, CSSBI 10M.

.2 Welding: in accordance with CSA W59, except where specified otherwise.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

3.3 ERECTION

.1 Erect steel deck as indicated and in accordance with CSA S136, CSSBI 10M and in accordance with reviewed erection drawings.

.2 Lap ends: to 150 mm minimum.

.3 Weld and test stud shear connectors through steel deck to steel joists/beams below in accordance with CSA W59.

.4 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

3.4 CLOSURES

.1 Install closures in accordance with approved details to ensure effective closure against weather, thermal and acoustic effects.

3.5 OPENINGS AND AREAS OF CONCENTRATED LOADS

.1 Cutting and reinforcing of openings in the steel roof deck shall be done at the time of the installation of the steel roof deck.

.2 No reinforcement required for openings cut in deck which are smaller than 150mm square.

.3 Reinforce deck openings with any one dimension between 150 to 450 mm as recommended by manufacturer, except as otherwise indicated.

.4 For deck openings with any one dimension greater than 450 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with the followings.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel decking installation.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

.1 CAN/CSA S16 Limit States Design of Steel Structures.

.2 CAN/CSA G40.20/G40.21 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.3 CSA S157/S157.1 Strength Design in Aluminum/Commentary on CSA S157, Strength Design in Aluminum.

.4 CSA W47.1 Certification of Companies for Fusion Welding of Steel.

.5 CSA W47.2 M Certification of Companies for Fusion Welding of Aluminum.

.6 CSA W55.3 Resistance Welding Qualification Code for Fabricators of Structural Members used in Buildings.

.7 CSA W59 Welded Steel Construction (Metal Arc Welding).

.8 CSA W59.2 M Welded Aluminum Construction.

.9 ASTM A36 Standard Specification for Carbon Structural Steel.

.10 ASTM A48 Standard Specification for Gray Iron Castings.

.11 ASTM A53 Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

.12 A108 Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished.

.13 ASTM A123/A, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.14 ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.15 ASTM A167 Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip.

.16 ASTM A193 Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and other Special Purpose Applications.

.17 ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

.18 ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile Strength.

.19 ASTM A312 Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipe.

.20 ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

.21 ASTM A511 Standard Specification for Seamless Stainless Steel Mechanical Tubing.

.22 ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip.

.23 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.

.24 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

.25 ASTM A276 Standard Specification for Stainless Steel Bars and Shapes Structural Members

.26 ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings.

.27 ASTM A786 Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.

.28 ASTM A793 Standard Specification for Rolled Floor Plate, Stainless Steel.

.29 ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

.30 ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

.31 ASTM B26 Standard Specification for Aluminum Alloy Sand Castings.

.32 ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.33 ASTM B221 Standard Specification for Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.34 ASTM B241 Standard Specification for Aluminum and Aluminum Alloy Seamless Pipe and Seamless Extruded Tube.

.35 B308 Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

.36 ASTM A429 Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

.37 ASTM B468 Standard Specification for Welded UNS N08020, N08024 and N08026 Alloy Tubes.

.38 ASTM B632 Standard Specification for Aluminum Alloy Rolled Tread Plate.

.39 ASTM F436 Standard Specification for Hardened Steel Washers.

.40 ASTM F738 Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs.

.41 ANSI B36.10 Pipe, Steel.

.42 ANSI/NAAMM MBG 531-88/NAAMM Metal Bar Grating Material.

.43 British Columbia Building Code (BCBC), 2012.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

.2 Indicate complete details necessary for fabrication and erection of the component parts of the structure, including:

.1 Location, type, size, and extent of welds.

.2 Include plans and elevations, details of sections and connection.

.3 Detail items indicating all dimensions, methods of anchorage and fixing, and accessory items.

.4 Confirm dimensions on site.

.5 Materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements

.1 Design miscellaneous metal items in accordance with applicable standards and as indicated on the drawings.

.2 Design work of this Section, which will support other items or will be required to support structural loads of any nature, by a professional structural engineer licensed in the Province of British Columbia. Affix professional seal and signature to shop drawings for such items.

.3 Design connections and splices using high strength bolts or welds. Use bearing type bolts for bolted connections.

.4 Where overlapping or contacting surfaces cannot be avoided, completely seal weld these surfaces. Where there is any evidence of rusting or deterioration of finish in such areas, carry out remedial seal welding and refinishing.

.5 Design aluminum work to CSA S157/S157.1 and CSA W59.2-M.

.6 Anchor sizing required a minimum factor of safety of 4 to 1 (allowable load vs. actual load).

1.4 SUBMITTALS

.1 Comply with Section 01 33 00 - Submittals.

.2 Shop Drawings: Submit shop drawings before fabrication commences of each metal fabrication item, showing in large scale fabrication details, thickness, anchors, location, dimensions, erection details, connections and jointing details, and finishes. Shop drawings to be signed and sealed by a Professional Engineer registered in BC.

.3 Submit welding procedure specification for each type of material.

.4 Coating applicator's Certificate of Compliance that hot-dip galvanized coating meets or exceeds the specified requirements of ASTM 123 or A153, as applicable. Coating applicator to also provide product data showing conformance to the specified product and indicating coating thickness.

1.5 QUALITY ASSURANCE

.1 Ensure workmanship of the highest quality throughout by employing only metal workers that have demonstrated the highest skills in this type of work and qualified welders certified to weld the materials used in fabrication of the miscellaneous metals.

1.6 QUALITY CONTROL

.1 Visual Requirements:

.1 Comply with the following requirements for steel exposed to view. Compliance will be judged from the closest in-service reviewing distance.

.2 Make all sections true, straight, with no dents, bends or other noticeable damage.

.3 In addition to the structural requirements, make all connection details meet, the aesthetic requirements of the Engineer.

.4 For all connections, respect the exposed nature of the element. Make all weld passes continuous with uniform bead size. Protect surrounding steel from damage due to weld spatter. Grind all welds to a smooth uniform surface to the approval of the Engineer.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries with construction schedule and arrange ahead for off the ground, covered storage locations.

.2 Handle and store metal materials at job site to prevent damage to other materials, existing buildings, structure, finishes or property.

.3 Handle components with care, and provide protection for surfaces against marring or other damage. Ship and store members with cardboard or other resilient spacers between surfaces.

.4 Use removable coatings or wrappings to protect exposed surfaces of prefinished metal work which does not receive site finishing. Use materials recommended by finishers or manufacturers to ensure that method is sufficiently protective, easily removed, and harmless to the finish.

.5 Prevent the formation of wet storage stain on galvanized members with the following measures:

.1 Stack members or bundle to allow air between the galvanized surfaces during transport from supplier. Load materials in position that continuous drainage could occur.

.2 Raise members from the ground and separate with strip spacers to provide free access of air to most parts of the surface. Incline in a manner which will allow continuous drainage. Do not lay galvanized steel on cinders, clinkers, wet soil or decaying vegetation.

.3 Handle galvanized members in such a manner as to avoid any mechanical damage and to prevent distortion.

1.8 COORDINATION

.1 Supply to concrete and/or other Sections, materials requiring setting and/or building-in in concrete or other trades. This includes inserts, anchors, frames, sleeves, etc. Verify locations of these materials on site before fabrication and erection.

Part 2 Products

2.1 GENERAL

.1 Where anchors, lifting hooks, screws, bolts, nuts, washers, hangers and other fasteners are not specifically shown or specified, provide such items with at least the strength and corrosion resistance properties of the metal fabrication for which they are required. Nuts and washers to be of same material and of equal or greater strength than bolts.

2.2 MATERIALS

.1 All metal fabrications and Fasteners to be as follows:

- .1 Interior of Buildings: galvanized steel with galvanized steel fasteners.
- .2 Roof hatch/cover: Hot dip galvanized steel or aluminum hatches with galvanized steel fasteners and anchors as indicated.
- .3 FRP Grating supporting beams: galvanized steel with galvanized steel fasteners.
- .4 Exterior or exposed stair platforms: Hot dip galvanized, unless noted otherwise.

.2 Metal Fabrications:

- .1 W and H Shapes:
  - .1 CAN/CSA-G40.20/G40.21 Grade 350W.
  - .2 ASTM A992, Grade 50 ksi.
- .2 Shapes Except W and H-Shapes, Rolled plates and Bars:
  - .1 CAN/CSA-G40.20/G40.21 Grade 300W.
- .3 Steel Pipe: ASTM A53, Type E or S, Grade B.
- .4 Hollow Structural Sections (HSS): CAN/CSA-G40.20/G40.21 Grade 350W Class C.
- .5 Cold Formed Sections:
  - .1 ASTM A653 Grade 340 (Grade 50), Fy = 345 MPa for coated sections.
  - .2 ASTM A1011 Grade 340 (Grade 50), Fy=345 MPa for uncoated sections.
- .6 Pipe Sleeves:
  - .1 ASTM A53/A53M, Schedule 40 steel pipe sleeves with continuously welded 5mm-thick seep ring with outside diameter 75mm greater than sleeve outside diameter. Hot-dip galvanize in accordance with ASTM A123/A123M.
- .7 High strength bolts:
  - .1 For structural connections at platforms, support frames and similar items; use ASTM A325 carbon steel high strength bolts hot dip galvanize to ASTM A153 with nuts and washers.
  - .2 Nuts: ASTM A563 and the recommended nut grade and style listed in Appendix X1, Table X1 thereof, hot dip galvanized.
  - .3 Washers: Bolted connections hardened steel washers conforming to ASTM F436. Hot dip galvanized washers with galvanized bolts

.3 Stainless steel: AISI Type 304.

.4 Welding materials: to CSA W59.

.5 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2 to ASTM A123.

.6 Drilled-in anchors: Hilti Kwik -Bolts 3, galvanized. If submerged, Type 304, stainless steel, with isolation washers, unless noted otherwise.

.7 Adhesive Anchors: Hilti HY200 or RE-500 with galvanized HAS anchor rods.

.8 Zinc primer: zinc rich, ready mix to CGSB 1- GP-181M.

.9 Bituminous Paint: CAN/CGSB-1.108 without thinner. Sealtight Galvafroid Zinc Rich Coating by W.R. Meadows Ltd.

.10 Isolation coating: CAN/CGSB 1.184, Coal Tar-Epoxy Coating.

.11 Grouting: Set 45 by Master Builders Technologies Ltd. M Bed Standard by Sternson Ltd., Sika Grout 212 by Sika Canada Inc.

2.3 FABRICATION

.1 Where possible, verify dimensions on site before preparing shop drawings or proceeding with shop work. Fit and shop assemble insofar as possible various sections of the work and deliver to the project site in the largest practical sections.

.2 The general dimensions and details of the metal fabrications are shown on the Drawings where practical. Such details and dimensions are suggested concepts for design.

.3 Assume responsibility for the correctness of the actual detailed dimensions used in fabrication and carefully check the same, by field measurement.

.4 Variations from suggested details are subject to acceptance in writing by the Engineer. Such acceptance does not in any way waive the above-mentioned responsibility.

.5 Wherever overlapping or contacting surfaces cannot be avoided, completely seal weld these surfaces. Rusting or deterioration of finish in such areas will require remedial seal welding and refinishing.

.6 Fabricate the work true to dimensions and square. Accurately fit members with hairline joints, and join using adequate fastening. Assemble members without twists or open joints.

.7 Construct finished work free from distortion and defects detrimental to appearance and performance.

.8 File or grind exposed welds smooth and flush. Do not leave grinding marks. Construct internal and external corners with sharp lines. Provide continuous welds unless otherwise accepted by the Engineer in writing. Brighten and buff aluminum and stainless steel welds to match appearance of adjacent surface.

.9 Remove weld spatter and slag. After finish grinding and smoothening welds, passivate welds with pickling paste.

.10 Fabricate metal work complete with components required for anchoring to concrete; bolting or welding to structural steel frames; standing free; or resting in frames or sockets, in a safe and secure manner.

.11 Countersink exposed fastenings, where such are accepted in writing, and make as inconspicuous as possible with bolts cut off flush with nuts. Construct fastenings of the same material and finish as the base material on which they occur. Where possible, fit and shop assemble work, ready for erection.

.12 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

.13 Provide drainage and vent holes as required for galvanizing.

2.4 STAIRS, GUARDS, AND LADDERS

.1 Accurately form connections with exposed faces flush; mitres and joints tight. Make ladder rungs of equal height within $\pm$ 3 mm.

.2 Install and fabricate stair rise and run to BCBC-2012 tolerances.

.3 Grind or file exposed welds and steel sections smooth.

Part 3 Execution

3.1 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Do stainless steel welding in accordance with AWS D1.6 unless specified otherwise.

.3 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.4 Provide suitable means of anchorage acceptable to Engineer such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.5 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

.6 Paint aluminum surfaces in contact with concrete with bituminous paint.

.7 Install isolator washers between aluminum and dissimilar metals.

3.2 INSTALLATION - ANCHORS AND FASTENERS

.1 Use anchor bolts of sufficient length to embed into concrete to develop full strength of the anchor or 200 mm minimum, the maximum governs, and project the threaded portion a minimum of 50 mm for the installation of the nuts.

.2 Set anchor bolts accurately in holes in concrete using plywood templates prepared from manufacturer's shop drawings. Set items in grout. Use anchor grout for submerged and exterior conditions.

.3 Do not offset bolts by deformation.

3.3 ANCHOR BOLT SCHEDULE

.1 Unless indicated otherwise on the Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas, e.g. Electrical Room, Screen Room, UV Room.	Hot-dip galvanized steel, headed anchor bolts, unless indicated, otherwise.	
Submerged, Interior Wet channels, and Corrosive Areas	Stainless steel 304 headed anchor bolts.	
Exterior Areas, e.g. Stair Platform, Exterior equipment space	Hot-dip galvanized steel, headed anchor bolts, unless indicated, otherwise.	
2. Anchor Bolts Cast into Concrete for Equipment Bases		
Interior Dry Areas	Hot-dip galvanized, carbon steel headed, anchor bolts, unless, otherwise specified with equipment.	
3. Post-Installed Drilled Anchors for Metal Components to Cast-in-Place Concrete (e.g., Ladders, Handrail Posts, Electrical Panels, and Equipment)		
Interior Dry Areas and exterior	Hot-dip galvanized, carbon steel headed, anchor bolts, unless, otherwise specified with equipment.	

.2 Anti-seizing Lubricant: Use on all stainless steel threads.

.3 Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 49°C.

.4 Install expansion anchors in accordance with manufacturer's instructions.

.5 Use alternative fastener if edge distances less than recommended.

.6 Tighten to recommend torque.

3.4 ADHESIVE ANCHOR INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install adhesive anchors with minimum 150 embedment.

.3 Thoroughly clean and brush out holes prior to injecting adhesive.

3.5 ANCHOR TESTING

.1 Test a minimum of six anchors selected by the Engineer to 130% of the specified load. If the working load is not specified test to the lesser of:

.1 150% of the safe working load specified by the manufacturer, or

.2 75% of the ultimate working load specified by the manufacturer.

.2 Apply the test load to the anchor for a minimum of five (5) minutes.

.3 Anchors to be tested with a jack and gauge calibrated within six (6) months of the test by a testing laboratory.

.4 Engineer's representative to witness the test.

.5 Anchors that fail to be replaced and additional anchors tested as directed by Engineer.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA International

- .1 CSA B111, Wire Nails, Spikes and Staples.
- .2 CSA O121, Douglas Fir Plywood.
- .3 CSA O141, Softwood Lumber.
- .4 CSA O151, Canadian Softwood Plywood.
- .5 CAN/CSA-O325.0, Construction Sheathing.
- .6 CAN/CSA-Z809, Sustainable Forest Management.

.2 National Research Council Canada (NRC)

- .1 National Building Code of Canada 2010 (NBC).

.3 Forest Stewardship Council (FSC)

- .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.

.4 Green Seal Environmental Standards (GS)

- .1 GS-11, Paints and Coatings.

.5 National Lumber Grades Authority (NLGA)

- .1 Standard Grading Rules for Canadian Lumber.

.6 Sustainable Forestry Initiative (SFI)

- .1 SFI Standard.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with MMCD.

.2 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.

1.3 QUALITY ASSURANCE

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

.3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

.4 Sustainable Standards Certification:

.1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 Store and protect wood from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:

.1 CAN/CSA-O141.

.2 NLGA Standard Grading Rules for Canadian Lumber.

.3 CAN/CSA-Z809 or FSC or SFI certified.

.2 Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing and sleepers:

.1 Board sizes: "Standard" or better grade.

.2 Dimension sizes: "Standard" light framing or better grade.

.3 Post and timbers sizes: "Standard" or better grade.

.3 Panel Materials:

.1 Douglas fir plywood (DFP): to CSA O121, standard construction.

.1 Urea-formaldehyde free.

.2 Canadian softwood plywood (CSP): to CSA O151, standard construction.

.1 Urea-formaldehyde free.

.3 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.

.1 Urea-formaldehyde free.

.4 Wood Preservative:

.1 Surface-applied wood preservative: clear, or 5% pentachlorophenol solution, water repellent preservative.

.2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used, pentachlorophenol-treated wood must be covered with two coats of an appropriate sealer.

.3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

.5 Primers, Coatings, Paints: in accordance with manufacturer's recommendations for surface conditions.

2.2 ACCESSORIES

.1 Fasteners: to CAN/CSA-G164, for exterior work.

.2 Nails, spikes and staples: to CSA B111.

.3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

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 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 Treat surfaces of material with wood preservative, before installation.

.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.

.4 Treat material as follows:

.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

.2 Wood furring on outside surface of exterior masonry and concrete walls.

.3 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.

3.3 INSTALLATION

.1 Comply with requirements of National Building Code of Canada (NBC), supplemented by the following paragraphs.

.2 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.

.3 Align and plumb faces of furring and blocking to tolerance of 1:600.

.4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.

.6 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

.7 Install sleepers as indicated.

.8 Use caution when working with particle board. Use dust collectors and high quality respirator masks.

.9 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.10 Countersink bolts where necessary to provide clearance for other work.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 23 – Final Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

- .1 ASTM C1126, Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- .2 ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- .3 ASTM E96/E96M, Standard Test Methods for Water Vapour Transmission of Materials.

.2 Canadian General Standards Board (CGSB)

- .1 CGSB 71-GP-24M, Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.

.3 CSA Group

- .1 CSA B149 PACKAGE, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.5 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
- .2 CAN/ULC-S704, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

1.2 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 Store and protect specified materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 INSULATION

.1 Extruded polystyrene (XPS) to CAN/ULC-S701.

.1 Type:4.

.2 Compressive strength: 40 psi.

.3 Thickness: as indicated.

.4 Size: standard available sizes, minimize joints where practical.

.5 Edges: square shiplapped.

2.2 ADHESIVE

.1 Adhesive (for polystyrene): to CGSB 71-GP-24M, low VOC, as recommended by insulation board manufacturer.

2.3 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.

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 board insulation application in accordance with manufacturer's written instructions.

3.2 INSTALLATION

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

.4 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.5 Offset both vertical and horizontal joints in multiple layer applications.

.6 Do not enclose insulation until it has been inspected and approved by Engineer.

3.3 RIGID INSULATION INSTALLATION

.1 Apply adhesive to insulation board in accordance with manufacturer's recommendations.

.2 Imbed insulation boards into vapour barrier type adhesive, applied as specified, prior to skinning of adhesive.

.3 In addition to adhesive, install mineral fibre insulation boards with insulation clips and disk, 2 per 600 x 1200 mm board minimum, fit boards tight, cut off fastener spindle 3 mm beyond disk.

.4 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide 0.15 mm modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

3.4 CAVITY WALL INSTALLATION

.1 Install polystyrene insulation boards on outer surface of inner wythe of wall cavity on bed of adhesive.

3.5 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:

.1 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 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.33, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for vapour retarders and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates:

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

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SHEET VAPOUR BARRIER

.1 Wall Vapour Retarder (Self-Adhesive): SBS modified bitumen membrane over cross-laminated polyethylene grid, self-adhering, self-sealing, 1.0 mm thickness. Designed to act as an impermeable Air/Vapour retardant sheet membrane to CGSB 37-GP-56M and ASTM E96. Water Vapour Permeance of <0.03, Air Permeability of <0.0005 @ 75 Pa.

.1 Acceptable Products:

.1 Bakor: Blueskin SA LA applied over Blueskin primer

.2 Iko Aquabarrier AVB applied over Aquabarrier primer.

.3 Soprema: Sopraseal Stick 1100T applied with Elastrocol 700 primer.

.2 Vapour Retarder extension: SBS modified bitumen membrane over cross-laminated polyethylene grid, self-adhering, self-sealing, designed to act as a transition sheet membrane to CGSB 37-GP-56M and ASTM E96.

.1 Acceptable Products:

.1 Bakor: Blueskin SA LA applied over Blueskin primer

.2 Iko Aquabarrier AVB applied over Aquabarrier primer.

.3 Soprema: Sopraseal Stick 1100T applied with Elastrocol 700 primer.

2.2 ACCESSORIES

.1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

.2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.

.3 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for vapour retarder installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate 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 Ensure services are installed and inspected prior to installation of retarder.

.2 Install sheet vapour retarder on warm side of exterior wall, ceiling assemblies prior to installation of gypsum board to form continuous retarder.

.3 Use sheets of largest practical size to minimize joints.

.4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.3 EXTERIOR SURFACE OPENINGS

.1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.4 PERIMETER SEALS

.1 Seal perimeter of sheet vapour barrier as follows:

.1 Apply continuous bead of sealant to substrate at perimeter of sheets.

.2 Lap sheet over sealant and press into sealant bead.

.3 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 LAP JOINT SEALS

.1 Seal lap joints of sheet vapour barrier as follows:

.1 Attach first sheet to substrate.

.2 Apply continuous bead of sealant over solid backing at joint.

.3 Lap adjoining sheet minimum 150 mm and press into sealant bead.

.4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.6 ELECTRICAL BOXES

.1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:

.1 Install moulded box vapour barrier.

.2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.7 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 in accordance with Section 01 74 23 – Final Cleaning.

.1 Remove insulation material spilled during installation and leave work area ready for application of wall board.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Requirements for the installation of preformed metal cladding/siding.

1.2 REFERENCES

.1 American National Standards Institute (ANSI).

.1 ANSI B18.6.4, Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM D2369, Test Method for Volatile Content of Coatings.

.2 ASTM D2832, Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.

.3 ASTM D5116, Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.

.3 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type.

.2 CAN/CGSB-93.2, Prefinished Aluminum Siding, Soffits and Fascia, for Residential Use.

.3 CAN/CGSB-93.3, Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use.

.4 CAN/CGSB-93.4, Galvanized and Aluminum-Zinc Alloy Coated Steel Siding Soffits and Fascia, Prefinished, Residential.

.5 CGSB 93.5, Installation of Metal Residential Siding, Soffits and Fascia.

.4 Canadian Standards Association (CSA International).

.1 CSA B111, Wire Nails, Spikes and Staples.

1.3 SUBMITTALS

.1 Product data: submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittals.

.2 Submit manufacturer's instructions, color samples, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

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

.2 Certificates: 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 60 00 – Basic 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 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.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis of Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 VicWest Steel

2.2 PERFORMANCE/DESIGN CRITERIA

.1 Design metal panel wall system in accordance with CSA S136.

.2 Design metal panel wall to provide for thermal movement of component materials caused by ambient temperature range of 60ºC without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

.3 Include expansion joints to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.

.4 Design members to withstand dead load and wind loads calculated in accordance with British Columbia Building Code 2012 and applicable local regulations, to maximum allowable deflection of $1/180^{th}$ of span.

.5 Provide for positive drainage of condensation occurring within wall construction and water entering at joints, to exterior face of wall in accordance with NRC "Rain Screen Principles".

.6 Design wall system to accommodate specified erection tolerances of structure.

2.3 STEEL CLADDING MATERIALS

.1 Galvanized sheet steel cladding: Z275 galvanized sheet steel applied to both sides, commercial steel (CS), type A, grade 230 to ASTM A653/A653M and as follows:

- .1 Nominal Core Thickness: 26 gauge or thicker to meet design loads.
- .2 Profile: As listed below.
- .3 Finish: prefinished; manufacturer's standard silicone modified polyester as specified below.

.4 Colour:

- .1 MC 1 Cocoa Brown (QC 16077)

.5 Profile:

- .1 Ribbed Profile 1: Vic West CL 6025-SR

2.4 PREFINISHED STEEL SHEET

.1 Prefinished steel with factory applied silicone modified polyester.

- .1 Class: F1S.
- .2 Colour: as indicated on drawings or if not indicated as selected by Contract Administration.
- .3 Specular gloss: 30 units +/ 5 to ASTM D523.
- .4 Coating thickness: not less than 20 micrometres.
- .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
  - .1 Outdoor exposure period 500 hours.
  - .2 Humidity resistance exposure period 500 hours.

2.5 ACCESSORIES

.1 Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material, thickness, and finish as cladding, with fastener holes pre-punched.

.2 Expansion joints: as recommended by Manufacturers Instructions.

2.6 FASTENERS

.1 Panel Fastenings: Manufacturer's standard to suit design loads and application. Finish all exposed fasteners to match metal panels; self-tapping screws, bolts, nuts, self-locking rivets and bolts, end welded studs, and other suitable fasteners designed to withstand design loads, and as follows:

.2 Use stainless steel fasteners for exterior applications and galvanized steel fasteners for interior applications.

2.7 CAULKING

.1 Sealants: in accordance with Section 07 92 00 - Joint Sealants and as recommended by manufacturer. Colour of exposed sealant to match adjacent panel.

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 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 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 Sealing.

3.3 CLEANING

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

3.4 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 DESCRIPTION

.1 Work under this section includes the supply of all labour, materials, plant and services necessary to install a new insulated roof membrane assembly.

.2 Method of application for roof membrane assembly will be by torch-on method.

1.2 REFERENCES

.1 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.

.2 ASTM C728 - Perlite Thermal Insulation Board.

.3 ASTM C1002 - Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.4 ASTM C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

.5 ASTM C1396/C1396M - Standard Specification for Gypsum Board.

.6 ASTM D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

.7 ASTM D2822 - Asphalt Roof Cement.

.8 ASTM D6162 - Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.

.9 ASTM D6163 - Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.

.10 ASTM D6164 - Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

.11 CSA A123.4 - Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.

.12 CAN/CSA S706 - Wood Fibre Thermal Insulation for Buildings.

.13 CAN/ULC-S701 - Thermal Insulation, Polystyrene, Boards.

.14 ARCA (Alberta Roofing Contractors Association) - Technical Bulletins.

.15 ARCA (Alberta Roofing Contractors Association) - Roofing Application Standards Manual.

.16 ULC (Underwriters Laboratories of Canada).

1.3 ROOF COVERING CLASSIFICATION

.1 Roof covering classification to be Class A in conformance CAN/ULC-S107.

1.4 SUBMITTALS

.1 Warranty: The Contractor is to supply a Ten (10) Year Warranty Certificate to the Owner, jointly issued by the Roofing Contractors Association of British Columbia and the roofing Contractor, upon completion of the new roofing portion of the project.

.2 Shop drawing to show accurate roof plan layout with sloped insulation panel thicknesses, RSI values, drain and equipment locations.

1.5 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Perform Work in accordance with RCABC Roofing Practices Manual.

.3 Installer Qualifications: Company specializing in performing the work with certified trained personnel.

.4 Only competent, qualified tradesmen using adequate plant and equipment shall execute the work as outlined under the terms of this Contract.

.5 If the Bid Package specifies work, materials and equipment of a quality better than those required by any codes or standards, the Bid Package shall have precedence and shall govern.

.6 A crew of qualified tradesmen consisting of:

.1 The foreman shall hold a current British Columbia Journeyman Certificate, with at least one other person holding a three (3) year Apprenticeship Certificate.

.2 The balance of the crew shall have completed some portion of the apprenticeship program, or at least have submitted application to the Department of Advanced Education and Manpower for certification as a "Tradesman". A Journeyman Certificate is acceptable in lieu of an Apprenticeship Certificate. Proof to be provided upon request.

1.6 PRECAUTIONS AGAINST FIRE

.1 The Contractor is to ensure that responsible personnel are on-site at all times during the re-roofing process and they shall remain on-site for at least two (2) hours after work has ceased or after torching has stopped as a fire precaution. During this period the safety person shall scan the perimeter and roof penetration details with a hand-held infrared gun. Localized hot spots to be investigated for potential fire hazards by cut test.

.2 The Contractor is responsible to ensure compliance with and enforce all safety requirements of the site, as required by the jurisdictional fire authorities. Before proceeding with the work, advise the local fire authority of the nature of the work to be undertaken and dates of construction.

.3 One fire extinguisher per torch system, used on the roof, shall be in place not less than 8 m from the area being worked on. Failure to provide, or having one available at prescribed distance, will result in immediate job shutdown.

.4 Adequate fire extinguishers shall be located near any kettle being used. Location of kettle is subject to approval by the Engineer or the Owner's representative. This approval does

not absolve the Contractor of the responsibility to protect the building at all times from possible construction damages.

.5 Locate the kettles so that smoke will not discolour building finishes, and where fumes will not enter interior of building.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Transport, handle, store, and protect products.

.2 Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.

.3 Store products in weather protected environment, clear of ground and moisture.

.4 Stand roll materials on end.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Do not expose products to environmental conditions affecting products on site.

.2 Do not apply roofing membrane during inclement weather.

.3 Do not apply roofing membrane to damp or frozen deck surface.

.4 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

.5 Application not to proceed if temperatures are below -18°C, as per Roofing Contractors Association of British Columbia application standards.

1.9 COORDINATION

.1 Coordination with other work having a direct bearing on work on this Section.

.2 Coordinate the work with installing associated metal flashings as the work of this Section proceeds.

Part 2 Products

2.1 MANUFACTURERS - MEMBRANE MATERIALS

.1 Accepted manufacturers:

.1 IKO.

.2 Soprema.

.2 All detailing to be completed as per membrane manufacturer’s written requirements.

.3 Contractor to complete manufacturer’s application training.

2.2 PRIMER

.1 Primer for torched systems to ASTM D41: Soprema Elastocol 500 or approved alternate.

2.3 MEMBRANE SYSTEM

.1 Membrane: Styrene-butadiene-styrene (SBS) prefabricated sheet reinforced with non-woven polyester reinforcement. System based on Soprema Products. RCABC accepted material.

.1 Base Sheet: non-woven polyester reinforcement and SBS bitumen, weighing 180 g/m². Based on Soprema Sopralene Flam 180.

.1 Application: fully torched.

.2 Top surface thermofusible plastic film.

.3 Underside thermofusible plastic film.

.2 Base Sheet Flashing combustible substrate: glass or non-woven polyester heavy duty reinforcement, weighing 145 g/m^2. Based on Soprema Sopralene Flam Stick.

.1 Application: self adhered.

.2 Top surface thermofusible plastic film.

.3 Underside self-adhesive.

.3 Base Sheet Flashing non-combustible substrate: non-woven polyester reinforcement, weighing 180 g/m².

.1 Application: fully torched.

.2 Top surface thermofusible plastic film.

.3 Underside thermofusible plastic film.

.4 Metal Flange Base Sheet Flashing: non-woven polyester reinforcement, weighing 180 g/m².

.1 Application: fully torched.

.2 Top surface thermofusible plastic film.

.3 Underside thermofusible plastic film.

.5 Drain Detail Flashing: non-woven polyester reinforcement, weighing 180 g/m².

.1 Application: fully torched.

.2 Top surface thermofusible plastic film.

.3 Underside sanded.

.6 Cap Sheet Membrane: non-woven polyester reinforcement and elastomeric bitumen, weighing 180 g/m². Based on Soprema Sopralene Flam 180 GR.

.1 Application: fully torched.

.2 Top surface granule surfaced. Color to be selected by Engineer from standard range of colors.

.3 Underside thermofusible plastic film.

.7 Cap Sheet Flashing: non-woven polyester reinforcement and elastomeric bitumen, weighing 180 g/m².

.1 Application: fully torched.

.2 Top surface granule surfaced. Color to be selected by Engineer from standard range of colors.

.3 Underside thermofusible plastic film.

.8 Fire Tape Membrane: self-adhesive elastomeric bitumen membrane with glass mat reinforcement.

2.4 DRAINAGE SHEET

.1 Drainage composite sheeting: Soprema Sopradrain Eco-vent or approved alternate.

2.5 INSULATION

.1 Insulation: Extruded Polystyrene board to CAN/ULC-S701, Type 4, rigid, pre-sloped, closed cell type with high density skin. Placed to RCABC requirements for protected roof system.

2.6 ACCESSORIES

.1 Sheathing Adhesive: Non-combustible type, for adhering gypsum sheathing to metal deck.

.2 Sheathing Joint Tape: Fire tape.

.3 Caulking: Tremco Dymonic Sealant.

.4 Vent Stack Flashings: One-piece aluminium pre-primed SJ-26 by Thaler Roofing Specialties Products Inc.

.5 Drain Reinforcement: SBS Membrane: 180 g/m² sanded polyester reinforced membrane - 750 mm x 750 mm.

.6 Flexible membrane for building expansion joints: Soprajoint by Soprema or approved equal.

Part 3 Execution

3.1 WORKMANSHIP

.1 Do roofing work in accordance with applicable, standard in RCABC (Roofing Contractors Association of British Columbia) - Roofing Application Standards Manual.

.2 Do priming for asphalt roofing in accordance with CGSB 37-GP-15M.

3.2 PROTECTION

.1 Cover walls and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Engineer.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.

3.3 PROTECTED MEMBRANE ROOFING APPLICATION

.1 Base sheet application:

.1 Apply fire tape at perimeter and curb details.

.2 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

.3 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.

.4 Lap sheets 75 mm for side and 150 mm for end laps, or as indicated by manufacture and to ARCA requirements.

.5 Application to be free of blisters, wrinkles and fishmouths.

.2 Cap sheet application:

.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

.2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.

.3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm from those in base sheet, or as indicated by manufacture and to ARCA requirements.

.4 Application to be free of blisters, fishmouths and wrinkles.

.5 Do membrane application in accordance with manufacturer's recommendations.

.3 Flashings:

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Install base and cap sheet onto substrate in 1 metre wide strips. Prime and apply self adhering sheets to wood or combustible construction, and torch sheets to all other surfaces.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.

.4 Lap flashing cap sheet to membrane cap sheet 250 mm and torch weld.

.5 Provide 75 mm side lap and seal.

.6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.7 Do work in accordance with manufacturer's recommendations.

.8 Secure self-adhesive membranes to substrates with mechanical fasteners as per ARCA minimum requirements.

.4 Roof penetration: Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with the manufacturer's recommendations and details.

.5 Insulation application:

.1 Insulation to be loose laid in parallel rows with ends staggered.

.2 Insulation application shall meet RCABC requirements.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 The Aluminum Association Inc. (AAI)

- .1 AA Aluminum Design Manual Part VIII Guidelines for Aluminum Sheet Metal Work in Building Construction.
- .2 AAI DAF45, Designation System for Aluminum Finishes.

.2 American Architectural Manufacturers Association (AAMA)

- .1 AAMA 611 Voluntary Specifications for Anodized Architectural Aluminum.
- .2 AAMA 621 Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Substrates.
- .3 AAMA 2603, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- .4 AAMA 2604 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .5 AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

.3 American National Standards Institute (ANSI)

- .1 ANSI/SPRI/FM 4435/ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

.4 ASTM International

- .1 ASTM A606/A606M, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
- .2 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM A755/A755M Standard Specification for Steel Sheet, Metallic coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
- .4 ASTM A 792/A 792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .5 ASTM B32, Standard Specification for Solder Metal.
- .6 ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 ASTM D 523, Standard Test Method for Specular Gloss.

.8 ASTM D1970/D1970M Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.9 ASTM F1667 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

.5 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type.

.6 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual.

.7 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI S8 Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.

.2 CSSBI B17 Barrier Series Prefinished Steel Sheet: Product Performance & Applications.

.3 CSSBI Sheet Steel Facts #12 2003 Fastener Guide for Sheet Steel Building Products.

.8 CSA Group

.1 CSA A123.3, Asphalt Saturated Organic Roofing Felt.

.2 CSA A123.22 Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.10 Sheet Metal and Air Conditioning Contractors Association of North America (SMACNA)

.1 Architectural Sheet Metal Manual

.2 Residential Sheet Metal Guidelines

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's printed product literature including product specifications and technical data sheets for sheet metal flashing fasteners and accessory materials. Include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Basic Product Requirements.

.2 Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.

Part 2 Products

2.1 METAL FLASHINGS

.1 Zinc coated galvanized steel sheet (pre-finished): Type A commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

.1 Class: F1S-Finsihed one side.

.2 Thickness: minimum 0.45 mm base metal thickness.

.3 Factory Finish: silicone modified polyester.

.4 Acceptable materials: Valspar WeatherX or Dofasco Perspectra.

.5 Colour: Colour as indicated on Drawings.

.2 Formed aluminum flashings: Tension levelled, aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 5005-H14 and as follows:

.1 Thickness: minimum 1.20 mm.

.2 Finish: anodized aluminum sheet, colour to match adjacent aluminum framing and as selected by Engineer.

.3 Form flashings, copings and fascias to profiles indicated.

2.2 EAVES TROUGHS AND DOWNSPOUTS

.1 Form downspouts from minimum 0.55 mm thick prefinished steel sheet metal. Sizes and profiles as indicated.

.2 Form eaves troughs from minimum 0.55 mm thick prefinished steel sheet metal. Sizes and profiles as indicated.

.3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

2.3 SCUPPERS

.1 Form scuppers from 0.70 mm thick galvanized steel sheet metal.

.2 Sizes and profiles as indicated.

.3 Provide necessary fastenings.

2.4 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB 37.5.

.3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

.4 Sealants: Section 07 92 00 – Joint Sealants

.1 Mastic Sealant: CAN/CGSB 37.29 polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.

.2 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00 – Joint Sealants.

.5 Fasteners: of same material as sheet metal, to CSA B111, as recommended by sheet metal manufacturer; non-corrosive. Finish of exposed parts to match material being fastened.

.6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.7 Solder: to ASTM B32, alloy composition Sn.

.8 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.

.9 Touch-up paint: as recommended by prefinished material manufacturer.

2.5 FABRICATION

.1 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.

.2 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.3 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

.4 Make flashings of prefinished metal for all cap flashings, for all flashings adjacent to roofing at roof edges and area dividers and where exposed to view from ground. Make flashings for other locations, of plain galvanized metal as follows:

.1 Use 0.45 mm metal core thickness except where otherwise indicated.

.2 Use 0.62 mm metal core thickness wherever a flat length exceeding 305 mm wide occurs.

.3 Use 0.80 mm metal core thickness for concealed fastening strips.

.5 All straight run joints shall be S-Lock in roof flashings.

.6 Make joints to allow for thermal movement, space S-Lock joints at 1500 mm maximum centres.

.7 Make flashings for building into masonry and concrete so that joints can be lapped 100 mm or more.

.8 Strengthen free edges of metal flashings by folding to form a 13 mm hem.

.9 Make flashings to curbs, walls and parapets a minimum of 200 mm high, where possible.

.10 Where curb-mounted roof penetrations are not required, provide flashing sleeves and collars for all pipes and conduit extending through the roof. Sleeves shall be soldered to a piece of sheet metal extending at least 150 mm onto the surrounding roof.

.11 Make joints for corners and intersections with standing seams except where exposed of pre-finished metal when seams shall be flat locked.

.12 All bends machine made; form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.13 All metal flashings shall be back painted with bituminous paint prior to installation.

2.6 EAVES TROUGHS AND DOWNPIPES

.1 Form eaves troughs and downpipes from 0.76 mm thick prefinished aluminum.

.2 Sizes and profiles as indicated.

.3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

.4 Form 600 mm × 600 mm splash pans from 0.76 mm prefinished aluminum.

2.7 REGLETS AND CAP FLASHINGS

.1 Form metal cap flashing of 0.070 mm thick sheet metal for base flashings as detailed.

.1 Provide slotted fixing holes and steel/plastic washer fasteners.

.2 Cover face and ends with plastic tape.

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 as detailed and in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal.

.1 Secure in place and lap joints 100 mm.

.2 Provide self-adhesive membrane to tie into adjacent assemblies.

.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.

.1 Flash joints using S-lock forming tight fit over hook strips, as detailed.

.5 Lock end joints and caulk with sealant.

.6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.

.7 Insert metal flashing under cap flashing to form weather tight junction.

.8 Caulk flashing at cap flashing with sealant.

.9 Install pans, where shown around items projecting through roof membrane.

.10 Where flashing installed with mechanical fasteners, install fasteners in slots or oversize holes to allow expansion and contraction of flashings.

.11 Provide isolation coating or impervious self-adhesive membrane to separate aluminum items from concrete and masonry.

3.3 GUTTERS AND DOWNPIPES

.1 Install gutters, with screen cover, and secure to building at 750 mm on centre maximum with gutter spikes through spacer ferrules.

.1 Slope gutters to downpipes as indicated.

.2 Seal joints watertight.

.2 Install downpipes and secure to wall.

.1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two straps per downpipe.

.2 Connect downpipes to drainage system and seal joint with plastic cement.

3.4 SCUPPERS

.1 Install scuppers as indicated.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 23 – Final Cleaning.

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

.3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Approved: 2012-12-31

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

- .1 ASTM A506, Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled.
- .2 ASTM B370, Standard Specification for Copper Sheet and Strip for Building Construction.
- .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM D2369, Standard Test Method for Volatile Content of Coatings.
- .5 ASTM D2832, Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
- .6 ASTM D5116, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.

.2 CSA International

- .1 CSA B111, Wire Nails, Spikes and Staples.

.3 Green Seal Environmental Standards (GS)

- .1 GS-11, Standard for Paints and Coatings.
- .2 GS-36, Standard for Adhesives for Commercial Use.

.4 The Master Painters Institute (MPI)

- .1 Architectural Painting Specification Manual
  - .1 MPI #76, Primer, Alkyd, Quick Dry, for Metal.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for roof hatches and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS
  - .1 Indicate VOC's for caulking materials during application and curing.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of British Columbia, Canada.
  - .1 Indicate size and description of components, materials, attachment devices, description of frame and finish, and construction details.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit operation and maintenance data for hardware complete with pertinent details, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 01 61 00 – Basic 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, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect roof hatches from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Roof hatches must withstand snow load of 3.5 kN/m^2, and wind uplift of 1 $kNm/m^2$and temperature range of 15°C without damage to unit or permanent deformation to seals.

2.2 MATERIALS

.1 Steel sheet: regular quality alloy steel to ASTM A506.

.2 Galvanized steel sheet: commercial quality to ASTM A653/A653M, Z275 designation zinc coating.

.3 Copper sheet: to ASTM B370 cold rolled.

.4 Gaskets: extruded resilient neoprene, with full recovery after 50% compression.

.5 Fasteners: screws to manufacturers standard galvanized steel nails to CSA B111.

.6 Sealants: as per manufacturers.

.1 Test for acceptable VOC emissions in accordance with ASTM D2369 and ASTM D2832

.7 Adhesives and sealants: VOC limit 30 g/L maximum.

.8 Paints, Primers, Coating: in accordance with manufacturer's recommendations for surface conditions

.9 Primer paint for steel: to MPI #76.

.10 Primer: VOC limit 250 g/L maximum.

.11 Isolation coating: alkali resistant bituminous paint or epoxy solution.

2.3 HATCH COVER

.1 Metal Cover:

.1 Preformed, galvanized steel, insulated sandwich construction 100mm overall thickness.

2.4 CURBED FRAME

.1 Preformed metal curb: 13 mm thick 305 mm high insulated sandwich construction, insulation, with deck flange for attachment, or as per manufacture’s recommendations.

2.5 ACCESSORIES

.1 Screws: galvanized steel for curb to structure for hatch lip frame to outer attachment.

.2 Hinges: type recommended by roof hatch manufacturer with heavy duty pintle type of galvanized steel.

.3 Latch: positive snap with turn handles inside and out and padlock hasps inside.

.4 Securing latch: hold open operating arm with vinyl grip handle to permit one-handed release.

.5 Resilient gasket/seal to inner face of lid in contact with hatch lid support frame and to skylight in contact with hatch lid.

2.6 FABRICATION

.1 Fabricate components free of twists, bends, or visual distortion and insulated. Weld corners and joints.

.2 Assemble roof hatch components as indicated.

.3 Ensure continuity of weather-tight seal.

.4 Design flashings to collect and lead off accumulated condensation.

.5 Zinc plate hardware and attachments and shop prime ready for field painting.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof hatch installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate 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 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 Erect components plumb, level and in proper alignment.

.2 Ensure continuity of building envelope air barrier and vapour retarder systems.

.3 Adjust and seal assembly with provision for expansion and contraction of components.

.4 Secure prefabricated curb assembly to structure.

.5 Coat aluminum and copper in contact with dissimilar materials, with isolation coating.

.6 Secure and seal frame to curb.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 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.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by roof hatch installation.

END OF SECTION

Part 1 General

1.1 INTENT

.1 This Section includes through penetration firestopping and smokeseal systems for penetrations through the following fire resistance rated assemblies, including both empty openings and openings containing penetrating items:

.1 Wall and partitions.

.2 Smoke barriers.

.3 Construction enclosing compartmentalized areas.

.2 This Section includes fire resistive joint systems for the following:

.1 Floor-to-wall joints.

.2 Head-of-wall joints.

.3 Wall-to-wall joints.

.3 This specification section provides requirements for Rated Systems or systems requiring Engineered Judgements:

.1 Use of materials that have not been tested in a system or that are not capable of obtaining an engineered judgement will not be acceptable for use on this Project.

.2 Materials having only a ULC label will not be acceptable for use on this Project.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

.2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM E814, Standard Test Method for Fire Tests of Penetration Firestop Systems.

.4 ASTM A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

.5 ASTM E1966, Standard Test Method for Fire-Resistive Joint Systems.

.6 ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops.

.7 ASTM E2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus.

.8 ASTM E2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Underwriter's Laboratories of Canada (ULC)

.1 ULC Guide No. 40 U19, Firestop Systems.

.2 CAN/ULC S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.3 CAN/ULC S102, Standard Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies.

.4 CAN4 S114, Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.5 CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems.

.6 CAN/ULC S702-AM1, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1(January 2012).

.7 ULC S702.2, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

.8 List of Equipment and Materials.

.4 Underwriters Laboratories Inc. (UL)

.1 ANSI/UL 1479, Standard for Fire Test of Through-Penetration Firestops.

.5 National Fire Protection Agency (NFPA)

.1 NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit 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 to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details should accurately reflect actual job conditions.

.4 Quality assurance submittals: submit following in accordance with Division 01.

.1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in fire stopping installations and approved by manufacturer with 5 years documented experience.

.2 Use materials and methods of determining required thickness of application that have the full acceptance of authority having jurisdiction.

.3 Use materials tested to CAN/ULC-S115. Assemblies containing the materials shall be in accordance with assemblies tested and approved by agencies acceptable to authority having jurisdiction.

.4 Source Responsibility: Obtain through penetration firestop and joint systems, for each kind of penetration and construction condition indicated, from a single source of installation responsibility.

.5 Delegated Design Professional: Use a professional engineer, registered in the province of the Work and familiar with installations of similar scope and complexity to design firestopping and smokeseals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Deliver materials to the site in undamaged condition and in original unopened containers.

.2 Storage and Protection:

.1 Store materials 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 MANUFACTURERS

.1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 3M Canada Inc.

.2 A/D Fire Protection Systems Inc.

.3 EZ-Path Fire Rated Pathways

.4 Firestop Systems Inc.

.5 Hilti Canada Ltd.

.6 Johns Manville Fire Protection Systems

.7 Nuco Self Seal Firestopping Products.

.8 Passive Fire Protection Partners Firestop Systems Inc.

.9 Roxtec, Preformed Fire Stopping Systems

.10 Specified Technologies Inc.

.11 Tremco Ltd.

2.2 PERFORMANCE/DESIGN CRITERIA

.1 Delegated Design Requirements: Design firestopping and smokeseals required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code.

.2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with the Building Code, Underwriters Laboratories Canada, and authorities having jurisdiction, and as follows:

.1 Provide through penetration firestop and joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire resistance rating of assembly penetrated:

.1 Fire resistance rated load bearing walls, including partitions, with fire protection rated openings.

.2 Fire resistance rated non-load bearing walls, including partitions, with fire protection rated openings.

.3 Fire resistance rated floor assemblies.

.2 F-Rated Systems: Provide through penetration firestop systems with F-ratings indicated, as determined by ULC S115 or ASTM E814, but not less than that equalling or exceeding fire resistance rating of constructions penetrated.

.3 T-Rated Systems: For the following conditions, provide through penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per by ULC S115 or ASTM E814, where systems protect penetrating items exposed to potential contact with adjacent materials:

.1 Penetrations located outside wall cavities.

.2 Penetrations located outside fire resistive shaft enclosures.

.3 Penetrations located in construction containing fire protection rated openings.

.4 Penetrating items larger than 100 mm diameter nominal pipe or 100 cm^2 in overall cross-sectional area.

.4 Firestopping and Smokeseals Systems Exposed to View: Systems exposed to view, traffic, moisture, and physical damage; provide products that after curing do not deteriorate when exposed to these conditions both during and after construction, and as follows:

.1 Provide moisture resistant through penetration firestop systems for piping penetrations for plumbing and wet pipe sprinkler systems.

.2 Provide firestopping and smokeseals systems capable of supporting floor loads involved either by installing floor plates or by other means for floor

penetrations with annular spaces exceeding 100 mm in width and exposed to possible loading and traffic.

.3 Provide firestopping and smokeseals systems not requiring removal of insulation for penetrations involving insulated piping.

.4 Provide products with flame spread ratings of less than 25 and smoke developed ratings of less than 50 for firestopping and smokeseals and joint systems exposed to view.

.5 Fire Resistance of Joint Systems: Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equalling or exceeding fire resistance rating of constructions in which joints are located.

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 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.4 FIELD QUALITY CONTROL

.1 Inspections: notify Engineer when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.5 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.6 SCHEDULE

.1 Fire stop and smoke seal at:

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

- .1 CGSB 19-GP-5M, Sealing Compound, One Component, Acrylic Base, Solvent Curing.
- .2 CAN/CGSB-19.13, Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .3 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .4 CAN/CGSB-19.17, One-Component Acrylic Emulsion Base Sealing Compound.
- .5 CAN/CGSB-19.24, Multi-component, Chemical Curing Sealing Compound.

.2 General Services Administration (GSA) - Federal Specifications (FS)

- .1 FS-SS-S-200, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Manufacturer's product to describe:
  - .1 Caulking compound.
  - .2 Primers.
  - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Samples:

- .1 Submit 2 samples of each type of material and colour.
- .2 Cured samples of exposed sealants for each colour where required to match adjacent material.

.4 Manufacturer's Instructions:

- .1 Submit instructions to include installation instructions for each product used.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with MMCD.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 Store and protect joint sealants from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.5 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°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.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Health Canada.

Part 2 Products

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

.3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Polysulphide two part:

.1 Self-levelling to CAN/CGSB-19.24, Type 1, Class

.2 Polysulphide two part:

.1 Non-sag: to CAN/CGSB-19.24, Type 2, Class B

.3 Silicones one part: to CAN/CGSB-19.13.

.4 Acrylics one part: to CGSB 19-GP-5M.

.5 Acrylic latex one part: to CAN/CGSB-19.17.

.6 Acoustical sealant: to ASTM C919.

.7 Preformed compressible and non-compressible back-up materials:

.1 Polyethylene, urethane, neoprene or vinyl foam:

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50 %.

.2 High density foam:

.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m^{3}density, or neoprene foam backer, size as recommended by manufacturer.

.3 Bond breaker tape:

.1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

.1 Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block, precast masonry): sealant type: polysulphide.

.2 Expansion and control joints in exterior surfaces of poured-in-place concrete walls: sealant type: polysulphide.

.3 Control and expansion joints in exterior surfaces of unit masonry walls: sealant type: polysulphide.

.4 Coping joints and coping-to facade joints: sealant type: polysulphide.

.5 Cornice and wash (or horizontal surface joints): sealant type: polysulphide.

.6 Exterior joints in horizontal wearing surfaces (as itemized): sealant type: polysulphide.

.7 Seal interior perimeters of exterior openings as detailed on drawings: sealant type: polysulphide.

.8 Control and expansion joints on the interior of exterior poured-in place concrete walls: sealant type: polysulphide.

.9 Expansion and control joints on the interior of exterior precast, architectural wall panels: sealant type: polysulphide.

.10 Control and expansion joints on the interior of exterior surfaces of unit masonry walls: sealant type: polysulphide.

.11 Interior control and expansion joints in floor surfaces: sealant type: polysulphide.

.12 Perimeters of interior frames, as detailed and itemized: sealant type: acrylic latex.

.13 Interior masonry vertical control joints (block-to-block, block-to-concrete, and intersecting masonry walls): sealant type: acrylic latex.

.14 Joints at tops of non-load bearing masonry walls at the underside of poured concrete: sealant type: polysulphide.

.15 Exposed interior control joints in drywall: sealant type: acrylic latex.

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.

.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 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

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

3.6 APPLICATION

.1 Sealant:

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

3.7 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Clean adjacent surfaces immediately.

.3 Remove excess and droppings, using recommended cleaners as work progresses.

.4 Remove masking tape after initial set of sealant.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 23 – Final Cleaning.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

Part 1 General

1.1 QUALITY ASSURANCE

.1 Manufacture hollow metal frames, doors and panels in accordance with the "Canadian Manufacturing Standards for Metal Doors and Frames" published by the Canadian Steel Door & Frame Manufacturer's Association.

.2 Manufacture fire rated frames, doors, components and assemblies to Underwriters' Laboratories of Canada requirements and NFPA 80 latest edition.

1.2 SUBMITTALS

.1 The shop drawings shall clearly indicate each frame type, type of door and panel, materials, gauge, mortises, reinforcements, anchors, hardware and location of exposed fasteners, and special features. Submit shop drawings in accordance with Section 01 33 00 – Submittals.

.2 Reference frames and door types of Door Schedule. Indicate door numbers and construction where applicable.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle hollow metal doors, frames and panels in a manner to prevent deterioration of shop finish and damage to their respective fabricated shapes.

.2 Store items in weatherproof shelters.

Part 2 Products

2.1 DOOR SCHEDULE

.1 Refer to drawings for size, type, and locations of all doors.

2.2 FRAME MATERIALS

.1 Frames: 1.5 mm core thickness, commercial quality steel cold rolled to ASTM A526, with W25 (wiped) zinc coating.

.2 Accessories: glazing stops, 0.9 mm core thickness, floor anchors, 1.5 mm core thickness, channel spreaders, 1.5 mm core thickness tee anchors, 1.2 mm core thickness wall stud anchors, all with W25 (wiped) zinc coating. Drill stud anchors for wire tie to studs. Lag bolts, shields and bushings for anchorage to concrete.

.3 Guard Boxes: minimum 0.75 mm steel core thickness.

.4 Door Bumpers: black neoprene.

.5 Prime: to CGSB 1-GP-191M.

2.3 DOOR MATERIALS

.1 Doors and Panels commercial quality steel, cold rolled to ASTM A366; Class 1, or ASTM A526 with W25 (wiped) zinc finish; 1.2 mm core thickness for face of interior doors, 1.55 mm core thickness for face of exterior doors. Provide honeycomb cores for interior doors and inorganic non-combustible insulated cores, for exterior doors and panels and fire rated doors.

.2 Primer: to CGSB 1-GP-181M.

2.4 REINFORCEMENT OF HARDWARE

.1 Carbon steel, welded in place, prime painted, to the following core thicknesses:

.1	Hinge, pivot and panic bar reinforcement	4.75 mm thick
.2	Strike reinforcements	2.0 mm thick
.3	Flush bolts reinforcements (frames)	2.0 mm thick
.4	Lock face, flush bolts, concealed bolts	2.7 mm thick
.5	Closer reinforcements	2.7 mm thick
.6	Other surface hardware reinforcements	2.7 mm thick

2.5 FABRICATION

.1 Frames:

.1 Fabricate pressed steel door frames, including all removable mullions, in accordance with drawing details, door schedules and approval shop drawings, provide ULC labels to fire rated metal frame assemblies. Frames to be welded type. Fabricate with double return throat openings, for all drywall partitions.

.2 Mortise, reinforce, drill and tap door frames and reinforcements to receive hardware using templates provided. Locate mortising to National Builders Hardware Association Standards.

.3 For exterior located doors, provide frames to receive continuous neoprene gasket as indicated in Hardware Schedules.

.4 Prepare interior located door frames, where indicated in Door Schedules to receive full perimeter sealing gasket.

.5 Prepare all non-sealing interior door frames with three double stud bumpers on strike jamb of single door frames and two bumpers on head of double door frames.

.6 Prepare exterior located door frames to receive continuous weatherstripping on two sides and head.

.7 Protect strike, hinge and door closer reinforcement completely by guard boxes welded to door frames.

.8 Cut mitres accurately to floor to maintain alignment and fit of frame profile.

.9 Provide minimum four anchors per jamb frame up to 2134 mm high and one additional for each 610 mm over 2134 mm high. Anchor arrangement constructed to allow for ease of fastening through metal studs.

.1 Minimum depth of door stops: 16 mm. Provide counter sink screws for mitre joints.

.10 Fill surface depressions and butted joints with metallic paste filler, sand to a uniform smooth finish. Grind welded corners to a flat plane.

.2 Doors:

.1 Manufacture doors and matching panels (where indicated) in accordance with drawing details, door schedules, approved shop drawings and ULC requirements.

.2 Refer to Door Schedule for required classes and ratings of fire doors. All doors flush type hollow steel construction.

.3 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided.

.4 Join door faces at intersecting edges with spot welds on strike side at top and bottom of door and above and below strike face. On hinge edge, spot weld above and below each hinge, fill and grind smooth. Finish door and panel faces flush without visible joints or distortion.

.5 Close top and bottom edges of doors and panels with recessed 1.2 mm thick steel channel, full width welded. Provide closure channel at top edge of exterior doors, and weep holes in exterior door bottom channel. Where scheduled to receive weatherstripping; cut short to allow for threshold.

.6 Provide stops. Weld stops to door on security side.

.7 Provide astragals for pairs of doors.

.8 Provide ULC labels for fire rated doors, install on butt edge at eye level.

.9 Bevel edge of doors 32 mm in 51 mm.

.10 Core Insulation: Honeycomb core with maximum 25 mm cell size; insulation to completely fill the inside of the door.

Part 3 Execution

3.1 INSTALLATION

.1 Frames:

.1 Set frames in plumb and square at correct locations and elevations. Limit of acceptable frame distortion - 2 mm out of plumb measured on face of frame, maximum twist corner to corner of 4 mm.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames solidly to maintain in position while being built-in.

.4 Install a temporary horizontal wood spreader at midheight of opening to maintain frame width until building-in work completed.

.5 Remove temporary spreaders only after completion of adjacent work.

.6 Coordinate grouting or building-in of frames in adjacent masonry construction.

.7 Where detailed on drawings, fill interior located hollow metal frame spaces, solid with acoustic batt insulation, between frame and adjoining construction to provide sound isolation.

.8 Fill exterior located hollow metal frame spaces solid with thermal batt insulation, between frame and adjoining construction.

.9 Touch-up damaged galvanized areas with primer.

.10 Provide sealant to perimeter of hollow metal frames, at all exterior applications and where indicated on drawings.

.11 Set in place, all removable mullions.

.2 Doors:

.1 Install doors and panels in accordance with manufacturer's instructions and drawings details. Maximum permissible warp of 4 mm diagonally across doors and panels.

.2 Prepare doors to receive finish painting. Touch-up damaged galvanized areas with primer.

.3 Note that tampering with or removal of factory installed U.L.C. labels will invalidate ratings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Provide four (4) motor operated insulated exterior metal rolling door that will be interior face mounted on a prepared opening as shown on the contract drawings and as needed for a complete and proper installation.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

.1 Overhead coiling doors: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 and CAN4-S105 for ratings specified or indicated.

.2 Fabricate and install overhead coiling doors to ANSI/NFPA 80 to suit fire protection rating required.

1.3 DESIGN CRITERIA

.1 Design rolling door curtain and assembly to withstand wind load of 1.0 kPa (unfactored) within door opening area.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

.2 Indicate each type of door, arrangement of hardware, required clearances, electrical characteristics including voltage, size of motors, auxiliary controls and wiring diagrams.

.3 Indicate assembly details and dimensions of fabrication, required clearances and electrical connections.

.4 Shop drawings in sufficient detail to show fabrication, installation, anchorage and interface of the Work of this Section with the work of adjacent trades.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for overhead coiling doors and hardware for incorporation into manual in accordance with MMCD Division 01.

1.6 UNUSED MATERIALS

.1 Divert used metal cut-offs from landfill by disposal into the on-site metals recycling bin at nearest metal recycling facility.

Part 2 Products

2.1 EXTERIOR OVERHEAD DOORS

.1 Curtain:

.1 Slat Material: No. 6F, (Listed Exterior/Interior):

.1 Galvanized Steel/Galvanized Steel: 24/24 gauge ASTM A653 (A 653M), Commercial Quality, with G-90 (Z 275) zinc coating.

.2 Insulation: 22 mm ($^{7}/_{8}$") foamed-in-place, closed cell urethane.

.3 Total Slat Thickness: 24 mm ($^{15}/_{16}$").

.2 Bottom Bar: Reinforced extruded aluminum interior face with full depth insulation and exterior skin to match curtain material and gauge.

.3 Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two rivets. Provide windlocks as required to meet design windload.

.4 Exterior Slat Finish:

.1 Galvanized Steel: Phosphate treatment followed by brown (to match entry doors) baked-on polyester enamel coating, minimum 0.015 mm (0.6 mils) cured film thickness.

.5 Interior Slat Finish:

.1 Galvanized Steel: Phosphate treatment followed by brown (to match entry doors) baked-on polyester enamel coating, minimum 0.015 mm (0.6 mils) cured film thickness.

.6 Bottom Bar Finish:

.1 Exterior Face: Match slats.

.2 Interior Face: Powder coat to match slats.

.2 Insulated Guides: Fabricate with minimum 5 mm ($^{3}/_{16}$") structural steel or aluminum angles. Provide windlock bars of same material when windlocks are required to meet design wind load. Install insulation and insulation retainer in accordance with manufacturer's recommendations.

.1 Finish:

.1 Steel: Phosphate treatment followed by a brown (to match entry doors) baked-on polyester powder coat; minimum 0.065 mm (2.5 mils) cured film thickness.

.3 Counterbalance Shaft Assembly:

.1 Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 2.5 mm/m (0.03 inches/foot) of width.

.2 Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 110 N (25 lbs). Provide wheel for applying and adjusting spring torque.

.4 Brackets: Fabricate from minimum 5 mm ($^{3}/_{16}$") steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.

.1 Finish:

.1 Light gray shop prime coat; minimum 0.015 mm (0.6 mils) cured film thickness.

.5 Hood: 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 6 mm (¼ in.) steel intermediate support brackets as required to prevent excessive sag.

.1 Finish:

.1 Galvanized Steel: Phosphate treatment followed by brown (to match entry doors) baked-on polyester enamel coating, minimum 0.015 mm (0.6 mils) cured film thickness.

.6 Weather stripping:

.1 Bottom Bar: Replaceable, 3-point, compressible vinyl gasket extending into guides.

.2 Guides: Replaceable vinyl strip on guides sealing against fascia side of curtain.

.3 Hood: Neoprene/rayon baffle to impede air flow above coil.

2.2 OPERATION

.1 Equip exterior doors for electric operation.

2.3 EXTERIOR DOOR ELECTRICAL OPERATOR

.1 Electrical motors, motor starters, controller units, pushbutton stations, control power transformers, relays and other electrical components: to CSA and ULC approval with EEMAC enclosures Class 1, group A.

.2 Power supply: 208 V, 3 phase.

.3 Motor: high starting torque, instant reversing, capacity to operate grille at 200 mm per second, removable without affecting emergency chain device or setting of limit switches. Equip motor with overload protection, centrifugal clutch and electric brake.

.4 Motor size matching gear reducer with gears running in oil bath.

.5 Controller units with integral motor reversing starter, three (3) heater elements for overload protection, including push buttons and control relays as applicable.

.6 Operation:

.1 One (1) wall mounted push button station: flush surface mounted with OPEN-STOP-CLOSE push buttons. Design brake to stop and hold doors in any position.

.2 Include hand chain crank interlocked auxiliary operator to disconnect motor mechanically and electrically when engaged and allow manual operation of door.

.3 Safety switch: electro mechanical or electro pneumatic device full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.

.4 Door speed: 229 mm/s for both electric and manual operation.

.5 Mounting brackets: galvanized steel, size and thickness to suit conditions.

.6 Control circuit: 24 VAC.

Part 3 Execution

3.1 INSTALLATION

.1 Install doors and grilles in accordance with manufacturer's printed instructions.

.2 Install electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door and grille operation.

.3 Installation includes electric wiring from power supply located near door and grille.

.4 Install master keyed cylinder specified in Section 08 71 10 - Door Hardware.

.5 Adjust door operating components to ensure smooth opening and closing of doors and grilles.

.6 Test labelled coiling doors for proper operation by activating fusible link. Test coiling door in presence of Engineer.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufactures' Association.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-69.17, Bored and Preassembled Locks and Latches.

.2 CAN/CGSB-69.18/ANSI/BHMA A156.1, Butts and Hinges.

.3 CAN/CGSB-69.19/ANSI/BHMA A156.3, Exit Devices.

.4 CAN/CGSB-69.20/ANSI/BHMA A156.4, Door Controls (Closers).

.5 CAN/CGSB-69.21/ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.

.6 CAN/CGSB-69.22/ANSI/BHMA A156.6, Architectural Door Trim.

.7 CAN/CGSB-69.24/ANSI/BHMA A156.8, Door Controls - Overhead Holders.

.8 CAN/CGSB-69.28/ANSI/BHMA A156.12, Interconnected Locks and Latches.

.9 CAN/CGSB-69.29/ANSI/BHMA A156.13, Mortise Locks and Latches.

.10 CAN/CGSB-69.30/ANSI/BHMA A156.14, Sliding and Folding Door Hardware.

.11 CAN/CGSB-69.31/ANSI/BHMA A156.15, Closer/Holder Release Device.

.12 CAN/CGSB-69.32/ANSI/BHMA A156.16, Auxiliary Hardware.

.13 CAN/CGSB-69.33/ANSI/BHMA A156.17, Self-closing Hinges and Pivots.

.14 CAN/CGSB-69.34/ANSI/BHMA A156.18, Materials and Finishes.

.15 CAN/CGSB-69.36/ANSI/BHMA A156.20, Strap and Tee Hinges and Hasps.

1.2 REQUIREMENTS REGULATORY AGENCIES

.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1.3 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 – Submittals.

.2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

.3 After approval, samples will be returned for incorporation in the Work.

1.4 HARDWARE LIST

.1 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

1.5 CLOSEOUT SUBMITTALS

.1 Brief maintenance staff regarding proper care, cleaning, and general maintenance.

1.6 DELIVERY AND STORAGE

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

.2 Store finishing hardware in locked, clean and dry area.

Part 2 Products

2.1 HARDWARE ITEMS

.1 Only door locksets and latchsets listed on CGSB Qualified Products List are acceptable for use on this project.

.2 Use one manufacturer's products only for all similar items.

2.2 DOOR HARDWARE

.1 Only door locksets and latchsets listed on CGSB Qualified Products List are acceptable for use on this project.

.2 Use one manufacturer's products only for all similar items.

2.3 DOOR HARDWARE LIST

.1 Butts:

.1 Two (2) pairs of butts for doors wider than 900 mm.

.2 Butts for exterior doors 115 x 115 heavy weight stainless steel, polished and dull chrome plated with non-removable stainless steel pins and two (2) permanently lubricated non-detachable ball races.

.2 Locksets:

.1 Schlage Type "ND Series", 95 mm backset, 6-pin Everest C123 keyway standard with two patented nickel silver keys per lock.

.2 Provide reinforcing plates.

.3 Refer to manufacturer's recommended installations.

.3 Latchsets: Schlage Type "ND" all to match locksets.

.4 Bathsets: Schlage Type "ND" to match latchsets but with button on inside and emergency keyway on outside.

.5 Closers: L.C.N. "Super Smoothee" 4040 and 4041 series where directed of type to suit particular installation.

.6 Door stops: Glynn-Johnson Type 60C aluminum and rubber wall bumper, GJ FB13/14 where wall bumper not possible.

.7 Kickplates: 250 x door width x 3 mm anodized aluminum plate with bevelled edges secured with countersunk stainless steel screws. Install on push side of interior doors with closers on both sides of exterior doors.

.8 Exit Devices: Exit device (panic hardware) VonDuprin-99 series, rim style, 630 finish.

.9 Exit Devices on Key Card Access Doors: Exit Device (panic hardware) VonDuprin-RX99 Series, rim style, 630 finish. Device to be equipped with one internal SPDT switch which monitors the push pad. Coordinate with Electrical.

.10 Threshold: Pemko 270A or as approved.

.11 Security Plates: Reinforce exterior doors in location of locks with blocker plates.

.12 Weatherstripping:

.1 Door bottoms for exterior doors: Pemko 216AV, extruded aluminum with cold weather neoprene inserts.

.2 Head and jamb weatherstrips: Pemko 332AR, extruded aluminum with cold weather neoprene inserts.

.3 Astragals for double doors: Pemko 355AV, extruded aluminum with vinyl insert mounted on active door.

.4 Weather stripping to be complete with cadmium-plated sheet metal screws and expansion shields.

2.4 FASTENINGS

.1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.2 Exposed fastening devices to match finish of hardware.

.3 Use fasteners compatible with material through which they pass.

2.5 KEYING

.1 Provide for construction keying.

.2 Provide all permanent cores and keys to Owner.

.3 Doors to be keyed after construction, doors to be keyed alike in groups and to the existing site great grand master schedule as directed. Prepare detailed keying schedule in conjunction with Engineer.

.4 Provide keys in triplicate for every lock in this contract.

.5 Provide three (3) master keys for each MK or GMK group.

.6 Stamp keying code numbers on keys and cylinders.

Part 3 Execution

3.1 INSTALLATION INSTRUCTIONS

.1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Furnish manufacturers' instructions for proper installation of each hardware component.

.3 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.

3.2 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 provide tight fit at contact points with frames.

3.3 HARDWARE CODE

.1 The following code represents the specific hardware required for installation on doors as listed on the Door and Hardware Schedule on the drawings.

HARDWARE CODE: H1 – EXTERIOR MAN DOORS				
Quantity	**Hardware/Item**	**Model**	**Finish**	**Brand**
3	Hinge	FBB191 114 x 102 NRP	C26D	Stanley Hardware
1	Lockset	ND80LD x RHO	626	Schlage
1	Deadlock	B660	626	Schlage
1	Closer	4041 LONG	689	LCN
1	Kick Plate	K10A 250 x 860	32D	Standard Metal
1	Threshold	CT-10 x 900	AL	KN Crowder
1	Door Sweep	W-13S x 900	CA	KN Crowder
1	Weather-strip	W-49 1 x 900 + 2 x 2150	AL	KN Crowder
1	Security Stop	FS18S		H.B. Ives
1	Lock Guard	1G7-32D	32D	H.B. Ives

HARDWARE CODE: H2 – INTERIOR DOORS (ENTRY)				
Quantity	**Hardware/Item**	**Model**	**Finish**	**Brand**
3	Hinge	FBB179 114 x 101	C26D	Stanley Hardware
1	Lockset	ND80LD x RHO	626	Schlage
1	Closer	1461 REG	689	Sargent
1	Kick Plate	K10A 250 x 860	32D	Standard Metal
1	Wall Stop	S122	26D	Standard Metal

HARDWARE CODE: H3 – OVERHEAD DOORS	
All hardware by door manufacturer.	

HARDWARE CODE: H4 – EXTERIOR MAN DOORS				
Quantity	**Hardware/Item**	**Model**	**Finish**	**Brand**
3	Hinge	FBB191 114 x 102 NRP	C26D	Stanley Hardware
1	Lockset	ND80LD x RHO	626	Schlage
1	Deadlock	B660	626	Schlage
1	Closer	4041 LONG	689	LCN
1	Kick Plate	K10A 250 x 1000	32D	Standard Metal
1	Threshold	CT-10 x 1050	AL	KN Crowder
1	Door Sweep	W-13S x 1050	CA	KN Crowder
1	Weather-strip	W-49 1 x 1050 + 2 x 2430	AL	KN Crowder
1	Security Stop	FS18S		H.B. Ives
1	Lock Guard	1G7-32D	32D	H.B. Ives

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI).

.1 ANSI Z97.1, Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM C542, Specification for Lock-Strip Gaskets.

.2 ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.3 ASTM D2240, Standard Test Method for Rubber Property - Durometer Hardness.

.4 ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.

.5 ASTM F1233, Test Method for Security Glazing Materials and Systems.

.3 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-12.1, Tempered or Laminated Safety Glass.

.2 CAN/CGSB-12.2, Flat, Clear Sheet Glass.

.3 CAN/CGSB-12.11, Wired Safety Glass.

.4 Canadian Standards Association (CSA International).

.1 CAN/CSA A440.2-09/A440.3, Fenestration energy performance/User guide to CSA A440.2-09.

.2 CSA Certification Program for Windows and Doors.

.5 Environmental Choice Program (ECP): CCD-045-95, Sealants and Caulking.

.6 Glazing Association of North America (GANA)

.1 GANA Glazing Manual.

.2 GANA Glazing Reference.

.7 Insulating Glass Manufacturers Alliance.

.8 National Fire Protection Association (NFPA):

.1 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

.2 NFPA 252, Fire Tests of Door Assemblies.

.3 NFPA 257, Fire Test for Window and Glass Block Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province, Canada.

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

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

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with MMCD Division 01.

.2 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

1.4 QUALITY ASSURANCE

.1 Certificates: 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 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 glazing and frames from nicks, scratches, and blemishes.

.3 Protect prefinished aluminum surfaces with strippable coating.

.4 Replace defective or damaged materials with new.

1.6 AMBIENT CONDITIONS

.1 Ambient Requirements:

.1 Install glazing when ambient temperature is 10ºC minimum. Maintain ventilated environment for 24 hours after application.

.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

2 Products

2.1 MATERIALS

.1 Design Criteria:

.1 Ensure continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:

.1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.2 Size glass to withstand wind loads, dead loads and positive and negative live loads to ASTM E330.

.3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.

.2 Float glass: to CAN/CGSB-12.3, glazing quality, 6 mm minimum thickness.

.3 Clear Float Glass: to CAN/CGSB-12.3, glazing quality, 6 mm minimum thickness.

.4 Safety glass: to CAN/CGSB-12.1, transparent, 6 mm minimum thickness and as indicated on Drawings.

.1 Type: 2-tempered.

.2 Class: B-float.

.3 Category: II – 540 J impact resistance.

.5 Wired glass: to CAN/CGSB-12.11.

.1 Type 1-Polished both sides (transparent).

.2 Wire mesh styles: as directed by Engineer.

.3 Fire Rating: As indicated in door and frame schedule.

.6 Sealant: in accordance with Section 07 92 00- Joint Sealants.

2.2 ACCESSORIES

.1 Setting blocks: Neoprene, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.

.2 Spacer shims: Neoprene, 50-0 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.

.3 Glazing tape:

.1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.

.2 Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two (2) sides, maximum water absorption by volume 2%, designed for compression of 25%, to affect an air and vapour seal.

.4 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, black colour.

.5 Glazing clips: manufacturer's standard type.

.6 Lock-strip gaskets: to ASTM C542.

.7 Mirror attachment accessories:

.1 Stainless steel edge clips, with fastening concealed behind mirror.

.2 Mirror adhesive, chemically compatible with mirror coating and wall substrate.

.8 Other Glazing Accessories: to CAN/CSA-A440.

3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

.3 Inform Engineer of unacceptable conditions immediately upon discovery.

.4 Proceed with installation only after unacceptable conditions have been remedied

3.2 PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)

.1 Perform work in accordance with GANA Glazing Manual, IGMA, and GANA Laminated Glazing Reference Manual for glazing installation methods.

.2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.

.3 Place setting blocks at ¼ points, with edge block maximum 150 mm from corners.

.4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.

.5 Place glazing tape on free perimeter of glazing in same manner described.

.6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

.7 Knife trim protruding tape.

3.4 CLEANING

.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.2 Remove traces of primer, caulking.

.3 Remove glazing materials from finish surfaces.

.4 Remove labels after work is complete.

.5 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.

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

3.5 PROTECTION OF FINISHED WORK

.1 After installation, mark light with an "X" by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Aluminum Association (AA)

.1 AA DAF 45, Designation System for Aluminum Finishes.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM C475, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.2 ASTM C514, Standard Specification for Nails for the Application of Gypsum Board.

.3 ASTM C557, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

.4 ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.

.5 ASTM C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

.6 ASTM C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.7 ASTM C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.8 ASTM C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.9 ASTM C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.

.10 ASTM C1280, Standard Specification for Application of Gypsum Sheathing.

.11 ASTM C1396/C1396M, Standard Specification for Gypsum board.

.3 Association of the Wall and Ceilings Industries International (AWCI)

.1 AWCI Levels of Gypsum Board Finish-GA-214.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.2 CAN/CGSB-71.25, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 60 00 – Basic Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address and applicable standard designation.

.3 Exercise care in unloading gypsum board materials shipment to prevent damage.

.4 Storage and Handling Requirements in accordance with ASTM C 840–16:

.1 Store gypsum board assemblies materials level flat off ground in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.

.3 Protect gypsum board from direct exposure to rain, snow, sunlight, or other excessive weather conditions.

.4 Protect ready mix joint compounds from freezing, exposure to extreme heat and direct sunlight.

.5 Protect from weather, elements and damage from construction operations.

.6 Handle gypsum boards to prevent damage to edges, ends or surfaces.

.7 Replace defective or damaged materials with new.

1.3 AMBIENT CONDITIONS

.1 Maintain temperature 10°C minimum, 21°C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.

.2 Apply board and joint treatment to dry, clean, frost free surfaces.

.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

.1 Gypsum board to ASTM C1396/C1396M 14, thickness and type as indicated on drawings.

.2 Standard board: to ASTM C1396/C1396M 14 regular, 1200 wide x maximum practical length, ends square cut, edges squared.

.3 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.4 Resilient clips: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.5 Steel drill screws: to ASTM C1002-14.

.6 Laminating compound: as recommended by manufacturer, asbestos-free.

.7 Casing beads, corner beads, control joints and edge trim: to ASTM C 1047, zinc coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.8 Sealants: in accordance with Section 07 92 10 - Joint Sealing.

.9 Polyethylene: to CAN/CGSB-51.34, Type 2.

.10 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.

.11 Joint compound: to ASTM C 475, asbestos-free.

.12 Stud adhesive: to ASTM C557.

2.2 FINISHES

.1 Texture finish: asbestos-free standard white texture coating and primer-sealer, recommended by gypsum board manufacturer.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C840-16 except where specified otherwise.

.2 Do application of gypsum sheathing to ASTM C1280-13a.

.3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840-16 except where specified otherwise.

.4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.5 Install work level to tolerance of 1:1200.

.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

.7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

.8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.10 Install wall furring for gypsum board wall finishes to ASTM C840–16, except where specified otherwise.

.11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

.12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

.13 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.

.14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.

.2 Apply single layer gypsum board to metal furring or framing using screw fasteners Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C840-16.

.2 Apply gypsum board on walls vertically or horizontally, providing sheet lengths that will minimize number of board edges or end joints.

.3 Apply single layer gypsum board to concrete block surfaces, where indicated, using laminating adhesive.

.1 Comply with gypsum board manufacturer's recommendations.

.2 Brace or fasten gypsum board until fastening adhesive has set.

.3 Mechanically fasten gypsum board at top and bottom of each sheet.

.4 Exterior Soffits and Ceilings: install exterior gypsum board perpendicular to supports; stagger end joints over supports. Install with 6 mm gap where boards abut other work.

.5 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

.6 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.7 Install gypsum board with face side out.

.8 Do not install damaged or damp boards.

.9 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure using contact adhesive for full length or screw fasteners at 150 mm on centre.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.

.6 Construct control joints of two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.

.7 Provide continuous polyethylene dust barrier behind and across control joints.

.8 Locate control joints where indicated.

.9 Install control joints straight and true.

.10 Ensure that screws or nails are properly applied in process of attaching gypsum board to framing without damaging of gypsum board edges and ends.

.11 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.

.12 Install expansion joint straight and true.

.13 Splice corners and intersections together and secure to each member with 3 screws.

.14 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

.15 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.16 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.17 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, invisible after surface finish is completed.

.18 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.19 Completed installation smooth, level or plumb, free from waves and other defects and ready for surface finish.

.20 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.

.21 Mix joint compound slightly thinner than for joint taping.

.22 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.

.23 Allow skim coat to dry completely.

.24 Remove ridges by light sanding or wiping with damp cloth.

3.5 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 in accordance with Section 01 74 23 – Final Cleaning.

.3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Environmental Protection Agency (EPA)

- .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.
- .2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.3 Master Painters Institute (MPI)

- .1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM).
- .2 Standard GPS-1, MPI Green Performance Standard.
- .3 Standard GPS-2, MPI Green Performance Standard.

.4 National Research Council Canada (NRC)

- .1 National Fire Code of Canada (NFC).

.5 Society for Protective Coatings (SSPC)

- .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

- .1 Provide manufacturer's instructions, printed product literature and data sheets for paint and paint products and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Confirm products to be used are in MPI's approved product list.

.3 Upon completion, provide records of products used. List products in relation to finish system and include the following:

- .1 Product name, type and use.
- .2 Manufacturer's product number.
- .3 Colour numbers.
- .4 MPI Environmentally Friendly classification system rating.
- .5 Manufacturer's Material Safety Data Sheets (MSDS).

.4 Samples:

.1 Submit full range colour sample chips in accordance with Section 01 33 00 – Submittals. Indicate where colour availability is restricted.

.5 Manufacturer's Instructions:

.1 Provide manufacturer's installation / application instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual.

.2 Include:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

1.4 QUALITY CONTROL

.1 Qualifications:

.1 Contractor: to have a minimum of 5 years proven satisfactory experience. When requested, provide list of last 3 comparable jobs including, job name and location, specifying authority, and project manager.

.2 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work.

.3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.

.4 Conform to latest MPI requirements for exterior painting work including preparation and priming.

.5 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.

.6 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested. Standard of Acceptance:

.1 Walls: no defects visible from a distance of 1000 mm to surface.

.2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

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.

.1 Labels: to indicate:

.1 Type of paint or coating.

.2 Compliance with applicable standard.

.3 Colour number in accordance with established colour schedule.

.3 Storage and Handling Requirements:

.1 Store materials in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Observe manufacturer's recommendations for storage and handling.

.3 Store materials and supplies away from heat generating devices.

.4 Store temperature sensitive materials and equipment in well ventilated area with temperature range as recommended by manufacturer.

.5 Keep areas used for storage, cleaning and preparation, clean and orderly. After completion of operations, return areas to clean condition to approval of Engineer.

.6 Remove paint materials from storage only in quantities required for same day use.

.7 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.8 Fire Safety Requirements:

.1 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada (NFC).

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 7 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.

.4 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.5 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless pre-approved written approval by engineer and product manufacturer, perform no painting when:

.1 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.

.2 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.3 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.

.4 Perform painting work when maximum moisture content of the substrate is below:

.1 12% for concrete and masonry (clay and concrete brick/block). Allow new concrete and masonry to cure minimum of 28 days.

.2 15% for hard wood.

.3 17% for soft wood.

.4 12% for plaster and gypsum board.

.5 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".

.6 Test concrete, masonry and plaster surfaces for alkalinity as required.

.6 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.

.7 Additional interior application requirements:

.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

1.7 ITEMS TO BE PAINTED

.1 All piping, mechanical and electrical equipment not prefinished and directed. This includes sleeves through floors and miscellaneous metals.

.2 Interior walls: if not pre-finished.

.3 Paint valve position indicators red where directed.

.4 PVC, HDPE, copper pipe, stainless steel, fibreglass, electrical conduit and galvanized cable trays are not to be painted unless directed.

Part 2 Products

2.1 MATERIALS

.1 Only Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Provide paint materials for paint systems from single manufacturer.

.3 Conform to latest MPI requirements for painting work including preparation and priming.

.4 For submerged surfaces, internal or external use only products approved for use in contact with potable water by one or more of the following:

.1 Health and Welfare Canada.

.2 American Water Works Association.

.3 United States Environmental Protection Agency.

.4 National Sanitation Foundation.

.5 Use only products/manufacturers listed in the CPCA Manual unless specifically approved otherwise.

2.2 COLOURS

.1 Match colour schedule exactly. The nearest match of a standard line will not be accepted.

.1 Drain (SAN) brown CGSB 504-102.

.2 Vent (VE) match system to which line is attached.

.3 Miscellaneous metal and pipe supports black CGSB 512-101.

.4 Valve hand wheels and operating levers red CGSB 509-103.

.5 Walls, interior, P1: Sherwin Williams SW 7035 – Aesthetic White.

.6 Doors & Frames, P2: Sherwin Williams SW 7041 – Van Dyke Brown.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Use and add thinner in accordance with paint manufacturer’s recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.4 Thin paint for spraying in accordance with paint manufacturer’s instructions.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity. Strain as necessary.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level Category	Units @ 60°	Units @ 85°
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

.2 Gloss level ratings of painted surfaces shall be as specified herein.

2.5 PAINT SYSTEMS

.1 Steel and Iron Piping and Equipment:

.1 Finished dry film thickness shall be 300 microns (12 mils).

.2 Approved products:
.1 Bar-Rust 233H by ICI Devoe.
.2 Amercoat 395FD by General Paints.

.2 Galvanized Miscellaneous Metals and Deck (in exposed locations):
.1 No coating required.

.3 Ferrous Metals (not listed above):
.1 Prime - Alkyd anti-corrosive primer.
.2 Intermediate - Alkyd-oil base, semi-gloss.
.3 Finish - Alkyd-oil base, semi-gloss.

.4 Bollards: Safety Yellow.

.5 Handrails: galvanized.

.6 Walls-Interior:
.1 Minimum:2 final coats.
.2 Gloss/sheen: G5.
.3 Approved products:
.1 Sherwin-Williams primer for concrete block walls.
.2 Sherwin Williams multi-purpose primer for interior plywood wall surfaces.
.3 Pro Industrial Epoxy Paint -final coat by Sherwin-Williams.

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.

3.3 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable to be painted in accordance with manufacturer's written instructions.

.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 Maximum moisture content as follows:

.1 Stucco, plaster and gypsum board: 12%.

.2 Concrete: 12%.

.3 Clay and Concrete Block/Brick: 12%.

.4 Hard Wood: 15%.

.5 Soft Wood: 17%.

3.4 PREPARATION

.1 Protection (not applicable to new painting work):

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Engineer.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.2 Surface Preparation (not applicable to new painting work):

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 Place "WET PAINT" signs in occupied areas as painting operations progress.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual regarding specific requirements. Preparation of iron and steel surfaces:

.1 Iron and steel surfaces that are not galvanized and will be subject to normal exterior or interior atmospheric exposure: Clean either in the shop or in the field by means of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials or methods to the specifications issued by the Steel Structures Painting Council, SSPC-SP1. After solvent cleaning, blast the metal with abrasives to standards specified by SSPC-SP6 or CGSB 31-GP-404, Type 2. Prime cleaned surfaces as soon as practicable after cleaning with the appropriate specified primer. Prior to applying subsequent coats, clean and reprime all welds and other damaged areas of shop primed surfaces. Neutralize and remove all slag and weld spatter by acid washing.

.2 Submerged exposures: All iron and steel surfaces that are not galvanized and will be subject to immersion, or which will be wet by spray or condensation, or as specified in the schedule: clean of all rust, millscale and other foreign matter to bright base metal by solvent cleaning to specification SSPC-SP1 issued by the

Steel Structures Painting Council and then blast cleaning to Standard SSPC-SP10 to CGSB 31-GP-404 Type 1. Carry out blast cleaning using abrasives of such particular shape, hardness and gradation as to effectively clean the metal and leave a roughened surface suitable for adequate bonding of subsequent coatings. As soon after cleaning as practicable, and prior to the formation of any corrosion from atmospheric moisture or other causes, clean all blast-cleaned metal surfaces of dust and coat with the specified primer, protective coating, or paint. Do not leave blast cleaned surfaces overnight prior to receiving the priming coat. Where manufacturer's requirements for surface preparation are more stringent than the foregoing. The manufacturer's requirement shall be followed.

.3 Prior to field application of subsequent coats, thoroughly clean the surfaces of shop applied coating with mineral spirits.

.4 Properly clean all welds or other unpainted areas as specified for the adjacent area. Give one coat of primer as specified.

3.5 EXISTING CONDITIONS

.1 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" and report findings to Engineer. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.2 Maximum moisture content as follows:

.1 Stucco: 12%.

.2 Concrete: 12%.

.3 Clay and Concrete Block/Brick: 12%.

.4 Hard Wood: 15%.

.5 Soft Wood: 17%.

3.6 APPLICATION

.1 Sand and dust between each coat to remove defects visible from a distance up to 1000 mm.

.2 Finish tops, bottoms, edges and areas not readily visible.

.3 Apply each coat as recommended by the manufacturer.

3.7 MECHANICAL/ELECTRICAL EQUIPMENT

.1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.

.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.4 Do not paint over nameplates.

.5 Keep sprinkler heads free of paint.

.6 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.7 Paint fire protection piping red.

.8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.9 Paint natural gas piping yellow.

.10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.11 Do not paint interior transformers and substation equipment.

3.8 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm to surface.

.2 Ceilings: no defects visible from floor to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.9 FIELD QUALITY CONTROL

.1 Field inspection of painting operations to be carried out by Engineer or designate.

.2 Advise Engineer when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

3.10 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 in accordance with Section 01 74 23 – Final Cleaning.

.3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.11 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for the building mechanical equipment shown in the schedules of the building mechanical design section, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop drawings:

.1 Drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 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.

1.2 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for all building mechanical equipment for incorporation into manual.

.1 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 Colour coding chart.

.2 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.

.3 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 HVAC.

.4 Approvals:

.1 Submit 1 copy of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.

.2 Make changes as required and re-submit as directed by Engineer.

.5 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.6 Site records:

.1 Engineer will provide 1 set of reproducible mechanical drawings. 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.

.7 As-Built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, 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 Engineer for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.8 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Furnish spare parts as follows:

.1 One glass for each gauge glass.

.2 One flange gasket for each piping accessory which flanged connected.

.3 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Execution

2.1 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 Owner and Engineer.

.2 Inform Engineer of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

2.2 PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

2.3 SYSTEM CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and fans.

2.4 DEMONSTRATION

.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.2 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.3 Instruction duration time requirements as specified in appropriate sections.

.4 Engineer will witness these demonstrations.

2.5 CLEANING

.1 Progress Cleaning: clean the area after the work completed.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

2.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

- .1 ASTM F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- .2 ASTM F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution System.
- .3 ASTM B88M, Specification for Seamless Copper Water Tube (Metric).
- .4 ASTM B42, Seamless Copper Tube, Standard Sizes.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

- .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
- .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)

- .1 AWWA C904, Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76 mm), for Water Service.

.4 CSA Group

- .1 CSA B137.5, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
- .2 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings and General Instructions No. 1.

.5 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC S101, Fire Endurance Tests of Buildings Construction and Materials.
- .2 CAN/ULC S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
- .3 CAN/ULC S115, Standard Method of Fire Tests of Firestop.

.6 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

- .1 MSS-SP-67, Butterfly Valves.
- .2 MSS-SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.7 National Research Council (NRC)

- .1 National Plumbing Code of Canada (NPC) 2015.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data

.1 Provide manufacturer's printed product literature and datasheets for domestic water copper piping and accessories.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for recycling.

Part 2 Products

2.1 PIPING

.1 Domestic hot and cold within building.

.1 Above ground:

.1 Piping up to NPS 1 ½ - PEX Piping to CSA B137.5.

.2 Piping NPS 2 and larger – Copper to ASTM B88M, ASTM B42-15a.

2.2 FITTINGS

.1 PEX fittings to CSA B137.5 and F1960.

.2 Copper fittings to ANSI/ASME B16.18.

2.3 JOINTS

.1 NPS 1 ½ and smaller: PEX fittings to CSA B137.5.

.2 NPS 2 and larger: ANSI/ASME B16.18. Elbows, adapters, couplings, plugs, tees, multi-port tees and valves.

2.4 BALL VALVES

.1 NPS 2 and under, screwed:

.1 Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.

Part 3 Execution

3.1 PREPARATION

.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 National Plumbing Code.

.2 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.

3.3 FIELD QUALITY CONTROL

.1 Pressure Tests

.1 Conform to requirements of Section 21 05 01- Common Work Results for Mechanical.

.2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.4 FLUSHING

.1 Flush entire system. Let stand for 24 hours, verify system is clean to federal potable water guidelines.

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.

3.6 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality to the Authority having jurisdiction for approval if required.

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.

.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 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 Verify compliance with safety and health requirements.

.3 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.9 CLEANING

.1 Clean in accordance with Section 01 10 00 – General Requirements.

.2 Waste Management: separate waste materials for recycling.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM B306, Standard Specification for Copper Drainage Tube (DWV).

.2 Canadian Standards Association (CSA International).

.1 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.2 CAN/CSA-B125.3, Plumbing Fittings.

.3 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada 2015 (NPC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 10 00 – General Requirements.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for drainage sewage waste and vent piping, and associated accessories.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary and vent Type DWV to: ASTM B306.

.1 Fittings.

.1 Cast brass: to CAN/CSA-B125.3.

.2 Wrought copper: to CAN/CSA-B125.3.

2.2 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating.

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.ASTM C564, or

.2 Stainless steel clamps.

.2 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Cold caulking compounds.

.2 Above ground sanitary: to CAN/CSA-B70.

.1 Hub and spigot:

.1 Caulking lead: to CSA B67.

.2 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

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 National Plumbing Code.

3.3 TESTING

.1 Pressure test systems before putting into operation.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 CLEANING

.1 Clean in accordance with Section 01 10 00 – General Requirements.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-Series B1800, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-36, Commercial Adhesives.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada (NPC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 10 00 – General Requirements.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Store at temperatures and conditions recommended by manufacturer.

.3 Packaging Waste Management: remove for recycle of crates, pallets, padding, and packaging materials.

Part 2 Products

2.1 PIPING AND FITTINGS

.1 For above ground PVC piping to: CAN/CSA B181.2.

2.2 JOINTS

.1 Solvent weld for PVC: to ASTM D2564.

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 the latest revisions of BC Plumbing Code and National Plumbing Code.

3.3 TESTING

.1 Pressure test installed systems before putting into operation.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 CLEANING

.1 Clean in accordance with Section 01 10 00 – General Requirements.

.2 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section IV.

.2 American National Standards Institute/Canadian Standards Association (ANSI/CSA)

.1 ANSI Z21.22-2015/CSA 4.4, Relief valves for hot water supply systems.

.3 Canadian Standards Association (CSA International)

.1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.

.3 CAN/CSA-C191, Performance of Electric Storage Tank Water Heaters for Household Service.

.4 CAN/CSA-C309, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

.4 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada (NPC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for domestic electric water heater, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

.2 Power ratings, number of heating elements, capacities.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove padding, crates, packaging materials, or pallets in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 COMPONENTS

2.2 ELECTRIC WATER HEATER

.1 Tank: 450 L, glass-lined tank, 750 mm diameter x 1580 mm high, 50 mm mineral wool or fibreglass insulation, enamelled steel jacket, 3 year warranty certificate.

2.3 ELECTRIC DHW HEATER AND STORAGE TANK

.1 DHW heater:

.1 General: packaged unit to CSA / ASME standards, stamped for 1034 kPa (150 psi) working pressure. Provide CSA certification.

.2 Heating capacity: 12 kW total, 3 heating elements.

.3 Tank: 450 L, glass-lined tank, 750 mm diameter x 1580 mm high, 50 mm foam insulation.

.4 Tank to be installed on 100mm concrete housekeeping pad.

.5 GOLDENROD® heating elements or equivalent to prevent scaling.

.6 Cabinet to have bonderized undercoat with baked enamel finish.

.7 Tank to have two anode rods for corrosion protection.

.8 CSA/ASME temperature and pressure relief valve.

.9 Internal surface:

.1 All internal surfaces exposed to water shall be glass-lined with alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range 760°C to 870°C.

.10 Controls:

.1 Adjustable temperature control and manual reset high temperature cut-off per element.

.11 Acceptable manufacturers: AO Smith, Rheem, Bradford-White.

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 manufacturer's recommendations and authority having jurisdiction.

.2 Heater tank to be installed on 100 mm housekeeping pad.

.3 Anchoring and mounting as per manufacturer instructions.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Clean the working area in accordance with authorities having jurisdiction requirements.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA)

.1 ANSI/AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.

.2 ANSI/AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.

.3 ANSI/AWWA C702, Standard for Cold Water Meters-Compound Type.

.3 CSA International

.1 CSA-B64, Backflow Preventers and Vacuum Breakers.

.2 CSA B79, Commercial and Residential Drains and Cleanouts.

.3 CAN/CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada 2015 (NPC).

.5 Plumbing and Drainage Institute (PDI)

.1 PDI-WH201, Water Hammer Arresters Standard.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Shop Drawings:

.1 Indicate on drawings to indicate accessories, dimensions, construction and assembly details, number of anchors, finishes, materials, method of anchorage.

1.3 CLOSEOUT SUBMITTALS

.1 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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

Part 2 Products

2.1 GENERAL

.1 All plumbing and piping accessories in the Screen Building (classified area as Class 1, Zone 2) to be produced from Stainless Steel or other non-corrosive metal or material. Protective coating is acceptable as long as it is suitable to withstand corrosive environments.

.2 All plumbing and piping accessories in the Treatment Building (non-classified) to be regular as specified.

2.2 FLOOR DRAINS

.1 Floor Drains: to CSA B79.

.2 FD-1: general duty; cast iron body as indicated, round, adjustable head, sediment basket, nickel bronze strainer, integral seepage pan, and clamping collar. Screen Building to have Stainless Steel top finish of the flood drain.

.3 FD-2: combination funnel floor drain; cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel.

.4 Approved manufacturers: Watts, Zurn, Mifab, Smith.

.5 Refer to mechanical schedules.

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 and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Unfinished Concrete Floors: cast iron round, nickel bronze gasket.

2.4 WATER HAMMER ARRESTORS

.1 Copper construction, bellows type: to PDI-WH201.

.2 Stainless Steel construction in Screen Building: to PDI-WH201

.3 Approved manufacturers: Watts, Zurn, Mifab, Smith.

2.5 BACK FLOW PREVENTERS

.1 Preventers: to CSA-B64 Series, application, double check valve assembly.

.2 Reduced Pressure Backflow Assemblies: to CSA-B64 Series

2.6 PRESSURE REGULATORS

.1 Capacity: as indicated.

.1 Inlet pressure max: 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.

2.7 BACKWATER VALVES

.1 Galvanized body with bronze seat, revolving bronze flapper and threaded cover.

.2 Access:

.1 Surface access.

.2 Access pipe with cover: maximum 300 mm depth.

.3 Steel housing with gasketted steel cover.

.4 Concrete access pit with cover, as indicated.

2.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Indoor type:

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas. Stainless Steel material for Screen Building.

.2 Accepted manufacturers: Watts, Zurn, Mifab

2.9 WATER METERS

.1 Turbine type to ANSI/AWWA C701.

.2 Meter to comply with local municipality requirements.

.3 Bronze lead free. Size as per associated piping.

.4 Accessories: remote readout device.

.5 Manufacturers: Neptune, Sensus.

2.10 TRAP SEAL PRIMERS

.1 Solenoid valve on timer.

.2 Approved manufacturers: Mifab, PPI.

2.11 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.

2.12 THERMOSTATIC MIXING VALVE

.1 Approved manufacturer: Watts/Power, Bradley or approved equivalent.

.2 Material: Lead free brass body.

.3 Compliant with CSA B125.

.4 Adjustable with lockable temperature setting.

.5 Installed as per manufacturer’s recommendations.

2.13 EMERGENCY SHOWER

.1 Approved manufacturer: Bradley or approved equivalent.

.2 Delivery: Emergency shower with eye-wash station as one package.

.3 Compliant with ANSI Z358.1.

.4 Installed as per manufacturer’s recommendations.

.5 Shower to have a Flow Switch with alarm to PLC.

2.14 ULTRA-VIOLET INLINE TREATMENT SYSTEM

.1 Approved manufacturer: Rainfresh or equivalent.

.2 Refer to mechanical schedules for details.

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 Owner and Engineer.

.2 Inform Engineer of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations 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 (NPC) and BC Plumbing Code.

.2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished 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.

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.

3.7 HOSE BIBS AND SEDIMENT FAUCETS

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.8 TRAP SEAL PRIMERS

.1 Install for all traps servicing floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, as indicated.

.3 Install PEX or PVC tubing to floor drain as indicated.

3.9 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.10 WATER METERS

.1 Install water meter provided by local water authority.

.2 Install water meter as indicated.

3.11 START-UP

.1 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.

.2 Provide continuous supervision during start-up.

3.12 TESTING AND ADJUSTING

.1 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.2 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.3 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.4 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.

.5 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.

.6 Roof drains:

.1 Check location at low points in roof.

.2 Check security, removability of dome.

.3 Adjust weirs to suit actual roof slopes, meet requirements of design.

.4 Clean out sumps.

.5 Verify provisions for movement of roof systems.

.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 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.11 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.12 Hose bibs, sediment faucets:

.1 Verify that flow and pressure meet design criteria.

.2 Check for leaks, replace compression washer if required.

.13 Water meters:

.1 Verify location and accessibility.

.2 Test metre reading accuracy.

3.13 CLEANING

.1 Progress Cleaning: clean the area after the work completed.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.14 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 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

.3 ASTM F594 Standard Specification for Stainless Steel Nuts.

.2 Canadian Standards Association (CSA International)

.1 CSA B51/ASME B31.3, Process Piping.

.3 National Fire Protection Association (NFPA)

.1 NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 10 00 – General Requirements.

.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 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.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 equipment from mechanical damage.

.3 Replace defective or damaged material with new.

.4 Contractor is responsible that the supplied materials are not damaged or missed from site.

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 CSA B51/ASME B31.3, Process Piping.

.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 and CSA B51/ASME B31.3, Process Piping. Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes: Pipe hangers and supports: stainless steel after manufacture.

.2 Upper attachment structural: suspension from upper flange of I-Beam:

.1 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 UL listed, FM approved.

.3 Upper attachment to concrete:

.1 Ceiling: stainless steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Concrete inserts: wedge shaped body with knockout protector plate UL listed.

.4 Hanger rods: 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 28 mm rod.

.5 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: stainless steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.6 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.7 U-bolts: stainless steel to MSS SP69 with 2 nuts at each end to ASTM F594.

.8 Pipe rollers: SS roll and roll stand with SS rod to MSS SP69. If SS is not available, use carbon steel galvanized.

2.4 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings

.2 Contractor to mount Ventilation Fan in accordance with manufacturer’s requirements of the weight support. Please refer to manufacturer’s installation requirements. Anchors for the fans to be Hilti HIT – TZ.

2.5 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 Provide supplementary structural steelwork where structural bearings do not exist.

.4 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.

3.3 HANGER SPACING

.1 Plumbing piping: to National Plumbing Code of Canada (NPC).

.2 Copper piping: up to NPS 1/2: every 1.5 m.

.3 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m

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 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.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Requirements.

.2 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, tools and equipment and clean space/floor.

.4 Remove and dispose the generated rubbish according to authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components, seismic control measures and their installation.

.2 Related Requirements:

.1 Seismic control measures to meet requirements of NBC.

.2 Provide seismic restraints on all piping, ducts and mechanical equipment. Restraints are to be in accordance with the latest edition of the Seismic Restraint Manual for Mechanical Systems produced by SMACNA and the latest edition of the ASHRAE Applications Handbook Chapter 49 Seismic Restraint Design.

.3 Provide seismic restraints on all cable trays, lighting, transformers and all other electrical equipment. Restraints to be in accordance with the latest edition of the Seismic Restraint Standards Manual - Guidelines for Electrical Systems, published by the Electrical Contractors Association of BC (ECABC).

.4 Where rotating equipment is factory installed in a cabinet or enclosure and the vibration isolation mounts are also factory installed, they are to have factory installed seismic restraints and provisions for anchoring complete unit to structure. The manufacturer is to supply certificates verifying the design of the seismic restraints in accordance with the provisions of this section.

.5 Before substantial performance, Contractor’s professional engineer for seismic design is to visit the site to verify seismic restraints installation and provide a letter of conformance in accordance with the applicable building code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals:

.1 Submit manufacturer's printed product literature, specifications and datasheets in accordance with Section 01 33 00 - Submittals. Include product characteristics, performance criteria, and limitations.

.2 Provide stamped and signed letter of assurance by Contractor’s Professional Seismic Engineer.

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

.1 Provide separate shop drawings for each isolated system complete with performance and product data.

.2 Provide detailed drawings of seismic control measures for equipment.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Basic Product Requirements.

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

1.4 SEISMIC CONTROL MEASURES

.1 General:

.1 Emergency lighting system to remain operational during and after earthquakes.

.2 Seismic control systems to work in all directions.

.3 Fasteners and attachment points to resist same maximum load as seismic restraint.

.4 Drilled or power-driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.2 Static equipment: Anchor equipment to equipment supports. Anchor equipment supports to equipment pad or slab.

.3 Suspended equipment: Use one or more of following methods or as indicated.

.1 Install tight to structure.

.2 Cross brace in all directions.

.3 Brace back to structure.

.4 Cable restraint system.

.4 Seismic restraints:

.1 Cushioning action to be gentle and steady.

.2 Never to reach metal like stiffness.

.5 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.6 Piping systems:

.1 To be compatible with requirements for anchoring and guiding of piping systems.

.7 Bracing methods:

.1 Designed by Professional Engineer registered in British Columbia.

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

Part 2 Products

2.1 CABLE RESTRAINTS

.1 Provide slack cable restraint systems and/or other approved systems, for general seismic bracing of suspended equipment.

.2 Acceptable material: Mason, Vibron.

.3 Other approved systems are conventional pipe guides, rigid restraint where the piping is non-isolated or passes through a block or concrete wall, or a cable strap and space piece attached to the structure, used where the piping is adjacent to a wall and conventional slack cable/rigid restraints cannot be used.

2.2 ELASTOMERIC MOUNTS

.1 Colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt down holes; ribbed top and bottom surfaces.

.2 Acceptable material: Mason, Korfund, Vibron.

2.3 SPRINGS

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for all installations.

.4 Colour code springs.

2.4 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built in resilient limit stops, removable spacer plates.

.3 Performance: 25 mm deflection.

.4 Acceptable material: Mason, Korfund, Vibron.

2.5 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.

.2 Type H1 - neoprene - in shear, molded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.

.4 Acceptable material: Korfund, Mason, Vibron.

2.6 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 10 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centreline of thrust.

.3 Acceptable material: Korfund, Mason, Vibron.

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 vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Where isolation is bolted to floor use vibration isolation rubber washers.

.4 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.5 Provide slack cable restrains on the fans, unit heaters, and other suspended equipment, and connect to the units in such a way that the axial projection of the wires pass through the centre of gravity of the equipment, where possible.

.6 Orient restrain wires on fans and equipment at approximately 90° to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45° to the slab.

.7 Select the restraints for the specified seismic requirements. (These requirements are generally 0.8 g for normal fans and piping and 1.4 g for piping and equipment containing toxic materials).

.8 Select the anchor in the concrete slab for a load equal to one quarter of the weight of the fan at a 45° pull (0.35 x the specified seismic requirements).

.9 Install cables using appropriate grommet, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connection points. Cables can be directly wrapped around the pipe as opposed to using collars.

.10 On piping systems, provide transverse slack cable restraints at a maximum spacing of 12.5 m and longitudinal restraints at 25 m maximum spacing, or as limited by anchor/slack cable performance.

.11 Vary adjacent spacing of restraints on a piping by 10% to 30% to avoid coincident resonances.

.12 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing is installed within 600 mm of the elbow or tee, and if the connected pipe is the same or smaller in size. Do not use branch lines to restrain main lines.

.13 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.

.14 Install restraints at least 25 mm clear of all other equipment and services.

.15 Adjust restraint cables such that they are not visibly slack, or that the flexibility is approximately 35 mm under thumb pressure for a 1500 mm cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable/spacer piece restrains to not exceed 6 mm.

.16 Bolt all non-isolated equipment to structure.

3.3 CLEANING

.1 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 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 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Engineer 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.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.

.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.

1.3 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.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 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.

1.6 PRE-TAB REVIEW

.1 Review Contract Documents before project construction is started confirm in writing to Engineer adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer 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 as required.

1.7 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.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.9 START OF TAB

.1 Notify Engineer and Owner 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 weather-stripping, 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.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 0% or code minimum.

.2 Water systems: plus, or minus 10%.

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Engineer and the Owner 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 Engineer.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Engineer, 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.

1.15 TAB REPORT

.1 Format in accordance with National Environmental Balancing Bureau (NEBB).

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 2 copies of TAB Report to Engineer for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Engineer.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Engineer.

.4 Pay costs to repeat TAB as required to satisfaction of Engineer or the Owner.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Engineer or Owner, 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.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Engineer.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of ASHRAE, SMACNA, or NEBB.

.2 Do TAB of following systems, equipment, components, controls:

.1 Treatment Building

.1 Supply Fan (SF-1) serving the main room.

.2 Supply Fan (SF-2) serving the electrical room.

.3 A/C system serving electrical room.

.4 Exhaust fan (EF-1) serving the washroom.

.5 Unit heaters (UH-1).

.6 Controls.

.2 Screen Building

.1 Supply fan (SF-3) serving the screen room.

.2 Exhaust fan (EF-2) serving the screen room.

.3 Supply fan (SF-4) serving the electrical room.

.4 Unit heaters (UH-2, UH-3).

.5 Controls.

.3 Qualifications: personnel performing TAB qualified to standards of AABC and/or NEBB; company or personnel in good standing of AABC and/or NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified to standards of NEBB and/or AABC.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures, 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).

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

1.21 SYSTEM BALANCE VALUES

.1 Refer to drawings and mechanical schedules.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.3 ASTM C916, Standard Specification for Adhesives for Duct Thermal Insulation.

.4 ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.5 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.6 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.7 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.8 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.

.9 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.10 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.11 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.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 Shop Drawings:

.1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.

.2 R-values to be shown with max operating temperature.

.4 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.3 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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect insulation from cuts, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

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 Approved manufacturers: Owens Corning, Knauf, Johns Manville.

.3 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.4 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.

.5 TIAC Code C-2: Mineral fibre blanket to CAN/CGSB51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.

.1 Mineral fibre: to CAN/CGSB51.11.

2.3 JACKETS

.1 3M Venture Clad jacket 1577CW-WME.

2.4 ACCESSORIES

.1 Vapor retarder lap adhesive.

.2 Water based, fire retardant type, compatible with insulation.

2.5 INSTALLATION

.1 Pre-installation requirements:

1. Pressure testing of ductwork system to be complete, witnessed and certified.
2. Surfaces to be clean, dry, free from foreign material.

.2 Install in accordance with TIAC National Standards.

.3 Apply materials in accordance with manufacturer’s instruction and this specification

.4 Use two layers with staggered joints when required nominal thickness exceed 75mm.

.5 Maintain uninterrupted continuity and integrity of vapor retarder jacket and finishes.

.6 Hangers, support to be outside vapor retarder jacket.

.7 Support, hanger in accordance with the present specification.

.8 Apply highly compressive strength insulation where insulation may be compressed by weight of ductwork.

.9 Fasteners: at 300mm in horizontal and vertical directions, minimum two rows each side.

.10 Insulation type and thickness: TIAC code – C1, 25mm with vapor retarder.

2.6 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories.

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, 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, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547, Mineral Fiber Pipe Insulation.

.7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.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.

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2, 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 Submittals: in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.

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, member or qualified to standards of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 equipment from mechanical damage.

.3 Replace defective or damaged material with new.

.4 Contractor is responsible that the supplied materials are not damaged or missed from site.

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°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.

.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

.5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: flexible unicellular tubular elastomer.

.1 Insulation: with vapour retarder jacket.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

.4 Certified by manufacturer: free of potential stress corrosion cracking corrodents.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C533.

.2 Maximum "k" factor: to CAN/ULC-S702.

.3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Tie wire: 1.5 mm diameter stainless steel.

.4 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.5 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.6 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint.

.3 Minimum service temperatures: -20°C.

.4 Maximum service temperature: 65°C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.75 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.

.2 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: corrugated

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.3 Stainless steel:

.1 Type: 316 or 304.

.2 Thickness: 0.25 mm.

.3 Finish: corrugated.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

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, flanges and unions at equipment, primary flow measuring elements. Also applied for generator exhaust piping, use special high temperature removable jackets.

.2 Design: to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: high temperature fabric.

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 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	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)
Domestic HWS	A-1	25	25
Domestic CWS with vapour retarder	C-2	25	25
Refrigerant liquid	4 - 13	A-6	25
Refrigerant liquid	below 4	A-6	25

.2 Finishes:

.1 Exposed indoors: PVC, SS.

.2 Exposed in mechanical rooms: PVC, SS jacket.

.3 Concealed, indoors: No canvas.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Finish attachments: SS bands, at 150 mm on centre. Seals: wing closed.

.6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 FIELD QUALITY CONTROL

.1 Verification requirements include:

.1 Storage and collection of recyclables.

.2 Construction waste management.

.3 Resource reuse.

.4 Recycled content.

.5 Local/regional materials.

.6 Certified wood. Low-emitting materials.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Requirements.

.2 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, tools and equipment and clean space/floor.

.4 Remove and dispose the generated rubbish according to authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 equipment from mechanical damage.

.3 Replace defective or damaged material with new.

.4 Contractor is responsible that the supplied materials are not damaged or missed from site.

Part 2 Products

2.1 HVAC CONTROLLERS

.1 Model T775M2048/U by Honeywell. Electronic Temperature Controller, Modulating, 2 SPDT, 2 sensor inputs, 1 temperature sensor included. This controller to be installed in UV Room of the Treatment Building (non-classified areas).

.1 Power Supply: 120/240 VAC.

.2 Analog Output: 2, Electronic Series 90; 4-20 mA; 0-10 Vdc; 2-10 Vdc.

.3 Relay Outputs: 2 SPDT.

.4 Relay Contact Ratings: 24 Vac-- 10.0A resistive; 120 Vac-- 1/2 HP; 9.8 AFL, 58.8 ALR, 125 VA Pilot Duty; 240 Vac-- 1/2 HP; 4.9 AFL, 29.4 ALR, 125 VA Pilot Duty.

.5 Sensor Element: 1097 ohms PTC at 25°C (77°F).

.6 Setpoint Temperature Range (C): -40°C to 120°C

.2 Heat pump temperature controller with integrated temperature sensor by the same manufacturer to be installed in electrical room.

.3 Model T775B2032/U by Honeywell. Electronic Remote Controller, 2 SPDT, 1 floating output, 2 sensor inputs, 1 temperature sensor included. This controller to be installed in the electrical room of the Screen Building.

.1 Power Supply: 120/240 VAC.

.2 Relay Outputs: 2 SPDT.

.3 Relay Contact Ratings: 24 Vac-- 10.0A resistive; 120 Vac-- 1/2 HP; 9.8 AFL, 58.8 ALR, 125 VA Pilot Duty; 240 Vac-- 1/2 HP; 4.9 AFL, 29.4 ALR, 125 VA Pilot Duty.

.4 Sensor Element: 1097 ohms PTC at 25°C (77°F).

.5 Setpoint Temperature Range (C): -40°C to 120°C.

2.2 EXPLOSION-PROOF THERMOSTAT

.1 Ouellet UE-BTX1-N-A.

.2 Application – OHX unit heaters in Screen Room.

.3 Explosion-proof, wall mount thermostat (Bi-metal), 5°C (40°F) to 25°C (80°F) (suitable for 24 VAC or 120 VAC control circuit).

.1 Power Supply: 120 VAC.

.2 Setpoint Temperature Range (C): 5°C to 25°C.

2.3 TIMER SWITCH

.1 Leviton, LTB60-1LZ, Decora Pre-set 60 Minute Countdown Timer – 120 VAC, 60 Hz, 1800 W Incandescent, 600 W CFL, 5A LED, 20 A Resistive/Inductive, 1 hp, single pole 3-way or more locations, four pre-set buttons for 10-20-30-60 minutes, neutral required. White assembled on device, ivory and light almond included.

.2 Timer switch to be used by Operations / Maintenance personnel during the works in the treatment room and electrical room of the Treatment Building. It will be interlocked with SF-2 to provide ventilation on demand in electrical room. Main room timer switch to be connected to respective temperature controller.

.3 Electrical room of the Screen Building to have a timer switch to be wired to Honeywell T775B2032/U controller. It will activate manual setback mode during maintenance works inside.

2.4 FAN DISCONNECT SWITCHES

.1 Wall switches by fan manufacturer or equivalent to allow energize/de-energize fans.

.2 SF-3 and EF-2 non-rated environment toggle switch Hi-Low-Off for two-speed motors.

2.5 WALL-MOUNTED EQUIPMENT GUARDS

.1 Temperature controller guards: plastic. Slots for air circulation to the equipment.

2.6 TEMPERATURE SENSOR

.1 UV room and electrical room (Screen Building) indoor sensor, (Sensor A) by Honeywell or Honeywell compatible. Sensors shall be mounted on the wall nearby the Honeywell controller. Sensors are included with the controllers.

.1 PT1000 Standard Temperature Probe, -40-350F, use with T775.

.2 51 mm long x 6 mm dia. probe with 2000 mm or longer lead.

.3 1097 ohms PTC at 25°C (77°F).

.4 Operating Temperature Range (C): -40°C to 132°C.

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 electric and electronic control systems 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 control devices.

.2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Requirements.

.2 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, tools and equipment and clean space/floor.

.4 Remove and dispose the generated rubbish per authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASME

- .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
- .2 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
- .3 ASME B31.5, Refrigeration Piping and Heat Transfer Components.

.2 ASTM International

- .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- .2 ASTM B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 CSA Group

- .1 CSA B52, B52 Package, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

- .1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

Part 2 Products

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

- .1 Hard copper: to ASTM B280.

.2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature 121°C.

.2 Brazed:

.1 Fittings: wrought copper to ASME B16.22.

.2 Joints: silver solder, 15% Ag-80% Cu-5%P and non-corrosive flux.

.3 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

.1 22 mm and under: Class 500, 3.5 MPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

2.5 INSULATION

.1 Per the refrigeration equipment suppliers recommended practices and ASHRAE 90.1.

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 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5.

3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

.1 General:

.1 Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Soft annealed copper tubing: bend without crimping or constriction.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified.

.2 Small riser: size for 5.1 m^3/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.

.3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:

.1 Twice to 14 Pa absolute and hold for 4 hours.

.2 Break vacuum with refrigerant to 14 kPa.

.3 Final to 5 Pa absolute and hold for at least 12 hours.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

.5 Submit test results to Engineer.

.7 Charging:

.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.

.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:

.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.

.2 Record and report measurements to Engineer.

.9 Manufacturer's Field Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.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, at stages listed:

.1 After delivery and storage of products, and when preparatory Work or other Work on which the Work of this Section depends is complete, but before installation begins.

.2 During progress of Work at 60% complete.

.3 Upon completion of the Work, after cleaning is carried out.

.4 Obtain reports, within 3 days of review, and submit, immediately, to Engineer.

3.7 DEMONSTRATION

.1 Demonstrate working system without any leaks detected in accordance with CSA B52.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 REFERENCE STANDARDS

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 10 00 – General Requirements.

.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 Instrument test ports.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 equipment from mechanical damage.

.3 Replace defective or damaged material with new.

.4 Contractor is responsible that the supplied materials are not damaged or missed from site.

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 DUCTS GENERAL

.1 Screen Room ducting shall be constructed from Aluminum to withstand indoor corrosive environment. All related accessories shall be manufactured from non-corrosive metal or shall be coated with industry approved practices.

.2 All other areas ducting to be done from regular materials.

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300mm: two sash locks complete with safety chain.

.2 301 to 450mm: four sash locks complete with safety chain.

.3 451 to 1000mm: piano hinge and minimum two sash locks.

.4 Hold open devices.

2.4 TURNING VANES

.1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

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 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 Access Doors and Viewing Panels:

.1 Size:

.1 As per fans and dampers manufacturers recommendations.

.2 Locations:

.1 Control dampers.

.2 Devices requiring maintenance.

.3 Required by code.

.4 Filters.

.5 Elsewhere as indicated.

.2 Instrument Test Ports:

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 At inlet and outlet of coils.

.3 And as indicated.

.3 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Requirements.

.2 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, tools and equipment and clean space/floor.

.4 Remove and dispose the generated rubbish per authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 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.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 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.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed blade type as indicated.

.2 Tamco Series 1000 or equivalent is acceptable.

.3 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.4 Pressure fit self-lubricated bronze bearings.

.5 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.6 Performance:

.1 Leakage: in closed position less than 2% of rated air flow at 100 Pa.

.2 Pressure drop: at full open position less than 5 Pa.

.7 Motorized actuators: 120 V, 1 Ph, 60 Hz.

.8 Damper motorized actuators shall be Class 1 Div.2 rated for Screen Building Process Room only (Rotork Schischek or equivalent). All other rooms in the two building are regular Belimo actuators or equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper.

.5 Ensure dampers are observable and accessible.

3.2 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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 AMCA 99, Standards Handbook.

.2 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Rating.

.3 AMCA 300, Reverberant Room Method for Sound Testing of Fans.

.4 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.5 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Rating.

.6 CGSB 1-GP-181M, Coating, Zinc Rich, Organic, Ready Mixed.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 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.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.4 FANS GENERAL

.1 Fans: statically and dynamically balanced in accordance with AMCA 204, constructed in conformity with AMCA 99.

.2 Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

.3 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

.4 Motors:

.1 Size and type as indicated.

.2 EC motor for SF-1. All others are regular motors.

.3 SF-3, EF-2 motors are rated for Class 1, Div.2 environment.

.4 Premium efficiency where available for size specified.

.5 Fan cabinet factory primed and finished as specified, or as indicated in fan schedules, before assembly, in colour standard to manufacturer.

.6 Screen Room fans to be rated for Class 1, Div.2 hazardous areas with all aluminum construction and AMCA Spark B minimum rating.

.7 Treatment building fans are of regular construction with spark-proofing option.

1.5 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

.1 Casings: welded steel with welded motor support, hinged access plates, streamlined inlet cone and discharge bell sections and integral silencer casing.

.2 Blade material: aluminum. Hub material: stainless steel.

.3 Supports:

.1 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.

.4 Bearings: ball or roller with extension tubes to outside of casing.

.5 Direct drive:

.1 Adjustable blade wheels: totally-enclosed, air over motors.

.2 Diameter of wheel hub: at least equal to that of motor frame.

1.6 INLINE CENTRIFUGAL FANS

.1 Casings: aluminum.

.2 Blade material: aluminum. Hub material: stainless steel.

.3 Supports:

.1 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.

.4 Bearings: ball or roller with extension tubes to outside of casing.

.5 Belt drive:

.1 Adjustable belt and pulleys.

.2 Provide spare belt for each belt-driven fan.

1.7 CEILING MIXING FANS

.1 Canarm CP - commercial ceiling fan, model CP36. White color. Fan size - 36’’.

.2 120V/ 1Ph/ 60Hz.

.3 Wall-mounted speed controller to be provided. 120 V.

Part 2 Execution

2.1 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. 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.

2.2 FAN INSTALLATION

.1 Install fans in accordance with the manufacturer’s instructions and Installation Guides, which includes acceptable mounting methods.

.2 Install fans as indicated, complete with resilient mountings, and flexible electrical leads.

.3 Provide test and weights required for final air balance.

.4 Bearings and extension tubes to be easily accessible.

.5 Motors, access doors and access panels to be easily accessible.

2.3 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.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

1.2 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 Store and protect diffusers, registers and grilles 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 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity

.2 Frames:

.1 Full perimeter gaskets.

.2 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by Engineer.

2.3 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES AND REGISTERS

.1 General: refer to mechanical schedules for sizes and types.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 General: refer to mechanical schedules for sizes and types.

2.6 DIFFUSERS

.1 General: refer to mechanical schedules for sizes and types.

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 diffuser, register and grille 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 in accordance with manufacturers instructions.

3.3 CLEANING

.1 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 REFERENCES

.1 ASTM E90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

.2 AMCA 511, Air Movement and Control Association - Certified Ratings Program for Air Control Devices.

1.2 PRODUCT DATA

.1 Submit product data.

.2 Indicate the following:

.1 Pressure drop.

.2 Water penetration data.

.3 Face area.

.4 Free area.

.5 Size.

1.3 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency based on procedures in accordance with AMCA 511.

Part 2 Products

2.1 FIXED LOUVRES

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stationary type with J style, 6063T5 extruded aluminum, 2 mm (0.081 in.) nominal wall thickness, positioned at 37 degree on approximately 102 mm centre.

.4 Frame: heavy gauge 6063T5 extruded aluminum, 102 x 2 mm (4 x 0.081 in.) nominal dimensions.

.5 Head member, jamb: incorporate an integral gutter and downspout so water drains to the head end, then down the downspouts and out at the louvre sill.

.6 Mullions: at 1220 mm maximum centres.

.7 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194- SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, SS washer and aluminum body.

.8 Screen: 19 mm intake mesh, 1.3 mm dia. wire expanded aluminum birdscreen on inside face of louvres in removable frame.

.9 Louvres to bear AMCA certified rating seals for air performance and water penetration.

.10 Finish: Factory applied Duranar. Colour to match trim or door colour and to Engineer's approval.

.11 Recess installation.

.12 Provide multiple equal section as required.

.13 Acceptable suppliers: Greenheck, EH Price, Ventex/Alumavent.

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with manufacturers and SMACNA recommendations.

.2 Anchor securely into opening. Seal with caulking all around to ensure weather tightness.

.3 Seal airtight to connecting ductwork or plenums.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 210/240, Unitary Air Conditioning and Air-Source Heat Pump Equipment.

.2 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)

.1 ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems.

.3 Air-Conditioning and Refrigeration Institute (ARI)

.1 ARI 320, Standard for Water-Source Heat Pumps.

.2 ARI 325, Standard for Ground Water - Source Heat Pumps.

.4 CSA International

.1 CAN/CSA-C656, Performance Standard for Split-System and Single Package Central Air Conditioners and Heat Pumps.

.2 CAN/CSA-C13256, Water-Source Heat Pumps-Testing and Rating for Performance, Part 1 Water-to-Air and Brine-to-Air Heat Pumps.

.5 Environment Canada, (EC) / Environmental Protection Services (EPS)

.1 EPS 1/RA/2, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

.2 Environment Canada, Ozone-Depleting Substances Alternatives and Suppliers List.

.6 National Fire Protection Association (NFPA)

.1 NFPA 90A, Standard for Installation of Air Conditioning and Ventilating Systems.

1.2 WARRANTY

.1 12 months warranty period is extended to 60 months.

Part 2 Products

2.1 DESCRIPTION

.1 Single-zone system.

.2 Heat pumps: to EPS 1/RA/2, CSA approved and with ARI or CSA certification seal.

.3 Approved Suppliers: Fujitsu, Mitsubishi, Daikin.

.4 Capacities and quantities: refer to mechanical schedules.

2.2 REFRIGERANTS

.1 Type of Refrigerant: R-410A.

2.3 DRAIN PANS

.1 Design and construct condensate drain pans under indoor coils so that no water can accumulate and install to allow for easy cleaning.

2.4 SINGLE PACKAGE AIR-SOURCE HEAT PUMP

.1 General:

.1 Outdoor unit heat pump floor-mounted year-round operation.

.2 Two ceiling mounted indoor cassettes heat pump units.

.3 Factory assembled and tested, complete with refrigerant charge, ready to operate.

.4 ULC Listed and labelled.

.2 Performance: as indicated in mechanical schedules.

.1 Ratings: in accordance with ANSI/ARI 210/240 and CAN/CSA-C656.

.3 Compressor:

.1 Welded, hermetic with crankcase heaters, vibration isolators.

.2 Design and test to operate with outside air at minus 15°C on heating cycle without shutting off and at 1.6°C on cooling cycle with specified air flow.

.3 Separate and independent refrigeration and control system for each compressor.

.4 Coils: aluminum fins, mechanically bonded to seamless copper tubes with all joints brazed.

.5 Condensate drain via drain pumps from the indoor units in accordance with Mechanical Package drawings. Drain pan for the outdoor units.

.6 Filters supplied by manufacturers.

.7 Refrigeration piping:

.1 Between compressor, condenser, and indoor units, complete with refrigerant metering devices and valves.

.2 Refer to Section 23 23 00- Refrigerant Piping for insulation and other requirements.

.8 Controls:

.1 Protection: manual reset high and low-pressure stats, loss-of-charge, indoor coil freeze stat, current temperature overload devices.

.2 Two compressor units to have 2-stage compressor heat and cool with built-in electric strip heat lock-out to prevent resistance heat operation above 4.4°C ambient.

Part 3 Execution

3.1 INSTALLATION

.1 Install where indicated and in accordance with manufacturer's instructions.

.2 Install outdoor unit on the roof steel base/platform provided by steel/roof Contractor. Coordinate with Structural/Steel contractor. Drain condensate to rain collecting system.

.3 Secure with hold-down bolts in accordance with manufacturer's recommendations.

.4 Level indoor units with fans running. Align duct work. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.

.5 Make refrigerant and condensate piping connections.

.6 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.2 DRAIN PANS

.1 Install so that no water can accumulate. Arrange easy access for cleaning.

.2 Include internal or external trap for proper draining to building drain on roof.

3.3 START-UP AND COMMISSIONING

.1 Have manufacturer certify installation.

.2 Have manufacturer present during start-up and certify performance.

.3 Submit written start-up and commissioning reports to Engineer.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM C916, Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).

.3 Underwriters' Laboratories (UL) Inc.

.1 UL 2021, Fixed and Location-Dedicated Electric Room Heaters.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Equipment, capacity and piping connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 equipment from mechanical damage.

.3 Replace defective or damaged material with new.

.4 Contractor is responsible that the supplied materials are not damaged or missed from site.

Part 2 Products

2.1 ELECTRIC UNIT HEATERS

.1 Cabinet Unit Heaters: to UL 2021.

.2 Screen Room only to have Class 1, Div.2 rated heaters.

.3 Refer to mechanical equipment schedules for quantities and types.

.1 Preferred supplier – Ouellet, Trane.

.4 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.

.5 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.

.1 Include spark free non-ferrous fan construction.

.6 Filters: removable 25 mm thick fibrous glass throwaway type.

.7 Capacity: as indicated.

.8 Control:

.1 Built-in on-off switch by manufacturer, operated with integral overloads wall mounted.

.2 Screen Room UH to be controlled via local Explosion-proof thermostat.

.3 Automated control through Temperature Controllers for all non-rated Unit Heaters.

2.2 BASEBOARD ELECTRIC HEATERS

.1 As per mechanical drawings and schedules.

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 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 in accordance with manufacturer's instructions.

.2 Check final location with Engineer if different from that indicated prior to installation.

.1 Should deviations beyond allowable clearances arise, request and follow Engineer’s directive.

.3 Provide supplementary suspension steel as required.

.4 Install control and isolating devices.

.5 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 10 00 – General Requirements.

.2 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, tools and equipment and clean space/floor.

.4 Remove and dispose the generated rubbish per authorities having jurisdiction.

3.4 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 Systems Sequences of Operation:

1.2 SEQUENCING – UV TREATMENT BUILDING

.1 Key Components:

- .1 Supply fan, SF-1.
- .2 Supply fan, SF-2
- .3 Heat pumps: HP-1 (outdoor unit), HP-2 and HP-3 (indoor units).
- .4 Exhaust fans, EF-1.
- .5 Ceiling fan, CF-1
- .6 Electric unit heaters.
- .7 Baseboard heater.
- .8 Motorized dampers.
- .9 Temperature controllers.
- .10 Occupancy timer switches.

.2 Port Alberni WWTP UV Treatment Building doesn't have a dedicated DDC control system. Indoor parameters are controlled by local controllers and sensors. Each room has its own temperature controller to provide simple control logic to system components.

.3 The control sequence breakdown is as follows:

- .1 Overall Strategy
  - .1 SF-1 is in the main UV room of the building. It provides supply air for the main UV room only.
  - .2 Outdoor air enters the SF-1 through the wall louver with motorized damper DM-1 and distributes to the room through (3) supply grilles. Fan operates on manual demand through timer switch and controller (setback, occupancy mode), and also on automatic demand for cooling if temperature rise above 26^{o}C. Occupancy mode shall run the fan providing constant ventilation for maintenance personnel during the room visits.
  - .3 Exhaust air leaves the room through the exhaust duct with (3) exhaust grilles. Motorized dampers are interlocked with SF-1 providing simultaneous operation.
  - .4 (2) UH-1 provide heating to the room when indoor temperature drops below 10^{o}C.
- .2 Electrical Room
  - .1 The area is served by SF-2 and HP-1, HP-2, and HP-3. CF-1 provides proper air mixing. Local temperature controller by heat pump manufacturer keeps setpoints for heating and cooling. The heating calls

when setpoint reaches 10°C, while cooling calls when temperature is above 26°C. SF-1 provides constant room ventilation on-demand only using the wall-mounted timer switch.

.3 Washroom

.1 The room has a dedicated exhaust fan EF-1 and baseboard heater BB-1. Local thermostat to be used when room is occupied. Local fan switch shall start the fan on call. The timer must de-energize the fan after 20 min. if personnel forgot to turn off the fan.

1.3 SEQUENCING - SCREEN BUILDING

.1 Key Components

.1 Supply fan, SF-3.

.2 Exhaust fan, EF-2.

.3 Supply fan, SF-4.

.4 Electric unit heaters: UH-2, UH-3.

.5 Motorized dampers.

.6 Temperature controller.

.7 Thermostat.

.8 Occupancy timer switch.

.2 Port Alberni WWTP Screen Building doesn't have a dedicated DDC control system. Indoor parameters are controlled by local temperature controller and explosion-proof thermostat. Each room has its own temperature controller or thermostat to provide simple control logic to system components. The screen room is rated as Class 1, Div.2 hence all the HVAC system components located there must be rated for such hazardous environment and to be constructed from the non-corrosive materials. Electrical room has a regular non-hazardous rating.

.3 The control sequence breakdown is following:

.1 Overall Strategy

.1 SF-3 and EF-2 provide constant ventilation with 12 air changes per hour (ACH) or 6 ACH. The two-speed motor will allow to switch between these modes manually via a toggle switch located in electrical room. 6 ACH to be used for every day non-occupied operation while 12 ACH to be used during maintenance/occupancy mode.

.2 EF-2 interlocked with SF-3.

.3 Air balance is negative which provides by the larger exhaust airflow of the EF-2.

.4 (2) UH-2 provide heating when setpoint drops below 10°C. They are controlled by Ouellet explosion-proof thermostat.

.5 Dampers are interlocked with SF-3 or EF-2.

.2 Electrical Room

.1 The area is served by SF-4 and UH-3. The heating calls when setpoint reaches 10°C. while cooling calls when temperature is above 26°C. SF-4

provides cooling while UH-3 provides heating. Temperature controller operates both of equipment. Dampers are interlocked with the fan. Timer switch activates occupied mode on-demand during maintenance / operations works.

.2 Ventilation is constantly provided during the occupied mode.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This Section covers items common to Sections of Division 26.

1.2 CODES AND STANDARDS

.1 Except where specified otherwise, do complete installation in accordance with CSA C22.1 Part I and as amended for use in the Province of British Columbia, henceforth alternatively referred to as the Rules and Regulations.

.2 Do overhead and underground systems in accordance with CSA C22.3, No.1 and CSA C22.3 No. 7, except where specified otherwise.

.3 Abbreviations for electrical terms: to CSA Z85.

.4 In addition to the above, the requirements related to electrical installations that are not governed by the Rules and Regulations but are required by the BC Building Code, BC Hydro, Telus, and WorkSafe BC, shall be met.

1.3 CARE, OPERATION AND START-UP

.1 Refer to Division 1 for Pre-start-up, Start-up and Commissioning requirements.

.2 Instruct operating personnel in the operation, care and maintenance of equipment.

.3 Arrange and pay for services of manufacturer's qualified field service representative (FSR) to supervise start-up of installation, check, adjust, balance and calibrate components.

.4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

.5 Submit a service and commissioning report, by the FSR, for each applicable piece of equipment or system.

1.4 UTILITY COORDINATION

.1 Submit all pertinent information to the electrical utility and when requested, to Technical Safety BC. Include short circuit ratings of the service entrance breaker and, where applicable, motor control centre components. Forward any recommended changes to Engineer for approval prior to making such changes.

.2 The existing service to site is a 12.5 kV overhead primary service. The Owner submitted an electrical service upgrade form to BD Hydro to account for the additional load of the proposed facility, but no changes to the existing service is expected.

.3 BC Hydro plans to upgrade the service voltage to 25 kV in the future. The existing private overhead line hardware is suitable for 25 kV operation, and all proposed new extension to that infrastructure shall be suitable for dual primary voltage operation.

.4 At the new treatment building a new, 25 kV, 3 phase, 3 wire overhead/underground connection is required to feed the new padmount transfomer. Past existing metering point, overhead line is private. Contractor to extend the existing overhead line to new treatment building padmount transformer.

.5 Overhead line to remain at operational at 12.5kV to power the existing buildings until BC Hydro initiates a service voltage upgrade in the future. New padmount transformer at new treatment building to be provided with dual primary windings to accommodate 12.5kV existing voltage and 25kV upgraded voltage.

1.5 VOLTAGE RATINGS

.1 Operating voltages: to CAN3-C235.

.2 Electric equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 PERMITS, FEES AND INSPECTION

.1 Submit to Technical Safety BC and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Upon request of Contractor, Engineer will provide drawings and specifications to Contractor, as required by Technical Safety BC and Supply Authority at no cost.

.4 Notify Engineer of changes required by Technical Safety BC prior to making changes.

.5 Furnish Certificates of Acceptance from Technical Safety BC and authorities having jurisdiction on completion of work. The Contractor's Declaration of Completion, countersigned by the Electrical Inspector will be accepted as the Final Certificate.

.6 Pay all fees and charges for FSR for testing, start-up, and commissioning of equipment.

1.7 MATERIALS AND EQUIPMENT

.1 Equipment and material to be of manufacturer's current design and to be certified by CSA or an equivalent certification agency as identified in the Rules and Regulations. Where there is no alternative to supplying equipment which is thus certified, obtain special approval from Technical Safety BC.

.2 Factory assemble control panels and component assemblies.

.3 Listing of a company as an acceptable manufacturer or supplier of equipment and materials is conditional to compliance with the specified requirements.

.4 Uniformity of equipment: Materials and equipment of similar or identical nature shall be of same manufacture and type.

.5 Upgrades to existing equipment: materials and equipment required for modifications to existing electrical equipment to be supplied and installed by the manufacturer's service group.

1.8 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish air dry enamel.

.1 Paint outdoor electrical equipment "dark transformer green" finish to EEMAC Y1-2.

.2 Paint indoor switchgear and distribution enclosures and outdoor junction boxes light grey air dry enamel to EEMAC 2Y-1.

.2 If acceptable to Engineer, clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.4 If acceptable to Engineer, apply Galvacon touch-up paint to damaged portions of galvanized threads and surfaces.

1.9 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment, instruments, control devices and mechanical equipment which have an electrical component with nameplates and labels as follows.

.2 Nameplates:

.1 Lamacoid 2-ply, 3 mm thick plastic engraving sheet, white face, black backing, attached with foam-tape 3M Scotch-Mount No. 4032 adhesive backing where used in controlled environment indoor areas and with self tapping screws (rivetting not acceptable) where used outdoors or in wet, damp or contaminated indoor areas. Epoxy glued where integrity of enclosure would be impeded by screwholes.

NAMEPLATE SIZES

Size 1	13 x 50 mm	1 line	4 mm high letters
Size 2	13 x 70 mm	1 line	4 mm high letters
Size 3	20 x 50 mm	2 lines	4 mm high letters
Size 4	20 x 70 mm	2 lines	4 mm high letters
Size 5	27 x 70 mm	3 lines	4 mm high letters
Size 6	27 x 90 mm	4 lines	3 mm high letters
Size 7	70 x 150 mm	as required	min. 10 mm high letters

.3 Labels:

.1 Embossed plastic labels with 6 mm high letters unless specified otherwise, for use inside cabinets and panels only.

.4 Nameplates shall include the device, loop number, and the description from the single line diagrams and schematics as typically shown below.

P-101 WATER PUMP #1

SF-250 CHEMICAL ROOM SUPPLY FAN

.5 Nameplate sizes shall be verified as being adequate before they are fabricated.

.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.

1.10 CONDUIT AND CABLE IDENTIFICATION

.1 Identify conduits and cables which are numbered on the drawings or schedules using the alpha-numeric tag number as shown. Attach a tag at each point of termination or connection.

.2 Identify conduits and cables installed in non-hazardous or non-corrosive indoor areas or within enclosures with white nylon marker plates, Panduit #MP xxx-C, fastened with locking-type black nylon ties. Use intermediate grade ties, Panduit #PLT xxI-CO. If tie also serves as cable strap, use heavier grade tie.

.3 Identify conduits and cables installed outdoors or in hazardous or corrosive areas with stainless steel, embossed metal marker plate, Panduit #MMP, fastened with stainless steel, Panduit #MLT PANSTEEL ties. Use #304 or #316 stainless steel as appropriate.

.4 Identify conduits and cables installed in areas where they are subjected to chemical attack with stainless steel marker plates as specified above and fastened with Panduit #PLT xx - x76 Pan-Ty TEFZEL ties.

.5 Provide the required embossing and printing equipment, complete with software where applicable. Keep equipment on-site until plant commissioning is complete.

.6 Catalogue numbers specified are for the purpose of illustrating features and quality of the conduit and cable identification system. Products from other manufacturers are acceptable subject to meeting or exceeding the specified products.

1.11 WIRE IDENTIFICATION

.1 Identify control and instrument wires with permanent, indelible numbered markings on both ends of wires, i.e. at all points of terminations and splices. Characters to be no less than 2 mm high. Numbering shall not be handwritten.

.2 Unless otherwise specified or shown, wire numbers and terminal block numbers shall be the same.

.3 Maintain phase sequence and colour coding of wires throughout.

.4 Colour code wires to CSA C22.1 and as follows:

.1 Power wires: phase A-B-C from left to right or front to back, red-black-blue

.2 Neutral: white

.3 AC, control: red

.4 AC, ground: green

.5 DC + (ungrounded): yellow

.6 DC- (grounded): blue

.7 Instrument wires: shielded twisted pairs, white for higher potential, black for lower potential, grey overall jacket.

.8 Taping for the purpose of colour coding will not be accepted for conductors less than #2 AWG.

1.12 CONDUCTOR TERMINATIONS

.1 Lugs, terminals, screws used for termination of conductors to be suitable for copper and aluminum conductors.

1.13 MANUFACTURERS AND APPROVAL LABELS

.1 Visible and legible after equipment is installed.

1.14 WARNING SIGNS

.1 As specified and to meet requirements of BC Electrical Safety Authority and Engineer.

.2 Decal signs, minimum size 175 x 250 mm.

1.15 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete, unless otherwise shown: Schedule 40 PVC, sized for free passage of conduit and cable, and protruding 50 mm.

.2 Install cables, conduits, and fittings to be plastered over, neatly and close to building structure so furring can be kept to minimum.

1.16 LOCATION OF WIRING, OUTLETS, AND EQUIPMENT

.1 Wiring, outlets and equipment locations shown on the drawings are of a general nature.

.2 Drawings do not show all conduits, cables and equipment. Those shown are in diagrammatic form only. Provide all wiring required to complete the systems.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 1000 mm, and information is given before installation.

.4 Check the location of all items fed by conduit embedded in or below the floor slab. Ensure that the conduit is located correctly.

1.17 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor (AFF) to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at the following heights unless indicated otherwise:

- .1 Switches: 1400 mm.
- .2 Wall receptacles:
  - .1 General: 400 mm.
  - .2 Process areas: 1000 mm.
  - .3 Above top of continuous baseboard heater: 200 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Thermostats: 1400 mm.

1.18 LOAD BALANCE

.1 Measure phase current with normal loads operating at time of acceptance. Adjust panelboard branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and, where applicable, adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, a report listing phase voltages, phase currents and if applicable, neutral currents on panelboard and motors, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.19 QUALITY CONTROL

.1 Test, calibrate and, unless otherwise specified, program and configure the new works to ensure that they are operating in accordance with the intent of the drawings and specifications. Any clarification required as to the intent of the drawings and specifications must be obtained prior to bid closing.

.2 Supply all necessary instruments, meters, equipment and qualified personnel to perform tests and calibrations.

.3 Furnish manufacturer's certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions.

.4 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument; use a 1000 V instrument for system voltages above 350 V. Note: Disconnect cables connected to instruments, controllers and similar devices.

.2 Check resistance to ground before energizing.

.3 Carry out tests in presence of Engineer.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project. Instruments should be calibrated within the last 12 months.

.5 Submit test results for Engineer's review.

.5 Check electrical equipment and motor nameplates to ensure that the breakers, fuses, overload heaters and conductors are sized in accordance with the Rules and Regulations.

.6 Ensure that circuit protective devices such as overcurrent trips, relays, fuses, and the like, are set to required values.

.7 Provide Engineer with list of test results including, but not limited to, the following:

.1 Nameplate full load current of each motor.

.2 Measured operating current of each motor.

.3 Cat. No. and current range of installed O/L heater or settings, as applicable.

.4 Setting of circuit breakers.

.5 Settings of all protective relays.

.6 Thermostat settings.

.7 Calibration calculations.

.8 Analog and control setpoints.

.9 Parameter setting record sheets for devices and equipment which need programming, e.g. UV control panel, chlorination control, and the like.

.10 All other relevant and similar data.

.8 Submit a completed Motor Data Sheet as shown appended to this Section.

1.20 GUARDING

.1 Guard exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.

1.21 PROTECTION

.1 Protect equipment and material from the weather, moisture, dust and physical damage.

.2 Cover equipment openings and open ends of conduit piping and pullboxes as work progresses. Failure to do so will result in the Contractor being required to adequately clean or replace materials and equipment at no extra cost to the Owner.

.3 Refinish damaged or marred factory finish to as-new condition.

.4 Protect all existing services encountered. Obtain instructions from the Engineer when existing services require relocation or modification, further to that defined in these contract documents.

1.22 CLEANING

.1 Do final cleaning in accordance with Section 01 74 23 – Final Cleaning.

1.23 WORKMANSHIP

.1 Workmanship shall be in accordance with well established practice and standards accepted by Engineer.

.2 The Engineer has the right to reject any item of work that does not conform to the contract documents and accepted standards of performance, quietness of operations, finish and appearance.

1.24 SEISMIC RESTRAINTS

.1 Provide seismic restraints for cable tray, luminaries, control panels and the like.

.2 Refer to Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

1.25 DRAWINGS AND MEASUREMENTS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of the work. Do not scale the drawings.

.2 Take field measurements where equipment and material dimensions are dependent upon buildings.

.3 Ensure adequate clearance in front of all electrical panels and equipment.

.4 Ensure that all suppliers of equipment and material have sufficient information to determine that their equipment and material is suitable for the intended use shown in these documents.

1.26 EXAMINATION

.1 Locations shown on the Drawings must be verified and the responsibility for any error resulting from failure to exercise such precaution shall be the responsibility of this Contractor.

.2 Examine the documents for details of work included. Obtain written clarification from the Engineer, in the event of conflict within the Specification, between the Specification and Drawings, or in the Drawings. Obtain written clarification from the Engineer if work affecting the installation is not clear.

1.27 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data as specified.

.2 Shop drawings depicting schematic and single line diagrams, connection diagrams, panel layouts, and the like must be prepared by electronic drafting means.

.3 Include information for the following:

.1 Electrical distribution equipment, such as panelboards.

.2 Lighting equipment including ballasts and applicable photometrics with coefficient of utilization tables.

.3 Instrumentation equipment.

.4 Information for the above listed items to include, but not be limited to, wiring diagrams, bills of materials, dimensional data and operating descriptions. Catalogue sheets may be submitted as shop drawings provided they are for actual piece of equipment supplied; literature which covers an entire family of equipment is only acceptable if the equipment proposed is clearly highlighted.

1.28 INSTALLATION INSTRUCTIONS

.1 Obtain the manufacturer's instructions necessary for the correct installation, calibration and adjustment for all equipment well in advance of commencement of shop and site work.

1.29 RECORD DRAWINGS

.1 Contractor to provide project record documents.

.2 Record drawings and information is to include but is not limited to the following:

.1 Field Instrument Manufacturer calibration certification sheets.

.2 Shop drawings, revised to as constructed status; refer also to another clause in this Section entitled Shop Drawings.

.3 Design drawings, revised to as constructed status.

.4 Instrument and calibration record forms.

.5 Data sheets with listing of programming and configuration variables of such equipment as Transmitters, Metering Systems, and the like.

1.30 OPERATIONS AND MAINTENANCE MANUAL

.1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manual.

.2 The data must include all information listed under another item of this Section entitled Shop Drawings and Product Data, supplemented by illustrated parts lists, catalogue numbers and detailed instructions to permit effective operation, maintenance and repair of the equipment.

.3 Include data for each type and style of device.

.4 For each manual, provide 1 print of each shop drawing, revised to as-built status, including all final settings and sizes of circuit breakers, fuses, relays, and the like.

.5 Information must be for actual piece of equipment supplied; literature which covers an entire family of equipment is only acceptable if the equipment in use is clearly highlighted.

1.31 TERMINOLOGY

.1 Unless further qualified, the following definitions apply:

.1 Wiring - refers to any or all of conduits, cables, wires, conductors and associated fittings and hardware.

.2 Conductor - refers to the current carrying portion of an insulated or non-insulated wire.

.3 Wire - refers to a single, insulated conductor.

.4 Cable - refers to an assembly of a single or multiple wires with shield, jacket, sheath or armour.

.5 Field wiring - refers to wiring outside a control panel or kiosk.

.2 Wherever the term 'duct' appears, it applies equally to conduit.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Approved: 2008-06-30

Part 1 General

1.1 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C61089, Round Wire Concentric Lay Overhead Electrical Stranded Conductors.

.2 CAN/CSA-C68.5 - Shielded and concentric neutral power cable for distribution utilities

.2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)

.1 ICEA S-93-639/NEMA WC74, 5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.2 Provide product data in accordance with Section 01 33 00 - Submittals.

.1 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 PRIMARY OVERHEAD CONDUCTORS

.1 Bare aluminum conductors steel reinforced: to CAN/CSA-C61089, size as indicated.

2.2 SHIELDED POWER CABLES (25000 V)

.1 Single copper conductor: to ICEA S-93-639/NEMA WC74, or CAN/CSA-C68.5-13, size as indicated.

.2 Strand shielding.

.3 Insulation: chemically cross-linked thermosetting polyethylene material rated 90°C and 25 kV.

.4 Barrier tape over shield.

.5 Overall jacket of PVC rated minus 40°C.

Part 3 Execution

3.1 INSTALLATION

.1 Install power cable in ducts and manholes or on pole lines as indicated and in accordance with manufacturer's instructions.

.2 Install power cable in trenches as indicated.

.3 Provide supports and accessories for installation of high voltage power cable.

.4 Install stress cones, terminations and splices in accordance with manufacturer's instructions

.5 Install grounding in accordance with local inspection authority having jurisdiction.

.6 Provide cable identification tags and identify each phase conductor of power cable.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.

.3 Engage an independent testing agent to test high voltage power cable. Submit test result and inspection certificate.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.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 Quality assurance submittals: provide in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

.1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.

.2 Conductors: bare, stranded, soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

.3 Conductors: bare, stranded soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.

.4 Conductors: pvc insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding metre and relay cases.

.5 Conductors: No. 3/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates, vault doors.

.6 Bolted removable test links.

.7 Gradient control mat: copper, size 1.8 x 1.2 m.

.8 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.9 Wire connectors and terminations: as indicated.

.10 Cable sheath isolating sleeves.

Part 3 Execution

3.1 INSTALLATION

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.

.2 Ground fences to grounding system independent of station ground.

.3 Install connectors and weld in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors during and after construction.

.5 Make buried connections, and connections to electrodes, structural steel work, using permanent mechanical connectors to ANSI/IEEE 837.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG mhd bare copper cable for taps on risers from main ground bus to equipment.

.8 Use tinned copper conductors for aluminum structures.

.9 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 ELECTRODE INSTALLATION

.1 Install ground rod electrodes. Make grounding connections to station equipment.

.2 Install ground rod electrodes at transformer and switchgear locations.

.3 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.

.4 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non current carrying

parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.

.2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

.3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

3.4 NEUTRAL GROUNDING

.1 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.

.2 Interconnect electrodes and neutrals at each grounding installation.

.3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

.4 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

3.5 POLE MOUNTED SWITCHING DEVICE GROUNDING

.1 Drive four ground rods 3 m long at base of each pole on which group-operated line switching devices are mounted.

.2 Install gradient control mat between the ground rods.

.3 Arrange rods in square formation with 3 m sides, located so that operator must stand within square to operate switch.

.4 Interconnect ground rods with No. 2/0 AWG stranded annealed copper conductor and join to switch operating handle ground wires.

.5 Connect operating handle of switch to handle base with No. 3/0 AWG extra flexible copper conductor.

3.6 CABLE SHEATH GROUNDING

.1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.

.2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.

.3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.

.3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction.

.4 Perform test before energizing electrical system.

.5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

END OF SECTION

Part 1 General

1.1 REQUIREMENTS

.1 This section is a general specification for the supply and installation of the electrical systems and components, as identified here-in.

.2 The scope of the work for this project is identified on the drawings.

.3 Not all systems and components identified in this specification section are required for this project.

.4 Components and systems identified is this section that are required to complete the scope of the work, or are incidental to complete the scope of work, or is required by other specification sections, shall be supplied and installed in accordance with the relevant parts of this section.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with the requirements of Division 1 and Section 26 05 02 – Electrical: General Requirements.

1.3 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for inclusion into manual specified in Section 26 05 02 – Electrical: General Requirements and Division 01.

1.4 POWER SERVICE

.1 A 12.5 kV (25 kV future), 3 phase, 4 wire overhead service is required at the new treatment building. Works include:

.1 Teeing off from existing private overhead line and constructing new overhead line / underground cable to new electrical building pad mount transformer.

.2 Energizing new line and dual-winding transformer at 12.5 kV.

.2 Coordinate works with BC Hydro and carry out the work in accordance with BC Hydro standards and requirements.

Part 2 Products

2.1 CONDUITS

.1 Conduit sizes, unless otherwise specified, are given in metric trade sizes as listed in the Rules and Regulations.

.2 Minimum size 21 mm, except as otherwise specified.

.3 Abbreviations shown in brackets correspond to type identification shown on drawings.

.4 Rigid aluminum threaded conduit (RA), to CSA C22.2 No. 45 and No. 18.

.5 Rigid PVC conduit (RPVC) to CSA C22.2 No. 211.2.

.6 Rigid DB2 PVC conduit, to CSA C22.2, No. 211.1.

.7 Liquid-tight flexible metal conduit (FLC), to CSA C22.2, No. 56 from flat spiral-wound galvanized steel strip, smooth inside, Thomas and Betts Type CSA.

.8 Liquid-tight flexible non-metallic conduit (FNC), to CSA C22.2, No. 227.2, Hubbell Polytuff Gray, Thomas and Betts Type LTC.

2.2 CONDUIT FASTENINGS AND SUPPORTS

.1 One hole malleable iron straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 For outdoor and corrosive environment applications, two hole ultra-violet stabilized PVC straps to secure surface conduits 50 mm and smaller. Two hole PVC-coated steel straps for conduits larger than 50 mm.

.3 Beam clamps to secure conduits to exposed steel work.

.4 Channel type supports for two or more conduits at spacing required by the Rules and Regulations.

.5 6 mm diameter threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS AND COUPLINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 Liquid tight connectors for flexible conduit; dry-type will not be accepted.

.4 Non-metallic connectors for non-metallic conduits.

.5 Threaded couplings for metal conduit. Solvent-weld couplings for PVC conduit.

2.4 WARNING TAPE

.1 Red (or Yellow) plastic tape, Brady No. 91295.

2.5 PULLSTRING

.1 6 mm stranded nylon pull string, tensile strength 5 kN.

2.6 WIREWAYS

.1 Sheet steel with hinged cover to give uninterrupted access, non-metallic (polyester or fibreglass) in outdoor and corrosive environments.

.2 Cross section dimensions: minimum 50 x 50 mm.

.3 Finish: baked grey enamel for metallic enclosures.

.4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

2.7 BUILDING WIRES

.1 Compliance: CSA C22.2, No. 38.

.2 Conductors: stranded; solid conductors will not be accepted.

.3 Copper conductors: size as specified, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.8 ETHERNET AND FIBRE OPTIC CABLING

.1 All Ethernet cabling must be CAT5e or better.

2.9 TECK CABLES AND CONNECTORS

.1 Compliance: CSA C22.2, No. 03 and No. 131.

.2 CSA Type TECK.

.3 Conductors:

.1 Grounding conductor: copper.
.2 Circuit conductors: copper, size as specified.

.4 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated type RW90.
.2 600 V insulation for circuits up to nominal 240 VAC.
.3 1000 V insulation for circuits above 240 VAC.

.5 Inner jacket: thermosetting polyvinyl chloride material.

.6 Armour: interlocking aluminum.

.7 Overall covering: polyvinyl chloride material, rated -40°C and meeting low gas emission and FT4 flame test requirements set forth in CSA C22.2, No. 03.

.8 Fastenings and Supports:

.1 Refer to another clause in this specification, entitled Conduit Fastenings.
.2 6 mm dia threaded rods to support suspended channels.

.3 Except as otherwise noted, cable ties are only to be used with the approval of the Engineer, and shall meet the requirements specified in Section 26 05 02 – Electrical: General Requirements.

.9 Connectors:

.1 Watertight, approved for TECK cable; dry-type not accepted.

.2 Approved for hazardous location where applicable.

.3 Acceptable products: Thomas and Betts "STAR TECK" series.

2.10 FLEXIBLE CABLES

.1 Compliance: CSA C22.2, No. 49.

.2 CSA Type SOW, size and number of conductors as shown.

.3 Other flexible cable as factory-supplied with equipment.

2.11 SHIELDED CABLES

.1 Compliance CSA C22.2 No. 239.

.2 CSA Type CIC (unarmoured) for installation into conduit.

.3 CSA Type ACIC (armoured) for surface or direct buried installation, or installation into non-magnetic conduit.

.4 Common features:

.1 Single or multiple twisted pair #16 AWG copper conductors, number as specified.

.2 300 V insulation, except 600 V insulation where required by the Rules and Regulations for installation on common raceway (tray) with other 600 V circuits.

.3 Shield with drain wire for each pair and overall shield with drain wire for multiple pair cables.

.4 PVC outer jacket, 90°C and -40°C, FT-4 rated.

.5 Acceptable products, in alphabetical order:

.1 for CSA Type CIC (unarmoured)
- Belden Series 224XX
- Nexans Series 900 000
- Shawflex Series 6B021M16XX

.2 For CSA Type ACIC (armoured)
- Belden Series 245XX (aluminum armour)
- Nexans Series 910 000 (aluminum armour)
- Shawflex Series 6B222M16XX (aluminum armour)

.3 The above product numbers are for 300 V-rated cables; adjust as required for 600 V-rated cables.

.6 Factory-supplied shielded cables where forming part of an instrument assembly.

2.12 INSTRUMENTATION WIRING

.1 Instrumentation and control wiring external of cabinets shall be as minimum:

.1 For control, no smaller than #14 AWG stranded copper or as indicated in drawings.

.2 For instrumentation, #16 AWG stranded copper or as indicated in drawings. All instrumentation wiring pairs shall be individually shielded.

.2 Control wires which terminate to a screw stud which are not equipped with terminal saddles shall be made using fork lugs that are insulated and locking.

.3 Wiring shall be free from abrasion and tool marks and shall have a minimum bending radius of 1¼ inch.

.4 Unsupported wiring on panels will not be permitted. Control wire and cable shall be formed in accordance with good wiring practices. Where cable bundles must be carried across hinges to devices mounted on doors, each cable or wire bundle shall be looped and carried between a clamp on the door and one on the fixed portion of the cabinet in such a manner that torsion and flexure in the loop shall be minimized. The cables shall be protected against abrasion with "spiral" or "snakeskin" protection material.

.5 Wiring between terminals of various devices shall be "point-to-point" (no splicing or tee connections of wire will be permitted), with wires neatly tucked along the back of the panels. Adequate support shall be provided to prevent sagging or damage from vibration in transit and operation.

.6 All wire shields / drain wires shall be grounded on the PLC side of the cable. Instrument side to be ground isolated.

.7 Refer to the Control Block drawing.

.8 Conductor color coding as follows:

.1 120 VAC line: Black.
.2 120 VAC neutral: White.
.3 120V control: Red.
.4 Ground: Green.
.5 24 VDC +: Yellow
.6 24 VDC Control: Yellow
.7 24 VDC -: Blue
.8 Input: Yellow.
.9 Output: Orange.
.10 Shielded twisted pairs: Black is positive; White or Clear is negative.

2.13 CABLE TRAYS AND SUPPORTS

.1 CSA Standard CSA22.2, No. 126.

.2 Acceptable manufacturers, subject to compliance with specified requirements, in alphabetical order: Canadian Electrical Raceways (CER), MP Husky, and Code Electric (Tech Tray).

.3 Catalogue numbers specified are for the purpose of illustrating features and to establish the grade of quality of the cable tray system. Products from other listed manufacturers which have identical features and characteristics are acceptable.

.4 Aluminum Tray:

.1 Made of 6063 aluminum with T6 temper, with minimum 100 mm loading depth.

.2 Ladder-type CSA Load Class D1, with 150 mm rung spacing, CER Type LDA5 for instrumentation cables and 300 mm rung spacing for other cables.

.5 Horizontal elbows, drop-outs, tees, wyes, reducers, and plates and vertical risers as required, of same material and finish as straight lengths. Fittings: manufactured accessories for the cable tray supplied. Radii on fittings: 300 mm and 600 mm as required.

.6 Rod hangers, hanger clamps, wall mounting support brackets, and all necessary accessories as required for complete installation, made from galvanized steel or Omnistrut fibreglass for metallic and non-metallic trays respectively.

.7 Hangers, rods, minimum 12 mm diameter.

2.14 VENTILATED POWER CABLE ENCLOSURE (CABLE BUS)

.1 Acceptable Manufacturers

.1 United Wire and Cable MAXIAMP Power Cable Feeder System

.2 Approved Equal

.2 Enclosure Material

.1 The cable feeder multiple level enclosure shall be constructed of high strength, high conductivity, 6063-T6 copper free, corrosion resistant aluminum alloy meeting the requirements of CSA C22.2 #126.1/NEMA VE-1 unless otherwise specified.

.3 Enclosure Ventilation

.1 The power cable system shall be completely enclosed on both sides. The ventilated top and bottom of the enclosure shall not allow exposure of the power cable conductors within the power cable system to mechanical damage at 90 degree entry from any surface.

.2 Free air ampacity rating of the power cables shall be achieved by air flow both vertically and longitudinally. Power cable systems which restrict air flow along the length of the enclosure shall not be accepted.

.4 Power Cable Feeder Supports Within Enclosure

.1 Cables shall be supported within the enclosure on each level by metal rungs which shall be at least 45 mm (1.77”) wide.

.2 The metal rung cable supports on each level shall be longitudinally offset by 1/2 of the support spacing, relative to the metal rung cable supports in the level immediately below.

.3 The metal rung cable supports shall be repeated throughout the cable enclosure at regular intervals not exceeding 305 mm (12 in.). Supports exceeding 12 in. shall not be accepted.

.5 Power Cable Feeder Clamping Within Enclosure

.1 Power cable conductors shall be secured to the metal rung cable support by a one-piece non-magnetic metal clamp, and allow for a trefoil cable arrangement.

.2 Cable clamps shall be affixed to the metal rung cable supports at every fourth rung horizontally, and every third rung vertically.

.3 Each one-piece clamp shall be pre-formed to ensure a minimum of one cable diameter spacing between power cable conductors for each level to achieve the free-air ampacity rating of the cables.

.6 Weatherproof Plate

.1 If the power cable termination points are exposed to moisture, a weatherproof plate shall be provided by the power cable feeder manufacturer to impede water from penetrating the termination housing at the point of entry. The weatherproof plate shall be pre-assembled with compatible weatherproof cable connectors and mounting hardware.

2.15 JUNCTION, PULL AND TERMINAL BOXES

.1 To CSA C22.2, No. 40.

.2 Welded steel or aluminum construction with screw-on flat covers for surface mounting in dry indoor areas.

.3 Non-metallic, PVC, fibreglass, polyester or similar materials, with screw-on covers for outdoor, wet and corrosive areas, such as chemical room and as shown on the drawings.

.4 Aluminum EEMAC Type 4 construction for larger size boxes used for outdoor surface mounting. Provide a breather fitting where box serves as a protective enclosure for other enclosed equipment.

.5 Copper free aluminum in areas classified as hazardous.

.6 Complete with terminal block kit assembly, where applicable.

.7 Provide appropriate terminations and identification in control terminal boxes (CTB) and instrument terminal boxes (ITB).

2.16 OUTLET AND CONDUIT BOXES GENERAL

.1 Compliance: CSA C22.2, No. 18.

.2 Size boxes in accordance with CSA C22.1.

.3 102 mm square or larger outlet boxes as required for special devices.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where more than one system is present.

.6 Boxes suitable for area classification shown or specified and where available or noted, made of same material or to have same finish as connecting conduit.

.7 Gang boxes where wiring devices are grouped.

.8 Cast FS or FD copper-free aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle. Pressed sheet steel boxes and sectional boxes not acceptable for surface-mounted devices.

.9 Surface-type FS or FD style fibreglass or PVC boxes with hubs and mounting feet for corrosive and wet locations, such as chemical room.

2.17 CABLE GRIPS

.1 Sized to suit cable diameter.

.2 With stainless-steel or non-metallic mesh.

2.18 FITTINGS

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of foreign materials.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes or enclosures.

2.19 SUPPORT CHANNELS

.1 C-shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

.2 Steel for dry indoor location, fibreglass for outdoor and wet and corrosive locations.

.3 Acceptable products: for fibreglass, Champion, available from Milham Industries, Delta, B.C.

2.20 SPLITTERS

.1 Compliance: CAN/CSA C22.2 - No. 76

.2 Sheet metal enclosure, welded corner and formed hinged gasketed cover suitable for locking in closed position.

.3 Main and branch lugs or connection bars to match required size and number of connecting conductors as indicated.

.4 At least three spare terminals on each set of lugs in splitters.

2.21 METER BASE

.1 Meter base/socket for 25 kV overhead service to BC Hydro requirements.

2.22 MOULDED CASE CIRCUIT BREAKERS

.1 Common-trip breakers: quick-make, quick-break type with single handle for multi-pole applications.

.2 Temperature compensation for 40°C ambient. Thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for overload and short circuit protection.

.3 Handle with door interlock, complete with interlock defeater mechanism.

.4 On-off locking device for operating handle.

.5 EEMAC Type 12 enclosure.

2.23 MAGNETIC MOTOR STARTERS

.1 Combination type magnetic motor starter with motor circuit interrupter.

.2 Magnetic starter, EEMAC-rated of size as indicated with 120 VAC coil, with:

.1 3-pole, ambient-compensated overloads with isolated N/C and N/O Contracts.

.2 Door-mounted manual reset button, labelled as “OVERLOAD RESET”.

.3 Accessories: Auxiliary contacts, push buttons, selector switches, pilot lights, as indicated on drawings.

.4 Power and control terminal blocks.

.3 Motor circuit interrupter with magnetic, instantaneous trip elements, with:

.1 Handle, with door interlock, complete with defeater mechanism.

.2 Adjustable trip setting from 3 to 18 times motor full load current.

.4 Charts listing motor overload heaters and motor circuit interrupter settings to be affixed to interior of door.

.5 EEMAC Type 12 enclosure; if required, use oversized enclosure to house auxiliary control devices.

2.24 PANELBOARDS

.1 Panelboard, not load centre, to CSA C22.2, No. 29.

.2 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. Buss bar arranged to permit installation of multi-pole branch breakers at any location.

.3 Voltage, mains, number of phases and circuits, and number and size of branch circuit breakers as indicated.

.4 Surface-mounted enclosure or mounted in a MCC, as shown on the drawings, with hinged door.

.5 Copper or aluminum bus with neutral of same ampere rating as mains.

.6 Ground bar.

.7 Mains: suitable for bolt-on breakers.

.8 Trim and door finish: baked grey enamel.

.9 "Full-width" circuit breakers moulded case with thermal and magnetic tripping; half-width type not acceptable.

.10 Common-trip breakers with single handle for multi-pole applications.

.11 Ground fault circuit interrupters (GFCI) breakers as indicated; Class A unless otherwise noted.

.12 Lock-Off/Lock-On devices for breakers serving critical circuits such as alarm and control circuits.

.13 Circuit schedule, typed on a removable cardboard for installation on inside of panel door.

2.25 LIGHTING EQUIPMENT

.1 Provide luminaires complete with lamps of type as shown on the drawings.

.2 Lamps.

.1 LED Bars, Boards and Lamps.

.1 Colour temperature 4000K unless otherwise specified. Refer to Luminaire Schedule.

.2 CRI not less than 80%.

.3 Rated life at 70% lumen maintenance (L70) minimum 50,000 hours.

.4 Power Factor at 85% of better, unless otherwise specified.

.3 Emergency Lights.

.1 Compliance: CSA Standard C22.2, No. 141.

.2 Control Unit.

.1 Supply voltage: 120 V, ac.

.2 Output voltage: 12 V dc.

.3 Operating time: 30 min.

.4 Battery: sealed, maintenance free, 10-year life, with 50% spare capacity to allow for connection of future additional light heads.

.5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected. Capable of restoring battery to full charge within 12 hours after a discharge of not more than 30 minutes at rated load.

.6 Solid state transfer.

.7 Low voltage disconnect: solid state, modular, to operate at 80% battery output voltage.

.8 Signal lights: solid state, life expectancy 100,000 h minimum, for 'AC Power ON' and 'High Charge'.

.9 Cabinet: EEMAC Type 12. Wall or shelf mounting as applicable, with provision for wiring entry.

.10 Ready access to battery.

.11 With integral lamp heads and provision for remote heads.

.12 Auxiliary equipment:

.1 Lamp disconnect switch.

.2 Test switch.

.3 Time delay relay upon return of normal power.

.4 ac input and dc output terminal blocks inside cabinet.

.5 Shelf or bracket as required.

.6 Cord and single twist-lock plug connection for ac connection.

.7 RFI suppressors.

.3 Lamp Heads

.1 Swivel-type integral on unit, 360° horizontal, 180° vertical adjustment.

.2 Remote-type for installation on surface-mounted box, with swivel-type adjustment.

.3 Remote, adjustable gimbal-type for installation in T-bar ceiling.

.4 Lamp type: LED, sealed-beam.

2.26 PHOTOELECTRIC LIGHTING CONTROL

.1 Wall or fixture mounting, as applicable.

.2 Capable of switching 1800 W of lighting at 120 V.

.3 Voltage variation: plus or minus 10%.

.4 Temperature range: -40°C to +40°C.

.5 Switching on lights at dusk.

.6 Switching off lights at dawn.

.7 Rated for 5000 operations.

.8 Switching time delay of minimum 30 s.

.9 Wall mounting bracket.

.10 Colour coded leads: size 10 AWG, 460 mm long.

2.27 LIGHT SWITCHES

.1 15 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.

.2 Manually-operated, general purpose, specification-grade, 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 Ivory or brown toggle for light or dark surrounding wall surfaces respectively.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Snap switch where used to switch a motor load.

.5 For wet and corrosive locations, such as chemical room, use IPEX/SCEPTER #VSC 15/10 cover plates.

2.28 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, premium specification-grade, with following features:

.1 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 Double wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground, premium specification-grade, with following features:

.1 Urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.

.3 Twistlock receptacles, specification grade, CSA type L5-15 R, 125 V, 15 A.

.4 Other receptacles with ampacity and voltage as indicated.

.5 Except as otherwise specified, ivory or brown coloured bodies for light or dark surrounding wall surfaces respectively.

.6 For wet and corrosive locations, such as chemical room, yellow melamine body Hubbell 52CM61/62.

2.29 WIRING DEVICE COVER PLATES

.1 Cover plates for wiring devices from one manufacturer throughout project.

.2 Brushed stainless steel coverplates for recessed locations.

.3 Sheet metal cover plates with rounded edges for wiring devices mounted in surface-mounted metal boxes.

.4 Lever-type Ipex/Sceptre, Type VSC 15/10, switchplates for weatherproof, wet or corrosive locations.

.5 PVC coverplates for PVC boxes.

.6 Cast aluminum with double lids "cover open" type, Hubbell Series 520*WO, receptacle plates for weatherproof, wet or corrosive locations.

.7 Provide multi gang cover plates on multi gang boxes.

2.30 MANUAL MOTOR STARTERS

.1 With inverse time-limit thermal overload to match the full-load current of the protected motor.

.2 Sufficient number of poles to disconnect all ungrounded conductors.

.3 Two-speed types to be compatible with motor winding configuration.

2.31 INTRUDER SWITCHES

.1 Oiltight limit switch, 120 VAC-rated, spring-return lever or push-type operator.

.2 N/O contact to be held closed when door is closed.

.3 Provide an actuator plate or bracket on the door, suitable for the limit switch supplied.

2.32 CONNECTORS

.1 Pressure type wire connectors: with current carrying parts sized to fit copper/ aluminum conductors.

.2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, flexible conduit, as required.

2.33 GROUNDING

.1 Unless specifically differentiated, the terms "grounding" applies equally to the system grounding and equipment bonding requirements.

.2 Clamps for connection of conductor, size as required to electrically conductive underground water pipe or ground electrode.

.3 Rod electrodes, copper clad steel 19 mm dia by 3 m long.

.4 Grounding conductors, bare and insulated stranded copper, size as indicated.

.5 Equipment bonding conductors, bare and insulated stranded soft annealed copper size as indicated or as required by the Rules and Regulations.

.6 Insulated grounding conductors: green, insulation to match circuit conductors.

.7 Non-corroding accessories necessary for grounding system, type, size, material as required, including but not necessarily limited to:

- .1 Grounding and bonding bushings.
- .2 Protective type clamps.
- .3 Compression type conductor to conductor connectors.
- .4 Exothermic welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure type conductor to equipment connectors.
- .7 Ground electrode box, Thomas & Betts #51629 or Slocan #22109.

.8 All grounding connections should be cleaned of oxidation prior to connection, and protected against corrosion by corrosion inhibiting compound, such as De-ox or approved similar.

Part 3 Execution

3.1 WIRING

.1 Wiring to be surface-installed, except where it services equipment located away from walls in which case wiring shall be installed in or below slabs, as indicated on the drawings.

.2 Where wiring is subject to mechanical injury, provide additional mechanical protection.

.3 Unless otherwise specified, do not install wiring on exterior building surfaces; instead, run conduit on inside wall and enter boxes and equipment from the back.

.4 Unless otherwise specified, minimum conductor size is #12 AWG, except for control and instrumentation wiring which may be done with #14 AWG and #18 AWG respectively.

.5 Line voltage wiring for the HVAC system shall be done to the same standards as specified in this Section. Low voltage wiring method must provide protection against physical damage.

.6 Run surface wiring parallel or perpendicular to building lines; where applicable, run wiring in flanged portion of structural steel. Wherever possible, group wiring on profile channels. Do not pass wiring through structural members except as indicated.

.7 Install wiring to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.8 Use rigid PVC conduit or Teck cable, except where specified otherwise. If metallic conduit is required use rigid aluminum.

.9 Use liquid tight flexible metal conduit or Type SOW cable, as permitted by the Rules and Regulations, for connection to motors and other devices requiring flexible connection. Maximum length 450 mm.

.10 Where permitted by the Rules and Regulations, Teck and Teck-style cable may be used in lieu of liquid-tight conduit for motors, control and instrumentation wiring respectively.

.11 In corrosive areas, and as permitted by the Rules and Regulations, liquid-tight conduit shall be non-metallic.

.12 Use DB2 conduit, rigid PVC conduit, or a combination thereof for wiring buried below grade or in wet and damp areas.

.13 CSA Type AC cable ("BX" cable) is not acceptable.

.14 Install plastic warning tape over underground wiring, placed 300 mm below finished grade. Minimum burial depth of conduit is 900 mm or as shown.

.15 Place U/G wiring in a sand envelope of not less than 100 mm.

.16 Slightly snake direct-buried U/G cable when laying into trench, to allow for some take-up during settlement of ground.

.17 Except as otherwise shown, maintain a separation of not less than 300 mm between analog instrumentation and power wiring where they run parallel to each other.

.18 Bend metal conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.19 Mechanically bend metal conduit over 19 mm diameter.

.20 Sleeves through concrete: Schedule 40 plastic pipe, sized for free passage of conduit or cable, and protruding 50 mm. After installation of conduit or cable, seal voids with approved compounds such as Duxseal or expandable foam material. Seal larger-sized openings, provided for passage of cables from one area to another, in a similar fashion. Seal all openings around wiring entering or leaving the wet well and building.

.21 Where it is essential that the integrity of a room or space is preserved, seal voids around sleeves, cables and conduits with fire-rated material approved for that purpose.

.22 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.23 U/G conduit joints for PVC conduits to be done with solvent cement; push-fit couplings not acceptable unless conduit is concrete encased.

.24 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.25 Dry conduits out before installing wire.

.26 Install pullstring in empty conduit.

.27 Use non-metallic boxes, fittings and straps in wet, damp and corrosive environments.

.28 Unless otherwise specified, terminate conduit sleeves and spare conduits in an coupling or end bell.

3.2 WATERPROOFING IN PITLESS ADAPTERS

.1 Wrap conduit connectors, fittings, as well as connection points, especially any exposed threads, with Denso Tape to prevent moisture from entering the electrical system.

.2 Follow the manufacturer's recommendations and instructions strictly in the application of the tape.

3.3 INSPECTION FOR BURIED WIRING

.1 Advise Engineer a minimum of 2 working days in advance of placing conduit and cables so that they may be present during installation, including cleanout and backfilling.

3.4 FIRE RATED SEALS

.1 After installation of cables and conduits, seal voids around cables and conduits with an approved re-enterable fire stop compound, full thickness of the construction material. Trim any excess material to obtain a neat appearance; do not damage outer jacket of armoured cable. Strictly follow the fire stop manufacturer's instructions.

3.5 WIREWAYS

.1 Wireways and auxiliary gutters may be used to facilitate multiple conduit or cable entries into an enclosure.

.2 Keep number of elbows, offsets, connections to minimum.

.3 Install supports, elbows, tees, connectors, fittings.

.4 Install barriers where required.

.5 Install gutter to full length of equipment.

3.6 BUILDING WIRES AND CABLES

.1 Do not pull spliced wires and cables inside conduits.

.2 Install multiple wires and cables into conduit simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 Wherever possible, group cables on channels.

.5 Terminate cables in strict conformance with manufacturer's instructions.

3.7 SHIELDED CABLES

.1 Unless cable has its own magnetic armour, install shielded cables for instrumentation wiring into magnetic, i.e. steel, conduit.

.2 Ground cable shield.

.3 Maintain a separation of not less than 300 mm between analog instrumentation and power wiring where they run parallel to each other.

3.8 JUNCTION AND PULL BOXES

.1 Install pull boxes in accessible locations.

.2 Only main junction boxes are indicated. Install pull boxes as required.

3.9 CABLE TRAYS AND SUPPORTS

.1 Install a complete tray system as shown and specified. Cut to length section of tray as required to fit into the available space.

.2 Install cable tray on wall brackets where tray runs along structural columns or walls.

.3 Space supports as required by classification rating and weight of cables to be installed. Allow for 50% additional cable weight in determining tray support spacing. Secure tray to supports by suitable brackets and bolts.

.4 At corners provide a support installed as close as possible to the corner.

.5 Provide vertical clearance of 300 mm above the trays. This clearance can be reduced at piping or duct crossovers, but shall not be less than 150 mm.

.6 Maintain minimum 20 mm clearance between tray and concrete surfaces.

.7 All trays are shown diagrammatically on the drawings. The exact location is to be determined in the field. Determine the exact location of tray supports and runs in the

field to prevent interferences with other structures and to maintain clearance for tray access.

.8 Use manufactured links to bolt individual tray lengths together or, where there is a separation between metallic tray sections, use a #4/0 copper bonding conductor between two sections.

.9 Install a #2 copper bonding conductor along the full length of the metallic tray system. Solidly bond the tray to the building steel and grounding system at the intervals required by the Rules and Regulations.

.10 Run trays parallel to building lines unless otherwise shown on the drawings.

.11 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.12 Use beam clamps to fasten support systems to structural steel. Welding, drilling and cutting of structural steel is not permitted without approval by the Engineer.

3.10 CABLE INSTALLATION IN TRAY

.1 Arrange cables so as to provide a minimum of cable crossovers. Except where otherwise noted, use random spacing with appropriate cable derating. Do not tie random spaced cables in horizontal tray.

.2 Maintain specified cable spacing for cables designated for maintained spacing.

.3 Lay cables into cabletray. Use rollers when necessary to pull cables.

.4 Provide cable support in cabletrays inclined by more than 30° and in vertical cable trays if vertical distance exceeds 2 m or if cables terminate vertically, to an enclosure or box. Position cable ties such that they cause no damage to other cables being pulled.

.5 Provide mechanical support for cables which exit trays.

.6 Generally, install cables of different voltage classes in separate trays. Where a common tray is shown on drawings, separate the cables for different voltage classes from each other by barriers as manufactured by the tray manufacture.

.7 After installation of cables, seal voids around cables and cable tray where they pass through an exterior wall or a fire-rated wall with an approved re-enterable fire stop compound. Trim any excess materials to obtain a neat appearance. Strictly follow the fire stop manufacturer's instructions.

3.11 CONDUIT AND OUTLET BOXES

.1 Use FS-style boxes for surface installations; sheet steel utility boxes not acceptable.

.2 Use non-metallic boxes in wet, damp or corrosive areas.

.3 Support boxes independently of connecting conduits and cables.

.4 Provide correct size of openings in boxes for conduit and cable connections. Reducing washers not allowed.

3.12 WIRING DEVICES

.1 Install wiring devices as indicated.

.2 Do not use coverplates meant for flush outlet boxes on surface-mounted boxes.

3.13 CONNECTORS

.1 Remove insulation carefully from ends of conductors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2, No. 65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

3.14 FASTENING AND SUPPORTS

.1 Secure equipment to metal members by clamping or by drilling and tapping. Welding will not be acceptable.

.2 Secure equipment to poured concrete with non-corroding expandable inserts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members. In outdoor or corrosive areas use non-metallic, stainless steel or brass materials and brass or stainless steel screws and bolts.

.4 Fasten exposed conduit or cables to structures or support system using PVC straps or other non-metallic straps. Straps exposed to daylight must be of ultra-violet stabilized materials.

.5 Suspended support systems:

.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.

.2 Support 3 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.6 For surface mounting of 3 or more conduits or cables use channels at spacing in accordance with the Rules and Regulations.

.7 Provide brackets, frames, hangers, clamps and related types of support structures as required to support conduit and cable runs.

.8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.9 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.10 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.

.11 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.

3.15 LIGHTING EQUIPMENT

.1 Locate and install luminaires as required and in accordance with manufacturer's instructions.

.2 Support luminaires level and plumb and true with structure and other equipment in horizontal or vertical position as intended. Install wall or side bracket mounted luminaire housings rigidly and adjust to a neat flush fit with mounting surface.

.3 Hang and mount luminaires to prevent distorting frame, housing, sides or lens.

.4 Connect suspended fluorescent luminaires to splice box through a length of flexible conduit.

.5 Use stainless steel fixture chain, hangers or rigid steel conduit for suspended luminaires in dry locations; stainless steel chain or nylon covered stainless steel wire in wet, unheated or corrosive areas. EMT is not acceptable for hanging luminaries.

.6 Use aligning channels approved as raceway for mounting suspended continuous row luminaires in dry locations.

.7 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.8 Align luminaires mounted individually parallel or perpendicular to building grid lines.

.9 Remove any noisy ballasts from the luminaires and replace at no additional cost to the Owner prior to completion and final acceptance of the installation.

.10 Emergency lights:

- .1 Fill batteries delivered in dry state with electrolyte.
- .2 Install unit equipment and remote mounted fixtures as indicated.
- .3 Direct heads as required to obtain optimum illumination.

.11 Completely clean all luminaires, including lenses, lamps, hangers and interiors at completion of project and before final acceptance of project.

.12 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements. Do not megger the luminaires.

3.16 SUBMERSIBLE PUMPS

.1 Cables to be installed directly to the junction boxes adjacent to the pitless adapters, without making a splice in the well.

.2 Where required, suspend cables from hooks using cable grips.

.3 Do not cut off excess lengths of flexible power and control cables; neatly coil any excess cable and attach to hooks with nylon ties.

3.17 GROUNDING SYSTEM

.1 Install complete system grounding and equipment bonding systems including number of electrodes, conductors, connectors and accessories to conform to requirements of Engineer, and local authority having jurisdiction over installation.

.2 Install a grounding conductor in each conduit run unless otherwise indicated.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections to electrodes using copper welding by exothermic process or high pressure compression connectors. Bolt-type connectors are not acceptable.

.6 Install an electrode box, placed flush with finished grade, high pressure compression connectors. Bolt-type connectors are not acceptable for access to top of ground rods.

.7 Use mechanical connectors for grounding connections to equipment provided with lugs.

.8 Use Penetrox "E" joint compound on all connections.

.9 Soldered joints not permitted.

3.18 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Identify each phase conductor of feeders and check phase rotation for 3-phase systems.

.3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.4 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer, to ensure compliance with the Canadian Electrical Code, but not to be less than 5 ohms. The test to include the complete grounding system.

.5 Provide Engineer with list of test results.

.6 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This Section covers the requirements of variable frequency drive (VFD) equipment. The VFD equipment consists of the following components: VFD controller, protection devices, input and output power conditioning devices, and ancillary control devices (switches, relays and signal conditioners). Note that throughout this section the term "VFD equipment" refers to the completely assembled and packaged system while the term "VFD controller" refers to just the component responsible for generating and controlling the variable frequency motive power.

.2 House the VFD equipment in a MCC, specified elsewhere.

.3 Switching, protection, power conditioning and ancillary control devices to be approved for use by the VFD controller manufacturer to provide a properly coordinated system.

.4 The components of the VFD equipment shall be standard "off the shelf" designs. No field modified or custom designed systems will be allowed.

1.2 VFD POWER SUPPLY

.1 The VFD equipment will be powered from a 600 VAC, 3-phase, 4-wire, 60 Hz solidly grounded utility system.

.2 Output to the motor shall be 600 V, 3-phase.

.3 VFD equipment input power shall be filtered through active harmonic filters, to limit both voltage and current harmonic distortions, located in MCC as shown on drawings.

1.3 DRIVEN MOTOR LOAD

.1 Provide VFDs suitable for the connected motors and the pump load characteristics.

1.4 DESCRIPTION OF EQUIPMENT

.1 VFD equipment to include the following components:

.1 Variable Frequency Drive controller including rectifier, D.C. bus, inverter, controller, control I/O, alarm I/O, and control panel door mounted keypad and display.

.2 Electrical switch components, power disconnect, etc.

.3 Electrical protection components, power fuses, circuit breakers, etc.

.4 Input power factor correction and harmonic correction components.

.5 Enclosure ventilation components (when required).

.6 Additional operator control and signal selection control devices.

1.5 PROGRAMMING, CONFIGURATION AND COMMUNICATION

.1 The VFD shall be programmed and configured by the supplier as specified in this Section.

.2 Communication between control panels and VFD drives to be Modbus TCP based.

1.6 QUALITY CONTROL

.1 The following terms are used for the purpose of describing quality assurance and testing requirements.

.1 Factory Tests: testing of components at the manufacturing level.

.2 Field Tests: testing of assembled VFD equipment. Includes load testing of each VFD with representative motor load and simulation of control signals.

.2 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements and the requirements specified in this Section.

1.7 REFERENCES AND STANDARDS

.1 Design and manufacture of VFD equipment (including all of its components) to conform to latest editions of applicable CSA, EEMAC, ANSI C-343, and IEEE 519 standards. Equipment to be ULC listed and/or CSA approved.

1.8 PRODUCT DATA AND SHOP DRAWINGS

.1 Submit product data and shop drawings in accordance with the requirements of Division 1 and 26 05 02 – Electrical: General Requirements.

.2 For each component included in the complete VFD equipment provide:

.1 Catalog and technical data.

.2 Control schematics.

.3 In addition, for the VFD controller, provide:

.1 Configuration manual and software (if applicable).

.4 For the complete VFD equipment provide:

.1 Outline and component mounting dimensions.

.2 Control schematics.

.3 External connection diagram showing function and identification of all terminals requiring external connections.

1.9 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for variable frequency drive controllers for incorporation into manual specified in Division 1 and Section 26 05 02 – Electrical: General Requirements.

.2 To include, but not be limited to:

.1 All approved shop drawing information listed above.

.2 Troubleshooting flowcharts for all component faults.

.3 An instruction manual for programming and hardware, provided with the VFD controller at time of shipment.

.4 Setting sheets to record all VFD controller configuration options/selections for drive setup.

.5 Component fabrication drawings consisting of detailed circuit schematics, printed circuit board drawings, and chassis layouts for all electrical and electronic components.

1.10 RECORD DRAWINGS

.1 Provide record drawings in accordance with the requirements of Division 1 and Section 26 05 02 – Electrical: General Requirements.

1.11 SPARE PARTS AND MAINTENANCE MANUALS

.1 Provide maintenance materials in accordance with Section 26 05 02 – Electrical: General Requirements and as recommended by VFD equipment manufacturer.

.2 In addition, provide a priced list of further recommended spare parts and maintenance materials at time of bid.

Part 2 Products

2.1 MANUFACTURERS

.1 The complete VFD equipment to be designed, manufactured and tested by a fully qualified and certified firm.

.2 Approved suppliers:

.1 Allen Bradley

.2 Eaton Cutler Hammer

.3 Schneider

.4 Siemens

.5 Danfoss Vacon

.6 Yaskawa

.7 ABB

2.2 EQUIPMENT RATINGS

.1 Unless otherwise noted, contactors, relays, switches to be NEMA-rated.

2.3 AMBIENT

.1 The VFD to be suitable for use in normal indoor non-hazardous industrial environments subject to the following conditions.

.2 For enclosed units, an ambient temperature range of 0 to 40°C (32 to 104°F).

.3 A humidity range from 5 to 95%, non-condensing.

2.4 VFD EQUIPMENT DESIGN AND CONSTRUCTION

.1 Design the VFD equipment to provide for ease of maintenance.

.2 Provide front accessible VFD equipment. Equipment shall not require rear access. Arrange units for clear entry of load and control cables. Separate the VFD power terminal blocks physically from control signal terminal blocks.

.3 VFD controller manufacturer to ensure adequacy of electrical protection of VFD equipment.

.4 VFD controller keypad/display unit and any control devices such as pushbuttons, selector switches and keypad to be door-mounted, visible and accessible while the VFD is in operation.

.5 Electrical noise, (radio interference and AC line harmonics) shall be limited to levels specified in applicable standards. VFD equipment to be so designed that use of radio communication equipment adjacent to VFD units is possible. Likewise, the VFD equipment shall not to be susceptible to interference from radio equipment operated adjacent to it.

.6 The VFD equipment shall maintain an electrical power load with a system power factor at no less than 95% lagging, but not to exceed unity over the entire speed range.

.7 The VFD equipment shall have a minimum efficiency of 96% at rated load.

.8 Provide forced air ventilation within the enclosure for cooling of the VFD equipment within the temperature conditions outlined. Forced air ventilation fan(s) shall be powered from an internal VFD 120 VAC power source, and shall be switched on to only operate while the specific VFD is operating a pump.

.9 Control Features:

.1 Refer to the control schematic drawings; control features include, but are not limited to:

.1 120 VAC control transformer of not less than 100 VA complete with both primary and secondary fusing. This transformer to be used to power the ventilation fans. The control transformer circuit can also be used for all external status (running/stop, fault, etc.) and command (run/stop) discrete control signals.

.2 Three position “Hand-Off-Auto” maintained position selector switch on the front of the control panel (CP-200). When the switch is in the “Hand” position the start/stop and speed reference signals to be from the VFD controller display/keypad unit mounted on control panel door. In the “Off” position the VFD equipment shall not provide any motor load power whatsoever. In the “Auto” position the run/stop and speed

control, including feedback information to be determined by pump system controller.

.3 Two position forward/reverse switch on front of the control panel (CP-200).

.4 Where applicable, one isolated form C contact (i.e. 1 each of NO and NC contacts) rated for 5A at 120 Vac for each of the following VFD equipment status conditions:

.1 VFD equipment "Running" status (within 5% of desired operating frequency greater than minimum operation frequency).

.2 VFD equipment "Fault" status.

.3 VFD equipment in "Remote" control mode.

.5 Where applicable, 120 V LED pilot lights to indicate status of pump operation. Pilot lights to be push-to-test type, with the colours as indicated on the drawings.

.6 Where applicable, one isolated 4-20 mA analog output signal. This signal shall be field configuration selectable to represent either the motor load or speed; speed shall be the default signal.

.7 One common "RESET" pushbutton on the door of the control panel to accomplish VFD fault and pump motor protective device reset.

.8 Control panel door mounted keypad with LCD display to allow programming of the VFD controller and to indicate status and fault conditions. Parameters to be displayed to include speed/frequency, voltage, current.

.10 Auto restart after power failure, provided that the 'Run' command is maintained.

2.5 VFD POWER SWITCH AND PROTECTION EQUIPMENT

.1 Provide fusing and VFD controller protection devices as required by VFD controller manufacturer.

.2 Provision for padlocking the VFD power supply disconnection device in ON and OFF positions.

2.6 INPUT AND OUTPUT FILTERS

.1 Provide active harmonic filters and output dv/dt filter within the NEMA 1 enclosure housing the VFD equipment.

.2 Active harmonic filters to be SinexcelAHF or approved equivalent.

.3 dV/dt filters to be MTE Sentry, or Mirus Inversine, or approved equivalent.

2.7 VFD CONTROLLER

.1 VFD Controller design:

.1 The VFD controller topology shall include input rectifier, DC storage capacitor, and sine-weighted pulse width modulated (PWM) type inverter section.

.2 A fully digital keypad/display to indicate all programming, operation, fault code diagnostic information within the VFD controller. Display capability shall include operational speed (rpm), load (0-100%), Hz, electrical parameters (Vin, Vout, Iin, Iout) fault conditions and operating status. The display shall default to speed indication. The keypad shall include: remote, local, start, stop, reset, increase, decrease pushbuttons.

.3 The VFD controller shall be configured to restart after power outage (provided run command is maintained).

.4 The VFD controller shall produce an output frequency proportional to the speed reference.

.5 For all external analog speed reference commands, the VFD controller shall maintain set frequency to within 0.6 Hz during power line fluctuations or changes in ambient temperatures.

.6 For all internal digital speed commands, the VFD controller shall maintain set frequency to within 0.01 Hz during power line fluctuations or changes in ambient temperatures.

.7 All VFD controller set-up operations and adjustments shall be digital and stored in a nonvolatile memory (EEPROM). No analog or potentiometer adjustments will be allowed.

.8 The VFD controller shall be modularly constructed. Provide printed circuit boards with plug-in connections, easily removable from the drive. Provide power components readily accessible with "Fast-on" or screw terminal connections for easy removal.

.2 The VFD controller shall operate with the following input power conditions:

.1 VFD Controller shall be capable of operation at full load under any or all of the following input supply variations:

.1 Sustained input supply average phase voltage level variations of up to 115% and down to 90% of the nominal supply voltage.

.2 Sustained input supply frequency variation of up to 62 Hz and down to 58 Hz.

.3 Sustained input supply phase unbalance voltage variations of up to 3% (calculated as maximum deviation of one phase from average voltage divided by average phase voltage).

.4 Power line interruptions of up to 0.5 seconds.

.5 If operation of the VFD controller beyond the input supply variations listed above can cause damage, then the VFD controller must detect a fault and automatically initiate an internal shut down.

.6 The VFD controller shall include transient voltage suppression to allow reliable operation encountered in an utility distribution system.

.3 The VFD controller shall provide power output that meets the following conditions:

.1 The VFD controller shall be suitable for use with the specified pump motors.

.2 The VFD controller shall be suitable for smooth operation in pumping applications.

.3 The VFD controller shall include inherent short circuit protection for output line to line and line to ground faults. If either of these faults occur on the output of

the VFD equipment, the VFD controller shall safely shut down without damaging any power circuit devices. VFD equipment or VFD controllers utilizing fuses or isolation transformers to provide this protection shall not be acceptable.

.4 The VFD controller shall include electronic instantaneous overcurrent protection.

.5 The VFD controller shall include current limit, adjustable between 0 and 150% of rated output. Independent adjustment shall be provided for both monitoring and regenerating operating modes.

.6 The VFD controller shall include adjustable minimum speed of 0-80% (0-48 Hz), and adjustable maximum speed of 50-110% (30-66 Hz).

.7 The VFD controller shall include separately adjustable acceleration and deceleration ramps.

.8 The VFD controller shall be capable of running without a motor connected for setup and testing.

2.8 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary voltage to be 600 VAC; secondary voltage to be 120 VAC.

.3 Primary protection as indicated or where required by UL/EEMAC.

.4 Secondary fuse as indicated or as required by load being served.

.5 Close voltage regulation as required by magnetic coils, solenoid coils.

.6 Transformers fused with separate fuse block. Fuses as specified in another clause of this section entitled Control Fuseholders and Fuses.

2.9 CONTROL FUSE HOLDERS AND FUSES

.1 Applicable to fuses protecting control circuits, primary and secondary windings of instrument transformers, voltage sensing circuits, and other similar circuits.

.2 Type and size as indicated or as selected by panel builder for optimum protection of equipment being served.

.3 Door mounted fuse holders for small dimension fuses 6.4 x 31.8 mm (1/4 in. x 1-1/4 in.), Bussmann. Where possible, use different models for different voltages:

.1 120 VAC circuits, Type HKL with clear octagon knob.

.2 12 V DC circuits, Type HKT with amber octagon knob.

.3 24 V DC circuits, Type HKX with amber flat sided knob.

.4 Fuse holders mounted on back pan to be dead-front indicating type, Gould Shawmut "Ultrasafe" Type USCC*I, for use with Class CC HRC fuses, or approved alternative.

2.10 OPERATOR DEVICES

.1 Applicable to push buttons, selector switches, and pilot lights.

.2 Heavy duty, nominal 30 mm size, oiltight.

.3 Contact rating EEMAC A600 (a.c.), P600 (d.c.)

.4 Selector switches:

.1 Maintained, spring return, 2, 3 or multiple position as indicated.
.2 Operator style: standard, unless otherwise indicated.
.3 Contact arrangement as indicated and to suit control requirements.
.4 For key-actuated switch, coordinate keying with Owner.

.5 Pushbuttons:

.1 Operator colour coding: red for stop, green for start, black for reset, others as selected by panel builder.

.6 Pilot lights:

.1 Push-to-test type where indicated with LED bulbs.
.2 AC type to be transformer type.
.3 Lens colours: green for running, red for stop, failure or alarm, amber or white for general status, or as indicated.

.7 Acceptable Product Families: Allan Bradley Bull.800T, Cutler-Hammer 30.5 mm heavy duty, oiltight.

2.11 TESTS

.1 Factory testing to be carried out to CSA, IEEE and local authority standards on all components prior to shipment.

.2 Shop Tests: to be done by manufacturer to ensure proper system operation, freedom from grounds and open and short circuits.

Part 3 Execution

3.1 INSTALLATION

.1 Assemble and install all components of VFD equipment into the MCC as specified.

3.2 FIELD TESTS AND START-UP SERVICES

.1 Perform tests in accordance with 26 05 02 – Electrical: General Requirements and:

.1 Verify continuity of wiring.
.2 Verify correctness of operation of all controls, interlocks.
.3 Adjust all setpoints, minimum frequency, maximum frequency, acceleration time, deceleration time, output current, constant speed, for each variable frequency drive based on the process requirements.
.4 Verify compliance of harmonic distortion limits against specified values. Provide the test instruments required for this task.

.2 Provide the services of the manufacturer's field service representative (FSR) to instruct Owner's operating personnel in the operation, care and maintenance of the equipment.

.3 Provide completion certificates for testing, load runs, commissioning procedures. Certificates to be signed and dated by the supervising FSR.

.4 Provide parameter setting sheet for review by Engineer. To be included in operation and maintenance manual.

.5 Provide operator's manuals and quick reference cards.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Petroleum Institute (API)

.1 API Std. 650, Welded Steel Tanks for Oil Storage 11th Edition.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-3.6, Regular Sulphur Diesel Fuel.

.3 Canadian Environmental Protection Act (CEPA)

.1 CCME PN 1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.

.4 CSA International

.1 CSA-B139, Installation Code for Oil Burning Equipment.

.5 International Organization for Standardization (ISO)

.1 ISO 3046-1, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional requirements for engines for general use.

.6 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1, Motors and Generators.

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S601, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and data sheets for power generators 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 the Province of British Columbia, Canada, and include:

.1 Engine: make and model, with performance curves.

.2 Alternator: make and model.

.3 Voltage regulator: make, model and type.

.4 Automatic transfer switch: make, model and type.

.5 Battery: make, type and capacity.

.6 Battery charger: make, type and model.

.7 Alternator control panel: make and type of meters and controls.

.8 Governor type and model.

.9 Block heater: make, type and model.

.10 Fuel supply system,

.11 Automatic engine room ventilation system.

.12 Cooling air requirements in m;/s.

.13 British standard or DIN rating of engine.

.14 Flow diagrams for:

- .1 Diesel fuel.
- .2 Cooling air.

.15 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.

.16 Continuous full load output of set at 0.8 PF lagging.

.17 Description of set operation including:

- .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
- .2 Manual starting.
- .3 Automatic shut down and alarm on:
  - .1 Overcranking.
  - .2 Overspeed.
  - .3 High engine temp.
  - .4 Low lube oil pressure.
  - .5 Short circuit.
  - .6 Alternator over voltage.
  - .7 Lube oil high temperature.
  - .8 Over temperature on alternator.
  - .9 Under frequency.
- .4 Manual remote emergency stop.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 01 78 23 – Operating and Maintenance Data.

.2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:

- .1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.

.2 Technical data:

.1 Illustrated parts lists with parts catalogue numbers. Schematic diagram of electrical controls.

.2 Flow diagrams for:

.1 Fuel system.

.2 Lubricating oil.

.3 Cooling system.

.3 Certified copy of factory test results.

.4 Maintenance and overhaul instructions and schedules.

.5 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 23 – Operating and Maintenance Data.

.2 Include:

.1 2 sets of fuses for control panel.

.2 Special tools for unit servicing.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Cullen Diesel Power Ltd.

.2 Cummins Power Generation.

.3 Kohler Power Systems.

.4 Caterpillar Power Systems.

.5 Custom Power Generation.

2.2 SYSTEM DESCRIPTION

.1 This section specifies the sizing, supply, and commissioning for the standby diesel generator.

.2 Outdoor installed with generator at 600 kW.

.3 The generation system shall consist of:

.1 Diesel engine.
.2 Alternator.
.3 Engine control panel (ECP).
.4 Battery charger and battery complete with containment enclosure.
.5 Engine cooling system.
.6 Double walled sub-base mounted steel tank.
.7 Air intake and exhaust system.
.8 Structural steel mounting base and vibration isolation.
.9 Weather enclosure.

.4 System designed to operate as standby power source for unattended operation.

.5 Automatic start from a remote signal or failure of normal supply voltage, and engine shutdown upon signal for return of normal supply voltage.

.6 Hard-wired I/O to control panel.

.7 Provide communication cards and adaptors are required to communication with the generator paralleling controller.

.8 System designed to operate as emergency standby.

2.3 DIESEL ENGINE

.1 Diesel engine: to ISO 3046-1.

.2 Turbo charged, synchronous speed 1800 rpm.

.3 Capacity:

.1 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = Generator kW divided by Generator efficiency at full load.

.1 Under following site conditions:

.1 Altitude: 76 m.
.2 Ambient temperature: -46 to +40°C.
.3 Relative humidity: 60%.

.2 Engine overload capability: rated for standby generation.

.4 Cooling System:

.1 Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side, with ethylene glycol anti-freeze non-sludging above -46°C.

.2 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40°C.

.3 Block heater: thermostatically controlled lube oil or liquid coolant heater to allow engine to start in room ambient 0°C.

.1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle.

.2 Plug-in type.

.5 Fuel: No. 2 Diesel Oil.

.6 Governor:

.1 Electronic isochronous type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.

.7 Lubrication system:

.1 Pressure lubricated by engine driven pump.

.2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.

.3 Lube oil cooler.

.4 Engine sump drain valve with remote drain.

.5 Oil level dip-stick.

.8 Starting system:

.1 Positive shift, gear engaging starter 12 or 24 V dc.

.2 Cranking limiter to provide 3 cranking periods of 10s duration, each separated by 5 s rest.

.3 Lead acid, 12 or 24 V storage battery with sufficient capacity to crank engine for 1 min at 0°C without using more than 25% of ampere hour capacity.

.4 Battery charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use.

.1 Regulation: plus or minus 1% output for plus or minus 10% input variation.

.2 Equipped with dc voltmeter, dc ammeter and on-off switch.

.3 Minimum charger capacity: 7 A.

.9 Vibration isolated engine instrument panel with:

.1 Lube oil pressure gauge.

.2 Lube oil temperature gauge.

.3 Lube oil level gauge.

.4 Coolant temperature gauge.

.5 Coolant level gauge.

.6 Running time meter: non-tamper type.

.10 Guards to protect personnel from hot and moving parts.

.1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.

.11 Drip tray.

2.4 ALTERNATOR

.1 Alternator: to NEMA MG1.Rating: 3 phase, 347/600 V, 4 wire, 600 kW, 60 Hz, at 0.8 PF.

.2 Output at 40°C ambient:

.1 100% full load continuously.

.2 110% full load for 1 hour.

.3 150% full load for 1 minute.

.3 Revolving field, brushless, single bearing.

.4 Drip proof.

.5 Amortisseur windings.

.6 Synchronous type.

.7 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.

.8 Exciter: permanent magnet.

.9 NEMA Class F insulation on windings.

.10 Platinum resistance temperature transducers embedded in stator winding and connected to alternator control circuitry.

.11 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:

.1 Stability: 0.25% maximum voltage variation at any constant load from no load to full load.

.2 Regulation: 0.25% maximum voltage deviation between no-load steady state and full-load steady state.

.3 Transient: 35% maximum voltage dip on one-step application of 0.8 PF full load.

.4 Transient: 35% maximum voltage rise on one-step removal of 0.8 PF full load.

.5 Transient: 5 s maximum voltage recovery time with application or removal of 0.8 PF full load.

.12 Alternator: capable of sustaining 300% rated current for period not less than 10 s permitting selective tripping of down line protective devices when short circuit occurs.

2.5 CONTROL PANEL

.1 Totally enclosed, mounting base isolated from diesel generator.

.2 Instruments:

.1 Digital, 100% solid state circuitry indicating type 2% accuracy, rectangular face, flush panel mounting:

.1 Voltmeter: ac, scale 0 to 800 V.

.2 Ammeter: ac, scale 0 to 1200 A.

.3 Wattmeter scale 0 to 800 kW.

.4 Frequency meter: scale 55 to 65 Hz.

.5 kW.h meter

.2 Voltmeter selector switch, panel mounting, four position, labelled "Off-Phase A-Phase B-Phase C".

.3 Ammeter selector switch, maintained contacts, panel mounting, designed to prevent opening of current circuits, four position labelled "OFF- Phase A-Phase B-Phase C".

.4 Instrument Transformers

.1 Potential-dry type for indoor use:

.1 Ratio: 600 to 120.

.2 Rating: 600 V, 60 Hz, BIL 10 kV.

.2 Current-dry type for indoor use:

.1 Ratio: 1200 to 5.

.2 Rating: 600 V, 60 Hz, BIL 10 kV.

.3 Positive action automatic short-circuiting device in secondary terminals.

2.6 CONTROLS

.1 Engine start button.

.2 Selector switch: Off-Auto-Manual.

.3 Engine emergency stop button and provision for remote emergency stop button.

.1 Alternator output breaker:

.1 Circuit breaker, solid state sensing with:

.1 Frame containing breaker contacts, arc quenchers, manual mechanism, quick- make, quick-break, spring-loaded overcentre switching mechanism, mechanically trip free from handle, fixed type.

.2 Static sensor: current monitors detect overload, short-circuit and ground-fault currents, and send these signals through solid-state circuits to static sensor which acts to trip breaker. Adjustable for current values and time of tripping.

.3 Flux-transfer shunt trip- magnetic tripping device actuated by signal from static sensor to open breaker contacts. Requires no external source of power.

.2 Voltage control rheostat: mounted on inside of control panel.

.3 Operating lights, panel mounted:

.1 "Normal power" pilot light.

.2 "Emergency power" pilot light.

.3 Green pilot lights for breaker on and red pilot lights for breaker off.

.4 1 NO/NC contact for remote indication of Generator Running.

.5 Solid state indicator lights for alarm with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation of 'Generator General Alarm':

.1 Low battery voltage.

.2 Ventilation failure.

.3 Low coolant temperature.

.6 Solid state indicator lights for alarm with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation of 'Low Fuel Alarm'.

.7 Solid state controller for automatic shutdown and alarms with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:

.1 Engine overcrank.

.2 Engine overspeed.

.3 Engine high temperature.

.4 Engine low lube oil pressure.

.5 Short circuit.

.6 AC over voltage.

.8 Lamp test button.

.9 Provision for remote monitoring.

2.7 AUTOMATIC TRANSFER SWITCH

.1 Supplied separately. See Section 26 36 23 – Automatic Transfer Switches.

2.8 STEEL MOUNTING BASE

.1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.

.2 Provide rubber isolators between genset and baseframe. Rigidly mount base frame to concrete pad.

2.9 EXHAUST SYSTEM

.1 Heavy duty industrial mounted exhaust silencer with condensate drain, plug and flanged couplings.

.2 Heavy duty flexible exhaust pipe with flanged couplings as required.

.3 Fittings and accessories as required.

.4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

.5 Positive crankcase ventilation as required.

2.10 FUEL SYSTEM

.1 Fuel storage tanks: to CAN/ULC-S601-07, ULC labelled.

.2 Double walled sub-base mounted steel tank: 24 hours run time at 100% load.

.3 Fuel level gauge and vent alarm.

.4 Drain and end plug.

.5 Copper feed and return lines, with flexible terminations at engine.

.6 Shut-off cock.

.7 Renewable cartridge filter.

.8 Fire valve.

.9 Isolating valves on lines serving auxiliaries.

.10 Check valve, if available.

.11 Low fuel level alarm for remote indication.

.12 Tank leak alarm for remote indication.

2.11 COOLING AIR SYSTEM

.1 Engine ventilating system:

.1 Cold air inlet damper assembly with modulating motor.
.2 Air discharge and intake gooseneck weatherhoods.
.3 Modulating thermostat.
.4 Replaceable air intake filters. air inlet damper assembly with modulating motor.

2.12 GENSET WEATHER ENCLOSURE

.1 Sized to house gen-set complete with 24-hour sub base fuel tank, control panel (ECP) battery charger and batteries and all appurtenances. The enclosure shall have its own base frame, or may be attached to the gen-set structural steel mounting base, and shall have smooth lines to present neat, streamlined contours. The roof shall be slightly sloped for rain water run-off.

.2 Rigid, self-supported, weather-protective, fully insulated, sheet metal enclosure with ventilation intake and discharge louvres manufactured from minimum 1.9 mm (14 Ga) sheet steel. Rigid, self-supported construction, reinforced to prevent “oil-canning”.

.3 Design enclosure to limit the noise level to 75 dBA at 6 m in all directions.

.4 Hinged or lift-out doors all around to give full unobstructed access to equipment. Hinges to have brass pins and bullet hinges with grease nipples. Lockable with door-stay devices which holds door in fully open position. Minimum 12.7 mm diameter hole to be drilled in each door latch for installation of pad locks by Owner. Except as further noted, maximum width for hinged doors 1100 mm, for lift-out panels 750 mm.

.5 Fixed, vandal-resistant, louvred vents with bird screen made from minimum 1.8 mm (14 Ga) aluminum for intake and discharge louvres. Minimum 100 mm overhang with drip ledge over all doors and openings.

.6 Clean-out and draining provisions where debris or rain water can accumulate.

.7 Space to be allowed for conduits to be brought up through concrete slab within the confines of the weather enclosure.

.8 Protective shielding around exhaust muffler and pipe, both inside and outside weather enclosure.

.9 Provide ready Operator access into interior of enclosure; provide detachable steps with non-slip surface for each 300 mm increment of step-up height.

.10 Provide fuel, lube oil and coolant drains as specified.

.11 Walk-on surfaces in interior of enclosure to be slip-resistant.

.12 Weather enclosure and gen-set structural steel base to be bolted together to form an integral unit suitable for handling by crane or hoist.

.13 External hardware to be stainless steel; bolts and screws to be tamper-proof.

2.13 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Control panel:

.1 Size 4 nameplates for controls including alternator breakers and program selector switch.

.2 Size 2 nameplates for meters, alarms, indicating lights and minor controls.

2.14 FABRICATION

.1 Shop assemble generating unit including:

.1 Base.

.2 Engine and radiator.

.3 Alternator.

.4 Control panel.

.5 Battery and charger.

.6 Automatic transfer equipment.

2.15 FINISHES

.1 Apply finishes in accordance with Section 26 05 02 – Electrical General Requirements.

.2 Alternator control cubicle: paint inside, exterior to match engine and alternator.

.3 Exhaust and inlet air hoods international orange.

.4 Other ducts and racks grey.

.5 Supply 0.25 L of grey touch-up enamel.

2.16 SOURCE QUALITY CONTROL

.1 Factory test generator set including engine, alternator, control panels, transfer switch and accessories. The Engineer reserves the right to attend the factory test.

.2 Notify Engineer 14 days in advance of date of factory test.

.3 Test procedure:

.1 Prepare blank forms and check sheet with spaces to record data and at top of first sheet record:

.1 Date.
.2 Generator set serial no.
.3 Engine, make, model, serial no.
.4 Alternator, make, model, serial no.
.5 Voltage regulator, make and model.
.6 Rating of generator set, kW, kVA, V, A, r/min, Hz.

.2 Mark check sheet and record data on forms in duplicate as test proceeds.

.3 Engineer's signature on completed forms to indicate concurrence in results of test.

.4 Tests:

.1 With 100% rated load, operate set for 8 hours, taking readings at 30 minutes intervals, and record following:

.1 Time of reading.
.2 Running time.
.3 Ambient temp in degrees C.
.4 Lube oil pressure in kPa.
.5 Lube oil temp in degrees C.
.6 Engine coolant temp in degrees C.
.7 Exhaust stack temp in degrees C.
.8 Alternator voltage: phase 1, 2, 3.
.9 Alternator current: phase 1, 2, 3.
.10 Power in kW.
.11 Frequency in Hz.

.12 Power Factor.

.13 Battery charger current in A.

.14 Battery voltage. Alternator cooling air outlet temp.

.2 At end of 8 hours run increase load to 110% rated value, and take readings every 15 minutes for 1 hour.

.3 After completion of 8 hours run, demonstrate following shut down devices and alarms:

.1 Overcranking.

.2 Overspeed.

.3 High engine temp.

.4 Low lube oil pressure.

.5 Short circuit.

.6 Alternator over voltage.

.7 Low battery voltage or no battery charge.

.8 Manual remote emergency stop.

.9 High alternator temperature.

.4 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:

.1 No load to full load to no load.

.2 No load to 70% load to no load.

.3 No load to 20% load to no load.

.4 20% load to 40% load to no load.

.5 40% load to 60% load to no load.

.6 60% load to 80% load to no load.

.5 Automatic starting of set and automatic transfer of load on failure of normal power.

.6 Operation of manual bypass switch.

.7 Automatic shutdown of engine on resumption of normal power.

.8 That battery charger reverts to high rate charge after cranking.

.5 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

Part 3 Execution

3.1 INSTALLATION

.1 Locate generating unit and install as indicated.

.2 Install fuel supply system as indicated in CSA-B139.

.3 Install ventilating air duct system as indicated.

.4 Pipe muffler drains to nearest floor drain.

.5 Complete wiring and interconnections as indicated.

.6 Start generating set and test to ensure correct performance of components.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Notify Engineer 10 working days in advance of test date.

.3 Provide fuel for testing and leave full tanks on acceptance.

.4 Demonstrate: Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.

.1 Unit start and shut down on "Manual" control

.2 Unit start and transfer on "Test" control.

.3 Unit start on "Engine start" control.

.4 Operation of manual bypass switch.

.5 Operation of automatic alarms and shut down devices.

.5 Run unit on load for minimum period of 4 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.

.6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

3.3 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 MAINTENANCE - CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA-B139.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA International

.1 CSA C22.1, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

.2 CSA C9, Dry-Type Transformers.

.3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.2 REFERENCE STANDARDS

.1 CSA International

.1 CSA C22.1, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transformers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 kVA rating.

.2 Primary and secondary voltages.

.3 Frequency.

.4 Three phase.

.5 Polarity or angular displacement.

.6 Full load efficiency.

.7 Regulation at unity pf.

.8 BIL.

.9 Insulation type.

.10 Sound rating.

.4 Factory Test Submittals: submit standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9.

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 dry type transformers for incorporation into manual.

.3 Operation and maintenance instructions to include:

.1 Tap changing.

.2 Recommended environmental conditions.

.3 Recommended periodic inspection and maintenance.

.4 Bushing replacement.

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 Store and protect transformers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.6 EXTRA MATERIALS

.1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

.1 Dry-type transformers: to CSA C9.

2.2 TRANSFORMER CHARACTERISTICS

.1 Type: ANN.

.2 Rating: As shown on drawings, 3 phase, 60 Hz.

.3 220 insulation system class, 130 degrees C temperature rise.

.4 Impedance: standard.

.5 Primary winding: 600 V, delta

.6 Secondary winding: 120/208 V, wye, four wire with neutral brought out and effectively grounded.

.7 No load and full load losses to exceed those indicated in CAN/CSA-C802.2.

2.3 ENCLOSURE

.1 Fabricated from sheet steel with drip shield.

.2 Bolted removable panels for access to tap connections, enclosed terminals.

.3 Conductor entry:

.1 Knockouts.

.2 Potheads.

.3 Junction boxes.

.4 Bushings.

.5 Clamping rings.

.6 Entry for cable.

.4 Designed for floor.

.5 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 65°C rise.

.6 Pad mounted type:

.1 Include conductor entry through bottom for underground distribution, with separate high and low voltage compartments divided by full length metal barrier.

.2 Ensure each compartment includes access door with concealed hinges.

.3 Secondary door to have 3-point latch, external operating handle, provision for padlocking and arranged so that secondary door must be open before access gained to primary compartment.

2.4 VOLTAGE TAPS

.1 Four 2.5% taps, 2 x FCAN and 2 x FCBN

2.5 WINDINGS

.1 Primary and secondary coils:

.1 Copper.

.2 Vacuum cast epoxy.

.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

.3 Sound level: not to exceed 55 dB.

2.6 ACCESSORIES

.1 Wiring and terminal box for protective devices.

.2 Dial type winding temperature indicator with alarm contacts.

.3 Grounding terminal: outside of enclosure.

2.7 APPROVED PRODUCTS

.1 Hammond Power, HPS Centurion

.2 Delta Mitigation Gold Series, Mitigator E-series Gold

.3 Approved Equal

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 02 – Electrical: General Requirements.

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 transformers 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.

3.2 INSTALLATION

.1 Locate, install and ground transformers in accordance with manufacturer's instructions.

.2 Set and secure transformers in place, rigid plumb and square.

.3 Connect primary terminals to high voltage circuit.

.4 Connect secondary terminals to secondary cable.

.5 Use flexible conduit to make connections to transformer.

.6 Energize transformers and check secondary no-load voltage.

.7 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.8 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Final 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 - Final Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by transformers installation.

END OF SECTION

Approved: 2006-12-31

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers, Inc. (IEEE)

.1 ANSI/IEEE 386, Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-C2, Single-Phase and Three Phase Distribution Transformers, Types ONAN and LNAN.

.2 CSAC227.4, Three-Phase Dead Front Pad-Mounted Distribution Transformers.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.

.3 Submit shop drawings and indicate:

.1 Anchoring method and dimensioned foundation template.

.2 Dimensioned cable entry locations.

.3 Dimensioned cable termination height.

.4 Identified internal and external component layout on assembly drawing.

.5 Insulating liquid capacity.

.6 Submit primary fuse and secondary breaker time-current characteristics.

.7 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Certificates: submit production certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.8 Closeout Submittals:

.1 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Include insulating liquid maintenance data.

1.3 MAINTENANCE

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 EQUIPMENT

.1 Three phase dead front pad mounted distribution transformers: to CSA C227.4.

.2 Separable insulated connectors for power distribution systems above 600 V: to ANSI/IEEE 386.

.3 Oil filled pad mounted distribution transformer complete with primary and secondary cable compartments, primary fused options and accessories to form complete factory assembled, self contained, steel fabricated unit for mounting on concrete pad.

.4 High voltage bushings or high voltage bushing wells for connection to distribution system through separable insulated connectors for dead front operation.

.5 Separable insulated connectors.

.6 Primary cable terminals with hole for 9.5 mm diameter, 16 thread bolt for attachment of solder lug or clamp connector in vertical plane.

.7 Spade type low voltage terminals.

.8 Connectors for primary and secondary cables.

.9 Single source primary feed, dual winding.

.10 Primary protection Bay-O-Net expulsion fuse with isolation link.

.11 Separate padlocking for primary compartment door.

.12 . MCOVE dead-front primary distribution class elbow arrester

.13 Load break inserts for elbow connectors.

.14 Stays to hold compartment doors in 110 degrees open position.

2.2 TRANSFORMER CHARACTERISTICS

.1 Primary voltage: Dual winding 12.5/25 kV, 60 Hz, delta connected, 3 phase.

.2 Secondary voltage: 347/600 V, wye connected, 3 phase, 4 wire, grounded.

.3 Capacity: 1000 kVA.

.4 HV Basic impulse level: 95 kV.

.5 LV Basic impilse level: 30kV

.6 Impedance: not less than 5%.

.7 Winding Temp Rise: 65°C.

2.3 VOLTAGE TAPS

.1 Four-2.5% taps, 2-FCAN, 2-FCBN.

2.4 TAP CHANGER

.1 Externally operated off-load tap changer, with provision for padlocking.

2.5 ACCESSORIES

.1 Liquid temperature thermometer with two sets of contacts.

.2 Liquid level gauge with two sets of contacts.

.3 Pressure relief device.

.4 25 mm drain valve.

.5 25 mm filler plug.

.6 Tap switch.

2.6 GROUNDING

.1 Copper grounding bus size 4 x 6 mm.

.2 Connectors for grounding conductors size as indicated.

2.7 FINISH

.1 Finish exterior of unit in accordance with Section 26 05 02 – Electrical: General Requirements.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 02 – Electrical: General Requirements

.2 Nameplate showing information in accordance with CSA C2.

2.9 WARNING SIGNS

.1 Provide warning signs in accordance with Section 26 05 02 – Electrical: General Requirements

2.10 SOURCE QUALITY CONTROL

.1 Submit to Engineer standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C2.

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 INSPECTION

.1 Check factory made connections of transformer unit for mechanical security and electrical continuity.

.2 Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

3.3 INSTALLATION

.1 Ensure concrete slab is fully cured before transformer is installed.

.2 Set and secure transformer unit in place, rigid, plumb and square.

.3 Make connections.

.4 Connect transformer unit ground bus to system ground.

.5 Wire one set of contacts on liquid temperature thermometer, liquid level gauge, to station PLC, wire second set of contacts to trip main circuit breaker in MCC.

.6 Ensure care is taken to prevent contamination of liquid and components when field filling transformer.

.7 Use only metal hose when field-filling transformer with oil: do not use rubber hose.

.8 Set taps to produce rated secondary voltage at no-load.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20°C.

.1 High voltage to ground with secondary grounded for duration of test.

.2 Low voltage to ground with primary grounded for duration of test.

.3 High to low voltage.

.3 Inspect primary and secondary connections for tightness and for signs of overheating.

.4 Inspect and clean bushings and insulators.

.5 Check oil level and temperature indicators.

.6 Set transformer taps to rated voltage as specified.

.7 Inspect for oil leaks and excessive rusting.

.8 Inspect oil level.

.9 Check fuses for correctness of type and size.

.10 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

3.5 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 REFERENCE STANDARDS

.1 Electrical Equipment Manufacturers Association of Canada (EEMAC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for motor control centres 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 the Province of British Columbia, Canada.

.2 Indicate on drawings:

.1 Outline dimensions.

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 Cable entry and exit locations.

.5 Dimensioned position and size of busbars and details of provision for future extension.

.6 Schematic and wiring diagrams.

.4 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 23 – Operating and Maintenance Data.

.2 Operation and Maintenance Data: submit operation and maintenance data for motor control centre for incorporation into manual.

.1 Include data for each type and style of starter.

1.4 EXTRA STOCK MATERIALS

.1 Submit maintenance materials in accordance with Section 01 78 23 – Operating and Maintenance Data.

.2 Include:

.1 Three (3) power fuses of each type in use.

.2 Five (5) control fuses of each type in use.

.3 Ten (10) pilot lamps of each type in use, including a lamp-removing tool if necessary.

.4 One (1) control relay of each type in use.

.5 One (1) time delay relay of each type in use.

.6 One (1) special sensing relay of each type in use.

.7 Two (2) relay sockets for each type of plug-in device in use.

.8 Touch-up paint, two (2) 750-mL aerosol cans.

.9 Any other additional components which the Supplier recommends to be kept as spares.

.3 Supply a full complement of these maintenance materials in their original packages for each site, clearly showing the manufacturers name and catalogue or part number.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect motor control centres from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MANUFACTURERS

.1 The complete MCC equipment to be designed, manufactured and tested by a fully qualified and certified firm.

.2 Approved suppliers:

.1 Allen Bradley

.2 Eaton Cutler Hammer

.3 Schneider Electric

.4 Siemens

.5 General Electric

2.2 SUPPLY CHARACTERISTICS

.1 347/600V, 60 Hz, wye connected, 3 phase, 4 wire, grounded.

2.3 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Indoor CSA 1 gasketted enclosure, front mounting.

.4 Class I, Type B.

2.4 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 305 mm high, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables to enter at top.

.8 Provision for outgoing cables to exit via top or bottom with terminals.

.9 Removable lifting means.

.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

2.5 SILLS

.1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.6 BUSBARS

.1 Main horizontal and branch vertical, three phase high conductivity plated copper or aluminum busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: 1200 A.

.2 Branch vertical busbars: 1200 A.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 100 kA rms symmetrical.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.7 GROUND BUS

.1 Copper ground bus extending entire width of motor control centre.

.2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

2.8 UNIT COMPARTMENTS, GENERAL

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons, selector switches, “Reset” devices, indicating lights, meters, and the like mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.9 MAIN SERVICE BREAKER COMPARTMENT

.1 Refer also to another item in this specification entitled "Moulded Case Circuit Breakers".

.2 Service breaker compartments constructed to utility company requirements. Submit copy of letter of approval from utility company.

.3 Provide neutral block for landing incoming neutral conductor(s) and for metering requirements.

.4 Flange or rotary-type operating handle interlocked with door. Interlock defeater mechanism.

.5 Nameplate listing frame size and trip range for circuit breaker.

2.10 MOULDED CASE CIRCUIT BREAKERS

.1 Common-trip breakers: with single handle for multi-pole applications.

.2 Quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for overload and short circuit protection.

.3 Main breaker to be 100% rated at 1200 Amps, complete with 1200 Amp solid state trip unit with adjustable long, short, instantaneous, and ground pick up and delay (LSIG). All other breakers to be thermal magnetic type trip.

.4 Circuit breakers with interchangeable trips as indicated for frame sizes 400 A and above.

.5 Motor circuit protector type (MCP), with magnetic instantaneous trip elements to operate only when value of current reaches setting, by means of magnetic tripping devices with adjustable setting to provide instantaneous tripping for short circuit protection. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.6 Moulded case thermal magnetic circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

.7 Optional features include:

.1 Shunt trip where indicated.

.2 "TRIP" auxiliary contact where indicated.

.3 "STATUS" auxiliary contact where indicated.

.4 On-off locking device.

.5 Handle with door interlock mechanism, complete with defeater feature.

2.11 FEEDER BREAKER UNIT COMPARTMENTS

.1 Flange or rod-type operating handles with door interlock mechanism, complete with defeater feature.

.2 Where possible, arrange for twin compartments with individual doors for each unit.

2.12 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary and secondary voltages as indicated.

.3 Primary protection as indicated or where required by CSA/EEMAC.

.4 Secondary fuse as indicated or as required by load being served.

.5 Close voltage regulation as required by magnetic coils, solenoid coils.

.6 If primary taps are required, refer to another clause in this specification, entitled Lighting Transformers.

2.13 SURGE PROTECTION DEVICE (SPD)

.1 Integrated mounting suitable for 600 V, 3-phase, 4-wire service entrance system, minimum 200 kA surge rating, L-L and L-G.

.2 Conformance: ANSI/IEEE C 62.41, Category C Type 2, ANSI-UL 1449 and CSA certified.

.3 Door-mounted module with dual colored phase indication for each phase, common fault indication and surge counter with reset button

.4 Form 'C' (SPDT) dry contact rated 5 Amps, 120 VAC, for remote status monitoring.

.5 Transient switch connected parallel to the SPD filter to reduce stress on the MOV components.

.6 Acceptable products subject to compliance with specified features, in alphabetical order: Cutler Hammer #SPD Series; Liebert 'LM' Series, or MCC manufacturer's own system.

2.14 DIGITAL METERING SYSTEM (DMS)

.1 Provide digital multi-function metering system

.1 Transducer option; 4 isolated analog outputs 0 – 20 mA and 4 – 20 mA, assignable to all measured parameters, 4 – 20 mA analog input, second RS485 communication port.

.2 Power analysis option; harmonic analysis, triggered trace memory waveform capture, event record, data logger, voltage disturbance recorder (VDR)

2.15 POTENTIAL TRANSFORMERS

.1 Potential transformers, if required: to CSA C13, dry type compound filter indoor-outdoor use, with following characteristics:

.1 Nominal voltage class: 0.6 kV.

.2 Rated frequency: 60 Hz.

.3 Basic impulse level: 10 kV.

.4 Voltage ratio: as required by instrument.

.5 Accuracy rating: to suit instrument.

.2 Potential transformers fused with separate fuse block. Fuses as specified in another clause of this section entitled Fuseholders and Fuses, and as indicated.

2.16 CURRENT TRANSFORMERS

.1 Current transformers: to CSA CA, dry type compound filled for indoor use with following characteristics:

.1 Nominal voltage class 0.6 kV.

.2 Rated frequency: 50-400 Hz.

.3 Basic impulse level: 10 kV.

.4 Accuracy rating: to suit instrument.

.5 Rated primary and secondary current: as required by instrument.

.2 Positive action automatic short-circuiting device in the secondary terminals.

2.17 CONTROL FUSE HOLDERS AND FUSES

.1 Applicable to fuses protecting control circuits, primary and secondary windings of instrument transformers, voltage sensing circuits, and other similar circuits.

.2 Type and size as indicated or as selected by panel builder for optimum protection of equipment being served.

.3 Door mounted fuse holders for small dimension fuses 6.4 x 31.8 mm (1/4 in. x 1-1/4 in.), Bussmann. Where possible, use different models for different voltages:

.1 120 VAC circuits, Type HKL with clear octagon knob.

.2 12 V dc circuits, Type HKT with amber octagon knob.

.3 24 V dc circuits, Type HKX with amber flat sided knob.

.4 Fuse holders mounted on back pan to be dead-front indicating type, Gould Shawmut "Ultrasafe" Type USCC*I, for use with Class CC HRC fuses.

2.18 CONTROL RELAYS

.1 Unless otherwise noted, use plug-in relays. If contact requirements exceed 3 NO/NC contacts use fixed-type relays with field convertible contacts.

.2 Plug-in relays encapsulated type with indicating lamp across coil for relay status.

.3 All relays 3 PDT relays with 11-pin base, unless otherwise specified.

.4 Relay contacts rated minimum 230 VAC, 10 A resistive, 6 A inductive, or as required by switching duty.

.5 Coil voltage as indicated.

.6 Acceptable products in alphabetical order, include: Allen-Bradley Bull. 700-HA **-4, Omron Model MK, Potter & Brumfield Type KRP-N, Releco, Model C.

2.19 TIMING RELAYS

.1 Unless otherwise noted, use plug-in timer relays.

.2 Construction: plexi-encapsulated with solid-state timing circuit.

.3 Operation: on-delay or off-delay as indicated.

.4 Supply voltage: as indicated.

.5 Timing range: selectable for seconds, minutes, hours.

.6 Output contact rating: 230 VAC, 5 A resistive and inductive.

.7 Overall accuracy: not less than ±5%.

.8 Repeat accuracy: not less than ±2%.

.9 Acceptable products in alphabetical order: Allen-Bradley Bull. 700-HR, Omron Model H3CR.

2.20 PLUG-IN SOCKETS

.1 Applicable to plug-in relays and timers.

.2 Front-wired with binding head screw terminals.

.3 Heavy-duty industrial type.

.4 Provision for relay retaining clip or hold-down spring.

2.21 OPERATOR DEVICES

.1 Applicable to push buttons, selector switches, and pilot lights.

.2 Heavy duty, nominal 30 mm size, oiltight.

.3 Contact rating EEMAC A600 (VAC), P600 (VDC)

.4 Selector switches:

.1 Maintained, spring return, 2, 3 or multiple position as indicated.

.2 Operator style: standard, unless otherwise indicated.

.3 Contact arrangement as indicated and to suit control requirements.

.5 Pushbuttons:

.1 Operator colour coding: red for stop, green for start, black for reset, others as selected by panel builder.

.2 Momentary contact, with flush head unless otherwise specified.

.3 Maintained contacts with push - pull red mushroom head for emergency stop buttons.

.6 Pilot lights:

.1 Push-to-test type where indicated with 24 VDC LED bulbs.

.2 Lens colours: green for running, red for stop, failure or alarm, amber or white for general status, or as indicated.

2.22 WIRES

.1 Stranded copper.

.2 Insulation Type TEW, 105°C for conductors 10 AWG, and smaller, Type RW X-link, 90°C for conductors larger than 10 AWG.

.3 Minimum 16 AWG for control wiring.

.4 Colour coding in accordance with Section 26 05 02– Electrical: General Requirements.

2.23 SHIELDED WIRES

.1 Copper, 7-strands, XLPE insulation, rated 300 V.

.2 Minimum 18 AWG.

.3 Twisted pair with foil shield and drain wire.

.4 Overall PVC jacket.

2.24 TERMINAL BLOCKS

.1 Rail mounted. Removal of individual terminal block must be possible without disturbing adjacent blocks.

.2 Clamping yoke-type with vibration resistant clamping screw or screwless tension clamp-type.

.3 Voltage and current ratings based on CSA/ULC, and unless otherwise specified, minimum rating suitable for the intended service.

.4 Complete with accessories such as partitions, endplates, tags, and the likes, required to form a complete system.

.5 Clamping screws large enough for screwdriver with 4 mm wide blade.

.6 One terminal block for each field-connecting conductor.

.7 Ten percent (10%) spare terminal blocks, with a minimum of three terminals, per unit compartment. 15% spare terminal blocks for relay panels.

.8 Clear and indelible identification using wire number of terminated conductor.

2.25 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 02 – Electrical: General Requirements.

2.26 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 In addition to manufacturer's standard nameplate, install a size no. 7 engraved nameplate bearing the motor control centre system data.

.3 Individual unit compartments to be identified with size no. 4 or 5 engraved nameplates bearing the name and number of the drive or equipment.

.4 Each component inside unit compartment to be identified with a nameplate or an embossed plastic label as further specified.

.5 Nameplates and labels clearly visible and positioned such that the removal of the device identified does not remove the nameplate or label.

.6 Nameplates and escutcheon plates to give an accurate description of the equipment or the functions of the device. Relays to be identified by their numbers corresponding to the drawings.

2.27 FINISHES

.1 Apply finishes in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Paint motor control centre exterior light grey and interiors white.

2.28 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Engineer to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

Part 3 Execution

3.1 EQUIPMENT MOUNTING

.1 Readily accessible for servicing, maintenance and adjustments.

.2 Space plug-in sockets as required for 11-pin devices to allow ready interchange between 8-pin and 11-pin plug-in relays and timers.

.3 Door-mount devices such as selector switches, pushbuttons, pilot lights, elapsed time meters, disconnect and circuit breaker operating handles.

.4 Devices and equipment which have integral indicating lights, LEDs and alpha-numeric displays must be viewable without the need to open a compartment door. Solid state timer relays are exempt from this requirement. Similarly, access to operational pushbuttons and control switches which are part of the devices must be accessible without the need to open the door.

.5 Door cut-outs for access to equipment must be finished with polyethylene grommet edging.

.6 Live terminals, subject to accidental contact when doors are open must be effectively guarded.

3.2 WIRE INSTALLATION AND TERMINATIONS

.1 Run wires in plastic wiring duct wherever possible. Bundle and tie wires neatly where not run in wiring ducts and hold with fastening tabs.

.2 Self-adhesive tabs not acceptable where bundle is under strain or weight is excessive.

.3 Use insulated compression spade lugs to terminate conductors on binding head screws. Crimping die as per manufacturer's instructions.

.4 Group ac-, dc- and instrumentation wires separately from each other.

.5 Terminate drain wire of a shielded cable on a terminal block. Ground shield at control panel end, unless otherwise indicated.

.6 Provide a terminal block for each field wire. Multiple connections will not be accepted.

3.3 SWITCHBOARD INSTRUMENT INSTALLATION

.1 Install meters and instrument transformers in separate compartment or as indicated. Instrument transformers must be readily accessible.

.2 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

.3 Do not connect other instruments, relays, devices to metering circuits.

.4 Program digital metering systems (DMS) in accordance with the manufacturer's instructions.

3.4 ADJUSTMENTS

.1 Ensure overload relays are correctly adjusted or fitted with the correct overload heater elements based on the motor nameplate data.

.2 If overload protection has been adjusted on account of a power factor correction capacitor, install a nameplate stating so.

.3 Ensure magnetic setting of motor circuit protectors is correctly adjusted or fuse type and size is correctly selected for motor or load short circuit protection, based on the load's nameplate data.

.4 Program and set all variables to put systems into proper operating mode.

3.5 SUPERVISION, START-UP AND COMMISSIONING

.1 Provide manufacturer's technical representative to assist the installation Contractor with installation and start-up of the equipment specified under this section. The equipment manufacturer's technical representative shall be familiar with the equipment supplied and shall come prepared with both knowledge and equipment to perform and interpret the manufacturer's requirements for the starting of equipment that has not previously been energized and operated.

3.6 TESTS

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Ensure moving and working parts are lubricated where required.

.3 Shop test prior to shipping:

.1 First tests to be done by manufacturer to ensure proper system operation, freedom from grounds and open and short circuits.

.2 Following above tests, notify Engineer minimum seven working days in advance of official shop tests.

.3 The Engineer reserves the right to witness official shop test.

.4 With all sections interwired permanently or temporarily and with control power applied, perform:

.1 Functional test of control circuits. Simulate field contacts where necessary.

.2 Functional test of communications, control and monitoring systems.

.3 Insulation resistance test on power and control wiring, freedom from grounds and open and short circuits.

.4 Demonstrate operation of entire system.

.4 Submit to Engineer one copy of test results.

3.7 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 in accordance with Section 01 74 23 – Final Cleaning.

END OF SECTION

Part 1 General

1.1 REQUIREMENTS

.1 This section specifies the supply and installation and, unless specified otherwise, the configuration, calibration and verification of instrumentation and control devices for this project.

1.2 REFERENCES AND STANDARDS

.1 For control equipment, conform to CSA Standard C22.2, No. 14 - Industrial Control Equipment.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Refer Section 26 05 02 - Electrical: General Requirements.

1.4 EQUIPMENT IDENTIFICATION

.1 Identify instruments with nameplates and labels as specified in Section 26 05 02 - Electrical: General Requirements.

1.5 QUALITY CONTROL

.1 Refer to Section 26 05 02 - Electrical: General Requirements.

.2 Instruments shall be pre-calibrated by manufacturer or supplier whenever possible. When pre-calibration is not possible or re-calibration is required, conduct instrument calibration.

.3 Verification of each instrument's calibration or pre-calibration shall be completed prior to its installation.

.4 Confirm instrument selection with manufacturer. In particular, confirm materials selection for process conditions (fluid type, temperature, pressure) and instrument sizing (device span, valve sizing, actuator sizing).

1.6 OPERATION AND MAINTENANCE MANUAL

.1 Refer to the requirements of Division 1 and Section 26 05 02 - Electrical: General Requirements.

1.7 RECORD DRAWINGS

.1 Refer to the requirements of Division 1 and Section 26 05 02 - Electrical: General Requirements.

.2 Provide calibration certification of all pre-calibrated instruments. Annotate such certificates with the instrument tag number.

.3 Provide calibration documentation for all instruments which require calibration.

.4 Provide verification testing documentation for all instruments.

.5 Organize all instrumentation field device pre-calibration, calibration and verification documentation on a per-device basis and provide in a single binder.

Part 2 Products

2.1 EQUIPMENT COMPONENTS

.1 Transmitters shall have adequate power output to drive all devices associated with the signal loop. Provide signal boosters as required to achieve adequate signal strength.

.2 All transmitters are to include a lamacoid label indicating the tag ID and description. The transmitter is to be mounted such that this label is visible from the normal operating floor position.

.3 Equipment tag numbers and quantities listed are for the benefit of the contractor. The contractor is responsible for ascertaining the correct quantities required.

.4 Transmitter and/or primary element enclosures (or housings) to be, as a minimum, rated NEMA Type 4; where located outdoors or in areas specified as corrosive, enclosures to meet NEMA Type 4X requirements.

.5 Transmitter flanges, adapters and associated bolts, nuts, etc. to be fabricated from 316 stainless steel.

.6 Provide all mounting brackets, cables, connectors and hardware necessary to install primary elements. Provide any and all brackets and sundry hardware to mount the transmitter on standard 50 mm pipe stands. Fabricate all brackets from aluminum or stainless steel and all sundry hardware from stainless steel. Primary elements and transmitters to be complete with all necessary liquid filling, identification, configuration, etc. as necessary to make the unit ready for use.

2.2 INTRUSION SWITCHES

.1 Provide and install one DPDT intrusion switch on each building entrance as shown on drawings.

2.3 INSTRUMENT SPECIFICATIONS

.1 Instruments to be supplied in accordance with individual instrument spec sheets included in this section.

.2 Where model numbers have been superseded or are unavailable, alternates following the specifications may be used.

.3 Alternate suppliers may be used following approval from the Engineer.

2.4 TIDAL GAUGE

.1 Specification page included in this section.

.2 Hydrostatic gauge to be suspended in estuary channel inside a PVC guide tube with screw off top for maintenance access.

.3 Gauge to be 24VDC loops powered.

Part 3 Execution

3.1 INSTALLATION

.1 Install instrumentation as shown on drawings, readily accessible for maintenance and adjustments.

.2 Install all security contacts such that a closed door or hatch provides a closed contact. Contact to open when door/hatch is opened.

END OF SECTION

Associated Engineering

INSTRUMENT SPECIFICATION
LEVEL TRANSMITTER, HYDROSTATIC

CLIENT	**THE CITY OF PORT ALBERNI**	JOB NUMBER	**2017-2972**
PROJECT	**PORT ALBERNI WW LAGOON UPGRADES**	LOCATION	**PORT ALBERNI**

TAG No.	**LT-100**	PROCESS DWG	**N/A**
SERVICE	**RAW WATER**	LOCATION DWG	**I-104**
MANUFACTURER	**WIKA**	LOOP DWG	**N/A**
MODEL SERIES	**LS-10**	DETAIL	**N/A**

OPERATING CONDITIONS

FLUID		Raw Water			
SPECIFIC GRAVITY		1.0			
TEMPERATURE ºC	MIN:	5	MAX:	30	
PRESSURE kPa	MIN:	ATMOS	MAX:	ATMOS	

TRANSMITTER / PROBE

MODEL No.		LS-10			
CALIBRATION		4 - 20 mA = 0 to 4m (Verify with engineer prior to placing purchase order)			
OUTPUT SIGNAL		4 - 20 mA DC	ACCURACY:	0.2% of full scale	
ENGINEERING UNITS		Metres	DAMPING:	1.0 Sec	
POWER SUPPLY		24V DC	FAIL POSITION:	Low	
LOCAL INDICATION		None			
CONTACTS	1.	N/A	2.	N/A	
	3.	N/A	4.	N/A	
TEMPERATURE COMPENSATION					
MEASURING RANGE		0 to 5 m H^2O			
MATERIALS	PROBE:	Integrated	PROCESS CERAMIC:	Aluminium Oxide Ceramic	
	CELL SEAL:	Stainless	PROTECTIVE CAP:	High-density polyethylene	
CABLE	LENGTH:	As required	TYPE:	As required	
APPROVAL	CSA:	Yes	AREA:	General	
ENCLOSURE		Nema 4X			
MOUNTING		As required			
ACCESSORIES		SS Tag			

NOTES

Include: 1) Additional weight if necessary.
2) Junction Box # 14052339
3) Anti-clog transmitter attachment
4) Guide tube required to fit probe.

REV	DESCRIPTION	REVISED BY	REVISION DATE

Associated Engineering

INSTRUMENT SPECIFICATION
FLOW METER, MAGNETIC

CLIENT		JOB NUMBER	
PROJECT		LOCATION	

TAG No.		PROCESS DWG	
SERVICE		LOCATION DWG	**N/A**
MANUFACTURER	**Endress + Hauser**	LOOP DWG	**N/A**
MODEL SERIES	**Proline Promag 53P**	DETAIL	**N/A**

OPERATING CONDITIONS

FLUID		0.8% NaOCl Solution			
SPECIFIC GRAVITY		~ 1.0	LINE SIZE:	80 mm	
TEMPERATURE °C	MIN:	0	MAX:	30	
FLOW RATE L/s	MIN:	0.65	MAX:	7	
PRESSURE kPa	MIN:	0	MAX:	448	

TRANSMITTER

MODEL No.		Promag 53P Series		
CALIBRATION		3-point 0.2% calibration, 4 to 20 mA = 0 to 7 L/s		
OUTPUT SIGNAL	(1)	4 - 20 mA DC	ACCURACY:	
	(2)	HART - current and frequency output		
POWER SUPPLY		120 VAC		
LOCAL INDICATION		LCD with touch control		
MOUNTING		Integral mount		
APPROVAL	CSA:	Yes	AREA:	General
ENCLOSURE		Nema 4X		
ACCESSORIES		Lamacoid tag		

ELEMENT

TAG NUMBER		N/A		
MODEL No.		Same as transmitter above		
PROCESS CONNECTION		Flange	METER SIZE:	50 mm
ELECTRODE TYPE				
MATERIALS	BODY:		LINER:	PTFE
	ELECTRODE:	Alloy C-22	FLANGE:	CI 150 ANSI B16.5, A105 FLANGES
COIL	VOLTAGE:		FREQUENCY:	
AREA CLASSIFICATION		General		
SIGNAL CABLE	LENGTH:	N/A	TYPE:	N/A
GROUNDING RINGS		Alloy C-22		
ACCESSORIES		SS Tag		

NOTES

Approved Alternate: Rosemount (all above specifications must be met and identified on the shop drawings).

REV	DESCRIPTION	REVISED BY	REVISION DATE

Associated Engineering

INSTRUMENT SPECIFICATION
LEVEL SWITCH, FLOAT TYPE

CLIENT	**THE CITY OF PORT ALBERNI**	JOB NUMBER	**2017-2972**
PROJECT	**PORT ALBERNI WW LAGOON UPGRADES**	LOCATION	**PORT ALBERNI**

TAG No.	**LSH-220**	PROCESS DWG	**D-004**
SERVICE	**RAW WATER**	LOCATION DWG	**I-102**
MANUFACTURER	**Flygt**	LOOP DWG	**N/A**
MODEL SERIES	**ENM-10**	DETAIL	**N/A**

OPERATING CONDITIONS

FLUID		Raw water			
SPECIFIC GRAVITY		1.0	SET POINT:		
TEMPERATURE	MIN:	5	MAX:	25	
PRESSURE kPa	MIN:	Atmos	MAX:	Atmos	

ELEMENT

FLOAT DISPLACER MATERIAL	Polypropylene
FLOAT DISPLACER SIZE	100 mm
MOUNTING	

SWITCH

QUANTITY / FORM	1 SPDT (Form C)
SET POINT	Open on rising level
AREA CLASSIFICATION	General
ACCESSORIES	SS Tag

NOTES

REV	DESCRIPTION	REVISED BY	REVISION DATE

Associated Engineering

INSTRUMENT SPECIFICATION
LEVEL TRANSMITTER, ULTRASONIC

CLIENT	**THE CITY OF PORT ALBERNI**	JOB NUMBER	**2017-2972**
PROJECT	**PORT ALBERNI WW LAGOON UPGRADES**	LOCATION	**PORT ALBERNI**

TAG No.	**LIT-405, -425**	PROCESS DWG	**D-007**
SERVICE	**RAW WATER**	LOCATION DWG	**N/A**
MANUFACTURER	**ENDRESS + HAUSER**	LOOP DWG	**N/A**
MODEL SERIES	**FMU 40**	DETAIL	**N/A**

OPERATING CONDITIONS

FLUID		SANITARY WASTEWATER		
SPECIFIC GRAVITY		1.0		
TEMPERATURE °C	MIN:	0	MAX:	25
PRESSURE kPa	MIN:	ATMOS	MAX:	ATMOS

TRANSMITTER

MODEL No.		Prosonic M FMU 40		
CALIBRATION		Adjust as required in field		
RANGE				
OUTPUT SIGNAL		4-20 mA		
ACCURACY				
ENGINEERING UNITS		Meters		
POWER SUPPLY		24V DC		
POWER CONSUMPTION		800 mW		
LOCAL INDICATION		Local Digital LCD Calibrated in meters		
MOUNTING		Flange Mounted		
APPROVAL	CSA:	Yes	AREA:	Class 1 Zone 1
ENCLOSURE		Nema 4X		
ACCESSORIES		SS Tag		

TRANSDUCER

TAG NUMBER				
MODEL No.				
AREA CLASSIFICATION		Class 1 Zone 1		
MEASURING RANGE		5m (Blacking Distance = 0.25m)		
BEAM ANGLE		11°		
TEMPERATURE COMPENSATION				
PROCESS CONNECTION		1½" NPT	FACE:	
MATERIALS	BODY:		TYPE:	Ultrasonic
CABLE	LENGTH:			
ACCESSORIES		SS Tag		

NOTES

Vendor to provide performance guarantee that instrument will measure foam level in tank.

Transmitter must include protective cover (order no. 543199-0001) and remote display FHX 40.

SET POINTS: Will determine alarm setpoints during commissioning in field.

REV	DESCRIPTION	REVISED BY	REVISION DATE

Associated Engineering

INSTRUMENT SPECIFICATION
MAGNETIC FLOW METER

CLIENT	**THE CITY OF PORT ALBERNI**	JOB NUMBER	**2017-2972**
PROJECT	**PORT ALBERNI WW LAGOON UPGRADES**	LOCATION	**PORT ALBERNI**

TAG No.	**FIT-535**	PROCESS DWG	**D-010**
SERVICE	**RAW WATER**	LOCATION DWG	**I-103**
MANUFACTURER	**GREYLINE**	LOOP DWG	**N/A**
MODEL SERIES	**AVFM 5.0**	DETAIL	**N/A**

OPERATING CONDITIONS

FLUID		RAW WATER		
SPECIFIC GRAVITY		1.0		
TEMPERATURE °C	MIN:	0	MAX:	30
FLOW RATE L/s	MIN:	0.1	MAX:	5.2
PRESSURE kPa	MIN:	0	MAX:	345

TRANSMITTER

MODEL No.		AVFM 5.0		
CALIBRATION		Area-Velocity		
OUTPUT SIGNAL	(1)	4 - 20 mA	ACCURACY:	+/- 2% Measuring Accuracy
	(2)	None		
POWER SUPPLY		24VDC		
LOCAL INDICATION		3-line display		
MOUNTING		Local - Mounted in chamber		
APPROVAL	CSA:	Yes	AREA:	General
ENCLOSURE		Nema 4X		
ACCESSORIES		SS Tag		

ELEMENT

TAG NUMBER		FE-535		
MODEL No.		Same as transmitter above		
PROCESS CONNECTION		Flange	LINE SIZE:	900 mm

NOTES

Other acceptable manufacturers: Isco Signature

REV	DESCRIPTION	REVISED BY	REVISION DATE

Associated Engineering

INSTRUMENT SPECIFICATION
PRESSURE TRANSMITTER

CLIENT	**THE CITY OF PORT ALBERNI**	JOB NUMBER	**2017-2972**
PROJECT	**PORT ALBERNI WW LAGOON UPGRADES**	LOCATION	**PORT ALBERNI**

TAG No.	**PIT-225**	PROCESS DWG	**N/A**
SERVICE	**RAW WATER**	LOCATION DWG	**I-102**
MANUFACTURER	**Endress & Hauser**	LOOP DWG	**N/A**
MODEL SERIES	**Cerabar S PMC71**	DETAIL	**N/A**

OPERATING CONDITIONS

FLUID		Raw Water		
SPECIFIC GRAVITY		1		
TEMPERATURE °C	MIN:	5		
FLOW RATE	MIN:			
PRESSURE	MIN:	900kPa		

TRANSMITTER

MODEL No.		PMC71 Series		
CALIBRATION		4 to 20 mA = 0 to 1034 kPa		
RANGE SUPP./ELEV.		0 kPa		
RANGE LIMIT		1034 kPa		
FAIL POSITION		Low	DAMPING:	
ADJUSTMENTS		Span and zero		
MAX. OVER PRESSURE				
OUTPUT SIGNAL		4-20mA DC	ACCURACY:	+/- 0.075% of set span
POWER SUPPLY		24Vdc		
INDICATOR		LCD Meter, Analog, 0-1034 kPa		
MOUNTING		Bottom Connection		
APPROVAL		CSA	AREA:	General
ENCLOSURE		NEMA 4X		
CONSTRUCTION	SENSOR	Ceramic		
	GASKET MATERIAL	EPDM Cell Seal		
SENSOR FILL FLUID		N/A		
PROCESS CONNECTIONS		1/2" NPT		
DRAINS		316 SS High		
DRAIN LOCATION		Side/ Top		
ACCESSORIES		Anderson Greenwood 316SS 2-valve manifold M25VIS-44		

NOTES

Approved Alternate: ABB 261GSH Series, Yokogawa EJX530 Series, Rosemount 3051 Series

REV	DESCRIPTION	REVISED BY	REVISION DATE
0	Issued for Tender	D. Desaulniers	June 27, 2018

Part 1 General

1.1 REQUIREMENTS

.1 This section describes the requirements for the fabrication, inspection, testing, delivery and installation of:

.1 Treatment Building Control Panel (CP-100).

.2 Screening Building Control Panel (CP-200).

1.2 CONTROL SYSTEM

.1 P&ID, controls schematic, and specifications forming part of these specifications are a guide for the detailed design and work of the overall control system.

.2 Examine and become familiar with control and instrumentation systems based on equipment specified and equipment being supplied.

.3 Complete the control panel designs and wiring, fabricate the control panels, configure all elements of the control system, and test and commission the control system.

.4 Make adjustments and modifications to the systems and equipment supplied as required during shop drawing, manufacture, installation, testing, and start-up stages.

1.3 REFERENCES AND STANDARDS

.1 Design and manufacture of equipment to conform to latest editions of applicable CSA and NEMA standards.

1.4 COMMUNICATIONS

.1 Cat6 (EIA/TIA-568) cabling to be used for all ethernet based communications.

.2 Station will communicate with the City's central SCADA system via 900 MHz spread spectrum radio.

.3 Communications between vendor supplied control panels and CP-100/200 will be Ethernet based using Modbus TCP protocols.

1.5 PROGRAMMING AND CONFIGURATION

.1 The city will provide a standard programming outline as used at all facilities.

.2 Control panels included in package equipment will be programmed by the vendor.

.3 Engineer to program CP-100 and HMI according to city standards.

.4 Engineer to program CP-200 according to city standards.

1.6 SOURCE QUALITY CONTROL

.1 Assembly and wiring of control panel by certified and qualified panel shop.

.2 Notify Engineer 3 days in advance of shop testing. Engineer reserves the right to witness shop testing of control panel including operation of switches, relays and controls.

.3 Supply all necessary instruments, meters, equipment, and qualified personnel to perform tests and calibrations.

.4 Provide a wiring person for the duration of shop testing to troubleshoot/ revise/interconnect the system as instructed by the Engineer.

1.7 PRODUCT DATA

.1 Include details of control and instrumentation equipment.

1.8 SHOP DRAWINGS

.1 Submit shop drawings for approval prior to fabrication of control panel in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Indicate:

.1 Outline dimensions of panels.

.2 Scaled door and interior layouts of panels.

.3 Power and control schematic wiring diagrams, complete with trip ranges and settings of circuit breakers, fuses, relays, as applicable.

.4 Cable entry and exit locations.

.5 Bill of materials with identification of each device by make and complete model number.

1.9 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for control panel and its contents for incorporation into manual as specified in Section 26 05 02 – Electrical: General Requirements.

1.10 RECORD DRAWINGS

.1 Provide record drawings in accordance with Section 26 05 02 – Electrical: General Requirements.

1.11 MAINTENANCE MATERIALS

.1 Provide maintenance materials.

.2 For each panel, provide:

.1 Three (3) power fuses of each type in use.

.2 Five (5) control fuses of each type in use.

.3 Two (2) pilot lamps of each type in use, including a lamp-removing tool if necessary.

.4 One (1) control relay of each type in use.

.5 Touch-up paint, one (1) 750-mL aerosol can.

.6 Any other additional components which the Contractor recommends to be kept as spares.

.3 Supply these maintenance materials in their original packages, clearly showing the manufacturers and catalogue or part numbers.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Allied Controls Ltd., Burnaby, BC.

.2 Interior Instrument Tech Services Ltd., Kelowna, BC.

.3 Stellar Power and Controls Solutions, Port Coquitlam, BC.

.4 Turn-Key Controls Ltd., Vernon, BC.

.5 Western Systems Controls Ltd., Kamloops, BC.

.6 Betts Electric Ltd, Penticton, BC.

.7 3 Phase Power Systems Inc, Delta, BC.

.8 Alternates must be approved by Engineer.

2.2 SUPPLY CHARACTERISTICS

.1 120 VAC, 60 Hz.

2.3 GENERAL DESCRIPTION (CP-100, CP-200)

.1 NEMA Type 12 enclosure, formed and welded from minimum 1.9 mm (14-gauge) sheet steel, suitable for wall or floor mounting as shown on drawings.

.2 Panel door with formed edges and 3-point automotive handle, snap-latch or twist-latch closures and pocket for schematic drawings. Hinged as shown on the drawings.

.3 Removable equipment mounting pan made from minimum 2.6 mm (12 gauge) steel.

.4 Exterior finish light grey, interior white.

.5 Size control panel generously, but not less than the dimensions shown on the drawings, to allow for future additional equipment. As a minimum allow for the future addition of:

.1 4 control or timer relays.

.2 20 terminal blocks.

.6 Utilize plastic wiring ducts such as Panduit for organization of all interior and field wiring. Ducts are to be filled to no more than 50% of capacity.

.7 A space of no less than 300 mm must be kept clear across the top or bottom of the panel for field wiring.

.8 Provide terminal block assemblies and wiring ducts for DC instrument signal wiring separate from 120 VAC control terminal blocks and wiring.

.9 Provide buss bars for grounding connection as shown on drawings.

.10 Acceptable manufacturers, in alphabetical order: Hammond and Hoffman.

.11 The control panel will be powered by a 120 VAC circuit as follows:

.1 The power feed circuit will be connected to terminal blocks and then directly feed a control panel right side panel mounted external duplex receptacle. UPS will be mounted on the right side of the control panel and be seismically restrained on contractor supplied UPS shelf.

.1 The external UPS will plug into this receptacle for power.

.2 The UPS will then feed UPS power to the control panel through a flexible cable with a plugged into one of the UPS output receptacles.

.3 The other end of the UPS power cable will connect directly to control panel terminal blocks which will then power the control panel equipment and I/O.

.4 The initial non-UPS feed into the panel, which powers the UPS, will be monitored by a relay whose contact will be monitored by the PLC. Normally when power is available, the relay contact will be closed. When power feeding the control panel fails, the relay will de-energize and open the contact that is monitored by the PLC to indicate a power failure and that the controls are now operating on UPS power.

.2 In case the UPS fails, configure the cable feeding the UPS power to the control panel so that it can be unplugged from the UPS and plugged into the control panel external receptacle thus bypassing the UPS and feeding the control panel controls with non-UPS power.

2.4 GROUNDING

.1 Copper buss size 25 x 6 mm minimum 150 mm long, located at bottom and bonded to metal cabinet. Drilled and tapped for lugs as required by the Rules and Regulations for each incoming and outgoing feeds; identified as "Panel Ground".

2.5 24 VDC POWER SUPPLY

.1 Short circuit protected.

.2 5A, 24 VDC output.

.3 Dual power supplies with Diode module to be installed for redundant protection.

.4 Acceptable manufacturer: Weidmuller or approved equivalent.

2.6 UNINTERRUPTIBLE POWER SUPPLY (UPS)

.1 Supplied and installed inside control on floor.

.2 Batteries integral or in a close-coupled separate enclosure, as dictated by standby capacity.

.3 Ratings:

.1 Minimum 1200 VA output capacity.
.2 120 VAC, 60 Hz input/output.
.3 3% THD or less.
.4 150% overload capacity for 60 seconds.
.5 30 minutes of operation at 100% rated load.

.4 True online UPS with protection against power failures, brownouts, sags, surges, high voltage, spikes, switching transients, line noise, frequency variations and harmonic distortion.

.5 Input power supply via a flexible cord connection CSA 5-15P.

.6 Output power provided from receptacle(s), CSA 5-15R.

.7 Acceptable manufacturers

.1 Eaton 5PX Series.
.2 Eaton Powerware Series.
.3 Always-On.
.4 APC.
.5 Engineer approved alternate.

2.7 ETHERNET SWITCHES

.1 Provide and install one managed ethernet switch with a minimum of 16 RJ-45 ports in CP-100 as shown on drawings.

.2 Provide and install a managed ethernet switch with a minimum of 8 RJ-45 ports in CP-200 as shown on drawings.

.3 Provide and install one PoE ethernet injector in each Control Panel (CP-100 and CP-200) as shown on drawings. Injectors to be 24VDC supplied, with a minimum of 4 PoE ports.

2.8 PROGRAMMABLE LOGIC CONTROLLER

.1 Provide and install a SCADAPack 334 PLCs in both CP-100 and CP-200 with required expansion I/O modules as shown on drawings.

2.9 HMI

.1 Supply and install an HMI terminal in CP-100 as shown on drawings.

.2 HMI must include:

.1 Full-colour graphical touch screen interface.
.2 Minimum one (1) Ethernet port.
.3 NEMA 4X front (screen) rating.
.4 Minimum display size of 9".
.5 Open access configuration and graphical design software, freely downloadable from vendor.
.6 Modbus TCP communication driver.

.3 Acceptable Products:

.1 Red Lion CR1000, CR3000, and Graphite HMI Modules.

2.10 SCADA RADIO

.1 Provide and install a 900 MHz spread spectrum radio for communication to the City of Port Alberni.

.2 Acceptable Products:

.1 GE MDS iNETII 900.
.2 GE MDS Orbit.
.3 Alternates must be approved by Engineer.

2.11 SECURITY CAMERAS AND NVR

.1 Provide one Network Video Recorder (NVR) for installation in CP-100

.2 NVR must include:

.1 Minimum 8 video channels with PoE compatibility.
.2 HDMI output.
.3 Video management system and configuration software.
.4 Remote viewing capability.

.3 PoE security cameras to be installed at Treatment Building and Screening Building as shown on drawings.

2.12 CONTROL RELAYS

.1 Unless otherwise noted, use plug-in relays. If contact requirements exceed 3 NO/NC contacts use fixed-type relays with field convertible contacts.

.2 Plug-in relays encapsulated type with indicating lamp across coil for relay status.

.3 All relays 3 PDT relays with 11-pin base, unless otherwise specified.

.4 Relay contacts rated minimum 230 VAC, 10 A resistive, 6 A inductive, or as required by switching duty.

.5 Coil voltage as indicated.

.6 Acceptable products in alphabetical order, include: Allen-Bradley Bull. 700-HA **-4, Omron Model MK, Potter & Brumfield Type KRP-N, Releco, Model C.

2.13 PLUG-IN SOCKETS

.1 Applicable to plug-in relays.

.2 Front-wired with binding head screw terminals.

.3 Heavy-duty industrial type.

.4 Provision for relay retaining clip or hold-down spring.

2.14 OPERATOR DEVICES

.1 Applicable to push buttons, selector switches, and pilot lights.

.2 Heavy duty, nominal 30 mm size, oiltight.

.3 Contact rating NEMA A600 (a.c.), P600 (d.c.)

.4 Selector switches:

.1 Maintained, spring return, 2, 3 or multiple position as indicated.
.2 Operator style: standard, unless otherwise indicated.
.3 Contact arrangement as indicated and to suit control requirements.

.5 Pushbuttons:

.1 Operator colour coding: red for stop, green for start, black for reset, others as selected by panel builder.

.6 Pilot lights:

.1 Push-to-test type where indicated with LED bulbs.
.2 AC type to be transformer type.
.3 Lens colours: green for running, red for stop, failure or alarm, amber or white for general status, or as indicated.

.7 Acceptable Product Families: Allen Bradley Bull.800T, Cutler-Hammer 30.5 mm heavy duty, oiltight.

2.15 WIRES

.1 Stranded copper.

.2 Insulation Type TEW, 105°C for conductors 10 AWG, and smaller, Type RW X-link, 90°C for conductors larger than 10 AWG.

.3 Instrumentation and Control wiring within cabinets shall be, as minimum #18 AWG or as indicated in drawings.

.4 Colour coding to Section 26 05 02 - Electrical: General Requirements.

2.16 SHIELDED WIRES

.1 Copper, 7-strands, XLPE insulation, rated 300 V.

.2 Minimum 18 AWG.

.3 Twisted pair with foil shield and drain wire.

.4 Overall PVC jacket.

.5 Acceptable manufacturers: Shawflex, Type 64021-1801, or as specified by equipment manufacturer.

2.17 TERMINAL BLOCKS

.1 Unfused terminals to be CSA approved for 600 V, 10 A, accepting #12 - #18 wire, and colored beige or grey. Terminals to be one of, or approved alternate:

.1 Phoenix Contact UK5N
.2 Wieland WK4U
.3 Weidmuller WDU4
.4 Allen-Bradley 1492-W4

.2 Fused terminals to be CSA approved for 300 V, 10A, with blown-fuse indicator operating on 120 VAC, accepting #10 - #14 wires, colored beige or grey, and either 5x20 mm fuses or ¼" x 1¼" fuses, or both. Terminals to be one of, or approved alternate:

.1 Phoenix Contact UK5HESI (Grey)
.2 Weidmuller WSI 6/LD (Beige)
.3 Wieland WK4/THSi6GL250U (Beige)
.4 Allen-Bradley 1492H5 (Grey)

.3 Provide and install 10% spare terminals of each type used.

.4 Grounding terminals to be CSA approved for 300 V, 15 A, accepting #14 wires, grounding to the rail, and colored green and yellow. Terminals to be one of, or approved alternate:

.1 Phoenix Contact USLKG5
.2 Wieland WK4SL/U
.3 Weidmuller WPE 2.5
.4 Allen-Bradley WG4

.5 Insulated shorting bars to be used for jumpering lengths longer than 2 terminals. Wire jumpers are not acceptable unless specific approval is obtained from engineer.

2.18 FUSES

.1 All control fuses shall be installed such that easy removal is possible without disconnecting the incoming power to the drive or the use of special tools (i.e. insulated fuse holders).

2.19 WIRE IDENTIFICATION

.1 Provide wire identification to match control panel termination designations.

2.20 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification.

.2 In addition to manufacturer's standard nameplate, install a size no. 7 engraved nameplate bearing the panel's tag number.

.3 Each component inside the panel to be identified with a nameplate or an embossed plastic label as further specified.

.4 Each door-mounted device to be identified with an engraved lamacoid nameplate.

.5 Nameplates and labels clearly visible and positioned such that the removal of the device identified does not remove the nameplate or label.

.6 Nameplates and escutcheon plates to give an accurate description of the equipment or the functions of the device. Relays to be identified by their numbers corresponding to the drawings.

Part 3 Execution

3.1 EQUIPMENT MOUNTING

.1 Readily accessible for servicing, maintenance and adjustments.

.2 Space plug-in sockets as required for 11-pin devices to allow ready interchange between 8-pin and 11-pin plug-in relays and timers.

.3 Door-mount devices such as selector switches, pushbuttons, pilot lights, elapsed time meters, disconnect and circuit breaker operating handles.

.4 Devices and equipment which have integral indicating lights, LED’s and alpha-numeric displays must be viewable without the need to open the panel door. Solid state timer relays are exempt from this requirement. Similarly, access to operational pushbuttons and control switches which are part of the devices must be accessible without the need to open the door.

.5 Door cut-outs for access to equipment must be finished with polyethylene grommet edging.

.6 Live terminals, subject to accidental contact when doors are open must be effectively guarded.

3.2 WIRE INSTALLATION AND TERMINATIONS

.1 Run wires in plastic wiring duct wherever possible. Bundle and tie wires neatly where not run in wiring ducts and hold with fastening tabs.

.2 Self-adhesive tabs not acceptable where bundle is under strain or weight is excessive.

.3 Use insulated compression spade lugs to terminate conductors on binding head screws. Crimping die as per manufacturer's instructions.

.4 Group ac-, dc- and instrumentation wires separately from each other.

.5 Terminate drain wire of a shielded cable on a terminal block. Ground shield at control panel end, unless otherwise indicated.

.6 Provide a terminal block for each field wire. Multiple connections will not be accepted.

3.3 PANEL INSTALLATION

.1 Set and secure panels in place, rigid, plumb and square to building floor and wall.

.2 Provide fastenings and supports to meet the seismic requirements.

.3 Make field power and control connections as indicated.

.4 Protect against dust and damage during entire construction period.

.5 After connections have been made, vacuum-clean interior. Hand-clean exterior and touch-up damaged paint.

3.4 UPS INSTALLATION

.1 Shelf-mount UPS inside cabinet on floor.

.2 Provide fastenings and supports to meet the seismic requirements.

.3 Secure power cord connections in field to prevent accidental disconnection.

3.5 TESTS

.1 Perform tests of controls and control panel prior to delivery to site.

.2 Ensure moving and working parts are lubricated where required.

.3 Shop test prior to shipping:

.1 First tests to be done by manufacturer to ensure proper system operation, freedom from grounds and open and short circuits.

.2 Following above tests, notify Engineer minimum seven working days in advance of official shop tests.

.3 The Engineer reserves the right to witness official shop test.

.4 Perform:

.1 Functional test of control circuits. Simulate field contacts where necessary.

.2 Insulation resistance test on power and control wiring, freedom from grounds and open and short circuits.

.4 Submit to Engineer one copy of test results.

3.6 CONTROL PHILOSOPHY

.1 Refer to the P&ID and the Controls Block Schematics for an overview of the system requirements.

3.7 COMMISSIONING AND START-UP

.1 Engineer to commission the complete installed control system and demonstrate operation under all operating conditions.

END OF SECTION

Approved: 2011-06-30

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA International

.1 CSA C22.2 No.5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).

.2 CSA C22.2 No.178.1, Automatic Transfer Switches.

.3 CAN/CSA C60044-1, Instrument Transformers.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2, Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches 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 The Province of British Columbia, Canada.

.2 Indicate on drawings:

.1 Make, model and type.

.2 Load classification:

.1 Motor load: 900kWRestricted use: resistance and general loads, 0.8 pf or higher: 55 kW.

.3 Single line diagram showing controls and relays.

.4 Description of equipment operation including:

.1 Automatic starting and transfer to standby unit and back to normal power.

.2 Test control.

.3 Manual control.

.4 Automatic shutdown.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 23 – Operating and Maintenance Data.

.2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.

.3 Detailed instructions to permit effective operation, maintenance and repair.

.4 Technical data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect transfer switches from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:

.1 Monitor voltage on phases of normal power supply.

.2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.

.3 Transfer load from normal supply to standby unit.

.4 Transfer load from standby unit to normal power supply.

.5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

2.2 MATERIALS

.1 Instrument transformers: to CAN/CSA C60044-1.

.2 Contactors: to NEMA ICS2.

2.3 CIRCUIT BREAKER TYPE TRANSFER EQUIPMENT

.1 Circuit Breaker Type Transfer Equipment: to CSA C22.2 No.5.

.2 Rated: 600 V, 60 Hz, 1200 A, 4 wire, solid neutral.

.1 Fault withstand rating: 42 kA symmetrical for 3 cycles with maximum peak value of 42 kA.

.2 One normal - 3 pole moulded-case circuit breaker with non-auto trip unit, mounted on common base, designed for double throw action, motor operated, mechanically held and interlocked.

.3 One emergency - 3 pole moulded-case circuit breaker with non-auto trip unit, motor operated, and interlocked.

.4 Circuit breakers:

.1 Trip free in closed position.

.2 Interrupting rating: 42 A symmetrical.

.5 Dead front construction with access to relays and controls for inspection and maintenance, and manual operating lever for transfer switch.

.6 Auxiliary contact: to initiate emergency generator start-up on failure of normal power.

.7 Solid neutral bar, rated: 1200A.

2.4 CONTROLS

.1 Selector switch - 4 position "Test", "Auto", "Manual", "Engine start".

.1 Test position - normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.

.2 Auto position - normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.

.3 Manual position - transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.

.4 Engine start position - engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Control transformers: dry type with 120 V secondary to isolate control circuits from:

.1 Normal power supply.

.2 Emergency power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

.1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.

.2 Time delay: normal power to standby, adjustable solid state, 20 s to 10 minutes.

.3 Time delay on engine starting to override momentary power outages or dips, adjustable 0 to 60 s delay.

.4 Time delay on retransfer from standby to normal power, adjustable 5 to 180 s.

.5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable 5 s intervals to 180 s.

.6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 s intervals to 180 s.

.7 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

.8 Neutral [disconnected] position delay: allow time for motors to delay between live sources, adjustable, 0 to 5 s.

.9 Dry contact for ATS to indicate “ATS in Emergency Mode” to plant PLC

2.5 ACCESSORIES

.1 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.

.2 Plant exerciser: 168 hours timer to start standby unit once each week for selected interval but does not transfer load from normal supply. Timer adjustable 0-168 hours in 15 minute intervals.

.3 Auxiliary relay to provide 1 N.O. for remote alarms.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Control panel:

.1 For selector switch and manual switch: size 4 nameplates.

.2 For meters, indicating lights, minor controls: use size 2 nameplates.

2.7 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested Engineer.

.2 Notify Engineer 5 days minimum in advance of date of factory test.

.3 Tests:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

.3 Check voltage sensing and time delay relay settings.

.4 Check:

.1 Automatic starting and transfer of load on failure of normal power.

.2 Retransfer of load when normal power supply resumed.

.3 Automatic shutdown.

.4 In-phase monitor operation.

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 transfer switches 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 Engineer.

3.2 INSTALLATION

.1 Locate, install and connect transfer equipment as indicated.

.2 Check relays and adjust as required to ensure correct operation.

.3 Install and connect remote alarms.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Electrical: General Requirements.

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

3.4 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 in accordance with Section 01 74 23 – Final Cleaning.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section specifies the supply and installation of thermal insulation for exposed and underground piping, valves, fittings and appurtenances as required.

.2 Apply insulation and recovering to all piping and appurtenances based on the following criteria:

.1 An operating surface temperature in excess of 50°C in order to maintain a maximum recovered surface temperature of 40°C.

.2 An operating surface temperature less than 10°C to prevent sweating or freezing.

.3 Where heat retention is required

.4 Where specified or shown.

1.2 DEFINITIONS

.1 Low temperature class: operating temperature range of minus 20°C to plus 40°C.

.2 Medium temperature class: operating temperature range of plus 40°C to plus 400°C.

.3 Recovering includes the insulation jacket, covers, vapour barriers and accessories required to complete the installation of the insulation.

1.3 SUBMITTALS

.1 Provide the following information in one complete submittal in accordance with Section 01 33 00 - Submittals:

.1 Schedule listing pipe systems to be insulated, type of insulation, insulation thickness and type of jacket to be installed.

.2 Manufacturer's literature which describes material and physical properties including: "K" value temperature rating, finish, recovery jacket materials proposed, thickness of material for individual service, applicable water vapour transmission rating, applicable stiffness and puncture ratings, recommended storage conditions, application details and instructions.

.3 Samples of proposed insulation and recovering materials.

1.4 SHIPMENT, PROTECTION AND STORAGE

.1 Deliver insulation and recovering to site using methods which do not damage insulation or recovering and in accordance with Section 01 61 00 – Basic Product Requirements.

.2 Deliver insulation materials to site clearly identified as to type and temperature rating.

.3 Store insulation materials on site as recommended by the manufacturer to prevent damage or weathering and in accordance with Section 01 61 00 - Basic Product Requirements.

Part 2 Products

2.1 MATERIALS

.1 General

.1 Provide new insulation materials and accessories, free from defects and which conform to the reference standards identified.

.2 Provide insulation materials and accessories which conform to fire and smoke hazard ratings as stated in the National Building Code.

.3 Provide insulation materials and accessories which withstand service temperatures without smouldering, glowing, smoking or flaming.

.4 Provide insulation accessories such as staples, adhesives, bonding agents, fastenings, breaching, rivets and tapes as recommended by the insulation manufacturer.

.5 Install heat tracing before insulation.

.2 Insulation

.1 Provide preformed tubular type or the flexible blanket type piping insulation.

.2 Provide valve, flange and other appurtenances insulation in accordance with pipe insulation specifications and in a shape suitable for the appurtenance; provide transition sections for joints between valves and piping insulation.

.3 Provide valve, flange and other appurtenances insulation recovering which is flexible, removable and reusable, with Velcro or lacing hook fasteners.

.4 Provide types of insulation as follows:

.1 Unicellular elastomeric thermal type insulation conforming to ASTM C534, Type I.

.2 Cellular glass type insulation conforming to ASTM C552, Type II.

.3 Fibreglass type insulation conforming to Thermal Insulation Association of Canada (TIAC) requirements for the service.

.4 Perlite type insulation conforming to ASTM C610, Type II.

.3 Insulation Selection

.1 Use unicellular elastomeric thermal, cellular glass or fibreglass type for low temperature class insulation.

.2 Use cellular glass or fibreglass type for medium temperature class insulation.

.4 Insulation Jackets

.1 Smooth finish aluminum jackets: alloy 5005; with integral vapour barrier and in accordance with ASTM B209; 0.4 mm thick. Secure jackets using stainless steel banding a minimum 12 mm wide by 0.5 mm thick with matching seals, on 300 mm centres; where required use stainless steel metal screws to secure jacketing.

.5 Insulation Covers

.1 Smooth finish aluminum covers: alloy 5005, with integral vapour barrier; conform to ASTM B209; match cover thickness to jacket used.

.6 Shields

.1 Unless specified otherwise, provide thermal pipe hanger shields at pipe support and hanger locations as required in Drawing Standard Details and Section 400507.

.2 Thermal hanger shield materials are specified in Section 400507.

.7 Flashing

.1 Provide flashing that includes aluminum caps, sealant and reinforcing.

.2 Provide aluminum caps, 20 gauge, cut to completely cover the insulation.

.3 Provide sealants as recommended by the insulation manufacturer.

2.2 PROTECTIVE COATINGS

.1 Do not paint metal pipe prior to insulating it.

.2 Paint exposed pipe between terminations or gaps in insulation, in accordance with Section 40 46 16 – Protective Coating and Lining for Steel Pipe.

.3 Do not paint PVC, polypropylene, aluminum or canvas recovering.

Part 3 Execution

3.1 INSTALLATION

.1 General

.1 Do not install insulation or recovering before piping has been tested and approved, unless directed otherwise. Thermal shields at pipe hangers and supports may be installed prior to testing.

.2 Install insulation and recovering according to the manufacturer's recommendations.

.3 Ensure surface is clean and dry prior to installation.

.4 Ensure insulation is dry before and during application.

.5 Finish systems while under operating conditions, where possible.

.6 Protect insulation and recovering from crushing, denting, puncture or similar damage during installation; remove damaged materials and replace with new materials.

.7 Unless specified otherwise, install a minimum insulation thickness of 25 mm. Use greater thicknesses as recommended by the insulation manufacturer, as required to lower the outer skin temperature to below 40°C.

.8 Unless specified otherwise, do not insulate wafer body valves.

.9 Do not insulate piping expansion joints or flexible connectors.

.10 For locations where integral vapour barriers are required, ensure recovering is resistant to moisture penetration and is sealed in accordance with the insulation manufacturer's recommendations.

.2 Pipe Insulation

.1 Unless otherwise specified, provide continuously insulated piping along the entire length, including all in-line appurtenances.

.2 Butt insulation firmly together and provide jacket laps and joint strips with lap adhesive.

.3 Terminate pipe insulation 100 mm on each side of all flanges and grooved joint couplings.

.4 Seal the ends of pipe insulation with a vapour barrier coating.

.5 Medium, high, and very high temperature class: Except for flexible blanket type, seal the ends of the insulation with end joint strips and secure with waterproof adhesive.

.6 Outdoor and underground piping:

.1 Unless specified otherwise, use cellular glass insulation protected with rigid aluminum jackets and covers for outdoor installations.

.2 Unless specified otherwise, continue above ground insulation and recovering to 500 mm below finished ground level.

.3 Jackets and Covers

.1 Recover all insulated pipe. Unless specified otherwise, provide pipe insulation with smooth finish aluminum jackets and covers.

.2 Unless specified otherwise, provide stainless steel banding, a minimum 12 mm wide by 0.5 mm thick with matching seals and on 300 mm centre.

.3 Align longitudinal seams in aluminum jackets and covers to shed water; overlap radial seams a minimum of 50 mm.

.4 Pipe Support and Shields

.1 Unless specified otherwise, install thermal pipe hanger shields and protective saddles at pipe hanger and support locations during pipe support and hanger installation.

.2 On hot pipe systems, apply a 75 mm wide vapour barrier tape or band over butt joints; on cold water pipe systems, apply a wet coat of vapour barrier lap cement on all butt joints and seal the joints with a 75 mm or greater vapour barrier tape or band.

.5 Flashing

.1 Provide flashing at all jacket penetrations and terminations; provide clearance for flashing between the insulation system and the piping supports.

.2 Provide a heavy tack coat of sealant trowelled over the insulation, extending over the jacket edge by 25 mm and over the pipe or penetration by 50 mm; stretch fitted reinforcement over the tack coat; strap the reinforcement with a continuous band of reinforcing to prevent curling; trowel sealant over the reinforcement to a minimum thickness of 3 mm.

.3 Form aluminum caps to fit over the adjacent jacketing and to completely cover coated insulation; secure the caps with jacket straps.

3.2 INSULATION THICKNESS SCHEDULE

Piping System	Up to 50 mm	50 mm to 100 mm	100 mm to 150 mm
Vacuum Air Valve Piping	-	-	* min. 25 mm

* Heating tracing supplier to verify required thickness of insulation for heat tracing.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft^3) (2,700kN-m/m^3).

.2 CSA International

.1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CSA A3000, Cementitious Materials Compendium.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Co-ordination: arrange with authority having jurisdiction for relocation of buried services that interfere with execution of work.

.1 Pay costs of relocating services.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit shop drawings as required by the Contract Drawings, in accordance with Section 01 33 00 - Submittals.

.2 Contractor to submit samples of all proposed fill materials to be used on site for testing at the Contractor's cost. Results of testing to be submitted to Engineer for review no later than 1 week before backfilling or filling work.

.3 Contractor to submit construction methodology for buried trenches for review by Geotechnical Engineer prior to construction.

.4 Contractor shall submit, at least 50 days prior to unshrinkable fill/Controlled Low Strength Material placement, the mix design including performance data, mix proportion and information for aggregates (qualification testing), bentonite (data sheets), supplementary cementing materials (mill certificates) and admixture data sheets.

.5 Site Quality Control Submittals: submit in accordance with Section 01 45 00 - Quality Control.

.1 Submit testing results as described in PART 3 - FIELD QUALITY CONTROL.

.6 Sustainable Design Submittals:

.1 Erosion and Sedimentation Control: submit erosion and sedimentation control plan in accordance with Provincial and Municipal authorities having jurisdiction, and Section 01 57 01 Environmental Protection.

Part 2 Products

2.1 GENERAL

.1 Gravel to be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In absence of satisfactory performance records over a five year period for particular source of material, soundness to be tested according to ASTM C88 or latest revised issue. Maximum weight average losses for course and fine aggregates to be 30% when magnesium sulphate is used after five cycles.

.2 All crushed gravel when tested according to and ASTM C136 and ASTM C117 or latest revised issue, to have a generally uniform gradation and conform to following gradation limits and 60% of the material passing each sieve must have one or more fractured faces. Determination of the amount of fractured material shall be in accordance with the Ministry of Transportation and Highways' Specification I-11, Fracture Count for Coarse Aggregate, Method which determines fractured faces by count. The Plasticity index for crushed gravel to not exceed 6.0.

2.2 MATERIALS

.1 Imported Fill Type A

.1 Imported Engineered Fill Type A shall consist of 75 mm minus well graded sand and gravel conforming to the following gradations. Contractor shall submit sieve analysis results of proposed fill material to Geotechnical Engineer for approval.

Sieve Designation (mm)	Percent Passing High (%)	Percent Passing Low (%)
75	100	100
37.5	100	60
19	80	35
9.5	60	26
4.75	40	20
2.36	30	15
1.18	20	10
0.6	15	5
0.3	10	3
0.075	5	0

.2 Imported Fill Type B

.1 Imported Fill Type B shall be well graded 150 mm minus crushed rock fill conforming to the following gradations. Contractor shall submit sieve analysis results of proposed fill material to Geotechnical Engineer for approval.

Sieve Designation (mm)	Percent Passing High (%)	Percent Passing Low (%)
150	100	100
75	100	40
37.5	65	20
9.5	40	5
2.36	25	0
0.075	5	0

.3 Granular Base

.1 To be 25 mm crushed sand and gravel conforming to following gradations. Contractor shall submit sieve analysis results of proposed fill material to Geotechnical Engineer for approval:

Sieve Designation (mm)	Percent Passing
25	100
12.5	75-100
9.5	60-90
4.75	40-70
2.36	27-55
1.18	16-42
0.600	8-30
0.300	5-20
0.075	2-8

.4 Clear Crush

.1 To be 25 mm clean crushed rock conforming to the following gradations Contractor shall submit sieve analysis results of proposed fill material to Geotechnical Engineer for approval:

Sieve Designation (mm)	Percent Passing
25	100
19	0-100
9.5	0-5
4.75	0

.5 Unshrinkable Fill: to be Controlled Low Strength Material, proportioned and mixed to provide:

.1 Minimum compressive strength at 24 hours: 0.1 MPa

.2 Minimum compressive strength at 28 days: 0.3 MPa.
.3 Maximum compressive strength at 28 days: of 1.3 MPa.
.4 Minimum fly ash content: 40%.
.5 Mix shall contain minimum of 10% (dry) bentonite (mass of cementing materials).
.6 Bentonite to be hydrated for a minimum of 24 hours prior to adding to the mix.
.7 Cement type: GU (Type 10) to CAN/CSA A3001.
.8 Concrete aggregates: to CAN/CSA-A23.1.
.9 Maximum size aggregate: 14 mm.
.10 Slump: 200 mm =/- 20 mm.
.11 Contractor to submit action and information submittals at least 50 days prior to placement as described herein.

.6 Geotextile to Section 31 32 19 - Geotextile.

.7 Riprap to Section 31 37 00 – Rip-rap.

Part 3 Execution

3.1 EXAMINATION

.1 Evaluation and Assessment:

.1 Examine geotechnical design report (171-04753-00) prepared by WSP Canada Inc (WSP).
.2 Examine project site and local conditions at time of construction.
.3 Before commencing work establish locations of buried infrastructure on and adjacent to site.

3.2 PREPARATION/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 requirements of Provincial and Municipal authorities having jurisdiction, and Section 01 57 01 - Environmental Protection.
.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 Protection of in-place conditions:

.1 Protect excavations from freezing.
.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 Site Inspector’s 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.

.6 Notify Engineer immediately of any unidentified buried structures encountered during excavations.

.3 Removal:

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Complete clearing and grubbing as required to remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within site grading areas designated on drawings.

.3 Remove stumps and tree roots below footings, slabs, and paving, and to 500 mm below finished grade elsewhere.

.4 Complete organics stripping prior to excavation as indicated on the drawings.

3.3 STRIPPING OF TOPSOIL

.1 After area has been cleared and grubbed, prior to excavation, strip topsoil over areas to be covered by new construction as indicated in Contract Drawings, over areas where grade changes are required, and over stockpile/laydown areas so that excavated material suitable for on-site reuse may be stockpiled without covering topsoil, to Section 31 14 13 – Soil Stripping and Stockpiling.

.1 Stockpile topsoil on site for later use as directed by the Engineer.

.2 Do not mix topsoil with subsoil.

.3 Dispose of unused topsoil off-site in accordance with local regulations.

3.4 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Worksafe BC requirements.

.1 Contractor to retain the services of a Geotechnical Engineer registered to practice in the Province of British Columbia to satisfy requirements of Worksafe BC and safety of temporary works.

.2 Where conditions are unstable, Contractor's Geotechnical Engineer to verify and advise methods.

.2 Obtain permit from authority having jurisdiction for temporary diversion of water course.

.3 Contractor to identify temporary Works as required to satisfy new construction and Contract Drawings and submit shop drawings for review by Geotechnical Engineer.

.4 During backfill operation:

.1 Unless otherwise indicated or directed by Site Inspector, remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.

.5 When sheeting is required to remain in place, cut off tops at elevations as indicated.

.6 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

.2 Remove excess materials from site and restore watercourses as required by Contractor's QEP per Section 01 57 01 – Environmental Protection and Contractor's QEP.

3.5 ISOLATION, DEWATERING, AND HEAVE PROTECTION

.1 Keep excavations free of water while Work is in progress.

.2 It is the responsibility of the Contractor to remove water from trenches and excavations and new berm construction areas, regardless of origin.

.3 Timing of work inside lagoons requiring dewatering to be coordinated with low tide.

.4 Provide for review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.

.5 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.

.6 Provide pumps and other equipment and materials necessary to keep excavations free of water while work is in progress.

.7 Equipment used for dewatering shall be of a suitable and rugged type to ensure continuous operation.

.8 Make provision as necessary to prevent floatation or damage to the work in case of accidental stoppage of de-watering equipment.

.9 Protect excavations and constructed slopes against flooding, erosion and damage due to surface run-off.

.10 Dispose of the water away from the Work in a manner such that there is no damage to the Work or other public or private property or persons.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.11 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 per Section 01 57 01 – Environmental Protection and Contractor's QEP.

.12 Provide silt fence, silt bags, straw bales or other suitable erosion control devices as required to minimize erosion of the excavation work per Section 01 57 01 – Environmental Protection and Contractor's QEP.

.13 Minimize disturbance to supporting soil.

3.6 REMOVAL OF UNSUITABLE MATERIAL

.1 Remove unsuitable material as shown in the Contract Drawings and as required by the Geotechnical Engineer.

.2 Dispose of unsuitable material off-site in accordance with local regulations.

3.7 EXCAVATION - GENERAL

.1 Advise Site Inspector at least 5 days in advance of excavation operations and take initial cross sections as required.

.2 Notify Engineer immediately of any obstructions or unanticipated ground conditions encountered during excavations.

.3 Shore and brace excavations, protect slopes and banks and perform work in accordance with Provincial and Municipal regulations whichever is more stringent.

.4 Excavate to lines, grades, elevations and dimensions as indicated or as required by Site Inspector.

.5 Excavate as required to carry out work.

.1 Notify Engineer immediately of any unidentified buried structures encountered during excavations.

.2 Do not disturb soil or rock below bearing surfaces without approval of Engineer.

.3 Notify Geotechnical Engineer when excavations are complete and subgrade is ready to be inspected.

.4 If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.

.5 Excavation taken below depths shown without Owner’s written authorization to be filled with approved material at Contractor's expense:

.1 Backfill and compact with approved material for earthworks.

.6 Stockpile suitable sand and gravel material excavated from lagoon as approved by the Geotechnical Engineer for re-use on site as fill or backfill as directed by Geotechnical Engineer.

.7 For trench excavation, unless otherwise authorized by Site Inspector in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.8 Excavate trenches to provide uniform continuous bearing and support for thickness of pipe bedding material as shown on Contract Drawings on solid and undisturbed ground.

.1 Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.

.9 Keep excavated and stockpiled materials safe distance away from edge of trench as required to comply with Worksafe BC requirements and as directed by Contractor’s Geotechnical Engineer.

.10 Restrict vehicle operations directly adjacent to open trenches.

.11 Excavate for roadworks and other works to subgrade levels.

.1 In addition, remove all topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.

.12 Dispose of surplus and unsuitable excavated material in approved location off site.

.13 Do not obstruct flow of surface drainage or natural watercourses.

.14 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.15 Notify Site Inspector when bottom of excavation is reached.

.16 Obtain Site Inspector approval of completed excavation.

.17 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Geotechnical Engineer.

.18 Correct unauthorized over-excavation as directed by Site Inspector, at Contractor's cost.

.19 Install geotextiles in accordance with Section 31 32 19 - Geotextile.

3.8 NEW BERM

.1 Isolate and dewater area of new berm footprint shown on Contract Drawings to the maximum economically achievable, to a minimum of the dewatered water level elevation shown on Contract Drawings.

.2 For all areas to be covered by new berm and/or preload, remove unsuitable subgrade material including sludge, surficial organics, loose/soft soils or other geotechnical unsuitable materials to expose the underlying sand.

.1 For new berm areas below elevation 2.0 m, assume 1m removal thickness below existing lagoon bottom. Contractor shall complete a pre-bid visit to confirm conditions and verify after Contract Award whether dredging will be required and submit proposed construction methodology to Engineer for review prior to construction.

.2 For new berm areas above elevation 2.0 m, assume min. 200 mm stripping of organics and debris per Section 31 14 13 – Soil Stripping and Stockpiling.

.3 Place woven geotextile if approved by the Geotechnical Engineer at base of subgrade.

.4 Fill to dewatered water level elevation with 10 kg riprap as shown in Contract Drawings.

.5 Place non-woven geotextile per Contract Drawings.

.6 Place compacted imported fill in lifts as shown on Contract Drawings.

.7 Install overflow box culverts.

.8 Install settlement gages, continue to place imported fill, and construct to preload level per Contract Drawings.

.9 Preload for duration recommended by Geotechnical Engineer, monitoring per Contract Drawings.

.10 After approval of Geotechnical Engineer, remove preload and construct berm and other structures to final design.

.11 Cap new berm with 200 mm thick granular base.

.12 Hydroseed and revegetate slopes of new berm per site restoration requirements of Section 01 57 01 – Environmental Protection.

3.9 BERM EXTENSIONS

.1 Isolate and dewater area of berm extensions footprint shown on Contract Drawings to the maximum economically achievable, to a minimum of the dewatered water level elevation shown on Contract Drawings.

.2 For all areas to be covered by berm extensions and/or preload, remove unsuitable subgrade material including sludge, surficial organics, loose/soft soils or other geotechnical unsuitable materials to expose the underlying sand.

.1 For berm extension areas below elevation 2.0 m, assume 1m removal thickness below existing lagoon bottom. Contractor to verify whether dredging will be required and submit proposed construction methodology to Engineer for review prior to construction.

.2 For new berm areas above elevation 2.0 m, assume min. 200 mm stripping of organics and debris per Section 31 14 13 - Soil Stripping and Stockpiling.

.3 Place woven geotextile if approved by the Geotechnical Engineer at base of subgrade.

.4 It is anticipated that no berm extensions will be required below minimum dewatered water leve shown on drawings, therefore it is anticipated that no 10 kg riprap will be required for berm extensions.

.5 Place compacted imported fill in lifts as shown on Contract Drawings, to design grade.

.6 Cap berm extensions with 200 mm thick granular base.

3.10 SCREENING FACILITY

.1 Clear and grub all areas to be covered by new construction and required laydown areas.

.2 Remove and strip organics and debris as shown on Contract Drawings.

.3 Following completion of ground improvements and building construction as shown on Contract Drawings, place and compact suitable native fill and imported fill to grading shown on Contract Drawings.

.4 Cap new construction at screening facility with 200 mm thick granular base to finished grade shown on Contract Drawings.

3.11 TREATMENT BUILDING

.1 Clear and grub all areas to be covered by new construction and required laydown areas.

.2 Remove and strip organics and debris as shown on Contract Drawings.

.3 Excavate berm at treatment building site outside of ground improvements zone, to required elevation as shown on Contract Drawings.

.4 Following completion of new berm, berm extensions, ground improvements and building construction as shown on Contract Drawings, cap treatment building site to finished grade with 200 mm thick granular base.

3.12 FIELD QUALITY CONTROL

.1 The Contractor shall be responsible for the quality of all work performed and shall carry out testing of materials and compaction of backfill as required by the Engineer to ensure the quality of the work.

.2 Not later than 1 week minimum before backfilling or filling, submit to Engineer results of backfill testing as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.3 Do not begin backfilling or filling operations until material has been approved for use by Site Inspector.

.4 Laboratory proctor tests shall be conducted on all types of backfill materials prior to construction to obtain the optimum moisture content and maximum dry density.

.5 At least one density test and one moisture content determination shall be made for each 500 m^3 or portion thereof of each type of compacted granular material placed during each shift. The Contractor is responsible for providing adequate quality control sampling and testing to the Engineer for review.

.6 If the material being tested fails to meet the required density, the material shall be reworked or replaced, and the construction methods shall be altered as necessary to obtain the required density.

.7 Any omissions or failure on the part of the Owner to disapprove or reject any work or materials shall not be construed as an acceptance of any defective work or materials.

.8 The Contractor is responsible for the cost of any repair, correction work and associated additional inspection and testing.

.9 Operations shall be suspended immediately whenever the conditions of climate, materials, equipment or workmanship are determined by the inspection and testing agency or the Owner to be unsatisfactory for the excavation or backfill operations.

.10 Accuracy of graded elevations to be within +/- 25 mm tolerance.

3.13 BACKFILLING

.1 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.

.2 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.

.3 Compaction of subgrade: compact existing subgrade under walks, paving, and slabs on grade, to same compaction as fill.

.1 Fill excavated areas with approved material per the Contract Drawings and compacted as specified for fill.

.4 Placing:

.1 Place backfill, fill and base course material in maximum 300 mm lifts or as shown on the Contract Drawings: control water content as required to achieve specified density.

.5 Compaction: compact each layer of material to following densities for material to ASTM D1557:

.1 To underside of base courses: 95%.

.2 Base courses: 95%.

.3 Elsewhere: 95%.

.6 Under slabs and paving:

.1 As shown on the Contract Drawings and described in the geotechnical report.

.7 In trenches:

.1 Up to 300 mm above pipe or conduit: unshrinkable fill as shown on the Contract Drawings.

.2 Over 300 mm above pipe or conduit: native sand and gravel approved by Geotechnical Engineer as shown on the Contract Drawings. Fill material shall not contain any organic matter, frozen lumps, snow, ice, weeds, roots, logs, stumps or any other objectionable matter.

.8 Under seeded and sodded areas: use site excavated material to bottom of topsoil except in trenches and within 600 mm of foundations.

.9 Blown rock material, not capable of fine grading, is not acceptable, imported material must be placed on this type of material.

.10 Against foundations (except as applicable to trenches and under slabs and paving): imported material to 200 mm thickness consisting of granular pipe bedding within 600 mm of structures.

.11 Concrete vaults: use granular pipe bedding to minimum 500 mm thickness below bottom of base or as shown on the geotechnical drawings.

3.14 GRADING

.1 Grade so that water will drain away from buildings, walls and paved areas, to the lagoon or to drainage swales and other disposal areas approved by Site Inspector.

.1 Grade to be gradual between finished spot elevations shown on drawings.

3.15 SURFACE RESTORATION

.1 General

.1 Restore all disturbed surfaces outside berm crest with topsoil and hydraulic seeding to requirements of Section 01 57 01 – Environmental Protection.

.2 Make good any damage to adjacent lands or improvements.

.3 Resolve all reasonable claims arising from Contractor's actions and obtain written releases from land owners following final restoration.

.4 Restore vegetated areas with approved topsoil and hydraulic seeding as shown on the Contract Drawings and as required by Section 01 57 01 – Environmental Protection.

.5 Contractor to submit proposed hydraulic seeding extents, documentation of proposed procedure and materials, proposed erosion control as recommended by hydraulic seeding supplier, and references of hydraulic seeding supplier to Engineer for review 30 days prior to commencement of seeding operations.

.2 Gravelled roads and berm crest

.1 Restore surface according to Contract Drawings.

.2 Compact to minimum 95% Modified Proctor density.

3.16 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Dispose of cleared and grubbed material off site daily.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 MEASUREMENT PROCEDURES

.1 Measure following items in hectares within limits as indicated:

.1 Clearing and Grubbing.

1.2 REFERENCE STANDARDS

.1 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

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, and surface debris.

.2 Grubbing consists of excavation and disposal of stumps and roots [boulders and rock fragments of specified size] to not less than specified depth below existing ground surface.

.3 EAB refers to Emerald Ash Borer a non-native, invasive beetle that is highly destructive to ash trees where it occurs.

.1 Woodchips in the context of EAB consist of untreated, raw bark and wood fragments broken or shredded from logs or branches. Woodchips are to be less than 2.5 cm in at least any two dimensions.

.2 Firewood in the context of EAB consists of non-manufactured, solid wood material, with or without bark, cut into sizes less than 1.2 m long and less than 25 cm in diameter which may be handled manually.

.3 Logs in the context of EAB consist of untreated, raw wood greater than 1.2 m in length and greater than 25 cm diameter.

.4 Enclosed vehicle in the context of EAB consist of any vehicle transporting regulated wood material that is equipped to prelude the loss of materials or the escape of EAB while in transit.

1.4 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 71 14 - Health and Safety Requirements.

1.5 STORAGE AND PROTECTION

.1 Prevent damage to root systems of trees, landscaping, water courses, trees, existing buildings, shrubs, bench marks, utility lines, site appurtenances, natural features which are to remain.

.1 Repair damaged items to approval of Owner.

.2 Replace trees designated to remain, if damaged, as directed by Site Inspector.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuel wood can be produced as saleable timber.

.1 Stockpile adjacent to site as required and in locations determined by the Contractor, per the general direction shown in Contract Drawings.

.2 Ash wood mixed with the wood of other species is to all be managed and disposed of as ash wood.

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 Section 015701 – Environmental Procedures.

.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 Site Inspector items designated to remain.

.2 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 Owner and Engineer in ample time to minimize interruption of service.

.3 Notify utility authorities before starting grubbing and clearing.

.4 Keep roads and walks free of dirt and debris.

3.3 APPLICATION

.1 Manufacturer's instructions: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.4 CLEARING

.1 Clearing includes trimming, felling, cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including rubbish, downed timber, brush, snags, occurring within cleared areas.

.2 Clear as indicated by Site Inspector, by cutting at height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.

3.5 GRUBBING

.1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.

.2 Grub out stumps and roots to not less than 200 mm below ground surface.

.3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m^3.

.4 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 grubbed and cleared materials off site to disposal area designated by Provincial and Municipal authorities.

.2 Cut timber greater than 125 mm diameter and stockpile on site. Stockpiled timber becomes property of Owner.

.3 Mulch and spread cleared and grubbed vegetative material on site as directed by Site Inspector.

.4 Any ash wood materials in the form of wood chips or logs are to be scattered widely, to maximum 75 mm depth as directed by Site Inspector.

.5 Any ash wood materials or firewood which is removed from the site is to be transported in an enclosed vehicle and disposed of at an authorized disposal facility.

.6 The Contractor is responsible for monitoring all cut ash wood and firewood until it is properly disposed of as determined by the Site Inspector.

3.7 FINISHED SURFACE

.1 Leave ground surface in condition suitable for immediate grading operations to approval of Site Inspector and Geotechnical Engineer.

3.8 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, flagging tape, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

Part 2 Products

2.1 NOT USED

.1 Not Used.

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 Section 01 35 43 - Environmental Procedures.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

.1 Ensure that procedures are conducted in accordance with applicable Municipal and Provincial requirements.

.2 Commence stripping of areas as indicated after area has been cleared of brush, weeds, and grasses and removed from site.

.3 Remove topsoil before construction procedures commence to avoid compaction of topsoil.

.4 Handle topsoil only when it is dry and warm.

.5 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by composting.

.6 Remove brush from targeted area by non-chemical means and dispose of through mulching.

.7 Strip topsoil to depths as indicated by Contract Drawings.

.1 Avoid mixing topsoil with subsoil.

.8 Pile topsoil in berms in locations as required.

.1 Stockpile height not to exceed 2.5 - 3 m.

.9 Dispose of unused topsoil from site and dispose at disposal area approved by Provincial and Municipal authority.

.10 Protect stockpiles from contamination and compaction.

.11 Cover topsoil that has been piled for long term storage, with trefoil or grass to maintain agricultural potential of soil.

3.3 PREPARATION OF GRADE

.1 Verify that grades are correct and notify Site Inspector if discrepancies occur. Do not begin work until instructed by Site Inspector.

.1 Grade area only when soil is dry to lessen soil compaction.

.2 Grade soil establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3.4 PLACING OF TOPSOIL

.1 Place topsoil only after Engineer has accepted subgrade.

.2 Spread topsoil during dry conditions in uniform layers not exceeding 200 mm, over unfrozen subgrade free of standing water.

.3 Establish traffic patterns for equipment to prevent driving on topsoil after it has been spread to avoid compaction.

.4 Cultivate soil following spreading procedures.

3.5 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 MEASUREMENT AND PAYMENT

.1 Include in appropriate pay item. Payment will be incidental to other items.

1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)

- .1 ASTM D 4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
- .2 ASTM D 4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
- .3 ASTM D 4716, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
- .4 ASTM D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-4.2, Textile Test Methods.
- .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Geomembranes.
  - .1 No.2, Mass per Unit Area.
  - .2 No.3, Thickness of Geotextiles.
  - .3 No.7.3, Grab Tensile Test for Geotextiles.
  - .4 No.6.1, Bursting Strength of Geotextiles Under No Compressive Load.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions. During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

Part 2 Products

2.1 MATERIAL

2.2 NON-WOVEN GEOTEXTILE

.1 The geotextile material shall be non-woven needle-punched polypropylene. The geotextile material shall be a minimum weight per the table below. The material Specifications shall be based on a minimum average roll values (MARV) not typical values.

.2 Geotextile to be as specified on the drawings or approved equal.

.3 The geotextile for the protection layer exhibit the properties described in the GRI GT12 Standards - "Test Methods and Properties for Non-woven Geotextiles used as Protection (or Cushioning) Materials".

.4 The rolls must be tagged to identify lot, batch, unique roll number, roll dimensions, manufacturer and material type. Provide QC testing certificate for each roll delivered, in accordance with the following required minimum properties:

Property	ASTM Test Method	Unit	MARV
Mass per unit area	D5261	oz/yd^2, g/m^2	12, 407
Grab tensile strength	D4632	N	1335
Grab tensile elongation	D4632	%	50
Trapezoidal tear strength	D4533	N	512
CBR Puncture strength	D6241	N	3671
UV resistance	D4533	% retained at 500 hrs	70
Apparent Opening Size	D4751	Mm	0.150
Permittivity	D4491	L/s	1.0
Water Flow Rate	D4491	$L/m/m^2$	3056

2.3 WOVEN GEOTEXTILE

.1 The geotextile material shall be woven polypropylene filaments. The material Specifications shall be based on a minimum average roll values (MARV) not typical values.

.2 Geotextile to be as specified on the drawings or approved equal.

.3 The rolls must be tagged to identify lot, batch, unique roll number, roll dimensions, manufacturer and material type. Provide QC testing certificate for each roll delivered, in accordance with the following required minimum properties:

Property	ASTM Test Method	Unit	MARV
Tensile Strength at 2% strain	D4595	kN/m	7.0
Tensile Strength at 5% strain	D4595	kN/m	21.0
Water Flow Rate	D4491	$L/m/m^2$	3056
Permittivity	D4491	L/s	1.0
Apparent Opening Size	D4751	Mm	0.425
UV resistance	D4533	% retained at 500 hrs	90

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 geotextile and GCL material installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Geotechnical Engineer, provide 72 hours notice prior to placement of geotextile or GCL and commencement of filling.

.2 Inform Engineer immediately of any deviations from the design.

3.2 INSTALLATION

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with securing pins.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.3 Overlap each successive strip of geotextile 500 mm over previously laid panel.

.4 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.5 Replace damaged or deteriorated geotextile to approval of Engineer.

.6 Loose edges of geotextile fabric shall not be exposed and shall be anchored per indicated.

3.3 PROTECTION

.1 Vehicular traffic not permitted directly on geotextile.

.2 Do not overload soil or aggregate covering on geotextile prior to installation.

END OF SECTION

Part 1 General

1.1 MEASUREMENT PROCEDURES

.1 Include in appropriate pay item where indicated in schedule of prices.

.2 Measurement for graded riprap will be for actual quantity placed based on weigh tickets provided to Site Inspector as loads are delivered with rip-rap placed beyond the designed limit to be deducted from the weight of rip-rap delivered. Measurement for such deduction will be by the most equitable volume measurement and conversion into weight as decided by Site Inspector.

Part 2 Products

2.1 ROCK

.1 Hard, durable, and angular quarry rock able to interlock with adjacent rock riprap, that will not disintegrate on exposure to water or the atmosphere. The rock will have a relative density (formally specific gravity) not less than 2.65, free from seams, cracks or other structural defects. Rock to be well graded, to meet following size distribution for use intended:

.1 Graded rip-rap:

.1 Size gradation for 10 kg riprap:

Percent Heavier Than	Weight (kg)	Equivalent Diameter (mm)
85	1	90
50	10	195
15	30	280

.2 Size gradation for 50 kg riprap:

Percent Heavier Than	Weight (kg)	Equivalent Diameter (mm)
85	5	155
50	50	330
15	150	475

.3 Minimum apron thicknesses for graded riprap unless shown otherwise on the Contract Drawings:

Graded Riprap Size (kg)	Minimum Thickness (mm)
10	350
50	550

.2 Rounded river rock or pit run stone not acceptable.

Part 3 Execution

3.1 PLACING

.1 Where required, excavate trench at toe of slope to dimensions as indicated.

.2 Grade area where riprap is to be placed to uniform, even surface. Fill depressions with approved material as specified on Contract Drawings and compact to provide firm bed.

.3 Place geotextile on prepared surface in accordance with Section 31 32 19.16- Geotextile and as indicated in the Contract Drawings. Place rocks to avoid dropping riprap and do not puncture geotextile. Vehicular traffic over geotextile not permitted.

.4 Place riprap to thickness and details as indicated in the Contract Drawings with suitable equipment.

.5 Place rock to secure surface and create a well-graded, interlocking, stable mass of large and small rocks (per gradation specifications in 2.1 above) to fill voids. Compact rocks, interlocking smaller rocks into voids of larger rocks.

.6 Finished tolerances

.1 Ensure finished riprap within +100 mm to -100 mm of specified grade.

.2 Ensure riprap slope within +2 degrees to -2 degrees of specified slope in degrees.

END OF SECTION

Part 1 General

1.1 PIPE INSULATION SYSTEM

.1 The pipe shall be insulated using the U.I.P.® factory insulation process, as supplied by Urecon Ltd., complete with black polyethylene jacket with UV inhibitor.

.2 The jacket thickness is dependent on the diameter and intended function.

.3 The insulation of associated joints, fittings and accessories shall be as per Urecon's recommendations, depending on the size and type of pipe involved.

.4 The product shall be manufactured in accordance to ISO 9001-2000 Standards, or approved equal.

Part 2 Products

2.1 INSULATION

.1 Material: rigid polyurethane foam, factory applied.

.2 Thickness: 50 mm (2 in.) or as required.

.3 Density: (ASTM D 1622) 35 to 46 kg/m^3

.4 Closed cell content: (ASTM D 6226) 90%, minimum.

.5 Water absorption: (ASTM D 2842) 4.0% by volume.

.6 Thermal conductivity: (ASTM C518) 0.020 to 0.026 W/m °C

2.2 SYSTEM PROPERTIES

.1 System compressive strength: (modified ASTM D 1621 with 125 mil jacket) approximately 414 to 552 kPa, varies with pipe diameter.

.2 Temperature limitations:

.1 Minimum ambient installation temperature @ -43°C.

.2 Service temperature approximately -45°C.

2.3 OUTER JACKET ON PIPE INSULATION

.1 Tape wrap system.

.2 Jacket material: Scapa #366 polyethylene, UV inhibited.

.3 Sealant: butyl rubber and resin, applied hot in 1.27 mm multiple layers providing a shrink tightened waterproof bond throughout its entire length.

.4 Minimum elongation: (ASTM D 1000) 300%, 6 month test.

.5 Tensile strength: (ASTM D-1000) 6.83 kg/cm wide.

2.4 INSULATED PIPE JOINTS

.1 Insulated pipe joints shall be completed using pre-fabricated rigid polyisocyanurate or urethane half shells and sealed with the application of suitable wrap around adhesive lined heat shrink sleeves as supplied by Urecon. The heat shrink sleeves shall overlap the insulation jacket by a minimum of 75 mm on either side of the joint.

Part 3 Execution

3.1 INSULATED PIPE INSTALLATION

.1 Install insulated pipe in accordance with manufacturer's instructions to lines and grades indicated on drawings.

.2 Terminate insulation in accordance with manufacturer's instructions for exposed, buried and sub-aqueous installations.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C111/A21.11, Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 ANSI/AWWA C200, Standard for Steel Water Pipe, 6 Inch (150 mm) and Larger.

.3 ANSI/AWWA C207, Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 Inch Through 144 Inch (100 mm Through 3,600 mm).

.4 ANSI/AWWA C906, Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

.2 ASTM International

.1 ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

.3 Canadian General Standards Board (CGSB)

.1 CGSB 41-GP-25M, Pipe, Polyethylene, for the Transport of Liquids.

.4 CSA International

.1 CSA B137 Series, Thermoplastic Pressure Piping Compendium.

.5 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.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 Shop Drawings:

.1 Submit drawings of connections per Contract Drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.

.2 Submit shop drawings showing proposed method of installation for sewage force main in undercrossing.

.4 Certification to be marked on pipe.

.5 Test and Evaluation Reports: submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

.6 Manufacturer's Instructions: submit to Engineer copy of manufacturer's installation instructions.

.7 Provide marked up field record drawings and sketches as necessary for the Engineer to produce accurate, complete office record drawings.

.8 Provide detailed operating and maintenance instructions for all equipment installed.

.9 Provide detailed lists of any special or proprietary tools or equipment which are required to assemble, disassemble, operate or maintain any device installed on this project.

.10 Where requested by Engineer, provide certified test results for materials to be employed.

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect pipes, fittings, appurtenances, and hardware from damage.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Polyethylene pressure pipes PE 4710: to AWWA C906, CSA B137.1:

.1 Sclairpipe or approved equal.

.2 Dimension ratio as identified on contract drawings.

.3 The raw material shall contain a minimum of 2%, well dispersed, carbon black. Additives that can be conclusively proven not to be detrimental to the pipe may also be used, provided the pipe produced meets the requirements of this standard.

.4 The pipe shall contain no recycled compound except that generated in the manufacturer’s own plant from resin of the same specification and from the same raw material supplier.

.5 Compliance with the requirements shall be certified in writing by the pipe supplier, upon request.

.6 Joints: Heat butt fusion to ASTM D2657 and in accordance with manufacturer’s recommendations

.7 Fittings

.1 Polyethylene fittings for use with the pipe shall be heat fusion fittings made of the same material of the pipe and be completely fibreglass reinforced as required to achieve at least the same pressure rating as the pipe to which it is to be joined.

.2 Flanged fittings shall comprise of a stub end, butt fused to the pipe end, together with a slip on flange which shall comply with ANSI B16.5 Class 150 bolt circles for the pipe size and shall be manufactured from ductile iron and epoxy coated. The securing bolts, nuts and washers shall be made of 316 stainless steel and be of a size and length to suit the flanges.

.3 Butt-fused fittings shall be used except where electro-fusion or flanged fittings are identified on drawings.

2.2 PPE INSULATION

.1 Refer to Section 33 07 16.01 – Watermain Pipe Insulation.

2.3 PIPE SURROUND

.1 Unshrinkable fill as indicated on the Contract Drawings.

2.4 BEDDING

.1 Unshrinkable fill as indicated on the Contract Drawings.

2.5 BACKFILL MATERIAL

.1 In-situ material as indicated on the Contract Drawings.

2.6 VALVES

.1 Install valves to manufacturer's recommendations at locations as indicated.

.2 Combination Air Release Vacuum Valves (CAV)

.1 Approved CAV Product:

.1 ARI Flow Control Accessories, Model D-90

.2 Or approved equivalent

.2 Adjusting Rings

.1 CAV access adjustments shall be undertaken using precast adjusting rings.

.2 Adjusting rings to ASTM C478M.

.3 Frames and Covers:

.1 Close-grained grey cast iron meeting ASTM A48, Class 20 or cast steel conforming to ASTM A27, Grade 70-36.

.2 The substitution of ductile iron meeting ASTM.A445 for cast iron or cast steel shall be subject to the approval of the Engineer.

.3 All frames and covers shall be true in form and dimension, free from faults, sponginess, cracks, blow holes, and other defects. Bearing surfaces shall be machined to prevent rocking.

.4 Frames and covers shall be hot dipped in asphaltic varnish.

.5 Standard frame and cover to be Norwood Foundry Model No. NF-39 manhole frame or approved equal.

2.7 JACKETS

.1 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: corrugated

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.8 COUPLING TO STAINLESS STEEL

.1 Victaulic style 77S or approved equal.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Site Inspector.

.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 Site Inspector.

3.2 PREPARATION

.1 Do preparation Work, in accordance with Section 31 00 00 – Earthwork.

.2 Pipes and fittings to be clean and dry.

.3 Prior to installation, obtain Engineer’s approval of pipes and fittings.

3.3 TRENCHING

.1 Do trenching Work, in accordance with Section 31 00 00 – Earthwork.

.2 Trench alignment and depth require approval from Site Inspector prior to placing bedding material or pipe.

3.4 BEDDING & PIPE SURROUND

.1 Place unshrinkable fill as indicated on Contract Drawings.

3.5 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.

.3 Compact backfill to at least 95% maximum dry density to ASTM D1557.

3.6 INSTALLATION

.1 Lay pipes in accordance with manufacturer's recommendations.

.2 Join pipes in accordance with manufacturer's recommendations.

.3 Avoid damage to machined ends of pipes in handling and moving pipe.

.4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

.5 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.6 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.7 Cut pipes in an approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.8 Align pipes carefully before jointing.

.9 Do not lay pipe on frozen bedding.

.10 Remove any pipe which has floated due to trench flooding and reinstall only after acceptable trench and bedding conditions have been re-established.

.11 Install all special structures such as air release valves, drains, blowoffs, hydrants, swabbing facilities and valve chambers at the locations indicated and in accordance with the contract documents.

.12 Protect pipe and fittings from excessive exposure to direct sunlight or other damage. Replace any pipe or fittings which have become discoloured, cracked or otherwise marred or damaged.

.13 Ensure proper operation of all fittings and appurtenances having moving parts both prior to and after installation.

.14 Coat direct buried metallic objects with a Denso paste and tape, or as approved.

3.7 COUPLINGS

.1 Install pipe stiffening inserts for all existing pipe and pipe with dimension ratio greater than DR 17.

.2 Install coupling and insert to manufacturer’s instructions.

3.8 CONNECTION TO EXISTING WATERMAINS

.1 Adhere to the scheduling stipulations for service interruptions obtained from the Owner prior to connecting.

.2 Provide 48 hr written notice to the Engineer and all connected customers whose water service will be interrupted by the connection.

.3 Adhere to standard or special tie-in details contained in the contract documents and confirm acceptability with the Engineer prior to proceeding.

.4 Make good at no expense to the Owner all damages resulting from an unsuccessful tie-in or failure of material installed to complete tie-in or damage to existing structures or works caused during performance of the tie-in.

3.9 HYDROSTATIC AND LEAKAGE TESTING

.1 General

.1 The initial fill of water for pressure testing will be supplied by the Owner at no cost to the Contractor. However, any subsequent refills of the line required by failure to meet the requirements of the tests will be charged to the Contractor at standard water rates.

.2 Water used for disinfecting of watermains may be used for leakage test.

.3 Complete watermain leakage test prior to the installation of service connections.

.4 Notify the Engineer a minimum of 24 hours in advance of all proposed tests. Perform tests in the presence of the Engineer.

.5 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.

.6 Control rate of filling of pipes to a velocity of less than 0.45 m/sec (1.5 ft/sec).

.7 Prior to pressure testing ensure that thrust blocks attain minimum 15 MPa concrete strength.

.8 Ensure that all air is purged from the watermain before performing leakage or pressure testing the system.

.9 For pipe materials other than Steel or HDPE, calculate leakage from formulas in the appropriate sections of AWWA Standards for that type of pipe.

.10 If the leakage exceeds the allowable, locate and repair leaks and defects. Repeat the test after repairs until the leakage does not exceed the allowable. Visible leaks must be repaired even when the leakage is below the allowable limits.

.11 Where new watermain sections cannot be isolated from existing mains, the Contractor may apply to the Engineer to establish an alternate test pressure or have the leakage testing requirement waived. Warranty obligations of the Contractor remain fully in effect in either event.

.2 Pressure Testing of HDPE Pipe

.1 Pressure test all pipes, couplings, joints and other appurtenances under a hydrostatic pressure in compliance with AWWA M55/ASTM 2164 latest edition. No leakage allowed.

.2 Should any test disclose excessive leakage, repair or replace defect and retest section until specified testing requirement is achieved.

3.10 FLUSHING AND DISINFECTION

.1 Do not use granular hypochlorite for disinfection of PVC pipe with solvent welded joints, as there is an explosive reaction potential.

.2 Retain water containing not less than 25 mg/L free chlorine in water system for a period of at least 24 h, in accordance with Continuous Feed Method. Submit outline of proposed disinfection procedure accompanied by marked up schematic drawing to Contract Administrator for approval 48 h in advance of commencement of disinfection.

.3 Allow water from existing distribution system, isolated by reduced pressure principle backflow prevention device or other approved source of supply, to flow at constant, measured rate into newly laid watermain. In absence of a meter, rate may be approximated by methods such as placing Pitot gauge in discharge, measuring time to fill container of known volume, or measuring trajectory of discharge and using formula presented in AWWA C651.

.4 At a point not more than 3 m downstream from beginning of new main, ensure water entering new main receives dose of chlorine fed at constant rate such that water will have not less than 25 mg/L free chlorine. To assure that this concentration is provided, measure chlorine concentration at regular intervals as specified in AWWA C651.

.5 Amount of chlorine required to produce 25 mg/L concentration in 30 m of pipe of various sizes is given in following table:

Pipe Size (mm)	100 Percent Chlorine (kg)	1 Percent Chlorine Solution (Litres)
100	0.006	0.61
150	0.014	1.36
200	0.024	2.46
250	0.039	3.86
300	0.054	5.45
400	0.098	9.85

.6 Allow flow of water containing ch orine to continue until entire main, all service connections, extremities and hydrants to be treated are filled with 25 mg/L chlorine solution. To ensure that this concentration has been attained throughout, measure free chlorine residual at a number of points and extremities along main. Retain chlorinated water in main for at least 24 h. During this time operate all valves, curb stops and hydrants in section treated in order to disinfect them thoroughly.

.7 At end of this 24 h period, treated water to contain no less than 10 mg/L free chlorine throughout main. If chlorine content is less than 10 mg/L repeat chlorination procedure until specifications are met.

.8 After completion of chlorination, flush chlorinated water from system, hydrants and services until chlorine concentration in remaining water is less than 0.3 mg/L chlorine residual.

.9 Upon completion of disinfection and flushing, Contractor to remove test and bleed point apparatus and backfill and complete any other work required for placing of waterworks system in service.

3.11 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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C111/A21.11, Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 ANSI/AWWA C200, Standard for Steel Water Pipe, 6 Inch (150 mm) and Larger.

.3 ANSI/AWWA C207, Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 Inch Through 144 Inch (100 mm Through 3,600 mm).

.4 ANSI/AWWA C906, Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

.2 ASTM International

.1 ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

.2 ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

.3 ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR). Based on Controlled Outside Diameter.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 41-GP-25M, Pipe, Polyethylene, for the Transport of Liquids.

.4 CSA International

.1 CSA B137 Series, Thermoplastic Pressure Piping Compendium.

.5 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for for pipes and backfill and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings of connections per Contract Drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.

.2 Submit shop drawings showing proposed method of installation for sewage force main in undercrossing.

.4 Certification to be marked on pipe.

.5 Test and Evaluation Reports: submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

.6 Manufacturer's Instructions: submit to Engineer copy of manufacturer's installation instructions.

.7 Provide marked up field record drawings and sketches as necessary for the Engineer to produce accurate, complete office record drawings.

.8 Provide detailed operating and maintenance instructions for all equipment installed.

.9 Provide detailed lists of any special or proprietary tools or equipment which are required to assemble, disassemble, operate or maintain any device installed on this project.

.10 Where requested by Engineer, provide certified test results for materials to be employed.

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect pipes, fittings, appurtenances, and hardware from damage.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Polyethylene pressure pipes PE 4710: to AWWA C906, CSA B137.1.

.1 Sclairpipe, Driscoplex, or approved equal.

.2 Joints: to ANSI/AWWA C207, thermal butt fusion, or flanged with steel backing flanges, as indicated on the Contract Drawings.

.2 Dimension ratio as identified on contract drawings.

.3 UV Stabilization

.1 The raw material shall contain a minimum of 2%, well dispersed, carbon black, to ASTM D3350 and ASTM D3035orr, and any additional requirements or additives recommended by the manufacturer to provide UV stabilization for continuous above ground and outdoor use. Additives that can be conclusively proven not to be detrimental to the pipe may also be used, provided the pipe produced meets the requirements of this standard.

.2 Contractor to submit documentation from manufacturer detailing proposed pipe material and manufacturer’s signed letter of support certifying raw material resin

design life of at least 50 years for continuous UV exposure during above ground and outdoor use.

.4 The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification and from the same raw material supplier.

.5 Compliance with the requirements shall be certified in writing by the pipe supplier, upon request.

.6 Joints: Heat butt fusion to ASTM D2657 and in accordance with manufacturer's recommendations

.7 Fittings

.1 Polyethylene fittings for use with the pipe shall be heat fusion fittings made of the same material of the pipe and be completely fibreglass reinforced as required to achieve at least the same pressure rating as the pipe to which it is to be joined.
.2 Flanged fittings shall comprise of a stub end, butt fused to the pipe end, together with a slip on flange which shall comply with ANSI B16.5 Class 150 bolt circles for the pipe size and shall be manufactured from ductile iron and epoxy coated. The securing bolts, nuts and washers shall be made of 316 stainless steel and be of a size and length to suit the flanges.
.3 Butt-fused fittings shall be used except where electro-fusion or flanged fittings are identified on drawings.

2.2 PIPE SURROUND

.1 Unshrinkable fill as indicated on the Contract Drawings.

2.3 BEDDING

.1 Unshrinkable fill as indicated on the Contract Drawings.

2.4 BACKFILL MATERIAL

.1 In-situ material or unshrinkable fill as indicated on the Contract Drawings.

2.5 VALVES

.1 Gate Valves (GAV):

.1 General: Direct buried valves to AWWA C515.
.2 Type: Ductile iron body fusion epoxy coating interior and exterior surfaces.
.3 Stem: Non-rising stem.
.4 Disk: Ductile Iron Wedge fully encapsulated with molded rubber.
.5 End Connection: 125 lb ANSI flanged.
.6 Operating Nut: 50 mm AWWA standard wrench nut.
.7 Operation: Open with a counter clockwise rotation.
.8 Approved manufacturers:
.1 Mueller
.2 Clow

.9 Valve Boxes and Covers:

.1 Adjustable design with cast iron upper section and PVC lower section.

.2 Cast iron top extensions with a minimum length of 300 mm.

.3 Approved Manufacturers:

.1 Norwood Foundries Ltd.

.2 Titan Foundries Ltd.

2.6 MANUAL AIR RELEASE VALVE

.1 Electrofusion Tapping Saddle – 50 mm Dia.

.2 Stainless Steel Compression Style Ball Valve – 50 mm Dia.

.3 DR 17 HDPE – 50 mm Dia.

2.7 COUPLINGS

.1 For coupling HDPE to AC pipe:

.1 Type: Fabricated steel flange coupling adaptor.
.2 Materials: Stainless steel fasteners, epoxy coated.
.3 Approved Product: Robar 7906 or approved equivalent.

.2 For coupling HDPE to HDPE pipe:

.1 Type: Butt Fusion.
.2 Designed and manufactured according to ASTM D2657.

.3 For coupling HDPE to PVC pipe:

.1 Type: Two bolt sleeve coupling with integral restraint system.
.2 Body: Ductile iron with fusion bonded epoxy coating.
.3 Gaskets: SBR per ASTM D2000.
.4 Grippers: Ductile iron with Xylan coating.
.5 Deflection allowance: 4° per joint.
.6 Approved Product: Romac Alpha or approved equivalent.

.4 Pipe stiffening inserts:

.1 Type: Split sleeve with wedge for adjusting to inside diameter of pipe.
.2 Material: 316 stainless steel.
.3 Size: To be confirmed by Contractor based on ID of existing pipes at tie-in location.
.4 Approved manufacturer: Romac.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Site Inspector.

.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 Site Inspector.

3.2 PREPARATION

.1 Do preparation Work, in accordance with Section 31 00 00 – Earthwork.

.2 Pipes and fittings to be clean and dry.

.3 Prior to installation, obtain Engineer's approval of pipes and fittings.

3.3 TRENCHING

.1 Do trenching Work, in accordance with Section 31 00 00 – Earthwork.

.2 Trench alignment and depth require approval from Site Inspector prior to placing bedding material or pipe.

3.4 INSTALLATION

.1 Lay pipes in accordance with manufacturer's recommendations.

.2 Join pipes in accordance with manufacturer's recommendations.

.3 Avoid damage to machined ends of pipes in handling and moving pipe.

.4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

.5 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.6 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.7 Cut pipes in an approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.8 Align pipes carefully before jointing.

.9 Do not lay pipe on frozen bedding.

.10 Remove any pipe which has floated due to trench flooding and reinstall only after acceptable trench and bedding conditions have been re-established.

.11 Install all special structures such as air release valves, drains, blowoffs, hydrants, swabbing facilities and valve chambers at the locations indicated and in accordance with the contract documents.

.12 Protect pipe and fittings from excessive exposure to direct sunlight or other damage. Replace any pipe or fittings which have become discoloured, cracked or otherwise marred or damaged.

.13 Ensure proper operation of all fittings and appurtenances having moving parts both prior to and after installation.

.14 Coat direct buried metallic objects with a Denso paste and tape, or as approved.

.15 Tolerances:

.1 Horizontal tolerance: +/- 50 mm from specified alignment.

.2 Vertical tolerance: +/- 25 mm from specified grade.

3.5 COUPLINGS

.1 Install pipe stiffening inserts for all existing pipe and pipe with dimension ratio greater than DR 17.

.2 Install coupling and insert to manufacturer's instructions.

3.6 BEDDING & PIPE SURROUND

.1 Place unshrinkable fill as indicated on Contract Drawings.

3.7 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.

.3 Compact backfill to at least 95% maximum dry density to ASTM D1557.

3.8 FIELD TESTING OF FORCE MAIN

.1 General

.1 The initial fill of water for pressure testing will be supplied by the Owner at no cost to the Contractor. However, any subsequent refills of the line required by failure to meet the requirements of the tests will be charged to the Contractor at standard water rates.

.2 Notify the Site Inspector a minimum of 48 hours in advance of all proposed tests. Perform tests in the presence of the Site Inspector.

.3 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.

.4 Control rate of filling of pipes to a velocity of less than 0.45 m/sec (1.5 ft/sec).

.5 Ensure that all air is purged from the force main before performing leakage or pressure testing the system.

.6 Where new force main sections cannot be isolated from existing mains, the Contractor may apply to the Site Inspector to establish an alternate test pressure or have the leakage testing requirement waived. Warranty obligations of the Contractor remain fully in effect in either event.

.2 Pressure Testing of HDPE Pipe

.1 Pressure test all pipes, couplings, joints and other appurtenances before backfill under a hydrostatic pressure in compliance with AWWA M55 and ASTM F2164 latest edition. No leakage allowed.

.2 Should any test disclose excessive leakage, repair or replace defect and retest section until specified testing requirement is achieved.

3.9 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.

END OF SECTION

Approved: 2009-06-30

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/National Electrical Manufacturers (NEMA)

.1 ANSI/NEMA C29.18, Composite-Distribution Line Post Type Insulators.

.2 Canadian Electrical Association Purchasing Specification (CEA)

.1 CEA LWIWG-02, Line Post Composite Insulator for Overhead Distribution Lines.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-G12, Zinc-Coated Steel Wire Strand.

.2 CAN/CSA-C83, Communication and Power Line Hardware.

.3 CAN/CSA-O80, Wood Preservation.

.4 CAN/CSA-O155, Wood Utility Poles and Reinforcing Stubs.

.5 CSA O116, Power and Communication Sawn Wood Crossarms.

.4 BC Hydro Standards

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet 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 British Columbia, Canada indicating:

.1 Materials.

.2 Method of anchorage.

.3 Number of anchors.

.4 Supports.

.5 Reinforcement.

.6 Assembly details.

.7 Accessories.

1.3 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

.2 Perform work to comply with applicable Technical Safety BC and WorksafeBC regulations.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MATERIALS

.1 Wood preservation: to CAN/CSA O80 Series.

.2 Power line hardware: to CAN/CSA-C83.

.3 Wood utility poles: to CAN/CSA-O15, wood, Class 3, preservative treated.

.1 50 foot long poles for primary circuits only.

.2 50 foot long poles for primary and secondary circuits.

.3 50 foot long poles for secondary circuits only.

2.2 CROSSARMS

.1 Wood crossarms: to CSA O116, pressure or vacuum treated.

.1 For primary circuits 1 per pole.

.2 For cornerdead end poles double arms.

.3 For horizontally mounted primary isolating switches double arms.

.4 For horizontally mounted primary load-break switches double arms.

.5 For each crossarm:

.1 Insulator pins.

.2 Two -32 x 6 mm galvanized steel braces.

.3 One -9 x 38 mm galvanized steel lag screw.

.4 Two -9 x 114 mm galvanized steel bolts.

.5 Through bolts and double arm bolts as required.

.2 Galvanized bolt eye (1 per suspension/dead end insulator) for dead end, high angle corner:

.1 Strain insulator rod and link installed as required.

.3 Cluster mount bracket for three single-phase transformer and recloser assembly.

.4 Single mount bracket for one single-phase transformer and recloser assembly.

2.3 INSULATORS

.1 Primary insulators:

.1 Pin type: to ANSI/NEMA C29.5 for low and medium voltages, nominal rating 25 kV, for primary conductors.

.2 Secondary insulators:

.1 Spool type: to ANSI/NEMA C29.3 mounted on secondary racks, for secondary runs.

.3 Guy strain insulators:

.1 Strain type: ANSI/NEMA C29.4, nominal rating 25 kV, one per guy wire.

.4 Post type insulators: to ANSI/NEMA C29.18, nominal rating 25 kV.

.5 Suspension/dead end insulators nominal rating 25 kV.

2.4 GUYS AND ANCHORS

.1 Guy wire: to CAN/CSA-G12, 9 mm nominal diameter, stranded, galvanized steel for dead ends and guys.

.2 Guy clamps: three-bolt heavy duty or preform grip type.

.3 Eye bolt: 19 mm thimble, length to suit, four hole guy straps and 16 mm machine bolt with square washer to attach guy wire to pole.

.4 Anchor rod: 19 mm diameter x 2.7m long, galvanized steel with thimble eye.

.5 Anchor: manufacturer's standard, approved by Engineer.

.1 Heavy duty expanding type, four way.

.2 Power installed screw anchor (PISA), double helix.

.3 Log anchor in earth or swamp.

.4 Rock anchor.

.6 Guy guard: half-round, galvanized steel 2.1 m long.

.7 Guy guard: plastic, colored yellow, 2.7 m long.

2.5 PRIMARY CONDUCTORS

.1 In accordance with Section 26 05 14 - Power Cable and Overhead Conductors (1001 V).

2.6 LOAD BREAK SWITCHES

.1 In accordance with Section 26 28 13.02 - Outdoor Load Break Switches and Fuses.

2.7 GROUND RODS, GROUND CONDUCTORS AND GRADIENT MAT

.1 In accordance with Section 26 05 27 - Grounding – Primary.

2.8 EQUIPMENT IDENTIFICATION

.1 Rustproof number nails with 50 mm high designated number.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Install electrical pole lines and hardware in accordance with manufacturer's written recommendations and specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION OF POLES

.1 Where poles require shortening, cut piece from top only.

.2 Roof top of poles with single slope bevelled top.

.3 Treat roof top, gains, bored holes with preservative before assembly.

.4 Cut parallel plane crossarm gains in face of pole for single and double arming, spacing as indicated.

.5 Bore hole in centre of each gain for crossarm bolt.

.6 Drill crossarms for pins, through bolts, double arm bolts and brace bolts.

.1 Pre-drill treated crossarms to standard spacing.

.7 Fasten insulator pins to crossarms with galvanized steel nails.

.8 Install crossarms and braces.

3.3 INSTALLATION

.1 Locate and dig pole holes.

.1 Make holes large enough to allow space for tamping backfill.

.2 Set poles.

.3 Align poles with crossarms at right angles to pole line on straight runs.

.4 At change in direction of line, set crossarms to bisect angle formed by change.

.5 Set poles to maintain even grade.

.1 Allow for contour of terrain and do not exceed grading of 1.5 m per pole.

.6 Replace backfill in 150 mm layers.

.1 Tamp each layer, and apply final layer to drain water away from pole.

.7 Swampy condition: install timber footings.

.8 Locate and install guy wires and anchors at dead-ends, at non-tangent poles, corner poles, and start of branch feeders.

.9 Insert anchor at least 1.8 m into ground. Backfill and tamp in 150 mm layers.

.10 Install insulators.

.11 Locate and construct transformer platform between 2 poles.

.12 Install number nails on each pole.

.13 Identify primary circuit on pole showing phasing of each conductor, every 1000 m and including origin of primary pole.

3.4 FIELD QUALITY CONTROL

.1 Perform tests and field inspection for pole lines and hardware prior to energization.

.2 Use qualified tradespersons for installation, termination and testing of high voltage power lines and hardware.

.3 Engage an independent testing agent to perform test and inspection on high voltage power lines and equipment.

.4 Submit test result and inspection certificate for review.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section of the specifications refers to the installation of equipment, piping, fittings, valves and all piping specialties and supporting devices provided under this contract within the building confines. Also included are the equipment, valve and commodity identification legends for all piping systems to be installed within the building.

.2 Control valves and other in-line equipment, to be installed under this Section.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 ANSI A13.1, Scheme for the Identification of Piping Systems
.2 ANSI B1.20.1, Pipe Threads, General Purpose
.3 ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
.4 ANSI B16.3, Malleable Iron Threaded Fittings Class 150 and 300
.5 ANSI B16.5, Pipe Flanges and Flanged Fittings
.6 ANSI B16.9, Factory-Made Wrought Steel Butt Welding Fittings
.7 ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded
.8 ANSI B16.12, Cast Iron Threaded Drainage Fittings
.9 ANSI B16.15, Pipe Flanges and Flanged Fittings, Classes 150 and 300
.10 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings
.11 ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
.12 ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes
.13 ANSI B31.1, Power Piping
.14 ANSI B31.3, Chemical Plant and Petroleum Refinery Piping
.15 ANSI B31.9, Building Services Piping
.16 ANSI B32, Solder Metal
.17 ANSI B36.10M, Welded and Seamless Wrought Steel Pipe
.18 ANSI B36.19M, Stainless Steel Pipe
.19 ASME Section IX, Boiler and Pressure Vessel Code; Welding and Brazing Requirements
.20 ASTM A47, Malleable Iron Castings
.21 ASTM A53, Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless
.22 ASTM A74, Cast Iron Soil Pipe and Fittings
.23 ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components
.24 ASTM A106, Seamless Carbon Steel Pipe for High Temperature Service
.25 ASTM A126, Grey-Iron Castings for Valves, Flanges, and Pipe Fittings

.26 ASTM A135, Electric-Resistance-Welded Steel Pipe

.27 ASTM A139, Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over)

.28 ASTM A167, Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate

.29 ASTM A181/181M, Forgings, Carbon Steel, for General Purpose Piping

.30 ASTM A182/182M, Forged or Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

.31 ASTM A193/193M, Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service

.32 ASTM A194/194M, Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service

.33 ASTM A197, Cupola Malleable Iron

.34 ASTM A234/A234M, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

.35 ASTM A240, Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels

.36 ASTM A269, Seamless and Welded Austenitic Stainless Steel Tubing for General Service

.37 ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes

.38 ASTM A307, Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength

.39 ASTM A312/312M, Seamless and Welded Austenitic Stainless Steel Pipe

.40 ASTM A320/320M, Alloy Steel Bolting Materials for Low-Temperature Service

.41 ASTM A403/A403M, Wrought Austenitic Stainless Steel Piping Fittings

.42 ASTM A409/A409M, Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service

.43 ASTM A480/A480M, General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

.44 ASTM A536, Ductile Iron Castings

.45 ASTM A563, Carbon and Alloy Steel Nuts

.46 ASTM A570/A570M, Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

.47 ASTM A774/A774M, As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

.48 ASTM A778, Welded, Unannealed Austenitic Stainless Steel Tubular Products

.49 ASTM B88, Seamless Copper Water Tube

.50 ASTM C76, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

.51 ASTM C564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings

.52 ASTM D638, Test Method for Tensile Properties of Plastics

.53 ASTM D792, Test Method for Specific Gravity and Density of Plastics by Displacement

.54 ASTM D1248, Polyethylene Plastics Moulding and Extrusion Materials

.55 ASTM D1457, PTFE Moulding and Extrusion Materials

.56 ASTM D1784, Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

.57 ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

.58 ASTM D2241, Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)

.59 ASTM D2466, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

.60 ASTM D2467, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

.61 ASTM D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

.62 ASTM D2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

.63 ASTM D2665, Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

.64 ASTM D2996, Filament-Wound Reinforced Thermosetting Resin Pipe

.65 ASTM D3212, Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals

.66 ASTM D3261, Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings

.67 ASTM D4101, Propylene Plastic Injection and Extrusion Materials

.68 ASTM D4174, Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems

.69 ASTM F441, Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

.70 ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

.71 AWWA C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids

.72 AWWA C110, Ductile-Iron and Grey-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids

.73 AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Grey-Iron Pipe and Fittings

.74 AWWA C115, Flanged Ductile-Iron and Grey-Iron Pipe with Threaded Flanges

.75 AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Moulds or Sand-Lined Moulds, for Water and Other Liquids

.76 AWWA C200, Steel Water Pipe, 6 Inches and Larger

.77 AWWA C203, Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

.78 AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inches through 144 Inches

.79 AWWA C206, Field Welding of Steel Water Pipe

.80 AWWA C207, Steel Pipe Flanges for Waterworks Services - Sizes 4 Inch Through 144 Inch

.81 AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings

.82 AWWA C209, Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines

.83 AWWA C210, Coal-Tar Epoxy Coating System for the Interior and Exterior of Steel Water Pipe

.84 AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines

.85 AWWA C301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids

.86 AWWA C303, Reinforced Concrete Pressure Pipe - Steel Cylinder Type, Pretensioned, for Water and Other Liquids

.87 AWWA C600, Installation of Ductile-Iron Water Mains and their Appurtenances

.88 AWWA C606, Grooved and Shouldered Joints

.89 AWWA C651, Disinfecting Water Mains

.90 AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches through 12 Inches, for Water

.91 AWWA M11, Steel Pipe - A Guide for Design and Installation

.92 CGA, Canadian Gas Association Standards

.93 CAN/CGA B105 - Installation Code for Digester Gas Systems

.94 CISPI 301, Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings

.95 CPC, Canadian Plumbing Code

.96 CSA B52, Mechanical Refrigeration Code

.97 CSA B64 Series CSA Standards on Vacuum Breakers and Backflow Preventers

.98 CAN3-B70 Cast Iron Soil Pipe, Fittings, and Means of Joining

.99 CSA B137.3, Rigid PVC Pipe for Pressure Applications

.100 CSA B139 Installation Code for Oil Burning Equipment

.101 CSA B140.0 General Requirements for Oil Burning Equipment

.102 CSA B158.1 Cast Brass Solder Joint Drainage, Waste and Vent Fittings

.103 CAN3-B181.2 PVC Drain, Waste and Vent Pipe and Pipe Fittings

.104 CSA CAN3-Z299.3, Quality Verification Program Requirements

.105 CSA CAN-Z183, Oil Pipeline Systems

.106 CSA Z184 Gas Pipeline Systems

.107 CSA B242 Groove and Shoulder Type Mechanical Pipe Couplings

.108 EJMA STDS, Standards of Expansion Joint Manufacturers' Association, Edition No. 6

.109 Fluid Sealing Association Technical Handbook, Rubber Expansion Joint Division

.110 FEDSPEC, L-C-530B (1), Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy

.111 MIL-H-13528B, Hydrochloric Acid, Inhibited, Rust Removing

.112 MIL-S-8660C, Silicone Compound

.113 MIL-STD-810C, Environmental Test Methods

.114 MSS SP25, Standard Marking System for Valves, Fittings, Flanges and Unions

.115 MSS SP43, Wrought Stainless Steel Butt Welding Fittings

.116 SAE J1227, Assessing Cleanliness of Hydraulic Fluid Power Components and Systems

.117 SSPC-P3, Canadian Government Standards Board

.118 SSPC-SP6, Canadian Government Standards Board

.119 SSPC-SP10, Canadian Government Standards Board

.120 Plumbing and Drainage Regulations of the Province of British Columbia

.121 Gas Protection Branch Regulations of the Province of British Columbia

.122 Pressure Vessels Act of the Province of British Columbia

.2 The American Society of Mechanical Engineers. (ASME)

.1 ASME Boiler and Pressure Vessel Code, Part I - Power Boilers

.2 ASME Boiler and Pressure Vessel Code, Part IV - Heating Boilers

.3 ASME Boiler and Pressure Vessel Code, Part VIII - Pressure Vessels

.4 ASME Boiler and Pressure Vessel Code, Part IX - Welding and Brazing Qualifications

.3 The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.5 Department of Environment of the Province of British Columbia

.6 Air-Conditioning and Refrigeration Institute (ARI)

.7 National Fire Protection Association (NFPA)

.8 Air Movement and Control Association (AMCA)

.9 Canadian Gas Association

.1 CAN/CGA B149.1 Natural Gas Installation Code

.2 CAN/CGA-B149.2 Propane Installation Code

1.3 OPERATING AND MAINTENANCE DATA

.1 Provide as specified in Section 01 78 23 – Operating and Maintenance Data.

1.4 SUBMITTALS FOR REVIEW

.1 Provide as specified in Division 1.

.2 Submit document listing pipe, fittings, flexible connectors, linings, coatings, and valving to be used for each pipe system.

.3 Radiographic Weld Testing: Submit the name and qualifications of at least two independent firms for the radiographic weld testing to be undertaken by the Contractor. The selected firm will be subject to the review and acceptance of the Engineer.

.4 Manufacturer's affidavit of compliance with specified AWWA standards for valves, pipe, fittings, linings, and coatings.

.5 Design, select, locate and provide piping supports, pipe guides, seismic bracing, expansion joints and anchors required for final piping layout. Typical details and acceptable attachments shown on the drawings are provided only for general guidance.

.6 Provide the necessary submittals and ensure the proper registration of piping systems and system components as required by the regulatory authorities having jurisdiction.

1.5 SUBMITTALS FOR INFORMATION ONLY

.1 For all pipe greater than or equal to 50 mm diameter, submit isometric drawings, to indicate the assembly details, the welds, flanges, valve placement, cathodic protection, seismic restraint system, expansion joints, guides, anchors, hangers, supports, and the provisions for thrust restraint, as well as any other pertinent details.

.2 Submit piping layout drawings by plant area which indicate location and placement of valves, fittings and other appurtenances for all piping, greater or equal to 150 mm diameter, in that area. Indicate location and clearances from structures and other utilities (ductwork, conduit, electrical tray, etc.).

.3 Submit copies of all original submittals and all related correspondence made as part of the regulatory submissions required by regulatory authorities.

.4 Product Samples: Where specified or when directed by the Engineer, provide mill test results or product samples.

.5 Provide hanger, expansion joint, guide, anchor, support and seismic restraint system design details including locations, load information, design calculations and illustrative drawings, stamped and signed by a Professional Engineer registered in the Province of British Columbia.

.6 For expansion joints submit manufacturer's catalogue data, shop drawings and assembly drawings confirming general arrangement, dimensions, and tolerances, materials of construction, weights and installation details. Submit calculations to substantiate expansion joint selection and amount of pre-compression, stamped and signed by a professional Engineer registered in the Province of British Columbia.

.7 Welding: Prior to commencing any welding of stainless steel pipe, prepare and submit to the Engineer a written description of welding techniques including but not limited to materials, methods, and quality control. Identify differences in shop and field techniques. Indicate in the submission that the welding technique has been reviewed for each commodity and certify that the technique is acceptable for the intended service condition. Written procedures to be stamped and sealed by a Professional Engineer registered in the Province of British Columbia, and qualified for welding design.

.8 Radiographic weld test results.

.9 Submit current and complete documentation of the welder's qualifications prior to the commencement of welding.

1.6 PIPE MATERIALS - GENERAL

.1 All pipe materials to be new, free from defects and conforming to applicable reference standards.

.2 All materials, linings and coatings in contact with water to be NSF approved for potable water.

.3 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the current standard.

1.7 PIPE SIZES

.1 Where the pipe size is not specified, provide pipe with the sizes required by the Plumbing Code. Small piping not described by the Plumbing Code or otherwise specified herein shall be 12 mm nominal diameter.

1.8 JOINTS - GENERAL

.1 Connect piping using joints not readily disassembled only where shown and where not otherwise specified. Provide joints which may be disassembled at the minimum, within 1.0 m of any connection to equipment, on both sides of structural penetrations, within 0.6 m of all threaded end valves, and at the spacing specified in the detailed piping specification sheets.

.2 For carbon steel piping less than 75 mm in diameter, butt-weld or use threaded couplings. Use unions where disassembly is required.

.3 For steel piping equal to or greater than 75 mm in diameter, where not specified or shown otherwise, butt-weld according to ASME Boiler and Pressure Vessel Code or furnish slip-on flanges, conforming to ANSI B16.5, Class 150. Unless indicated otherwise on the drawings or detail specifications, where disassembly is required, use flanges.

.4 For stainless steel tubing use stainless steel compression fittings.

.5 For schedule rated stainless steel pipe smaller than 75 mm in diameter, socket-weld pipe. Where disassembly is required, use threaded unions.

.6 For thin wall or schedule rated stainless steel pipe equal to or greater than 75 mm in diameter, butt-weld pipe unless otherwise shown or specified.

.7 For copper or brass piping, use soldered couplings. Where disassembly is required, use compression unions.

Part 2 Products

2.1 FLANGES

.1 Unless otherwise noted, make flanges on steel pipe Class 150, conforming to ANSI B16.5. Companion flanges for connection to cast iron or ductile iron equipment flanges shall be refaced to be flush with the companion flange.

.2 Unless otherwise noted, make flanges on stainless steel piping stainless steel slip-on, rolled-angle Van-Stone type, with a galvanized steel back-up ring drilled to ANSI B16.1, Class 125. Make the angle ring thickness equal or greater than the pipe or fitting to which it is welded. For submerged joints, make the backup ring stainless steel. For digester gas services, make the flanges Lap-joint type with galvanized steel Lap-joint flange and in accordance with CGA B105. For instrument air services, make the flanges Lap-joint type with a galvanized steel Lap-joint flange. For submerged joints, make the Lap-joint flange stainless steel.

.3 Provide Class 125 flanges on cast or ductile pipe, conforming to ANSI B16.1.

.4 General requirements for flanges are as follows:

.1 Compatible flanges for mating to equipment or valves.

.2 Provide flat-faced flanges on each side of butterfly valves.

.3 For steel piping, provide weld neck flanges on both sides of wafer or lug body valves.

.5 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets.

2.2 SOLDERED COUPLINGS

.1 Soldered couplings for copper pipe conform to ANSI B16.26. Solder to be lead free conforming to ASTM B32 and the Plumbing Code.

2.3 THREADED COUPLINGS

.1 Make screwed joints using American Standard threads to ANSI B1.20.1.

.2 Use Teflon tape as thread lubricant for threaded joints.

.3 Conform to ASTM A182 or ASTM A276, Class 150, for threaded connections to stainless steel pipe, threadolets to be shop welded to the pipe at the locations specified.

.4 Provide threaded-end to flanged-end adaptors where required to connect to flanges.

2.4 COMPRESSION COUPLINGS

.1 Furnish compression couplings for stainless steel tubing of the same material as the pipe, capable of withstanding the maximum pressure to which the pipe is subjected.

.2 Furnish compression couplings for copper and brass tubing of copper, suitable for the maximum pressure of the pipe, conforming to ANSI B16.26.

2.5 GROOVED JOINT COUPLINGS

.1 Fabricate grooved joint couplings of ductile iron to ASTM A536, and in accordance with AWWA C606. Provide cut and rolled grooves in pipe and fittings in accordance with AWWA C606.

.2 Steel Pipe: Use flexible style couplings for all buried service pipe, all pipe greater than 300 mm in diameter, for pipe less than 300 mm in diameter in rack mounted piping assemblies, and for grooved joints adjacent to pump or blower suction and discharge where grooved joints are used for noise and vibration control. Acceptable products are: Gustin-Bacon 100 or Victaulic Style 77. Use rigid style couplings in all other applications. Acceptable products are: Gustin-Bacon 120 Rigi-Grip or Victaulic Style 07 Zero-Flex.

.3 Stainless Steel Pipe: Couplings shall consist of ASTM A536 ductile iron housings and ASTM A449 zinc-electroplated steel bolts and nuts, or ASTM A351, Grade CF8M, stainless steel housings with ASTM F593/F594 stainless steel bolts and nuts.

.1 Schedule 5S and 10S stainless steel pipe shall be grooved using a Victaulic grooving tool equipped with RX roll sets for OGS groove profile couplings and RWX for AGS groove profile couplings, designed specifically for thin wall stainless steel pipe.

.2 Rigid: Housing key shall engage the bottom of the groove to provide a rigid joint. Victaulic Style 89 (DI) and Style 489 (SS). Victaulic Style W07 (DI).

.3 Flexible: Victaulic Style 77S (SS). Victaulic Style W77 (DI).

.4 AGS series two-segment couplings with lead-in chamfer on housing key and wide-width FlushSeal gasket. Victaulic Style W89 (rigid).

.4 Where grooved joint piping systems connect to equipment or to flanged valves, meters, or other sensing devices; use grooved joint flanges or flange adapters. Acceptable products are: Tyler Groove to Flange Fittings or Victaulic Flange adaptors. Where the Contractor chooses to use grooved joint flanges rather than the indicated adapters, piping modifications required to suit this change are the responsibility of the Contractor. Make full allowance for piping disassembly and access to the face of equipment.

2.6 FLEXIBLE COUPLINGS

.1 Flexible Couplings - Type I:

.1 Flexible sleeve type couplings: cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts. Acceptable products are:

.1 Dresser Style 38

.2 Ford Meter Box FC1

.3 Robar 1408

.4 Rockwell Type 411

.5 Viking Johnson Quick-Fit

.2 Flanged flexible sleeve type couplings: flanged cylindrical centre ring, a companion flange, one follower ring, one resilient gasket, and connecting bolts. Acceptable products are:

.1 Dresser Style 128

.2 Ford Meter Box FCA

.3 Robar 7808

.4 Rockwell Type 913

.5 Viking Johnson Quickfit Flange Adapter

.3 Transition flexible sleeve type couplings: Cylindrical centre ring, two follower rings two resilient gaskets, and connecting bolts. Acceptable products are:

.1 Dresser Style 62

.2 Robar 1408

.4 Centre ring: steel, shop coated for corrosion protection.

.5 Gaskets: fabricated of material suitable to the service conditions.

.6 For submerged, buried or below structure applications, use stainless steel bolts, nuts and washers.

.7 Provide the necessary amount and appropriate size of restraining rods and gussets as recommended by the manufacturer.

.8 Type 1 - Restrained; use a flexible sleeve-type coupling with restraining rods, and gussets welded to the pipe to AWWA M11. Provide sufficient restraint to resist pressure equal to twice the system test pressure.

.2 Flexible Couplings - Type II:

.1 Flexible pipe couplings: progressive sealing, capable of two degrees angular deflection in all directions, leakproof. Acceptable manufacturers:

.1 Straub.

.2 Victaulic Bolted Split-Sleeve (previously called Depend-o-lok)

.2 Casing: 304 or 316 stainless steel.

.3 Lockparts: Steel, shop coated for corrosion protection. 304 stainless steel for buried or submerged services.

.4 Gaskets: fabricated of material suitable to the service conditions.

.3 Unless specifically shown otherwise use Type I flexible couplings where a flexible coupling is shown or required.

2.7 POLYETHYLENE (HDPE) PIPE JOINTS

.1 Refer to pipe manufacturer's specifications for product information and installation instruction.

.2 Provide bell and spigot type joints conforming to ASTM D3212.

.3 Provide pipe, pipe support and restraints to withstand stresses induced by joint design.

.4 Provide pipe, pipe supports and restraints to withstand the stresses incurred during placement of concrete surround.

2.8 EXPANSION JOINTS

.1 Design and fabricate expansion joints in accordance with EJMA standards and to meet the requirements of this Division.

.2 Provide expansion joints as shown and in accordance with this Division. Unless otherwise specified provide elastomer spool type expansion joints.

.3 Ensure corrugated type expansion joints are capable of a minimum 10,000 pressure, temperature and deflection cycles, not concurrent.

.4 For metal expansion joints of the metal bellows type, in systems handling gases, air, water or other liquids, provide liners to produce a smooth flow path, reduce vibration and reduce noise through the expansion joint.

.5 Provide sufficient bends and expansion joints to allow for thermal movement of piping from 0°C to maximum service temperature.

.6 Provide factory precompressed expansion joints where required to suit installation temperature.

.7 Formed Bellows Type, Low Temperature:

.1 For up to 150°C, fabricate with 321 stainless steel corrugations, rated for the design pressure and temperature. Factory pressure and leak test at the design temperature.

.2 Determine expansion joint design to meet the requirements of movement specified (axial, lateral, and angular). Utilize a minimum safety factor of 1.35 for movement in anchor to anchor pipe run length over entire temperature range.

.3 For expansion joints with specified lateral movements greater than 3.0 mm, provide expansion joints with control rings and control rods or alternate method to equally distribute lateral movement among each corrugation and prevent squirm or buckling of the corrugations. Control rings shall be nickel-iron rated for 1000 kPa at 150°C. Required lateral movements are as listed on the drawings or specified.

.4 Provide limit rods which are full load rated in the event of anchor failure and to protect expansion joint from excessive axial movement.

.5 Unless otherwise specified, provide Van Stone flanges with galvanized steel backing flanges drilled to ANSI B16.5 for all expansion joints without limit rods.

.6 Provide fixed forged steel flanges on expansion joints requiring limit rods.

.7 Acceptable manufacturers are:

.1 American BOA

.2 Senior Flexonics

.3 Hyspan Precision Products.

.8 Steel Expansion Compensator Type:

.1 Provide steel compensator type expansion joints in steel pipe systems of 65 mm diameter and less for CWR, CWS, DHF, GLR, GLS, HRR and HRS systems only.

.2 Use 2-ply stainless steel bellows with carbon steel shroud and end fittings. Compensators to be rated for 1.2 MPa maximum working pressure and 400°C.

.3 Acceptable products are:

.1 Senior Flexonics Model H

.2 Hyspan Series 8500

.3 Keflex 7Q

.9 Bronze Expansion Compensator Type

.1 Provide bronze compensator type expansion joints in copper pipe systems of 50 mm diameter and less for DHF, DHR, RFH, RFL and RFS systems only.

.2 Use multi-ply phosphor bronze or stainless steel bellows with copper tube end fittings. Compensators to be rated for 1.0 MPa and 205°C.

.3 Acceptable products are:

.1 American BOA

.2 Senior Flexonics Model HB

.3 Hyspan Series 8500

.4 Keflex 7Q

.10 Elastomer General:

.1 Select materials suitable for service commodity, temperature and pressure. Conform to the requirements of the Fluid Sealing Association, Rubber Expansion Joint Division.

.2 Provide control rods on expansion joint connectors to prevent excessive axial elongation and to accept the static pressure thrust in the piping system. Manufacturer to determine number and sizes of control rods.

.3 Use Provide elastomer cover of the same material as the elastomer tube liner. For service temperatures between 80°C and 120°C, use chlorobutyl or EPDM for the elastomer tube. For temperatures below 80°C, use EPDM, Neoprene or Buna-N tube elastomer.

.4 For single arch or single spherical rubber expansion joints in piping up to and including 200 mm diameter, make expansion joint face-to-face dimension 150 mm, nominal. For pipe greater than 200 mm and less than or equal to 300 mm, make expansion joint face-to-face dimension 200 mm, nominal.

.11 Elastomer Spool Type:

.1 Unless otherwise specified, provide spool, resilient arch type expansion joints.

.2 Construct of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body.

.3 Provide backup or retaining rings of galvanized steel construction. Make retaining rings a nominal 10 mm thick, split type.

.4 Use filled arch type expansion joints on all piping systems conveying fluids containing solids and at connection to Process Air blowers.

.5 Acceptable manufacturers are:

.1 Senior Flexonics

.2 Garlock

.3 Mercer

.4 Techniquip

.12 Elastomer Spherical Moulded Type:

.1 Construct of multiple plies of nylon tire cord fabric and elastomer suitable for specified commodity, temperature and pressure.

.2 Provide galvanized steel floating flanges, such that no metal parts come in contact with the fluid.

.3 Acceptable manufacturers are:

.1 Senior Flexonics
.2 Garlock
.3 Mercer
.4 Techniquip
.5 Proco

2.9 SLIDING JOINTS - LIQUID SERVICE

.1 Provide single end type sliding expansion joints able to allow longitudinal movement and radial stresses while maintaining pipe alignment. Provide through rods where necessary to maintain alignment.

.2 Limit longitudinal separation of the two pipe sections to 50% of the manufacturer's recommended maximum by a restraining flange affixed to the slip pipe with the bolts extending through this flange.

.3 Use packing material suitable for the service conditions.

.4 Acceptable products are:

.1 Dresser Style 63
.2 Ford Meter Box FEJ
.3 Robar 8808-1
.4 Rockwell 611

2.10 FLEXIBLE HOSE CONNECTORS

.1 Where other types of flexible expansion joints are not shown or specified, provide flexible hose connectors within 2 metre pipe length of rotating equipment suction, discharge and ancillary service connection. Do not provide flexible connectors on sump pump connection piping.

.2 Provide flexible hose connectors with live lengths suitable for a line pressure equal to the test pressure of the pipe and for 12.5 mm lateral movement each side of the pipe centreline.

.3 Provide one union for pipe diameters ≤65 mm or floating flange for pipe diameter >65 mm, per flexible connector as appropriate to minimize the possibility of torque damage during installation.

.4 Provide flexible hose connectors capable of minimum of 10,000 cycles at the manufacturer's published minimum intermittent centreline bend radius and maximum working pressure.

.5 The design standard for flexible hose connectors on piping systems up to and including 50 mm diameter is Senior Flexonics Type 461 helically corrugated hose connectors.

.6 Acceptable manufacturers for flexible hose connectors on piping systems up to and including 50 mm diameter are:

.1 American BOA
.2 Flex-Weld
.3 Senior Flexonics

.7 The design standard for flexible hose connectors on piping systems larger than 50 mm diameter is Senior Flexonics Type 401 M corrugated flexible metal hose connectors.

.8 Acceptable manufacturers for flexible connectors on piping systems larger than 50 mm diameter are:

.1 American BOA
.2 Flex-Weld
.3 Senior Flexonics

2.11 EQUIPMENT CONNECTIONS

.1 Unless specified otherwise provide the following pipe end for equipment connections. See below for Dissimilar Metal Connections.

	Equipment End: Tubing/Various	Equipment End: Brass or Bronze Female Thread	Equipment End: Cast Iron or Steel Female Thread
Piping Material	**Pipe End (Diameter Range)**		
a) Stainless Steel: Tubing	(6 - 25 mm) Nut and Double Ferrule Type Connectors or Adaptors as Required Rating: Class 1000	(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250	(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250
b) Stainless Steel: Gauge & Schedule 10S		(10 - 65 mm) Socket Weld Nipple and Union Rating: Class 3000	(10 - 65 mm) Socket Weld Nipple and Union Rating: Class 3000
c) Stainless Steel: Schedule 40S		(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250	(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250
d) Steel: Standard Wt. and Schedule 40		(10 - 65 mm) 150 mm Galvanized Threaded Nipple and Union Rating: Class 250	(10 - 65 mm) 150 mm Galvanized Threaded Nipple and Union Rating: Class 250
e) Steel: Schedule 80		(10 - 65 mm) Threaded Nipple and Union Rating: 3000 kPa	(10 - 65 mm) Threaded Nipple and Union Rating: 3000 kPa
f) Ductile Iron			
g) Cast Iron			

	Equipment End: Tubing/Various	Equipment End: Brass or Bronze Female Thread	Equipment End: Cast Iron or Steel Female Thread
Piping Material	**Pipe End (Diameter Range)**		
h) Copper		(10 - 65 mm) 150 mm Copper Threaded Nipple and Union Rating: Class 250	(10 - 65 mm) 150 mm Copper Threaded Nipple and Union Rating: Class 250
i) PVC: Schedule 40			
j) PVC: Schedule 80		(10 - 65 mm) 150 mm PVC Nipple and Union Rating: Schedule 80	(10 - 65 mm) 150 mm PVC Nipple and Union Rating: Schedule 80
k) HDPE		(10 - 65 mm) 150 mm Galvanized Steel Nipple and Grooved Joint, Transition Coupling	(10 - 65 mm) 150 mm Galvanized Steel Nipple and Grooved Joint, Transition Coupling
	Equipment End: Cast Iron / Flanged	Equipment End: Steel/Stainless / Flanged	Equipment End: Steel/Stainless / Plain End
Piping Material	Pipe End (Diameter Range)		
a) Stainless Steel: Tubing			
b) Stainless Steel: Gauge & Schedule 10S	(>65 mm) Rolled Angle Van Stone or Lap-Joint Flange, as specified Rating: Class 125 FF	(>65 mm) Rolled Angle Van Stone or Lap-Joint Flange, as specified Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF
c) Stainless Steel: Schedule 40S	(>65 mm) Rolled Angle Van Stone Flange Rating: Class 125 FF	(>65 mm) Rolled Angle Van Stone Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF
d) Steel: Standard Wt. and Schedule 40	(10 - 65 mm) Threaded Steel Flange Rating: Class 125 FF (>65 mm) Steel Flange Rating: Class 125 FF	(10 - 65 mm) Threaded Steel Flange Rating: Class 150 RF (>65 mm) Steel Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF
e) Steel: Schedule 80	(10 - 65 mm) Threaded Steel Flange Rating: Class 125 FF (>65 mm) Steel Flange Rating: Class 125 FF	(10 - 65 mm) Threaded Steel Flange Rating: Class 150 RF (>65 mm) Steel Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF

	Equipment End: Tubing/Various	Equipment End: Brass or Bronze Female Thread	Equipment End: Cast Iron or Steel Female Thread
Piping Material	**Pipe End (Diameter Range)**		
f) Ductile Iron	(>65) Grooved End to Flanged Adaptor Rating: Class 125 FF	(>65) Grooved End to Flanged Adaptor Rating: Class 150 RF	
g) Cast Iron	(>65) Grooved End to Flanged Adaptor Rating: Class 125 FF	(>65) Grooved End to Flanged Adaptor Rating: Class 150 RF	
h) Copper	(10 - 65 mm) Threaded Copper Flange Rating: Class 125 FF	(10 - 65 mm) Threaded Copper Flange Rating: Class 150 RF	
i) PVC: Schedule 40	(>65) PVC Van Stone Flange Rating: Class 125 FF	(>65) PVC Van Stone Flange Rating: Class 150 RF	
j) PVC: Schedule 80	(>65 mm) PVC Flange (Sch.80) Rating: Class 125 FF	(>65 mm) PVC Flange (Sch.80) Rating: Class 150 RF	
k) HDPE	Stub End and Ductile Iron Backup Ring Rating: Class 125 FF	Stub End and Steel Backup Ring Rating: Class 150 RF	
	Equipment End: Steel or Stainless Welding End	Equipment End: Fibreglass Flanged	Equipment End: PVC Female Thread
Piping Material	Pipe End (Diameter Range)		
a) Stainless Steel: Tubing			(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250
b) Stainless Steel: Gauge & Schedule 10S	Butt Welded (SS Equip. End)	Rolled Angle Van Stone or Lap-Joint Flange, as specified Rating: Class 150 RF	(10 - 65 mm) Socket Weld Nipple and Union Rating: Class 3000
c) Stainless Steel: Schedule 40S	Butt Welded (SS Equip. End)		(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250
d) Steel: Standard Wt. and Schedule 40	Butt Welded (Steel Equip. End)		(10 - 65 mm) 150 mm Galv. Threaded Nipple and Union Rating: Class 250

	Equipment End: Tubing/Various	Equipment End: Brass or Bronze Female Thread	Equipment End: Cast Iron or Steel Female Thread
Piping Material	**Pipe End (Diameter Range)**		
e) Steel: Schedule 80	Butt Welded (Steel Equip. End)		(10 - 65 mm) Threaded Nipple and Union Rating: 3000 kPa
f) Ductile Iron			
g) Cast Iron			
h) Copper			
i) PVC: Schedule 40			150 mm PVC Nipple and Union Rating: Schedule 80
j) PVC: Schedule 80			150 mm PVC Nipple and Union Rating: Schedule 80
k) HDPE			

2.12 FITTINGS

.1 For steel pipelines 75 mm in diameter or greater, fittings to conform to ANSI B16.9, ANSI B16.11 or ANSI B16.5. Provide fittings with a wall thickness equal to or greater than the pipe. In steel pipelines less than 75 mm in diameter provide threaded malleable iron fittings, conforming to ANSI B16.3.

.2 Provide long radius steel grooved-joint fittings conforming to ANSI B16.9 in steel grooved-joint pipeline systems. Grooved joint adapters may be welded to fitting ends; dimension and cut the groove of the adapter in accordance with the coupling manufacturer's recommendations; materials and inside diameter to be the same as the pipe; grind the interior weld smooth and meet the lining manufacturer's recommendations.

.3 For steel grooved-joint pipe of diameters of 150 mm and less, the Contractor may provide ductile iron grooved-joint fittings which have an outside diameter equal to the steel pipe diameter. Provide ductile iron to ASTM A536, dimensioned to 1.5 diameter radius bends, and cut grooving dimensions to AWWA C606 IPS dimensions. The lining and coating of the ductile iron fittings must equal the lining and coating of the steel pipeline system.

.4 Standard radius elbows to dimensions of ANSI B16.5 may be provided on clean water grooved-joint piping systems only.

.5 Provide butt welding fittings in stainless steel pipelines less than 75 mm of the same class as the pipe, conforming to ASTM A403 and ANSI B16.11. Provide socket welding fittings in stainless steel pipelines less than 75 mm to Cl. 3000, same material as the pipe, and ANSI B16.11. Fabricate fittings in stainless steel pipelines equal to or greater than 75 mm in diameter using similar materials and classes as the pipe and conform to ASTM A774.

.6 Provide copper fittings in copper pipelines conforming to ANSI B16.26.

.7 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.

.8 Provide concentric reducers in vertical lines unless indicated otherwise.

.9 Provide long radius elbows unless otherwise shown. Provide smooth flow carbon or stainless steel elbows 350 mm and less, to ANSI B16.9. Provide mitred elbows greater than 350 mm, to AWWA C208 unless otherwise shown or specified. Use 3-piece construction unless otherwise shown or specified.

2.13 GASKETS

.1 For flat faced flanges, use full-face gaskets. For raised-face flanges, use ring type gaskets. Conform to ASTM B16.21.

.2 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline. Refer to detailed pipe specifications for recommended gasket material. Material designations used in the detailed pipe specification sheets are as follows:

.1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer.

.2 Bl. Neoprene: neoprene (black) 70 durometer.

.3 Nitrile: nitrile (Buna N).

.4 SBR: Styrene-butadiene (red).

.5 Natural rubber: natural rubber.

.6 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400), and neoprene binder: 1.7 MPa (ASTM F152), 0.2 mL/h Leakage Fuel A (ASTM F37).

.7 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400) and SBR binder: 1.7 MPa (ASTM F152), 0.1 mL/h Leakage Fuel A (ASTM F37).

.8 Gylon - Type 1: Garlock Style 3500, 1.35 MPa (ASTM F152), 0.22 mL/h Leakage Fuel A (ASTM F37).

.9 Gylon - Type 2: Garlock Style 3510, 1.35 MPa (ASTM F152), 0.04 mL/h Leakage Fuel A (ASTM F37).

.10 CPE - Chlorinated Polyethylene.

.3 Unless otherwise specified, minimum Gasket Material Thickness for full face gaskets:

.1 75 to 250 mm pipe diameter; 1.6 mm thick.

.2 Greater than 250 mm pipe diameter; 3.2 mm thick.

.4 Unless otherwise specified, minimum gasket material thickness for raised face ring gaskets:

.1 75 to 100 mm pipe diameter; 1.6 mm thick.

.2 Greater than 100 mm pipe diameter; 3.2 mm thick.

.5 Grooved joint gasket materials to be as recommended by the manufacturer for the service conditions indicated. Unless otherwise specified, provide flush seal type gaskets for all grooved joint systems. Acceptable products: Gustin-Bacon Rigigrip, Victaulic Flush-Seal.

2.14 BOLTS AND NUTS

.1 Provide hex head bolts and nuts. Threads to be ANSI B1.1, standard coarse thread series.

.2 For general service, use bolts and nuts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A. For general interior service, use bolts and nuts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A.

.3 Provide stainless steel bolts, nuts and washers for submerged, buried and concrete encased service; bolts conforming to ASTM A193, Gr. B8, C1.1; nuts conforming to ASTM A194, Gr.8. For exposed (exterior), submerged, buried and concrete encased service, provide stainless steel bolts, nuts and washers; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8.

.4 Provide hot dip galvanized bolts, nuts and washers for use with hot dip galvanized Van Stone flange back-up rings and Lap-joint flange back-up rings.

.5 Provide hex nuts equal to or less than 25 mm. Greater than 25 mm, provide heavy hex.

2.15 WELDING MATERIALS

.1 Use welding materials conforming to CSA W48.1.

.2 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

.3 Provide proper storage for welding rod. Provide rod ovens in cold or inclement weather.

2.16 DISSIMILAR METAL CONNECTIONS

.1 Where dissimilar metals are to be connected, furnish dielectric fittings and/or isolating flanges.

2.17 CATHODIC PROTECTION

.1 Provide cathodic protection of piping, pipe fittings and appurtenances where specified.

2.18 HEAT TRACING

.1 Provide heat tracing for all piping and appurtenances where specified.

2.19 INSULATION

.1 Provide insulation where specified.

2.20 INTERIOR FINISHES

.1 Provide products with factory applied coatings and finishes unless otherwise noted. Fittings and pipe of any one pipe system to be lined by the same manufacturer.

.2 Do not shop coat the internal surface of stainless steel or plastic piping.

.3 Provide No. 1 or No. 2B standard finish for gauge stainless steel pipe, as specified in ASTM A480. Finish heavier pipe to No. 1 mill finish or better, as specified in ASTM A480.

.4 Unless otherwise specified, finish fittings in the same manner as the pipe run.

2.21 EXTERIOR FINISHES - SHOP APPLIED

.1 Provide products with factory applied coatings and finishes as specified in the detailed pipe specification sheets.

.2 Yellow Jacket:

.1 High density polyethylene (HDPE) jacket extruded over a mastic base.

.2 Manufacture, test, inspect and report procedures to meet or exceed CAN3-Z299.3 (Quality Assurance Program - Category 3).

.3 Prior to mastic application, sandblast pipe in conformance with requirements or SSPC SP6.

.4 Adhesive consists of a rubberized asphalt mastic, non-hygroscopic, formulated for use with Yellow Jacket. Apply to prepared surfaces in thickness exceeding 0.175 mm.

.5 HDPE to have following minimum properties: Ultimate tensile strength, 21 MPa; Tensile elongation at break, 600 percent; Shore "D" hardness, 60; and Brittleness temperature -50°C.

.6 Apply HDPE by extruding over adhesive in an even thickness to provide a smooth continuous outer sheath, free of pinholes, bubbles, wrinkles, blisters, cracks, or mechanical damage. Minimum HDPE thickness will be as follows:

Nominal Pipe Size (mm)	Minimum HDPE Thickness (mm)
20	0.55
25	0.55
30	0.60
40	0.65
50	0.70
65	0.70
75	0.70
100	0.75
150	0.90
≥200	1.00

.7 All flaws (up to 3 per pipe) to be repaired by cutting out each damaged area and applying sealant lined 200 mm diameter patch or heat shrink sleeve not exceeding
400 mm in length. Overlap undamaged area by a minimum of 75 mm around cut out section.

.8 Where the number of flaws or damaged areas per pipe exceeds 3 or any flaw is too large to be repaired with a patch or sleeve, the pipe will be rejected.

.3 Tape Wrap: shop applied tape wrap may be used as an alternative to Yellow Jacket. Two or three layer methods can be used, meeting or exceeding the application and performance requirements of AWWA C214.

.4 Coal Tar Epoxy: apply coal tar epoxy to the exterior of piping in accordance with AWWA C210.

2.22 EXTERIOR FINISHES - FIELD APPLIED

.1 Use field applied finishes only for: short lengths of metal pipe in a piping system where the length of pipe which requires coating is less than 3.0 m unless otherwise specified; to repair shop-applied exterior finishes; to make up cutback distances at joints; and for fittings, couplings, valves and other appurtenances.

.2 Tape Wrap:

.1 For welded joints on Yellow jacketed pipe and at other indicated locations apply tape to buried pipe and fittings. Use Polyken, Polyguard 600 or Denso Clad consisting of primer and tape applied to minimum thickness of 0.90 mm in accordance with AWWA C209.

.2 For flanged or coupled joints and for fittings use petrolatum primer, mastic and tape; Tec-Tape or Denso, in accordance with AWWA C217.

.3 Shrink Sleeve: as an alternative to tape wrap, shrink sleeves are acceptable if material and method of installation is reviewed and accepted by the Engineer prior to use.

.4 Coal Tar Epoxy: apply coal tar epoxy to the exterior of piping in accordance with AWWA C210.

2.23 STRAINERS

.1 Air and Gas Strainers:

.1 Provide strainers with Y-pattern, cast iron body, with 40 mesh Moel screens packed with Everdur wool. For copper piping, provide bronze bodies.

.2 Fit air line strainers with a brass blowoff cock.

.3 Acceptable manufacturers are:

.1 Armstrong

.2 Mueller

.2 Steam and Water Strainers:

.1 Provide steam and water strainers with Y-pattern unless otherwise specified.

.2 Provide carbon steel body for steam strainers, cast iron body for water strainers, and bronze bodies for copper piping systems.

.3 Provide 304 stainless steel screens and tapped and plugged blowoff connections. Screen perforations shall be 0.5 mm for steam service and 1.15 mm for water service.

.4 Acceptable manufacturers are:

.1 Armstrong

.2 Mueller

2.24 QUICK DISCONNECTS

.1 Provide quick disconnects which are not disconnectable under pressure. Unless otherwise shown or specified, provide products listed below.

.2 For air service, acceptable products are:

.1 Dixon Air King

.2 Tomco, 12 mm diameter. Tomco, THK.

.3 For water service, sizes as shown. Acceptable products are:

.1 For 25 mm or less diameter hose, two lug, malleable iron, female NPT: Dixon Air King.

.2 For 38 mm and 50 mm diameter hose, two four lug, malleable iron, female NPT: New Line Dixon Air King.

.3 For 75 and 100 mm diameter or greater; quick-acting, dual clip: Rite-pro, Dixon.

2.25 FLUSHING CONNECTIONS

.1 Provide flushing connections on all piping for the conveyance of sludge, scum, grit or other liquid containing solids greater than 0.5 percent. Locate flushing connections adjacent to all isolation valves, on dead end branches, at tees and 90 degree elbows, and at intermediate locations which limit the distance between flushing connections to less than 30 to 50 m. Show flushing connections on piping submittals.

2.26 PURGE CONNECTIONS

.1 Provide purge connections on all gas lines. Locate adjacent to both sides of all isolation valves and spectacle flanges, and at any other locations shown in the drawings. Purge points shall be a minimum of 20 mm NPS pipe, fitted with a shut-off valve which shall be capped.

2.27 MECHANICAL BRANCH CONNECTIONS

.1 Provide mechanical branch connections as required for flushing connections and pipe tappings. Provide branch connection recommended by the manufacturer for the service and pipe installed. Acceptable products are:

.1 Gruvlock Clamp T

.2 Ford Service Saddles (F/FS)

.3 Victaulic Mechanical T

2.28 ACCESS DOORS

.1 Provide access doors to concealed mechanical equipment for operating, inspecting and servicing.

.2 Flush mounted, 600 x 600 mm size for body entry and 300 x 300 mm for hand entry, unless noted otherwise.

.3 Doors to open 90°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.4 Finishes:

.1 General: prime coated steel

.2 Special areas such as tiled or marble surfaces: stainless steel.

.5 Acceptable product: Buensod, Le Hage, Zurn.

2.29 DIELECTRIC COUPLINGS

.1 Wherever pipes of dissimilar metals are joined.

.2 Insulating unions for pipe sizes 50 mm and smaller and insulating flanges for pipe sizes larger than 50 mm.

2.30 DRAIN VALVES

.1 Locate at all low points and section isolating valves unless otherwise specified.

.2 Minimum 20 mm size unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap and chain.

2.31 VIBRATION ISOLATION

.1 Elastomeric Pads:

.1 Type P1: neoprene waffle or ribbed, 9 mm minimum thickness, 50 durometer, maximum loading 350 kPa.

.2 Type P2: rubber waffle or ribbed, 9 mm minimum thickness, 30 durometer natural rubber, maximum loading 415 kPa.

.3 Type P3: neoprene-steel-neoprene, 9 mm minimum thick neoprene bonded to 1.71 mm steel plate, 50 durometer neoprene, waffle or ribbed, holes sleeved with isolation washers.

.4 Type P4: rubber-steel-rubber, 9 mm thick rubber bonded to 1.71 mm steel plate, 30 durometer natural rubber, waffle or ribbed, holes sleeved with isolation washers.

.5 Acceptable product: Korfund, Vibron, Vibro-Acoustics.

.2 Elastomeric Mounts:

.1 Type M1: colour coded, neoprene-in-shear, maximum durometer of 60, threaded insert and two bolt-down holes, ribbed top and bottom surfaces.

.2 Acceptable product: Korfund, Vibron, Vibro-Acoustic.

.3 Springs Mounts:

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.

.2 Cadmium plate for outdoor installations.

.3 Colour code springs

.4 Zinc or cadmium coated hardware, housings coated with rust resistant paint.

.5 Type M2: stable open spring, support on bonded 6 mm thick ribbed neoprene or rubber friction and acoustic pad.

.6 Type M3: stable open spring, 6 mm minimum thickness ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate, internal adjustment, equipment bolting not necessary.

.7 Type M4: Restrained stable open spring, supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, built-in resilient limit stops, removable spacer plates.

.8 Type M5: enclosed spring mounts with snubbers, for isolation up to 23 kg maximum.

.9 Performance: as indicated.

.10 Acceptable product: Korfund, Masdom VM, Vibron, Vibro-Acoustics.

.4 Spring Hangers:

.1 Colour coded springs, rust resistant, painted, box type hangers. Swivel arrangement to permit hanger box or rod to move through a 20° arc without metal-to-metal contact.

.2 Type H1: neoprene, in shear.

.3 Type H2: stable spring, elastomeric washer.

.4 Type H3: stable spring, elastomeric element.

.5 Type H4: stable spring, elastomeric element with lockout plate and indicator.

.6 Performance: as indicated.

.7 Acceptable product: Korfund, Masdom VM, Vibron, Vibro-Acoustic.

.5 Acoustic Barriers for Anchors and Guides:

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

.2 Acceptable product: Masdom VM, Vibron, Vibro-Acoustics.

.6 Horizontal Thrust Restraint:

.1 Spring and elastomeric element housed in box frame, assembly complete with rods and angle brackets for equipment and ductwork attachment, provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Restraints arranged symmetrically on either side of unit and attached at centerline of thrust.

.3 Acceptable product: Korfund, Masdom VM, Vibron, Vibro-Acoustic.

.7 Structural Bases:

.1 Type B1 - prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension; split for field welding on sizes over 2400 mm on smallest dimension and reinforced for drive and drive alignment, without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - steel rail base: structural steel, positioned for drive and driven alignment, without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

.4 Acceptable product: Korfund, Masdom VM, Vibron, Vibro-Acoustic.

.8 Inertia Base Forms:

.1 Type B3 - Full depth perimeter structural or formed channel frames: welded in place, reinforcing rods running in both directions; spring mounted units carried by gusseted height saving brackets welded to frame; and clear housing pads by 50 mm minimum.

.2 Bases: "T" shaped, where applicable, to provide support for pump elbows.

.3 Concrete: to Division 03.

.4 Acceptable product: Korfund, Masdom VM, Vibron, Vibro-Acoustic.

.9 Roof Curb Isolation Rails:

.1 Structural steel or aluminum upper and lower members: separated by continuous flexible reinforced water- and air-tight seal, fastened to upper and lower members, complete with a removable metal weather shield to protect seal. Supply in one piece, no field joints, support to curb by stable steel springs, maximum deflection 50 mm, with closed cell neoprene gasket bonded to upper and lower surfaces of curb base. Provide neoprene cushioned restraints which become engaged and resist a wind load in any direction.

.2 Acceptable product: Korfund, Masdom VM, Vibron, Vibro-Acoustic.

2.32 DRIVES, GUARDS AND LUBRICATION ACCESSORIES

.1 Select variable and adjustable pitch sheaves unless otherwise specified.

.2 Provide motor driven equipment using 3 or more belts with fixed sheaves.

.3 Fit reinforced belts in sheave matched to drive. Multiple belts on unit to be matched set.

.4 Use cast iron or steel sheaves secured to shafts with removable keys.

.5 Standard adjustable pitch drive sheaves having + 10% range to be used on motors from 0.25 kW to 7.5 kW. Use mid-position of range for specified RPM.

.6 For drives larger than 7.5 kW, sheaves to be split tapered bushing and keyway having a fixed pitch, unless specifically required for item concerned. Provide sheave of correct size for balancing.

.7 Minimum drive rating to be 1.5 times nameplate rating of motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.8 Motor slide rail adjustment plates to allow for centerline adjustment.

.9 Provide guards for exposed drives.

.10 Guards for drives to have:

.1 Expanded metal screen welded to 25 mm steel angle frame.

.2 18 Ga. galvanized sheet metal tops and bottoms.

.3 Removable sides for servicing.

.4 40 mm diameter holes on both shaft centers for insertion of a tachometer.

.11 Secure guards to driven machine, foundations or floors with heavy angle supports and anchor bolts.

.12 Do not short circuit vibration isolators.

.13 Provide means to permit lubrication, use of speed counters, or other maintenance and testing operations, with the guard in place.

.14 Install belt guards to permit movement of motors for adjusting belt tension.

.15 For flexible couplings, provide removable "U" shaped guards fabricated from 12 Ga. galvanized steel frame with 18 Ga. expanded mesh face.

.16 Provide protective screen on both inlet and outlet of exposed fan blades. Screen to be fabricated from 20 mm mesh minimum galvanized expanded metal such that the net free area of openings is not less than 80% of the original opening.

.17 Provide oil gauges, grease cups, oil cups or grease gun fittings at all points requiring lubrication. Extend all fittings as required to be fully accessible without requiring any disassembly or removal of guards.

Part 3 Execution

3.1 VALVES AND EQUIPMENT IDENTIFICATION

.1 Valves and equipment are identified in the following manner:

.1 Valve Identification:

.1 Valve Designation Example:

GAV - 100

Where:

GAV	Identity Symbol
1	Area Number
00	Sequence Number (00, 01, 02…)

.2 Valve Identity Symbols

SYMBOL	VALVE TYPE
AR	Air Release Valve
ARV	Air Release/Vacuum Valve

AVV	Air Vacuum Valve
BAV	Ball Valve
BBV	Block and Bleed Valve
BUV	Butterfly Valve
BV	Block Valve
CAV	Combination Air Release-Vacuum Valve
CHV	Check Valve
()CV	Control Valve
	() - Primary Controlled Variable
	Valve May Have Several Functions
	F - Flow rate
	P - Pressure
	L - Level
	S - Surge
	T - Temperature
DIV	Diaphragm Valve
FGV	Flap Gate Valve
GAV	Gate Valve
GLV	Globe Valve
KGV	Knife Gate Valve
MUV	Mud Valve
NEV	Needle Valve
PLV	Plug Valve
PV	Pinch Valve
RGV	Rotary Valve
SG	Sluice (Slide) Gate Valve

.3 Valve Marking: Each valve to bear the manufacturers name or trademark and reference symbol to indicate the service conditions for which the manufacturer guarantees the valve. The marking to be in accordance with MSS-SP-25.

.4 Valve Tagging: Valves to be tagged as follows:

GAV - 100
Component
Area Number
Sequence Number

.2 Equipment Identification

.1 Equipment Designation: Equipment to be identified in the following manner:

AER - 105 A

Where:

AER	Identity Symbol
1	Area Number
00	Sequence Number (00, 01, 02…)
A	Duplication Identifier (optional usage)

i.e.: Aerator, Equipment sequence No. 100, Item A.

.2 Plumbing Symbols

SYMBOL	EQUIPMENT
AC	Air Compressor
AD	Area Drain
BFP	Backflow Preventer
BT	Bathtub
BWV	Backwater Valve
CS	Counter Sink
CO	Clean out
DF	Drinking Fountain
DWH	Domestic Water Heater
ESH	Emergency Shower
EW	Eyewash
FD	Floor Drain
GD	Gutter Drain
GM	Gas Meter
HB	Hose Bibb
HD	Hub Drain
HR	Hose Reel
INS	Interceptor Sump
KS	Kitchen Sink
LAB	Laboratory Sink
LAV	Lavatory
LH	Lawn Hydrant
LS	Laundry Sink
MH	Manhole
MS	Mop Sink
P	Pump
RD	Roof Drain
RWL	Rain Water Leader
SH	Shower
SS	Service Sink
ST	Sample Trough
T	Tank
UR	Urinal
US	Utility Sink
VS	Vanity Sink
WC	Water Closet
WS	Water Softener

.3 Fire Protection Symbols

SYMBOL	EQUIPMENT
DPH	Dry Pipe Hydrant
DSP	Dry Stand Pipe
FAV	Fire Alarm Valve

FDC	Fire Department Connection
FEX	Fire Extinguisher
FH	Fire Hydrant
FHC	Fire Hose Cabinet
FHR	Fire Hose Reel
P	Pump
SPH	Sprinkler Head
SPV	Sprinkler Valve
WPH	Wet Pipe Hydrant
WSP	Wet Stand Pipe

.4 Heat Generation

SYMBOL	**EQUIPMENT**
CMU	Chemical Mixing Unit
DH	Dearator Heater
FOF	Fuel Oil Filter
FUR	Furnace
GUH	Gas Unit Heater
HWG	Heating Water Generator
IRH	Infra-Red Heater
P	Pump
SGH	Steam Generator - High
SGL	Steam Generator - Low
T	Tank
WTU	Water Treatment Unit

.5 Liquid Heat Transfer

SYMBOL	**EQUIPMENT**
AAV	Automatic Air Vent
AV	Air Vent (Manual)
ATF	Airtrol Tank Fitting
BBC	Baseboard Convector
BF	Bypass Filter
CC	Cooling Coil
CFP	Chemical Feed Pot
CONV	Convective Heater
CT	Cooling Tower
CUH	Cabinet Unit Heater
ECU	Evaporative Cooling Unit
FCU	Fan Coil Unit
FTT	Float and Thermostatic Trap (Steam)
HC	Heating Coil
HCS	Heating Coil (Steam)
HCW	Heating Coil (Water)
HEX	Heat Exchanger
HRC	Heat Recovery Coil
HUM	Humidifier
HWG	Hot Water Generator

LCH	Liquid Chiller
P	Pump
RHB	Reheat Box
RHC	Reheat Coil
RU	Roof Top Unit
SG	Sight Glass
SUH	Steam Unit Heater
T	Tank
WFC	Wall Fin Convector
WUH	Water Unit Heater

.6 Refrigeration Symbols

SYMBOL	**EQUIPMENT**
ACC	Air Cooled Condenser
ACU	Air Cooled Condensing Unit
LCC	Liquid Chiller - Centrifugal
LCR	Liquid Chiller - Reciprocating
PAC	Packaged Air-Conditioning Unit
RC	Refrigeration Compressor
REC	Refrigerant Receiver
T	Tank
WCU	Water Cooled Condensing Unit

.7 Air Distribution Symbols

SYMBOL	**EQUIPMENT**
ADE	Air Diffuser - Exhaust
ADR	Air Diffuser - Return
ADS	Air Diffuser - Supply
AF	Air Filter
AHU	Air Handling Unit
BD	Barometric Damper
BDD	Back Draft Damper
CD	Control Damper
DH	Dehumidifier
EXF	Exhaust Fan
EXH	Exhaust Hood
F	Fan
FRD	Fire Damper
GEX	Gravity Exhauster
HRU	Heat Recovery Unit
LFH	Laboratory Fume Hood
MAU	Make-up Air Unit
MD	Manual Damper
RAF	Return Air Fan
RU	Roof Top Unit
SAF	Supply Air Fan
SAU	Sound Attenuator Unit
TB	Terminal Box

VIH	Ventilation Intake Hood
VIP	Ventilation Intake Penthouse
VRH	Ventilation Relief Hood
VRP	Ventilation Relief Penthouse
VVB	Variable Air Volume Box

.8 Process Equipment Symbols

SYMBOL	**EQUIPMENT**
ALT	Liquid Alum Tank
ART	Air Receiver Tank
ASP	Alum Solution Pump
ALP	Alum Liquid Pump
BFP	Backflow Preventer
BLO	Blower
BSP	Backwash Supply Pump
BWP	Backwash Waste Pump
CAC	Calibration Chamber
CEC	Chlorine Expansion Chamber
CEV	Chlorine Evaporation
CF	Coalescing Filter
CGD	Chlorine Gas Detector
CGF	Chlorinator
CL	Clarifier
CLA	Chlorine Analyser
COMP	Compressor
COP	Coagulant Pump
COT	Coagulant Tank
CR	Crane
CSP	Caustic Soda Pump
CST	Caustic Soda Tank
CU	Compressor Unit
DAF	Dissolved Air Flotation Clarifier
DCL	Dust Collector
DL	Dock Leveller
DS	Diaphragm Seal
ED	Eductor or Ejector
FLT	Filter
FG	Flow Sight Glass
FI	Flow Rate Indicator
FLO	Flocculator
FM	Flash Mixer
H	Hoist
HPT	Hydropneumatic Tank
HLP	High Lift Pump
IMP	Impactor
LA	Loading Auger
LD	Liquid Diffuser

LG	Level Gauge Glass
LLP	Low Lift Pump
M	Motor-Electric
MH	Manhole
MV	Meter Vault
MX	Mechanical Mixer
P	Pump (Unspecified Service)
PCF	Powered Carbon Feeder
PCH	Powered Carbon Hopper
PCSP	Powered Carbon Slurry Pump
PCST	Powered Carbon Slurry Tank
PD	Pulsation Damper
PG	Pipe Guide
PH	Pipe Hanger
PL	Pig Launcher
PND	Pneumatic Damper
PPF	Potassium Permanganate Feeder
PPH	Potassium Permanganate Hopper
PPSP	Potassium Permanganate Solution Pump
PPST	Potassium Permanganate Solution Tank
PR	Pig Receiver
PS	Pipe Support
PWP	Potable Water Pump
PYF	Polyelectrolyte Feeder
PYH	Polyelectrolyte Hopper
PYST	Polyelectrolyte Solution Tank
PYSP	Polyelectrolyte Solution Pump
QC	Quick Connect
RAD	Refrigerated Air Dryer
RCP	Recycle Pump
RD	Rupture Disc
RWP	Raw Water Pump
SC	Scraper
SCU	Solids Contact Clarifier
SOF	Soda Ash Feeder
SOH	Soda Ash Hopper
SOSP	Soda Ash Solution Pump
SP	Sludge Pump
SPST	Soda Ash Solution Tank
SS	Service Sink
STCR	Steam Convertor
STL	Stop Logs
STR	Strainer
SUP	Sump Pump
T	Tank
TWP	Treated Water Pump

TWS	Travelling Water Screen
VC	Valve Chamber
WS	Weigh Scale

3.2 PIPING INSTALLATION

.1 General:

.1 Conform to requirements of ANSI B31 code for pressure piping.

.2 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.

.3 Install groups of piping parallel to each other, spaced to permit application of insulation, identification, and service access, on trapeze hangers.

.4 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.5 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.6 Install flanged or welded nozzles, branch connections, welding outlets, adapters and taps, true and faced at right angles to the axis of the pipe. Do not extend connection inside of pipe.

.7 Make pipe ends round and true, suitable for weld connection.

.8 Prepare pipe ends in accordance with ANSI B16.25 for butt welding.

.9 Copper pipe and tubing to be free from surface damage. Replace damaged pipe or tubing.

.10 Ream ends of pipe and tubes before being made up.

.11 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.

.12 Use non-corrosive lubricant or teflon tape applied to male thread only.

.13 Groove pipe ends, cut square, seating surface clean and free from indent and score marks.

.14 Install dielectric fittings wherever piping of dissimilar metals are joined.

.15 Install flanges or unions to permit removal of equipment without disturbing piping systems, as required by piping standard.

.16 Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

.17 Support piping during construction to prevent abnormal stresses on the pipe works.

.18 Install pipe supports where indicated on the drawings or as required.

.19 Install pipe hangers as required.

.2 Flanges Bolting to Valves:

.1 Do not weld adjacent flanges on butterfly valves when the valve is in place.

.2 Remove valve prior to welding.

.3 Clean gasket surfaces, flange faces and butt welding connections.

.4 Protect connecting surfaces.

.3 Bolted Connections:

.1 Clean pipe ends and gaskets.

.2 Lubricate gaskets with soapy water and bolts with thread lubricant.

.3 Tighten bolts progressively by crossover method and not in rotation around the joint.

.4 Tighten bolts to the torque recommended by the manufacturer.

.5 Use properly sized wrenches for bolt tightening to prevent rounding of nut and bolt heads.

.4 Branch Connections: branch connections to be in accordance with the following for ANSI 150, 300, 600, 900 and 1500 ratings:

BRANCH

MAIN	20	25	40	50	65	75	100	150	200	250
20	T									
25	RT	T								
40	RT	RT	T							
50	C	TH	RT	T						
65	C	RT	RT	RT	T					
75	C	C	C	RT	*RT	T				
100	C	C	C	*W	*RT	RT	T			
150	C	C	C	*W	*RT	W	RT	T		
200	C	C	C	*W	*W	W	W	RT	T	
250	C	C	C	*W	*W	W	W	RT	RT	T
300	C	C	C	*W	*W	W	W	RT	RT	RT
350	C	C	C	*W	*W	W	W	RT	RT	RT
400	C	C	C	*W	*W	W	W	RT	RT	RT
450	C	C	C	*W	*W	W	W	W	RT	RT
500	C	C	C	*W	*W	W	W	W	RT	RT
600	C	C	C	*W	*W	W	W	W	W	W
750	C	C	C	*W	*W	W	W	W	W	W

BRANCH

MAIN	300	350	400	450	500	600	750
300	T						
350	RT	T					
400	RT	RT	T				
450	RT	RT	RT	T			
500	RT	RT	RT	RT	T		
600	RT	RT	RT	RT	RT	T	
750	RT	RT	RT	RT	RT	RT	T

Legend: T - Straight Tee RT - Reducing Tee
TH - Thredolet C - Coupling
W - Weldolet

*For Class 150 - A1 line class, including A1A and A1B, but not A1C, piping 65 mm size and under to be screwed connections. The branch connections will, therefore, be TH (thredolet).

3.3 VALVES INSTALLATION

.1 Storage of Valves:

.1 Store valves in cool and clean location, away from moving vehicles or other objects.

.2 Prevent dirt and debris entering the valve internals.

.3 Protect the valve seats against painting.

.4 Store valves with their handwheels, operator shafts and operators in an upright position.

.2 Handling Valves:

.1 Do not place chains, cables and ropes through valve ports or attached to operators or handwheels.

.2 Use sling either around valve body or with bolts or rods through the flange holes.

.3 Installation of Valves:

.1 Installation of valves to be by competent personnel and in strict accordance with manufacturer's instructions.

.2 Inspect pipe and remove all foreign debris or objects that may prevent closing of valves prior to the installation of any valves.

.3 Install butterfly valves with their operating shafts in the vertical position unless otherwise directed by the Engineer.

3.4 PROTECTION OF OPENINGS

.1 Protect equipment and system openings from dirt, dust and other foreign materials.

.2 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances prior to being put into operation.

3.5 V-BELT DRIVES

.1 Tension all belt drives to manufacturer's recommendations before start-up and after first 100 hours of operation, using calibrated belt tensioning gauge.

3.6 EQUIPMENT PIPING CONNECTIONS

.1 Where equipment connections are a different size from the piping serving it all associated isolating valves and fittings to be the larger pipe size unless specifically indicated otherwise on the drawings. This rule to also apply in the case of control valves.

3.7 EQUIPMENT LUBRICATION

.1 All equipment placed in operation prior to the completion of the contract to be maintained and adequately lubricated in accordance with the manufacturer's instructions.

.2 All equipment to be lubricated in accordance with the manufacturer's instructions prior to acceptance of any system.

.3 Oil level gauges, grease cups and grease fittings for all machinery bearings, etc., to be provided as recommended by the manufacturer. Locate oil level gauges for easy viewing.

.4 All bearings to be flushed out and refilled with new change of oil prior to final acceptance.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion.

3.8 SLEEVES

.1 Provide individual metal sleeves for all pipes, tubes or ducts penetrating all walls and floor slabs. Grout tightly in place for full depth of wall or slab.

.2 Standard sleeves to be 22 Ga. galvanized sheet steel with lock seam joints.

.3 Use cast iron or steel pipe sleeve with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.4 Sizes:

.1 Refer to mechanical drawings for details.

.2 Provide 6 mm clearance all around, between sleeves and pipe or between sleeve and insulation.

.5 Terminate sleeves flush with surface of concrete and masonry and above floors.

.6 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight, durable joint.

.7 Voids Around Pipes:

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with oakum and PC-4 caulking compound between sleeve and pipe.

.2 Where sleeves pass through walls or floors, caulk space between sleeve and insulation or between sleeve and pipe with dry oakum. Seal space at each end of sleeve with waterproof, fire retardant, non-hardening mastic.

.3 Ensure no contact between copper tube or pipe and ferrous sleeve.

.4 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

.8 Where pipes and ducts pass through walls and floors having a fire separation rating, pack the space with approved caulking material and seal in accordance with CGSB 19-GP-9.

3.9 ESCUTCHEONS AND PLATES

.1 Install on pipes passing through finished walls, floors and ceilings.

.2 Use chrome or nickel plated brass, solid type with set screws for ceiling or wall mount.

.3 Inside diameter to fit around finished pipe. Outside diameter to cover opening or sleeve.

.4 Where sleeve extends above finished floor, escutcheons or plates to clear sleeve extension.

.5 Secure to pipe or finished surface but not to insulation.

3.10 VIBRATION ISOLATION

.1 Installation:

.1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mounting to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to 100 mm size: first 3 points of support; 150 mm to 200 mm size: first 4 points of support; 250 mm size and larger: first 6 points of support.

.2 First point of support to have static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.4 Where isolation is bolted to the floor avoid short circuiting of sound pads by using vibration isolation washers.

.5 Block and shim level all bases so that ductwork and piping connections can be made to a rigid system at the operating level before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.11 CUTTING AND PATCHING

.1 Minimize cutting and patching required. Set sleeves and mark openings in concrete forms and masonry structure prior to the placement of concrete or masonry.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This Section specifies hangers and supports for piping systems.

.2 Design, select, locate and provide pipe hangers and supports for piping in accordance with the requirements of the specifications and as shown.

.3 This section does not include pipe supports for fire sprinkling systems, seismic restraints or pipe anchors and guides specified elsewhere.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).

.2 ANSI/ASME B31.1, Power Piping, (SI Edition).

.2 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP-69, Pipe Hangers and Supports - Erection and Application.

.3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.4 ULC, Underwriters' Laboratories of Canada.

.5 WW-H-171E, Federal Specification.

.6 British Columbia Building Code.

.7 British Columbia Plumbing Code.

.8 CAN/CGA B149.2 Natural Gas Installation Code.

1.3 DESIGN REQUIREMENTS

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

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.

.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 all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 30 00 - Submittals.

.2 Submit shop drawings and product data for following items:

.1 All bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Submittals to include all design details for pipe hangers and supports systems, including, but not limited to, locations, load information, design calculations, type of support system and illustrative drawing. Submittal and design details to be stamped and signed by Professional Engineer registered in the Province of British Columbia.

.4 Design detail and drawings to be coordinated with and inclusive of all seismic requirements specified in Section 40 05 01 – Mechanical General Requirements.

1.5 MAINTENANCE DATA

.1 Provide maintenance data.

Part 2 Products

2.1 MATERIALS

.1 Unless otherwise specified, pipe hangers and supports, structural attachments, fittings and accessories are to be hot-dipped galvanized after fabrication. Pipe hangers and supports which are not standard copper plated and are to be plastic coated or lined with dielectric material or neoprene, are to be hot dip galvanized before coating or lining.

.2 Provide AISI Type 304 stainless steel nuts, bolts, washers and threaded rods, for submerged and exposed, above ground conditions. Provide cadmium plated steel nuts, bolts, washers and threaded rods in non-corrosive, controlled environment areas.

.3 Pipe hangers and supports in submerged locations to be 304 stainless steel.

2.2 PIPE HANGERS AND SUPPORTS

.1 Type 1 - Clevis Pipe Hanger: Provide carbon steel clevis hangers with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3100, Grinnell Fig. 260, Superstrut C-710, or Taylor No. 24, or Hunt 32; with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3100, Grinnell Fig. 260, Superstrut C-710, or Taylor No. 24 or Hunt 32.

.3 Cast and ductile iron pipe - B-Line B3102, Grinnell Fig. 590, Superstrut C-710, or Taylor No. 24 or Hunt 32 sized for DI pipe.

.4 Copper pipe (uninsulated) - B-Line B3104 CTC, Grinnell Fig. CT-65 (plastic coated), Superstrut CTL-710 (plastic coated), or Taylor No. 56CT or Hunt 30C (plastic coated).

.5 Copper pipe (insulated) - B-Line B3100, Grinnell Fig. 260, Superstrut C-710, or Taylor No. 24 or Hunt 32; with insulation shield.

.6 Plastic pipe - B-Line B3100 C, Grinnell Fig. 260 (plastic coated), or Taylor No. 24 (plastic coated), or Hunt 32 (plastic coated).

.2 Type 2 - "J" Pipe Hanger: Provide carbon steel hangers with configuration and components as follows:

.1 Steel pipe - B-Line B3690, Grinnell Fig. 67, Superstrut C-711 or Unistrut J1205-J1280 Series.

.2 Steel pipe (insulated) - B-Line B3690, Grinnell Fig. 67, Superstrut C-711 or Unistrut J1205-J1280 Series; with insulation shield.

.3 Copper pipe (insulated) - B-Line B3690, Grinnell Fig. 67, Superstrut C-711 or Unistrut J1205-J1280 Series; with insulation shield.

.4 Copper (uninsulated) and plastic pipe - B-Line B3690C (plasticoat) Grinnell Fig. 67 (plastic coated), Superstrut C-711P or Unistrut J 1205N - J1280N series.

.3 Type 3 - Pipe Clamp: Provide carbon steel pipe clamps, with configuration and components as follows:

.1 Steel pipe (insulated) - Double Bolt Pipe Clamp: B-Line B3144, or Grinnell Fig. 295, or Hunt 70H.

.2 Steel pipe (uninsulated) - Single Bolt Pipe Clamp: B-Line B3140, or Grinnell Fig. 212, or Hunt 60.

.3 Copper pipe (insulated) - Double Bolt Pipe Clamp: B-Line B3144, or Grinnell Fig. 295, or Hunt 70H; lined with dielectric material.

.4 Type 4 - Adjustable Roller Hanger: Provide cast iron rollers, carbon steel yoke and cross bolt with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3110, Grinnell Fig. 181, or Superstrut C-729, or Hunt 3436; with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3110, Grinnell Fig. 181, or Superstrut C-729, or Hunt 3436.

.3 Copper pipe (insulated only) - B-Line B3110, Grinnell Fig. 181, or Superstrut C-729, or Hunt 3436; with insulation shield.

.4 Plastic pipe - B-Line B3110, Grinnell Fig. 181, or Superstrut C-729, or Hunt 3436.

.5 Type 5 - Single Pipe Roll: Provide cast iron rollers and sockets, and steel cross rods with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3114, or Grinnell Fig. 171, or Hunt 37; with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3114, or Grinnell Fig. 171, or Hunt 37.

.3 Plastic pipe - B-Line B3114, or Grinnell Fig. 171, or Hunt 37.

.6 Type 6 - Framing Channel Pipe Clamp: Provide steel pipe clamps with configuration and components as follows:

.1 Steel pipe (uninsulated) - B-Line 2007, Powerstrut PS1100, or Unistrut P1109 Series.

.2 Steel pipe (insulated) - B-Line 2007, Powerstrut PS1100, or Unistrut P1109 Series; with insulation shield.

.3 Copper pipe (uninsulated) - B-Line B2023 Series, Powerstrut PS 1200 or Unistrut P2024PC Series; plastic coated or lined with a dielectric material.

.4 Copper (insulated) - B-Line B2023 Series, Powerstrut PS 1200 or Unistrut P2024 Series; with insulation shield.

.7 Type 7 - U-Bolt: Provide carbon steel U-bolts with configuration as follows:

.1 Steel pipe (uninsulated) - Grinnell Fig. 137, B-Line B3188, or Superstrut H-115, or Hunt 80.

.2 Steel pipe (insulated) - Grinnell Fig. 137, B-Line B3188, or Superstrut H-115, or Hunt 80; with insulation shield.

.3 Cast and ductile iron pipe - Grinnell Fig. 137, B-Line B3188DI, or Superstrut H-115, or Hunt 80.

.4 Copper pipe (uninsulated) - B-Line B3188C, Grinnell Fig. 137C, Superstrut H-115 (with plastic coating), or Unistrut No. 13 (with plastic coating), or Hunt 80 (with plastic coating).

.5 Copper pipe (insulated) - Grinnell Fig. 137 or B-Line B3188, Superstrut H-115, or Hunt 80; with insulation shield.

.8 Type 8 - Adjustable Pipe Roll Support: Provide cast iron rollers and sockets, and carbon steel cross rod and support rods with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3122, or Grinnell Fig. 177, or Hunt 37 (with support rods and nuts); with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3122, or Grinnell Fig. 177, or Hunt 37 (with support rods and nuts).

.3 Copper pipe (insulated only) - B-Line B3122, or Grinnell Fig. 177, or Hunt 37 (with support rods and nuts); with insulation shield.

.4 Plastic pipe - B-Line B3122, or Grinnell Fig. 177, or Hunt 37 (with support rods and nuts).

.9 Type 9 - Welded Pipe Stanchion: provide a carbon steel, standard schedule pipe stanchion, cut stanchion to match contour of pipe elbow. Use only for ambient commodity systems.

.10 Type 10 - Pipe Stanchion saddle: Provide carbon steel saddles and yokes as follows:

.1 Steel pipe (insulated) - B-Line B3090, or Grinnell Fig. 259, or Hunt 500S; with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3090, or Grinnell Fig. 259, or Hunt 500S.

.3 Cast and ductile iron pipe - B-Line B3090 DI, or Grinnell Fig. 259, or Hunt 500S.

.4 Copper pipe (uninsulated) - B-Line B3090, or Grinnell Fig. 259, or Hunt 500C; with insulation shield or lined with dielectric material.

.5 Copper pipe (insulated) - B-Line B3090, or Grinnell Fig. 259, or Hunt 500C; with insulation shield.

.6 Plastic pipe - B-Line B3090, or Grinnell Fig. 259, or Hunt 500S; lined with 1.6 mm thick neoprene.

.11 Type 11 - Offset Pipe Clamp: Provide carbon steel pipe clamps with configuration and components as follows:

.1 Steel pipe - B-Line B3148, or Grinnell Fig. 103, or Hunt 301.

.2 Cast and ductile iron pipe - B-Line B3148 NS, or Grinnell Fig. 103, or Hunt 301.

.3 Copper pipe - B-Line B3148 (plastic coated), or Grinnell Fig. 103 (plastic coated), or Hunt 301 (plastic coated).

.4 Plastic pipe - B-Line B3148 (plastic coated), or Grinnell Fig. 103, (plastic coated), or Hunt 301 (plastic coated).

.12 Type 12 - Riser Clamp: Provide carbon steel riser clamps with configuration and components as follows:

.1 Steel pipe - B-Line B3373, Grinnell Fig. 261, Superstrut C-720, or Taylor No. 82, or Hunt 40.

.2 Cast and ductile iron pipe - B-Line B3373, Grinnell Fig. 261, Superstrut C-720, on Taylor No. 82, or Hunt 40.

.3 Copper pipe - B-Line B3373 CTC, Grinnell Fig. CT-121C, Superstrut C-720 (plastic coated), or Taylor No. 86, or Hunt 42C (plastic coated).

.4 Plastic pipe - B-Line 3373C, Grinnell Fig. 261 (plastic coated), or Superstrut C-720 (plastic coated), or Taylor No. 82 (plastic coated), or Hunt 40 (plastic coated).

.5 Type 13 - Framing Channel Pipe Strap: Provide carbon steel pipe strap with configuration as follows:

.6 Steel pipe (uninsulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U, or Unistrut P2558 Series, or Hunt 67.

.7 Steel pipe (insulated) - B-Line B-2400 Series, Powerstrut PS3126, Superstrut C-708-U, or Unistrut P2558 Series, or Hunt 67; with insulation shield.

.8 Copper pipe (uninsulated) - B-Line B-2400 Series, Powerstrut PS3126, Superstrut C-708-U, or Unistrut P2558 Series, or Hunt 67; with insulation shield or lined with dielectric material.

.9 Copper pipe (insulated) - B-Line B-2400 Series, Powerstrut PS3126, Superstrut C-708-U, or Unistrut P2558 Series, or Hunt 67; with insulation shield.

.10 Plastic pipe - B-Line B-2400 Series, Powerstrut PS3126, Superstrut C-708-U, or Unistrut P2558 Series, or Hunt 67. Use only if hanging pipe below framing channel.

.13 Constant Support Spring Hangers:

.1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/- 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

.14 Variable Support Spring Hangers:

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.3 RACK AND TRAPEZE SUPPORTS

.1 Unless otherwise specified, provide steel trapeze and pipe rack components having a minimum thickness of 2.7 mm with a maximum deflection 1/240 of the span.

.2 Type 20 - Trapeze Pipe Support: Provide trapeze pipe support cross members. Provide 41 mm square carbon steel flat plate fittings of standard design manufactured by framing channel manufacturer, B-Line B202-2, Powerstrut PS619, or Unistrut P2471.

.3 Type 21 - Pipe Rack Support: Provide post and cross member framing channels. Provide carbon steel pipe rack fittings of standard design manufactured by framing channel manufacturer. Provide gusset type, 90° fittings B-Line B844, Grinnell PS3373, or Unistrut P2484.

2.4 STRUCTURAL ATTACHMENTS

.1 Type A - Malleable Iron Concrete Insert: Provide malleable iron concrete inserts with insert nuts; B-Line B3014 with B3014N, Grinnell Fig. 282, or Unistrut M26 with M2808 through M2824.

.2 Type B - Side Beam Bracket: Provide malleable iron or carbon steel bracket; Grinnell Fig. 202, or B-Line B3062, or Hunt 50.

.3 Type C - Malleable Beam Clamp With Extension Piece: Provide malleable iron clamp and extension pieces with steel tie rods; Grinnell Fig. 218 with Fig. 157 extension piece, or B-Line B3054 with Fig. B3203 extension piece, Hunt 812.

.4 Type D - Steel Beam Clamp with Eye Nut: Provide forged steel beam clamps and weldless eye nuts; Grinnell Fig. 292, B-Line B3291 series.

.5 Type E - Steel channel clamp: Provide malleable iron clamp and heel plates, and steel bolts and nuts; Grinnell Fig. 226 with Fig. 157 extension piece.

.6 Type F - Welded Beam Attachment: Provide carbon steel beam attachments; B-Line B3083, or Grinnell Fig. 66, or Hunt 52B.

.7 Type G - Adjustable Beam Attachment: Provide carbon steel beam attachments; B-Line B3082, or Hunt 50S.

.8 Type H - Double Channel Bracket: Provide single channel attachment. Provide a carbon steel double framing channel cantilever bracket assembly; B-Line B297-12 through B297-36, Powerstrut PS809, or Unistrut P2542 series.

.9 Type J - Single Channel Bracket: Provide single channel attachment. Provide a carbon steel single framing channel cantilever bracket assembly; B-Line B198-6 through B198-24, Powerstrut PS661, or Unistrut P2231 through P2234.

.10 Type K - Wall mounted channel: Provide 41 mm x 62 mm carbon steel framing channel; B-Line B12 or Unistrut P5500.

.11 Type L - Pipe stanchion attachment: Provide minimum 12 mm thick carbon steel baseplate. Anchor bolt holes: 1.6 mm larger than bolt diameter. Provide non-shrink grout between the baseplate and upstand.

.12 Type M - Welded Steel Bracket: Provide carbon steel brackets which comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket; Grinnell Fig. 195. Heavy welded bracket to comply with MSS Type 33 and FEDSPEC Type 34; Grinnell Fig. 199.

.13 Type P - Framing Channel Post Base: Provide carbon steel post bases of standard design manufactured by framing channel manufacturer. Single channel: Unistrut P 2072A, B-Line B280, Powerstrut PS 3033. Double channel: Unistrut P2073A, B-Line B281, or Powerstrut PS3064.

.14 Type Q - Continuous concrete inserts: provide 300 mm long carbon steel concrete inserts; Unistrut P3253.

2.5 ACCESSORIES

.1 Hanger Rods: Provide AISI Type 304 stainless steel rods, threaded on both ends or continuous threaded and sized as required.

.2 Weldless Eye Nut: Provide forged steel eye nuts and comply with MSS and FEDSPEC Type 17; Grinnell Fig. 290, or B-Line B3200, or Hunt 88.

.3 Welded Eye Rod: Provide carbon steel eye rods with eye welded closed. Inside diameter of eye to accommodate a bolt diameter 3.2 mm larger than the rod diameter; Grinnell Fig. 278, or B-Line B3211, or Hunt 95R.

.4 Turnbuckle: Provide forged steel turnbuckles; Grinnell Fig. 230, or B-Line B3202, or Hunt 84.

.5 Framing Channels: Provide 41 mm x 62 mm roll formed carbon steel framed channel, having a thickness of 2.7 mm. Channel to have a continuous slot along one side with in-turned clamping ridges. Single Channel: Unistrut P5500, B-Line B12, Powerstrut PS150. Double Channel: Unistrut P5501, B-Line B12A, Powerstrut PS 150 2T3.

2.6 THERMAL PIPE HANGER SHIELD

.1 Provide thermal shields or protective saddles on pipe requiring insulation. Type 3, Type 11, and Type 12 hangers clamp directly to pipe therefore thermal shields are not required but insulation shall be continued around the hangers.

.2 The shield consists of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer. Minimum shield length is as follows:

Pipe, mm	Shield Length, mm
12 - 38	100
50 - 150	150
200 - 250	225
300 - 450	300

.3 Thermal shield to same thickness as the piping system insulation.

.4 Use standard shield for hot systems and vapour barrier shield for cold systems.

.5 Use stainless steel band clamps to ensure against slippage between the pipe wall and the thermal shield.

.6 Standard Shield

.1 Insulation:

.1 Hydrous calcium silicate, high density, waterproof.

.2 Compressive strength: 700 kPa average.

.3 Flexural strength: 500 kPa average.

.4 R. unit: 2.16 at 37.8°C mean.

.5 Temperature range: -7°C to 260°C.

.2 Steel Jacket: galvanized steel, thickness as per manufacturer's standard, supplied for the given pipe size. For pipe in "submerged" location, provide stainless steel jacket.

.3 Connection: Steel jacket and insulation to be flush with end of thermal shield. Butt connect shield to pipe insulation.

.7 Vapour Barrier Shield

.1 Insulation:

.1 Hydrous calcium silicate, high density, waterproof.

.2 Compressive strength: 700 kPa average.

.3 Flexural strength: 500 kPa average.

.4 R. unit: 2.16 at 37.8°C mean.

.5 Temperature range: -7°C to 260°C.

.2 Steel Jacket: Galvanized steel, thickness as per manufacturer's standards, supplied for the given pipe size. For pipe in "submerged" locations provide stainless steel jacket.

.3 Connection: Insulation to extend 25 mm each side of steel jacket for vapourtight connection to pipe insulation vapour barrier. Butt connect shield to pipe insulation

Part 3 Execution

3.1 HANGER AND SUPPORT LOCATION

.1 Design and locate hangers and supports as near as possible to concentrated loads such as valve, flanges, etc. Locate hangers, supports and accessories within appropriate span lengths to support continuous pipeline runs unaffected by concentrated loads.

.2 Provide hangers and/or base supports within one metre of each change in direction on each leg, on one side of each valve, and on the first spool piece or fitting extending from a piece of equipment.

.3 Locate hangers and supports to ensure that connections to equipment, tanks, etc. are substantially free from loads transmitted by the piping.

.4 Support piping so that temporary pipe supports will not be required when removing parts of the piping system for equipment maintenance.

.5 Support piping so that no pockets will be formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

.6 Provide supplementary structural steel members where structural bearing does not exist or where inserts are not in suitable locations.

.7 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.

.8 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.

3.2 INSTALLATION

.1 Unless otherwise specified, do not drill or burn holes in the building structural steel.

.2 Do not use hanger components for purposes other than for which they were designed. Do not use hanger components for rigging and erection purposes.

.3 Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

.4 Use embedded anchor bolts instead of concrete inserts for support installations in areas below water surface or normally subjected to submerging.

.5 Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation to be made at the time of insulation installation in accordance with the manufacturer's recommendation.

.6 Hanger and support components in contact with plastic pipe to be free of burrs and sharp edges.

.7 Rollers to roll freely without binding.

.8 Finished floor beneath Type L structural attachments and framing channel post bases to be roughened prior to grouting. Grout between base plate and floor to be free of voids and foreign material.

.9 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

.10 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 2200 mm above the floor.

.11 Recoat ends of framing channels cut to length with zinc dust-zinc oxide coating.

.12 Include any piping support modifications on the shop drawings submitted prior to fabrication or installation.

.13 Review the drawings prior to installation of piping, conduit, and fixtures by this or any other Division. Identify any conflicts, and confirm the routing of each section of pipework prior to commencement of installation. Advise of any conflicts with existing services. Where necessary, amend the routing of pipework to avoid conflict and provide shop drawings showing proposed routing.

.14 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

.15 All minor modifications to accommodate installed equipment and structural components are subject to review. Do not commence work on related piping until Engineer’s review is complete.

3.3 ADJUSTMENTS

.1 Adjust hangers and supports to obtain required pipe slope and elevation. Use shims made of material that is compatible with the piping material. Adjust stanchions prior to grouting of baseplates.

END OF SECTION

Part 1 General

1.1 CODES

.1 Do all work associated with the welding process, such as procedure qualification, welder qualification, lineup, welding, and weld testing, in accordance with the latest edition of ANSI B31.3 shop welding applications and CSA Z662.

Part 2 Products

2.1 PIPE

.1 Stainless steel pipe: per Section 40 23 24 – Detailed Piping Specifications.

2.2 FILLER MATERIAL

.1 Gas tungsten arc electrodes (manual welding) to conform to CSA W48.3. Grade to be of tensile strength equivalent to or greater than the ultimate tensile strength of the parent metal, and to be suitable for the electric current characteristics, position of welding, and other conditions of intended use.

2.3 END BEVELS

.1 Provide pipe ends with mill bevels. Bevels to be 30° with a vertical lip of 1.60 mm unless specified otherwise. Field bevels to be reasonably smooth and uniform, and dimensions are to be in accordance with the qualified welding procedure.

2.4 EQUIPMENT

.1 Welding equipment to be 200 A or larger DC machines, and to be designed and maintained in an acceptable condition to obtain the specified results.

Part 3 Execution

3.1 GENERAL

.1 Perform welding using procedures qualified to CSA Z662, Clause 7.2. Surfaces to be welded are to be smooth, uniform, free of fins, lamination, tears, slag, grease, paint, and other deleterious conditions which might adversely affect welding. All aspects of the process as outlined in CSA Z662, Clause 7.2.5.2 shall conform to the welding procedure specification.

.2 Submit proposed welding procedure to Engineer using the forms provided at the end of this section. Procedure to be used to prepare the test joints required for qualification.

3.2 WELDER QUALIFICATION

.1 Welders engaged on the work to possess valid certificates of qualification from the appropriate governing authority for pipeline welding in the flat, vertical, and overhead positions. Certificates to be for the gas tungsten arc method of welding. Provide copies of certificates to Contract Administrator when qualification test results are submitted.

.2 Welders to qualify under CSA Z662, Clause 7.2.6.

.3 Make a record of the test given to each welder and of the detailed results of each test. Record to be maintained by Contractor and a list of qualified welders and procedures in which they are qualified to be provided to the Engineer. Welders may be required to requalify if there is a question about their ability.

3.3 QUALIFICATION OF THE WELDING PROCEDURE

.1 Prepare test joints in accordance with the proposed welding specification and as stated in the proposed welding procedure submitted to the Engineer. Give Engineer written notice of when and where the welding of the test joints will take place so that the Engineer can be present. Joints to be tested at Contractor's expense, and in accordance with CSA Standard Z662, Clause 7.2.5.4. Upon qualification, no change in the procedure will be permitted without the Engineer's written approval.

3.4 FIELD WELDING

.1 Field welding of stainless steel pipe is permitted, but is to be minimized. Use similar procedures as for shop welding, but modified for field welding.

3.5 PRODUCTION WELDING

.1 Production welding to conform to CSA Z662, Clause 7.2.7 for field welding, and ANSI Code B31.3, Chapter V for shop welding, and the following stipulations:

.1 No pup shorter than 1 m or 3 pipe diameters, whichever dimension is greater to be installed in the line. There is to be at least 1 full joint of pipe installed between pups which are shorter than 5 m. All pups must be moved ahead on a current basis and installed in the line.

.2 No two weld beads are to be started or stopped in the same location. Visually examine each weld pass and repair any defects (i.e., pin holes, slag inclusions, gas pockets, and undercutting, etc.) prior to welding the next pass.

.3 Do not strike the arc on the pipe at any point other than the welding groove. Any section of pipe which has been arc burned may, at the Engineer's discretion, be cut out and replaced at the Contractor's expense.

.4 No weld to be subjected to sudden variations in temperature and no welded sections to be subjected to stresses, due to movement of pipe, loading on pipe, etc., until the welds have cooled below 38°C. Damage caused by the welded pipe being subjected to stresses before complete cooling of welds to be corrected at the Contractor's expense.

.5 All temperatures to be measured by pyrometric crayons or other suitable devices approved by the Engineer.

.6 All passes to have no more than 5 minutes elapse between the previous pass termination and the commencement of the next pass. When ambient temperature is below 0°C, maximum lapse time allowable is 4 minutes.

.7 Use inert gas backing for stainless steel welding. Solar flux prohibited for liquid commodity piping.

.8 Use "stainless steel only" brushes, grinding wheels and other tools during fabrication of pipe spools.

.9 Pickle all joints and heat affected zones on interior and exterior. Use of pickling paste subject to Engineer's review. Observe regulatory requirements for disposal of acid.

.10 Passivate exterior of all stainless steel welds after completion. Neutralize and rinse joints.

3.6 POST-WELD CLEANING

.1 Passivate all stainless steel welds in accordance with ASTM A380 and ASTM A967. Coat stainless piping welds with the appropriate pickling paste or immersed in a liquid bath of pickling solution. Any pickling product for use on piping for a potable system shall be NSF certified. Any noticeable discolouration found on the stainless pipe shall also be removed by pickling.

.2 Once sufficient pickling time has elapsed, the passivated surface shall be cleaned of all acids by thoroughly rinsing the pipe. Observe regulatory requirements for disposal of acid.

.3 Burnish exterior of pipe and fittings where residual tapes, markings, fabrication or transportation blemishes are evident to Engineer to produce a clean, even appearance. Do not use carbon steel tools or materials for burnishing.

3.7 LINEUP CLAMPS

.1 Use of lineup clamps to conform to CSA Z662, Clause 7.2.7.4. Internal lineup clamps to be used whenever practicable and when used are not to be removed until root bead is complete. External lineup clamps may be used only when use of internal lineup clamps is not practicable. Root bead segments used in connection with external lineup clamps to be uniformly spaced around the circumference of the pipe, and to have an accumulative length of not less than 50% of the pipe circumference before the clamp may be removed. Pipe to remain supported and stationary until root bead is completed.

3.8 CLEARANCE

.1 Clearance to be in accordance with CSA Z662, Clause 7.2.7.8. When the pipe is welded in a trench, bell hole to be of sufficient size to provide the welder or welders ready access to the joint so that their skill is not impaired. When pipe is welded above ground, the working clearance around the pipe at the weld shall be not less than 400 mm.

3.9 PIPE HANDLING

.1 Extreme care to be exercised to prevent damage to pipe. Damage to be repaired as directed by the Engineer and at the expense of the Contractor. Bevel ends to be repaired if damaged.

.2 All dents in the pipe deeper than 3.20 mm to be removed by cutting dented portion of the pipe out, rebevelling the cut ends, welding and recoating.

.3 Do not contaminate pipe or fittings by contact (impact/rubbing) with carbon steel components. Pickle and/or passivate stainless steel components should contamination occur.

3.10 INSPECTION

.1 Inspection will be conducted in accordance with ANSI B31.3. After completion of the welding operation, pipe to be left uncoated for a period sufficient to permit Engineer to inspect the welds.

.2 Work performed will be rigidly inspected. Such inspection will not relieve Contractor of responsibility for performing work in conformance with the specifications. Notify Engineer in advance of performing any work in order that inspection may be arranged. Engineer may reject any work that does not comply with the specified requirements. Furnish the Engineer reasonable facilities and space for inspection, testing, and obtaining any information Engineer desires respecting the character of material used and progress and condition of the work.

.3 Ten percent of welds are subject to radiographic inspection, the cost of which will be borne by the Contractor. Radiographic inspection to be carried out by operators certified in conformance with CSA W178.1 and W178.2. Submit inspection results to Engineer.

.4 Engineer may use any method of inspection necessary to establish quality control and ensure adherence to welding procedures. Engineer has the right to accept or reject any weld not meeting the approved procedures and/or specified requirements.

3.11 REPAIR OR REMOVAL OF WELD DEFECTS

.1 Repair or removal of weld defects to be in accordance with CSA Z662, Clause 7.2.10. Backwelding is not allowed without qualification of the welding procedure used.

.2 All costs for repairing defective welds, including radiographic inspection of the corrected work, to be borne by the Contractor.

PROPOSED WELDING PROCEDURE

DATE _____

JOB TITLE _____

ASSOCIATED ENGINEERING PROJECT NO. _____

CLASSIFICATION OF PIPE _____

MAXIMUM TENSILE STRENGTH _____

MAXIMUM YIELD STRENGTH _____

PERCENTAGE ELONGATION IN 50 mm _____

MILL TEST FORWARDED TO ASSOCIATED ENGINEERING (YES/NO) _____

LADLE ANALYSIS FORWARDED TO
ASSOCIATED ENGINEERING (YES/NO) _____

CARBON CONTENT _____

CARBON EQUIVALENT _____

PROCESS _____

DIAMETER AND WALL THICKNESS _____

JOINT DESIGN _____

FILLER METAL

Pass	Size	AWS Classification	Voltage	Amperage	Polarity	Brand
1						
2						
3						
4						
5						

POSITION _____

DIRECTION OF WELDING _____

NUMBER OF WELDERS _____

TIME LAPSE BETWEEN PASSES _____

INTER-PASS HEATING (IF REQUIRED) _____

METHOD OF HEATING _____

CLEANING BETWEEN PASSES _____

_____

_____

PREHEAT _____

MINIMUM AMBIENT TEMPERATURE _____

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section refers to shop and field welding of carbon steel pipe.

1.2 CODES

.1 All work associated with the welding process such as welder qualifications, line-up, welding and weld testing, is to be performed in accordance with the latest edition of AWWA C206 and CSA Z662 except when the terms of these standards are added to or modified by these specifications.

Part 2 Products

2.1 PIPE MATERIAL

.1 The chemical and physical characteristics of the pipe are specified in Section 40 23 24 - Detailed Piping Specification.

2.2 FILLER MATERIAL

.1 Manual arc-welding electrodes for welding carbon steel to carbon steel are to conform to the latest edition of CSA W48.1. The grade is to be E70XX equivalent or better depending on the ultimate tensile strength of the parent metal, and be suitable for the electric current characteristics, position of welding, and other conditions of intended use.

2.3 END BEVELS

.1 Pipe ends to be provided with mill bevels. Bevels are to be 30° to 40° with a vertical lip of 1.5 mm ±0.75 mm unless specified otherwise. Field bevels are to be reasonably smooth and uniform and in conformance with mill bevels.

2.4 EQUIPMENT

.1 Welding equipment is to be 200 A or larger DC machines, and be designed and maintained in a condition so as to obtain the specified results.

Part 3 Execution

3.1 GENERAL

.1 Perform welding using procedures qualified to CSA Z662, Clause 7.2.5. Surfaces to be welded are to be smooth, uniform, free of fins, laminations, tears, slag, grease, paint and other deleterious materials which might adversely affect welding. The joint design is to conform with the welding procedures specifications to be used.

3.2 JOINT PREPARATION

.1 Clean the pipe ends and bevels and make free of all detrimental materials.

3.3 WEATHER CONDITIONS

.1 Welding is not to be done when the quality of completed weld would be impaired by prevailing weather conditions, including but not limited to, moisture, blowing sands, high winds or low temperatures. Reference CSA Z662, Clause 7.2.7.7. The use of wind shields may make conditions for welding satisfactory.

.2 If, in the opinion of the Engineer, protection from prevailing weather conditions is necessary, cease welding until this protection has been placed correctly. The Contractor will not be compensated for downtime delays of this nature.

.3 Metal surfaces in and adjacent to the welding groove are to be dry before welding commences and while welding is in progress.

.4 When ambient temperature is below -12°C, cease welding operations unless a sub-zero welding procedure is approved.

3.4 WELDED JOINTS

.1 Unless specified otherwise, prepare pipe joints and fittings for single butt V-joints. Carefully fit the end of each pipe to mate to the preceding end in accordance with AWWA C206 and CSA Z662 and retained in position during the welding operation.

.2 Pipe which must be cut in the field for closing pieces and other field joints is to be cut with an approved, mechanical cutting machine to the required bevel. Edges are to be smooth and serrated. After cutting, grind smooth rough edges. Hammering rough edges in an attempt to make them smoother will not be permitted.

.3 Mitering pipe in the field will only be permitted providing the cutting and bevelling of welding edges, design of weld and welding are satisfactory to the Engineer.

.4 Weld penetration on butt welds is to be flush with inside surface of steel pipe.

.5 Deposit the entire root bead with the pipe in a stationary position. Take care that the pipe is not stressed nor the lineup of the joint changed while the root bead is being deposited.

.6 Remove scale and slag from each bead and groove. Cleaning may be done with either hand or power tools. Cleaning is not to affect the geometry of the joints.

.7 Make position welds with the parts to be joined, secure against movement and with adequate clearance around the joint to allow the welder or welders space in which to work.

.8 Unless the welding procedure provides otherwise, and has been qualified accordingly, commence no bead until the preceding bead has been completed. The number of beads is to be such that the completed weld will have substantially uniform cross-section around the entire circumference of the pipe and be uniformly convex. At no point is the crown

surface to be below the outside surface of the pipe nor be raised above the parent metal by more than 3 mm.

.9 No pup shorter than 1200 mm or three pipe diameters, whichever dimension is greater, is to be installed in the line unless shown on the drawings.

.10 Each welder is to identify his work in a manner specified by the Engineer. Steel dye stamping of the pipe for this purpose is prohibited.

.11 Provide a list of identification symbols assigned to each qualified welder. This list is to be kept up-to-date at all times and copies of updated list sent to the Engineer.

.12 Protect the pipe lining from damage during the welding operation.

3.5 LINE-UP CLAMPS

.1 Use line-up clamps for butt-welded joints in conformance with CSA Z662, Clause 7.2.7.4. Use internal line-up clamps whenever practicable and when used do not remove until the root bead is complete. Ensure that the clamps are compatible with the internal pipe coating and do not cause irreparable damage to the coating. Root bead segments used in connection with external line-up clamps to be uniformly spaced around the circumference of the pipe and have an accumulative length of not less than 50% of the pipe circumference before the clamp may be removed. The pipe is to remain supported and stationary until the root bead is complete.

3.6 CLEARANCE

.1 Clearance in accordance with CSA Z662, Clause 7.2.7.8. When the pipe is welded in a trench, the bell hole is to be of sufficient size to provide the welder or welders ready access to the joint so that their skill is not impaired. When the pipe is welded above ground, the working clearance around the pipe at the weld is not to be less than 400 mm unless shown otherwise on the drawings.

3.7 PIPE HANDLING

.1 Exercise extreme care to prevent damage to pipe. Repair damage as directed by the Engineer and at the expense of the Contractor. Repair bevel ends if damaged.

.2 Remove all dents in the pipe deeper than 3 mm by cutting the dented portion of the pipe out, re-bevelling the cut ends, welding up and recoating. No compensation will be allowed the Contractor for such work.

3.8 WELDING PROCEDURE SPECIFICATIONS

.1 Prior to carrying out of any welding, submit three (3) copies of the proposed welding procedure to the Engineer for approval. Submit proposed welding procedure using the forms provided at the end of this section. The Engineer will return one copy with his approval, after which welding may be started. No change is to be made in this procedure without first obtaining the Engineer 's approval in writing.

.2 All passes are to have no more than five (5) minutes elapse between the previous pass termination and the commencement of the next pass. When the ambient temperature is below 0EC, the maximum lapse time allowable will be four (4) minutes.

.3 No two weld beads are to be started or stopped in the same location.

.4 Visually examine each weld pass and repair any defects (pin holes, slag inclusions, gas pockets and undercutting) prior to welding the next pass.

.5 Do not strike the arc on the pipe at any other point, other than the welding groove. Any section of pipe which has been arc burned may, at the Engineer's discretion, be cut out and replaced at the Contractor's expense.

.6 All dirt and debris is to be swabbed from inside the pipe before welding into the line.

.7 Night caps are to be put on the welded part of the line to prevent entry of foreign materials.

.8 Do not subject welds to sudden variations in temperature and subject no welded sections to stresses, such as due to movement of pipe and loading on pipe until the welds are cooled below 38°C.

.9 Measure all temperatures by pyrometric crayons or other suitable devices approved by the Engineer.

.10 Damage to the welded pipe, due to the pipe being subjected to stresses before complete cooling of welds, will be completely corrected at the Contractor's expense.

.11 Prepare lap joint test joints and sections and air test in accordance with AWWA C206, Article 6.2. Give the Engineer timely written notice of when and where he will be conducting the welding of the test joints so as the Engineer can be present. Submit the qualification test results to the Engineer for approval. Written approval of the Engineer must be obtained prior to proceeding with the weld operation.

.12 Prepare a butt weld test joint and qualify using non destructive test methods (radiographic) to CSA Z662.

3.9 WELDER QUALIFICATIONS

.1 Welders engaged on the work are to possess a valid certification of qualification from the appropriate governing authority for pipeline welding in the flat, vertical and overhead positions. Certificates are to be for the Shielded Metal Arc Method of Welding. Submit copies of these certificates to the Engineer by the Contractor when the qualification test results are submitted to the Engineer.

.2 Welders are to qualify under CSA Z662, Clause 7.2.6. Each welder will also be required to demonstrate his ability to produce acceptable welds using the approved procedure. Make test welds under the supervision of the Engineer. Take filler metal for tests from the Contractor's stock at the site of the work.

.3 If, in the opinion of the Engineer and the Contractor, failure of a welder to pass is due to conditions beyond his control, he may be given a second opportunity to qualify. No further retests, beyond the second opportunity, will be given until the welder has submitted proof of subsequent welder training acceptable to the Engineer.

.4 Make a record of the test given to each welder and of the detailed results of each test. Maintain this record and a list of qualified welders and procedures in which they are qualified and provide to the Engineer. A welder may be required to requalify if there is a question about his ability.

.5 Provide a yard in Sooke for testing of the welding crews.

3.10 WELD SPREAD

.1 All welding undertaken in any day is to be completed that same day.

3.11 COATED PIPE PROTECTION AND FIELD COATING

.1 Protect and prepare for field welding all steel water pipe which has been previously coated.

.2 After field welding of steel water pipe, pipe coating of welded joints to be completed as follows:

.1 Coating of welded joints in the field to be done in accordance with AWWA C210, Section 3.5. Primer and field coating of bare surfaces to be the same materials as used for shop coating of pipe.

.3 If damage of the coating occurs in the field, repair damaged portions in accordance with AWWA C210, Section 3.4.

3.12 INSPECTION

.1 Conduct inspection and testing of production welds in accordance with CSA Z662, Clause 7.2.8. After completion of the welding operation, leave the pipe uncoated for a period sufficient to permit the Engineer to inspect the welds. The Engineer will not unduly delay the inspection of the welds.

.2 Rigidly inspect work performed. Such inspection will not relieve the Contractor of his responsibility for performing work in conformance with the specifications. Notify the Engineer in advance of performing any work in order that inspection may be arranged. The Engineer may reject any work that does not comply with the specified requirements. Furnish reasonable facilities and space for inspection, testing and obtaining any information he desires respecting the character of materials used and progress and condition of the work.

.3 The Engineer may use any method of inspection necessary to establish quality control and ensure adherence to welding procedures. The Engineer has the right to accept or reject any weld not meeting the specified approved procedures and/or requirements.

.4 Air test pipe closures using butt strap or lap joint welds in accordance with AWWA C206 Article 6.2.

.5 Radiographically inspect ten percent of welds in accordance with CSA Z662, Clauses 7.2.9 and 7.2.12.8, the cost of which will be borne by the Contractor. Engineer to select welds for testing.

3.13 REPAIR OF DEFECTIVE WELDS

.1 Repair or removal of weld defects is to be in accordance with CSA Z662, Clause 7.2.8.4.

.2 Major defects and all cracks are to be cut out mechanically and the joint rewelded.

.3 Bear all cost for repairing defective welds, including radiographic inspection of the corrected work.

3.14 STORAGE OF ELECTRODES

.1 Protect the welding electrodes from any deterioration prior to use and any portion of carton or box found to be damaged or damp will be cause for rejection of entire box or carton.

.2 Closely follow manufacturer's recommendations for the care and storage of electrodes.

.3 Store welding electrodes which are susceptible to adverse effects of atmospheric moisture, such as the low hydrogen type electrodes and lime-coated stainless steel electrodes, in heated ovens when not in use. These ovens are to have an internal temperature of at least 150°C. Electrodes of this type, which have been exposed to the atmosphere more than 4 hours, are to be returned to the heated oven for a minimum of 8 hours before they may be used.

PROPOSED WELDING PROCEDURE

DATE _____

JOB TITLE _____

ASSOCIATED ENGINEERING PROJECT NO. _____

CLASSIFICATION OF PIPE _____

MINIMUM TENSILE STRENGTH _____

MINIMUM YIELD STRENGTH _____

PERCENTAGE ELONGATION IN 50 mm _____

MILL TEST FORWARDED TO ASSOCIATED ENGINEERING (YES/NO) _____

LADLE ANALYSIS FORWARDED TO
ASSOCIATED ENGINEERING (YES/NO) _____

CARBON CONTENT _____

CARBON EQUIVALENT _____

EXTERNAL COATING _____

INTERNAL COATING _____

PROCESS _____

DIAMETER AND WALL THICKNESS _____

JOINT DESIGN _____

FILLER METAL

Pass	Size	AWS Classification	Voltage	Amperage	Polarity	Brand
1						
2						
3						
4						
5						

POSITION _____

DIRECTION OF WELDING _____

NUMBER OF WELDERS _____

TIME LAPSE BETWEEN PASSES _____

INTER-PASS HEATING (IF REQUIRED) _____

METHOD OF HEATING _____

CLEANING BETWEEN PASSES _____

_____

PREHEAT _____

MINIMUM AMBIENT TEMPERATURE _____

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section refers to supply, testing, delivery, off-loading, installation, startup and commissioning of new stop logs, complete with frames, seals, lifting devices and davit crane, to be installed in the existing Emergency Overflow structure. Stop logs will control the emergency overflow height of the lagoon. The top one or two logs can be added or removed as required.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

- .1 ASTM A276, Stainless Steel and Heat-resisting Steel Bars and Shapes
- .2 ASTM D1248, Polyethylene Plastic Moldings and Extrusion Materials
- .3 ASTM D2000, Rubber Products in Automotive Applications
- .4 ASTM F593, Stainless Steel Bolts, Hex Cap Screws, and Studs
- .5 ASTM F594, Stainless Steel Nuts

1.3 SUBMISSIONS

.1 Shop drawings: submit in accordance with Section 01 33 00 - Submittals.

- .1 Layout.
- .2 Frame assembly details with anchor bolt sizes and locations.
- .3 Concrete embedment details.
- .4 Installation details and assembly details.
- .5 Seal details.
- .6 Materials of construction.

.2 Operating and maintenance data: provide for incorporation in operation and maintenance manual as specified in Section 01 78 23 – Operating and Maintenance Data.

.3 The gate manufacturer shall submit design calculations and supporting data for all gates showing stresses, loads and deflections for critical parts under design head conditions.

Part 2 Products

2.1 GENERAL

.1 Stop logs shall be shop assembled and inspected to ensure that field fitting will not be required.

.2 Stop logs shall be constructed entirely of stainless steel.

.3 All hardware shall be stainless steel.

.4 The frame shall be made of stainless steel channels. The frame shall be suitable for embedding in a channel.

.5 All of the seals shall be mounted on the log to facilitate seal replacement.

.6 Welds shall be performed by welders with ASME Section IX or AWS D1.6 certification.

.7 The stop log manufacturer shall be ISO 9001 certified.

.8 Individual stop log widths (weight) to be selected to allow handling by two operations personnel.

2.2 LIFTING DEVICE

.1 A stainless steel lifting device shall be provided to install and remove the stop logs from the frame.

.2 The lifting device shall automatically engage each stop log individually for installation or removal from the operating deck.

.3 The portion of the lifting device that engages the frame shall be outfitted with UHMWPE bearing strips to ensure no metal-to-metal contact occurs between the lifting device and in the inside of the frame.

.4 The lifting device shall be provided with a lifting lug on the top and utilized in conjunction with the davit crane.

2.3 SCHEDULE

.1 Emergency Overflow stop logs:

.1 Two (2) sets of stop logs.
.2 Stop Logs will be installed during normal operation.
.3 Top two (2) rows of stop logs to be sized at 200 mm each.
.4 One (1) set of lifting device including davit crane.
.5 Stop log frames for Emergency Overflow must fit existing block-outs.
.6 See Drawing 2972-00-D-561.

Stop Log Description	**Stop Log Number & Identification**
Emergency Overflow Stop Log 1	SL-353-01, 02, 03…
Emergency Overflow Stop Log 2	SL-354-01, 02, 03…
Channel Details	
Channel Width	2590 mm
Channel Invert Elevation	0.420 m
Top of Stop Log Elevation	3.200 m

.2 Screen Building stop logs:

.1 Four (4) stop log frames with two (2) sets of stop logs, one (1) set of stop logs will be for the screen influent side and the other one (1) set of stop logs will be for the screen effluent side.

.2 One (1) lifting device.

.3 Stop logs will not be installed during normal operation.

.4 See drawings 2972-00-D-121 and 2972-00-D-321.

Stop Log Description	**Stop Log Number & Identification**
Channel 1&2 - Screen Influent Stop Logs	SL-200 / SL-210 – 01, 02, 03…
Channel 1&2 - Screen Effluent Stop Logs	SL-203 / SL-213 – 01, 02, 03…
Channel Details	
Screen Influent	
Channel Width	800 mm
Channel Invert Elevation	2.80 m
Top of Channel Elevation	5.50 m
Maximum Water Elevation	4.90 m
Top of Stop Log Elevation	5.20 m
Screen Effluent	
Channel Width	800 mm
Channel Invert Elevation	2.60 m
Top of Channel Elevation	5.50 m
Maximum Water Elevation	3.89 m
Top of Stop Log Elevation	4.20 m

2.4 LEAKAGE

.1 The leakage rate shall not exceed 0.025 L/s per metre of wetted perimeter under the maximum seating and unseating pressure.

2.5 ACCEPTABLE MANUFACTURER

.1 RW Gate

.2 Golden Harvest

.3 Waterman Industries

2.6 MATERIALS

Component	Material
Frame and Reinforcements	Stainless steel ASTM A276, Type 304L
Stop Log Guide	Ultra-high molecular weight polyethylene (UHMWPE) ASTM D1248
Seal	Neoprene ASTM D2000, Grade 2 BC-570
Fasteners	Stainless steel AISI Type 316 to ASTM A276
Anchor bolts and connecting hardware	Stainless Steel ASTM A276, Type 316
Stop Logs	304 Stainless Steel

2.7 COORDINATION

.1 Work closely with the Engineer to resolve the detailed features and dimensions of the stop logs to the satisfaction of the Engineer; reviewed shop drawings are the governing documents.

.2 Field verify required dimensions of existing Emergency Overflow structure and after concrete/channel install for the Screen building.

.3 Ship, protect and store the stop logs as specified in Division 1 and the manufacturer's written instructions.

Part 3 Execution

3.1 MANUFACTURER'S REPRESENTATIVE

.1 Manufacturer's representative shall be required to attend the site to train the installation personnel and to witness the installation and testing to ensure the equipment is installed and operated as intended.

3.2 TESTING

.1 Conduct field leakage tests in accordance with Section 6 of AWWA C561.

.2 Fulfill the requirements for successful testing of the equipment as documented by the Equipment Installation Certification Form illustrated in Section 017501.01.

Part 4 Execution

4.1 INSTALLATION

.1 Gates and appurtenances shall be handled and installed in accordance with the manufacturer's recommendations.

.2 Carefully align and install all stop log assemblies in their respective location, straight, plumb and free from all distortion and undue strain.

.3 Where frames are anchored to concrete walls, provide a grout pad (non-shrink) between the frame and wall, in accordance with manufacture's written instructions.

.4 Provide anchor bolts of sufficient size and number to provide a tight installation.

4.2 COMMISSIONING

.1 Supplier or supplier's representative provide start up and commissioning for system. A minimum of four hours shall be allowed.

4.3 TRAINING

.1 Provide four hours field training instruction. Training session is to take place after commissioning.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section specifies the supply, installation, testing and commissioning of slide gates, complete with slides, frames, operating stems, seals and operators and other appurtenances.

.2 Conform to the general requirements of Section 40 05 01 – Mechanical General Requirements unless otherwise specified.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards in accordance with Section 01 42 19 - Reference Standards:

.1 ASTM A276, Stainless Steel and Heat-resisting Steel Bars and Shapes

.2 ASTM A484, Stainless and Heat-resisting Steel Bars, Billets and Flanges.

.3 ASTM A707, Flanges, Forged, Carbon and Alloy Steel for Low Temperature Service

.4 ASTM B209, Aluminum and Aluminum-Alloy Sheet and Plate

.5 ASTM B584, Copper Alloy Sand Castings for General Application

.6 ASTM D1056, Flexible Cellular Materials - Sponge or Expanded Rubber

.7 ASTM D1248, Polyethylene Plastic Moldings and Extrusion Materials

.8 ASTM D2000, Rubber Products in Automotive Applications

.9 ASTM F593, Stainless Steel Bolts, Hex Cap Screws, and Studs

.10 ASTM F594, Stainless Steel Nuts

.11 AWWA C561, Fabricated Stainless-Steel Slide Gates

1.3 EQUIPMENT LIST

Equipment Name	Qty.	Equipment No.
Channel 1 Screen Influent Slide Gate	1	SGV-201
Channel 1 Screen Effluent Slide Gate	1	SGV-202
Channel 2 Screen Influent Slide Gate	1	SGV-211
Channel 2 Screen Effluent Slide Gate	1	SGV-212

1.4 SUBMITTALS FOR REVIEW

.1 In addition to the submittals specified in Section 40 05 01 - Mechanical General Requirements, provide the following information in one complete submittal and in accordance with Section 01 33 00 - Submittals:

.2 Manufacturer's data including construction details, weight of slides and frames, and layout drawings.

.3 Drawings showing frame, slide, wall castings, stem, stem extension, stem guide, operator, stem cover and all other appurtenances plus mounting details and seal details, along with dimensions.

.4 Cross-sectional details with complete materials list.

1.5 SUBMITTALS FOR INFORMATION ONLY

.1 In addition to the submittals specified in Section 40 05 01 - Mechanical General Requirements, provide the following information in one complete submittal and in accordance with Section 01 33 00 - Submittals:

.2 Design calculations and supporting data for all slide and frame members showing stresses, loads and deflection for critical parts under design head conditions.

.3 Operating and maintenance data as specified in Section 01 78 23 - Operating and Maintenance Data.

1.6 COORDINATION

.1 The Contract Drawings are general in nature and are not intended to show exact detail; make such alterations to the concrete structure as necessary to accommodate the slide gates selected.

.2 Work closely with the Engineer to resolve the detailed features and dimensions of the various gates to the satisfaction of the Engineer; reviewed shop drawings are the governing documents.

1.7 SHIPMENT, PROTECTION AND STORAGE

.1 Ship, protect and store the slide gates in accordance with Section 01 61 00 - Basic Product Requirements and the manufacturer's written instructions.

Part 2 Products

2.1 FUNCTION

.1 Slide gates isolate screen units and channels as necessary.

.2 Provide slide gates to meet the following functional requirements:

Location	Equipment No.	Gate Type	Stem Type	Mount Type
Channel 1 Screen Influent Slide Gate	SGV-201	SG	NRS	WC
Channel 1 Screen Effluent Slide Gate	SGV-202	SG	NRS	WC
Channel 2 Screen Influent Slide Gate	SGV-211	SG	NRS	WC
Channel 2 Screen Effluent Slide Gate	SGV-212	SG	NRS	WC

.3 Abbreviations:

.1 SG - Slide gate c/w frame, slide, gear operator and electric motor actuator.

.2 WC - Wall mounted in channel.

.3 WF - Wall mounted on face of wall.

.4 CE - Concrete embedded.

.5 NRS - Non-rising stem.

2.2 ACCEPTABLE MANUFACTURERS

.1 Provide slides, frames and operators for all slide gates as products of a single manufacturer.

.2 Provide products modified as necessary to meet the specified features and operating conditions.

.3 Acceptable manufacturers:

.1 Golden Harvest

.2 RW Gate

.3 Waterman Industries

2.3 CAPACITIES AND PERFORMANCE

.1 Identify slide gates by the equipment number.

.2 Slide gates have the following operating characteristics:

Equipment	Maximum seating head[a], m	Maximum unseating head, m	Opening direction	Opening invert elevation, m	Gate height, mm	Opening width, mm
SGV-201	0.90	1.1	Upward	2.80	2400	800
SGV-202	0.49	-	Upward	2.60	1600	800
SGV-211	0.90	1.1	Upward	2.80	2400	800
SGV-212	0.49	-	Upward	2.60	1600	800

[a]Head is referenced to the centreline elevation of the slide gate opening from water surface.
[b]Refer to structural drawings to confirm clear opening dimensions.
Note 1 - Elevation to be verified at time of construction.
Note 2 - Gate height includes 30 cm above max. water level.

2.4 MATERIALS

Component	Material
Frame/Slide	Stainless steel, ASTM A276 Type 304
Stem guides	Stainless steel, ASTM A276 Type 304
Stem guide liner	Ultra high molecular weight polyethylene (UHMWPE), ASTM D1248
Threaded stem	Stainless steel, ASTM A276 Type 303 MX
Stem extension	Stainless steel, ASTM A276 Type 304
Fasteners	Bolts: ASTM F593 GR1 for Type 304
Nuts:	ASTM F594 GR1 for Type 304
Side and seals	Ultra high molecular weight polyethylene (UHMWPE) ASTM D1248.
Bottom seal	Neoprene ASTM D2000, Grade 2BC 510

Handwheel, handcrank, pedestal	Stainless steel, ASTM A276 Type 304
Lift nut	Manganese Bronze ASTM B584 Alloy 421 C86500 (421)
Stem cover	Clear polycarbonate, ASTM A707
Gasket (between frame and wall)	EPDM ASTM 1056
Compression cord	Nitrile ASTM D2000 M6BG 708, A14, B14, E014, E034
Anchor bolts and connecting hardware	Stainless steel ASTM A276, type 304

2.5 EQUIPMENT COMPONENTS

.1 General:

.1 Ensure working stresses do not exceed one third the value of the yield strength.

.2 Evaluate working stresses on the basis of the forces that can reasonably be exerted on and by operating mechanisms, as well as the basis of hydraulic loads.

.3 Design slide gates to resist all stresses which may occur during installation and operation.

.4 Slide gates to be self-contained, non-rising stem configuration.

.2 Frame

.1 Provide stainless steel guides, welded together to form a rigid one piece frame.

.2 Design frames suitable for bolting to the channel walls or for embedding in the concrete walls, as indicated.

.3 Design the frame so that the top, side and bottom seals may be replaced without removing the slide gate.

.4 Provide minimum thickness of stainless steel frame members of 6.35 mm.

.3 Slide

.1 Flat plate type reinforced with formed plates or structural members to limit its deflection to 1/720 of the span of the frame opening at maximum head.

.2 Manufacturer slides to have a minimum of 20 mm of seating surface on each guide.

.4 Seals

.1 Provide side and bottom seals for all gear operated slide gates.

.2 For gear operated slide gates, provide seals of the self adjusting type and maintain a leakage rate of less than 1.24 litres per minute per metre of wetted perimeter in both seating and unseating conditions.

.5 Stem and Couplings

.1 Design the operating stem to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 175 N effort on the handwheel or hand-crank.

.2 Design the stem so that the slenderness ratio (L/r) for the unsupported length of the stem does not exceed 200.

.3 Provide machined cut threads of the ACME type.

.4 For stems in more than one piece and with a nominal diameter of 45 mm and larger, join the different sections together by grooved and keyed solid couplings of greater strength than the stem; thread and bolt couplings for all stem diameters in accordance with AWWA C561.

.5 Stems less than 45 mm diameter to be joined to an extension tube using pins.

.6 Hollow stems will not be accepted.

.7 Provide two lifting mechanisms connected by a tandem shaft for gates having widths equal to or greater than two times the height.

.6 Stem Guides

.1 Provide stem guides adjustable in 2 directions and space them in accordance with the manufacturer's recommendation.

.7 Stem Cover

.1 Provide rising stem, slide gates with a stem cover complete with a cap, condensation vents and with position indicators.

.2 Field apply the indicator tape to the stem cover after the slide gate has been installed and positioned.

.8 Thrust Nut

.1 Provide each slide gate with a thrust nut.

.2 For rising stem arrangement, locate the thrust nut at the operator level.

2.6 ELECTRIC ACTUATORS FOR SLIDE GATES

.1 Acceptable Manufacturer:

.1 For slide gates: Rotork IQ series, rated 600 V 3 phase 60 Hz.

.2 Electric Actuators:

.1 General:

.1 Electric actuators selected by the supplier shall conform to the latest edition of AWWA C540 Section 3, except as modified or supplemented herein.

.2 Each electric-motor actuator shall include as one integral unit, but not be limited to, the electric motor, reduction gearing, drive coupling, torque and positioning controls, extension spindle, gear case, and auxiliary handwheel. The valve and actuator combination should be self locking.

.3 All electrical actuator enclosures shall be rated NEMA Type 4X.

.4 Valve actuator suppliers shall have local representation including trained technicians on-call for field service. The suppliers shall carry locally or have available within a 24-hour period all necessary spare parts including, but not limited to, switches, switch drives, motors and F/R contactors.

.5 Electric actuators shall have been manufactured previously for a minimum period of five (5) years of the same design submitted.

.6 Provide the actuator with a permanent stainless steel "tag" which will include the valve field location and pre-assigned equipment number.

Provide three (3) sets of electrical schematic and wiring, and assembly drawings.

.2 Power Gearing:

.1 Reduction shall be by means of spur, helical, bevel and/or worm gears. Gears shall be steel. Worm gears shall be bronze. The use of non-metallic or aluminum gears in the power train will not be accepted.

.2 A lost motion device independent of gear backlash shall be supplied as an integral part of the actuator gear train. This device shall allow the motor to attain full speed before the load is engaged. The lost motion device shall be removable from the actuator in the event that the valve is required for modulating service.

.3 Support all gears and shafting on anti-friction bearings. Where thrust is a consideration, roller or axial-thrust-needle bearings shall be provided.

.4 Grease or oil lubricate all gearing and bearings. Provide seals at all shaft penetrations of the gear case to prevent leakage of lubricant, regardless of position. Lubricants shall be suitable for year round service based on prevailing ambient temperature conditions and operating temperature conditions which range from -35ºC to +65ºC.

.3 Handwheel:

.1 Equip the actuator with a handwheel with a maximum nominal diameter of 200 mm of the automatic declutching type for manual operation, so connected that operation by the motor shall not cause the handwheel to rotate, and the operation of the handwheel shall not cause the motor to rotate. Should power be returned to the motor while the handwheel is in use, the design of the unit shall prevent the transmission of the motor torque to the handwheel. The maximum pull on the rim of the handwheel necessary to develop the full actuator torque shall not be more than 27 N-M at any point through valve travel, seating or unseating. The handwheel shall be required to hold any position between fully-open and fully-closed on the valve. The handwheel shaft of the valve shall be vertical or horizontal and shall turn clockwise to close the valve. The handwheel shall have an arrow and the word "open" or "close" indicating the required direction of rotation.

.2 Provide a declutch lever to place the actuator in manual mode. It shall be lockable in either position and shall require not more than 10 lbs. force to operate at any point during valve operation, including end of travel.

.4 Motor:

.1 Design electric motors for valve actuator service as applicable, and shall conform to NEMA type "D" design criteria or an equivalent high starting-torque design. The motor shall produce a minimum of 40% rated torque on starting.

.2 The motor shall be adequately rated and capable of developing sufficient torque to operate the valve under the specified conditions.

.3 Actuator motor duty cycle ratings shall be 25%, defined as 15 min. on/45 min. off with maximum of 600 starts/hr.

.4 Overload protection shall be means of overload relays or solid state overload relays.

.5 All motors shall be totally enclosed and non-ventilated.

.6 Insulate all motors with high temperature moisture-resistant materials (insulation Class B), and equip with an internal heating element.

.7 Provide all motors with a stainless steel nameplate which shall indicate the motor horsepower, service factor, operating voltage, full load current and carry the seal of the Canadian Standards Association.

.8 All motors shall be suitable for 3-phase, 60 Hz nominal at 600 VAC ±10% operation.

.5 Position Indication System (Open and Closed):

.1 Open and closed positions shall be indicated by use of limit switches or by the use of a proven electronic positioning system.

.2 Limit switches shall be geared to the drive mechanism and in step at all times whether the unit is operated electrically or manually. The switches shall be of field adjustable type capable of being set either fully open, fully closed or intermediate position. Limit switch gearing shall be appropriately lubricated and totally enclosed to prevent entrance of foreign material or loss of lubricant.

.3 Electronic positioning systems shall consist of a hall effect sensor driven directly from the actuator drive. The system shall allow for easy adjustment of the valve position settings and should be retentive so that valve position is not lost when power is removed from the actuator.

.6 Over-Torque Protection:

.1 Provide all actuators over-torque protection by means of torque switches or proven electronic torque sensing.

.2 Torque switch systems shall include an adjustable positive trip torque switch and thrust-switch arrangement to break the control power circuit when the valve requiring torque seating has reached the fully open or fully closed position (stops), or when an obstruction has been encountered in either direction of travel. Open and close torque switches shall be adjustable by means of individually calibrated dials marked "OPEN" and "CLOSE". An open torque-switch bypass circuit shall be provided for torque-seated valves to eliminate nuisance trip during unseating.

.3 Torque sensing systems shall electronically measure motor parameters to produce a torque value which is compared with a preset value, and if exceeded, will trip the motor contactor.

.4 The torque sensing system shall include motor voltage sensing to compensate for line voltage fluctuations. The preset torque value shall be fully adjustable. Torque sensing shall be present throughout the opening and closing travel ranges. A torque-sensing bypass feature shall be provided to eliminate nuisance tripping during unseating of closed valves. The duration of the bypass period shall be adjustable.

.7 Electrical Controls Enclosure:

.1 Electrical enclosures provided with properly threaded conduit hubs that allow minimum 5-thread conduit engagement. A minimum of three (3) conduit hubs shall be provided to allow for separate power, control and analogue wiring.

.2 All electrical controls enclosures shall be rated NEMA 4X.

.8 Drive Coupling:

.1 Mating of the electrical actuator to the stem shaft of quarter turn valves shall be accomplished by means of a separate removable splined gear which will allow for a minimum of eight (8) mounting positions.

.2 Mating of the electrical actuator to the stem shaft of rising stem valves shall be accomplished by means of a separate removable bronze stem nut drive coupling.

.9 Position Indication:

.1 Position indication, shall be accomplished by means of an LCD or indicator dial in full step at all times with valve or sluice-gate travel during both power or manual operation. The indicator dial shall be graduated in 25% increments as a minimum, that is, closed, quarter open, half open, three-quarters open, and open.

.10 Opening/Closing Time:

.1 Size electric actuators such that the valve travel time from fully open to fully closed is less than 10 minutes and shall be accomplished by reduction gearing.

.11 Electrical Controls:

.1 All electric equipment shall be CSA approved. The actuator name plate shall bear the CSA seal or equivalent electrical approval marking.

.12 Terminal Blocks and Wiring:

.1 Provide easily accessible terminal blocks where all power, control indication, limit switch, and auxiliary contact devices are connected. Terminal blocks shall have each terminal identified in a permanent fashion so that any conductor disconnected in service can easily be replaced in its assigned terminal location.

.2 The terminal block compartment shall be sealed externally, and from the other parts of the actuators so that moisture cannot penetrate from one compartment into other parts of the actuator or motor.

.3 A ground lug shall be supplied for termination inside the terminal block compartment.

.4 SEach factory wired conductor shall be identified at both ends by means of Electrovert Type Z or Type C PVC markers or other approved means bearing the coded identifications given by the approved shop schematics. Hand-written wire markers are not acceptable.

.13 Actuator to be complete with the following signals:

.1 Actuator closed status (ZIC).

.2 Actuator open status (ZIO).

.3 Actuator closed command (ZCC).

.4 Actuator open command (ZCO).

.5 Local/Remote switch status (HS).

.14 Control Power Transformer: Control voltage shall be 120 V, single phase, 60 Hz. The control transformer shall be designed to transform 600 V three phase, 60 Hz

power to 120 V, single-phase power. The transformer shall be complete with a grounded and fused primary and secondary.

.15 Push Buttons: Supply the actuator complete with OPEN (N.O.), STOP (N.C.), CLOSE (N.O.) push buttons or toggle switches.

.16 Indicating Lights: Furnish the actuator complete with open-close light indication for valve or sluice-gate position. Lenses shall be green for open and red for close. Both lenses shall be lit during intermediate travel.

.17 Selector Switch: Supply a LOCAL-OFF-REMOTE selector-switch function to isolate the incoming process-signal control function from the manual push-button controls.

2.7 FACTORY TESTING

.1 Factory test fully assembled slide gate and actuator, prior to shipment to site.

Part 3 Execution

3.1 INSTALLATION

.1 Provide the services of a qualified technical manufacturer's representative for a minimum of one trip of one day duration to provide instruction on installation requirements and two trips of one day duration each to witness installation.

.2 Align and install each slide gate in accordance with manufacturer's written instructions.

.3 Carefully install all slide gates in their respective locations, straight, plumb and free from all distortion and undue strain. Take extreme care to obtain true alignment in setting wall castings in forms.

.4 Where frames are anchored to concrete walls, provide a grout pad between the frame and the wall.

.5 Provide anchor bolts of sufficient size and number to provide a tight installation in accordance with structural specification.

.6 Protect exposed metal during erection from mortar drippings, wet concrete or other adhering substances.

3.2 TESTING

.1 Test each slide gate in accordance with Section 01 75 00 - Pre-start-up, Start-up and Commissioning.

.2 Provide the services of a qualified technical manufacturer's representative for a minimum of two days duration to witness testing.

.3 Following testing, operate each slide gate through at least two complete open-close cycles.

.4 Conduct field leakage tests in accordance with Section 5 of AWWA C561.

.5 For gear-operated gates, ensure the maximum leakage rate does not exceed 1.24 L/m per metre of wetted perimeter at the specified seating and unseating conditions.

3.3 COMMISSIONING

.1 Ensure a manufacturer's representative attends the site during the commissioning of the process system which includes the slide gates specified in this section and in accordance with Section 01 75 00 - Pre-start-up, Start-up and Commissioning.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section specifies the supply, installation and testing of manually operated valves used for isolation, manual throttling, and bypass and for specialty valves requiring electric, hydraulic or pneumatic actuation.

1.2 DEFINITIONS

.1 Valve Identification

.1 Process, HVAC and yard piping valves are identified on the drawings by valve symbols. Refer to the drawings for lists of valve symbols and labels.

.2 Actuators

.1 Supply valves with standard operators as detailed herein unless otherwise noted in the Contract Documents.

.2 All valves must be operable from grade.

1.3 SUBMITTALS FOR REVIEW

.1 Submit the following:

.1 Catalogue cuts and/or shop drawings for each type of valve indicating valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.

.2 For actuated valves, provide catalogue cuts and/or shop drawings for each actuator type indicating actuator number, materials of construction, dimensions, I/O, and power requirements.

.3 An amended Detailed Valve Specification Sheet or Specialty Valve Data Sheet for all valves. Indicate with check marks where valve supplied meets requirements specified and with written amendments where product differs from the specification.

1.4 SUBMITTALS FOR INFORMATION ONLY

.1 Submit the following:

.1 Operating and Maintenance data for incorporation in operation and maintenance manual, as specified in the Contract Documents. Include complete description of operation together with detailed drawings, a complete list of replacement and repair parts, and parts manufacturer's identifying numbers.

.2 Affidavits and registration numbers described below in Quality Assurance.

1.5 QUALITY ASSURANCE

.1 Provide affidavits of compliance, as required by AWWA C500 for gate valves.

.2 For butterfly valves to be installed below ground provide affidavits of compliance with AWWA C504.

.3 Valves are to be marked in accordance with MSS SP25.

1.6 SHIPMENT, PROTECTION AND STORAGE

.1 Deliver valves to site using loading methods which do not damage casings or coatings.

.2 Clearly tag valves, stating size, type, coating and mating parts.

.3 Store on site until ready for incorporation in the work using methods recommended by manufacturer to prevent damage, undue stresses, or weathering.

.4 Deliver and store valves in accordance with Section 01 61 00 – Basic Product Requirements.

Part 2 Products

2.1 GENERAL

.1 Provide valves of the same type, size range and service from a single manufacturer.

.2 Provide new, unused valves for the work.

.3 Valve materials to be free from defects or flaws, with true alignment and bores.

.4 Unless otherwise indicated, valves shall be the same size as the pipe run in which they are to be installed.

.5 Clearly mark valve bodies in raised lettering to indicate the valve type, rating, and where applicable, the direction of flow. Conform to MSS SP25.

.6 Provide padlockable lockout feature on all sizes of the following valve types or where indicated on drawings:

.7 Automated Control Valves (electric and pneumatic): Flow Control, Level Control and Pressure Control and XV Valves only.

.1 Specialty Valves: FV and Pressure Relief Valves only.

.2 Manual Isolation and Shut-off Valves: AV, BD, Butterfly, Ball, Diaphragm, Globe, Gate, Knife Gate, Pump Discharge, Pinch, Plug, and Mixing Valves only.

.8 Valves to open counter-clockwise.

2.2 VALVE SPECIFICATION

.1 Refer to specification Section 40 23 24 – Detailed Piping Specifications for each valve specification according to type and line code.

2.3 SPECIALTY VALVE SCHEDULE

.1 As shown below:

P&ID	Tag		Valve Type	Size (mm)
D-009	MV	511	Electrical open/close knife gate valve	500
D-009	MV	521	Electrical open/close knife gate valve	500
D-010	MV	531	Electrical open/close knife gate valve	500
D-010	MV	541	Electrical open/close knife gate valve	500
D-010	MV	551	Electrical open/close knife gate valve	500
D-010	AVV	500	Air Vacuum Valve	150
D-010	AVV	501	Air Vacuum Valve	150

2.4 AIR VACUUM VALVES (AVV-500, AVV-501)

.1 Furnish air vacuum release valves as automatic release valves for wastewater application.

.2 The main valve part shall be:

.1 Cast Iron ASTM A126 Cl. B body
.2 316 stainless steel trim and float
.3 Non-stick Fusion Bonded Epoxy (internal & external).
.4 Buna-N Seat

.3 General sizing information:

.1 Flow Rate: 0.925 m^3/s.
.2 Pressure: - 0.4 bar.

.4 Acceptable product: Valmatic Model 306AS or approved alternate.

2.5 ELECTRICALLY ACTUATED CONTROL VALVES (MV-511, MV-521, MV-531, MV-541, MV-551)

.1 Valve type: knife gate valve, lugged style, refer to Section 40 23 24 – Detailed Piping Specifications.

.2 Valve size: 500 mm.

.3 General sizing information:

.1 Fluid: Effluent water, 0 to 20°C.
.2 Flow Rate: 0 – 30 MLD.
.3 Maximum Inlet Operating Pressure: 0 - 100 kPA.

.4 Acceptable actuator product: Rotork IQ series or approved alternate.

.5 Electric Actuators:

.1 General:

.1 Electric actuators selected by the supplier shall conform to the latest edition of AWWA C540 Section 3, except as modified or supplemented herein.

.2 Each electric-motor actuator shall include as one integral unit, but not be limited to, the electric motor, reduction gearing, drive coupling, torque and positioning controls, extension spindle, gear case, and auxiliary handwheel. The valve and actuator combination should be self locking.

.3 All electrical actuator enclosures shall be rated NEMA Type 4X.

.4 Valve actuator suppliers shall have local representation including trained technicians on-call for field service. The suppliers shall carry locally or have available within a 24-hour period all necessary spare parts including, but not limited to, switches, switch drives, motors and F/R contactors.

.5 Electric actuators shall have been manufactured previously for a minimum period of five (5) years of the same design submitted.

.6 Provide the actuator with a permanent stainless steel “tag” which will include the valve field location and pre-assigned equipment number. Provide three (3) sets of electrical schematic and wiring, and assembly drawings.

.2 Power Gearing:

.1 Reduction shall be by means of spur, helical, bevel and/or worm gears. Gears shall be steel. Worm gears shall be bronze. The use of non-metallic or aluminum gears in the power train will not be accepted.

.2 A lost motion device independent of gear backlash shall be supplied as an integral part of the actuator gear train. This device shall allow the motor to attain full speed before the load is engaged. The lost motion device shall be removable from the actuator in the event that the valve is required for modulating service.

.3 Support all gears and shafting on anti-friction bearings. Where thrust is a consideration, roller or axial-thrust-needle bearings shall be provided.

.4 Grease or oil lubricate all gearing and bearings. Provide seals at all shaft penetrations of the gear case to prevent leakage of lubricant, regardless of position. Lubricants shall be suitable for year round service based on prevailing ambient temperature conditions and operating temperature conditions which range from -35ºC to +65ºC.

.3 Handwheel:

.1 Equip the actuator with a handwheel with a maximum nominal diameter of 200 mm of the automatic declutching type for manual operation, so connected that operation by the motor shall not cause the handwheel to rotate, and the operation of the handwheel shall not cause the motor to rotate. Should power be returned to the motor while the handwheel is in use, the design of the unit shall prevent the transmission of the motor

torque to the handwheel. The maximum pull on the rim of the handwheel necessary to develop the full actuator torque shall not be more than 27 N-M at any point through valve travel, seating or unseating. The handwheel shall be required to hold any position between fully-open and fully-closed on the valve. The handwheel shaft of the valve shall be vertical or horizontal and shall turn clockwise to close the valve. The handwheel shall have an arrow and the word "open" or "close" indicating the required direction of rotation.

.2 Provide a declutch lever to place the actuator in manual mode. It shall be lockable in either position and shall require not more than 10 lbs. force to operate at any point during valve operation, including end of travel.

.4 Motor:

.1 Design electric motors for valve actuator service as applicable, and shall conform to NEMA type "D" design criteria or an equivalent high starting-torque design. The motor shall produce a minimum of 40% rated torque on starting.

.2 The motor shall be adequately rated and capable of developing sufficient torque to operate the valve under the specified conditions.

.3 Motors shall be capable of operating through two complete cycles, open-close-open and close-open-close, under the maximum specified operating conditions without overheating when voltage to the motor is within ±10% of the specified voltage.

.4 Actuator motor duty cycle ratings shall be 100%, defined as 40 min. on/40 min. off with maximum of 600 starts/hr.

.5 Overload protection shall be means of overload relays or solid state overload relays.

.6 All motors shall be totally enclosed and non-ventilated.

.7 Insulate all motors with high temperature moisture-resistant materials (insulation Class B), and equip with an internal heating element.

.8 Provide all motors with a stainless steel nameplate which shall indicate the motor horsepower, service factor, operating voltage, full load current and carry the seal of the Canadian Standards Association.

.9 All motors shall be suitable for 3-phase, 60 Hz nominal at 208 VAC ±10% operation.

.5 Position Indication System (Open and Closed):

.1 Open and closed positions shall be indicated by use of limit switches or by the use of a proven electronic positioning system.

.2 Limit switches shall be geared to the drive mechanism and in step at all times whether the unit is operated electrically or manually. The switches shall be of field adjustable type capable of being set either fully open, fully closed or intermediate position. Limit switch gearing shall be appropriately lubricated and totally enclosed to prevent entrance of foreign material or loss of lubricant.

.3 Electronic positioning systems shall consist of a hall effect sensor driven directly from the actuator drive. The system shall allow for easy adjustment of the valve position settings and should be retentive so that valve position is not lost when power is removed from the actuator.

.6 Over-Torque Protection:

.1 Provide all actuators over-torque protection by means of torque switches or proven electronic torque sensing.

.2 Torque switch systems shall include an adjustable positive trip torque switch and thrust-switch arrangement to break the control power circuit when the valve requiring torque seating has reached the fully open or fully closed position (stops), or when an obstruction has been encountered in either direction of travel. Open and close torque switches shall be adjustable by means of individually calibrated dials marked "OPEN" and "CLOSE". An open torque-switch bypass circuit shall be provided for torque-seated valves to eliminate nuisance trip during unseating.

.3 Torque sensing systems shall electronically measure motor parameters to produce a torque value which is compared with a preset value, and if exceeded, will trip the motor contactor.

.4 The torque sensing system shall include motor voltage sensing to compensate for line voltage fluctuations. The preset torque value shall be fully adjustable. Torque sensing shall be present throughout the opening and closing travel ranges. A torque-sensing bypass feature shall be provided to eliminate nuisance tripping during unseating of closed valves. The duration of the bypass period shall be adjustable.

.7 Electrical Controls Enclosure:

.1 Electrical enclosures provided with properly threaded conduit hubs that allow minimum 5-thread conduit engagement. A minimum of three (3) conduit hubs shall be provided to allow for separate power, control and analogue wiring.

.2 All electrical controls enclosures shall be rated NEMA 4X.

.8 Drive Coupling:

.1 Mating of the electrical actuator to the stem shaft of quarter turn valves shall be accomplished by means of a separate removable splined gear which will allow for a minimum of eight (8) mounting positions.

.2 Mating of the electrical actuator to the stem shaft of rising stem valves shall be accomplished by means of a separate removable bronze stem nut drive coupling.

.9 Opening/Closing Time:

.1 Size electric actuators such that the valve travel time from fully open to fully closed is between 4 and 6 minutes and shall be accomplished by reduction gearing.

.10 Electrical Controls:

.1 All electric equipment shall be CSA approved. The actuator name plate shall bear the CSA seal or equivalent electrical approval marking.

.2 Terminal Blocks and Wiring:

.1 Provide easily accessible terminal blocks where all power, control indication, limit switch, and auxiliary contact devices are connected. Terminal blocks shall have each terminal identified in

a permanent fashion so that any conductor disconnected in service can easily be replaced in its assigned terminal location.

.2 The terminal block compartment shall be sealed externally, and from the other parts of the actuators so that moisture cannot penetrate from one compartment into other parts of the actuator or motor.

.3 A ground lug shall be supplied for termination inside the terminal block compartment.

.4 Each factory wired conductor shall be identified at both ends by means of Electrovert Type Z or Type C PVC markers or other approved means bearing the coded identifications given by the approved shop schematics. Hand-written wire markers are not acceptable.

.3 Control Power Transformer: Control voltage shall be 120 V, single phase, 60 Hz. The transformer shall be complete with a grounded and fused primary and secondary.

.4 Push Buttons: Supply the actuator complete with OPEN (N.O.), STOP (N.C.), CLOSE (N.O.) push buttons or toggle switches.

.5 Indicating Lights: Furnish the actuator complete with open-close light indication for valve or sluice-gate position. Lenses shall be green for open and red for close. Both lenses shall be lit during intermediate travel.

.6 Selector Switch: Supply a LOCAL-OFF-REMOTE selector-switch function to isolate the incoming process-signal control function from the manual push-button controls.

2.6 OTHER VALVE SPECIFICATION

.1 Refer to Section 40 23 24 – Detailed Piping Specification according to type and line code for valves not specifically specified in this section.

2.7 DRAWINGS

.1 Process schematics indicate major process valves required for the process to operate as intended.

.2 Detailed process drawings, HVAC drawings, process standard drawings, HVAC standard drawings, yard piping drawings and service piping schematics indicate the valves on the process schematics plus other valves required for isolation.

.3 In pipe runs less than 100 mm diameter, in addition to the valves indicated on the P&IDs, detailed drawings and standard drawings, provide isolation valves in straight pipe runs at intervals no greater than 60 m and at takeoffs to individual services. Provide ball isolation valves in pipe of 65 mm diameter and less, or in pipe of less than 100 mm diameter and carrying solids. Provide butterfly isolation valves in pipe of 75 mm diameter and greater and not carrying solids.

.4 In pipe runs carrying sludge or scum tap bottom of pipe at low point of runs and install short nipple and valve.

.5 Provide valves and taps on top of pipe at high point in all liquid pipe runs greater than 60 m length where the change in slope exceeds 4 percent.

.6 Provide flushing connections and valves as shown in standard details, at 30 metre intervals on any primary sludge, primary and thickener scum and thickened secondary sludge lines.

.7 Unless otherwise specified, provide gate valves 400 mm and larger with a bypass valve sized in accordance with AWWA C500.

2.8 VALVE ENDS

.1 In pipe runs less than 75 mm diameter provide valves with female threaded ends, unless indicated otherwise. Threads to conform to ANSI B1.20.1.

.2 Valves in pipe runs equal to or greater than 75 mm diameter to be flanged unless indicated otherwise.

.3 For cast iron body valves, drill flanges to Class 125 pattern conforming to ANSI B16.1. For steel body valves, flanges to be Class 150 pattern or Class 300 pattern conforming to ANSI B16.5 or as noted.

.4 Do not use grooved joint valve ends.

.5 Use flanged joints for buried and exterior valves. Flanges to be compatible with pipe and jointing technique used.

.6 Use flanged joints for buried butterfly valves.

.7 Lug style wafer body valves shall have tapped holes, suitable for the bolt spacing of the pipe flanges placed on either side.

.8 Wafer body valves shall have positioning holes, suitable for the bolt spacing of the pipe flanges placed on either side.

.9 End flanges for gate valves to be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1, Class 125 flanges.

2.9 MANUAL OPERATORS

.1 Valves must be operable from grade elevation unless otherwise noted.

.2 Provide valves with manual operators unless specifically indicated otherwise.

.3 For hand wheels, clearly show direction of opening in raised lettering and symbols.

.4 Hand wheel diameter to conform to the following:

Nominal Valve Size (mm)	Minimum Hand Wheel Diameter (mm)
12	50
20	50
25	60
38	75
50	85
65	105
75	200
100	250
150	300
200	350
250	400
300	450
350	450
400	550
450	600
500	600
600 / 750	600

.5 Maximum rim pull on a hand wheel not to exceed 300 N when one side of the valve is at test pressure and the other side is at atmospheric pressure. Provide gear operator where a shaft mounted hand wheel would require greater than this force to operate. Unless different operators are scheduled or shown in the drawings, conform to the following minimum requirements:

.1 Gate Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.

.2 . Knife Gate Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.

.3 Globe and Needle Valves: less than 200 mm, hand wheel; equal to or greater than 200 mm, gear operator.

.6 Match existing operating nuts. Provide two eight-point operating wrenches.

.7 Supply stem extensions and valve boxes for buried valves. Provide two operating tees.

.8 Lever operators to conform to the following dimensions:

Nominal Valve Size (mm)	Minimum Length of Lever (mm)
6	80
12	80
20	100
38	150
50	150
65	150
75	175
100	225
150	250
200	300
250	450
300	450

.9 Quarter turn lever operators to be perpendicular to the pipe run when the valve is closed.

.10 Lever operators on ball valves to be two position. Provide butterfly valves with 10 position latching levers except where used to balance air flows. Where used to balance air flows provide infinite position, screw down levers.

.11 Maximum pull at the end of the lever arm not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. Provide a gear operator where greater than this force would be required to operate the valve with a lever. Conform to the following minimum requirements unless different operators are scheduled or shown in the drawings:

.1 Ball Valves: less than 150 mm, lever operator; greater than or equal to 150 mm, gear operator.

.2 Butterfly Valves: less than 150 mm, lever operator; greater than or equal to 150 mm, gear operator.

.12 Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equip operators with adjustable, self-locking mechanical stop-limiting devices designed to hold the valve in any intermediate position between full open and full closed to prevent overtravel of the disc/ball in the open and closed positions. Gear operators to be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.

.13 Manual operators for butterfly and gate valves for buried service to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures to 700 kPa (all mounting hardware to be stainless steel). Operators for exposed service to be gasketed for weatherproof service. Gear boxes to be placed above ground and liquid surfaces.

.14 Gear and manual operators for submerged service to be permanently lubricated and sealed for operation at water pressures to 700 kPa.

.15 Provide chain wheel gear operators for manual valves on lines 75 mm and greater, mounted over 2.0 m above the operating floor. Design the operator so that a force of 150N is sufficient to open the valve when one side of the valve is at test pressure and the other side is at atmospheric pressure. The chain pulley to mesh positively with the chain. Chain to extend from valve operator to operating height 1.2 m above the floor or as directed by the Engineer. Exact dimensions to be field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

2.10 VALVE STEM EXTENSIONS

.1 Provide valve stem extensions where additional clearance is required for pipe insulation or where valve operation without the extension is difficult and in manholes.

.2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

2.11 VALVES

.1 Hose Bibbs – General duty.

- .1 Body: Cast Bronze: ASTM B584.
- .2 Size: 20mm (3/4”).
- .3 Connection: Threaded.
- .4 Seat Disc: Buna-N.
- .5 Seat Disc Screw: Stainless Steel.
- .6 Hand Wheel: Epoxy coated Zinc alloy.
- .7 Hose Connection: 20mm (3/4”) MIP to Hose.
- .8 Approved Manufacturers:
  - .1 Wilkins
  - .2 Zurn.
  - .3 Watts.
  - .4 Nibco.

.2 Hose Bibb – use for headworks

- .1 Stainless steel ball valve, equal to Crane model CSC-9502-2.
- .2 20mm male solid brass hose connection, equal to Crane model 525 or 526.
- .3 Complete with cap nut and chain.
- .4 Hose Connection: 20 mm (3/4 in.) MIP to Hose.

.3 Ball Valves (BAV) - 100 mm and smaller.

- .1 Rating: 400 psi WOG.
- .2 Body: bronze/brass.
- .3 Ball: bronze chrome plated.

.4 Stem: brass, blowout proof design.

.5 Packing: PTFE.

.6 Seat: PTFE.

.7 Operator: lever.

.8 End conns: NPT.

.9 Approved Manufacturers:

.1 Crane.

.2 Watts.

.3 Nibco.

2.12 INSULATION

.1 Insulate valves in accordance with Section 27 07 15 – Thermal Insulation for Piping and Equipment.

.2 Preform insulation in a shape suitable for the valve, of the same material specified in Section 27 07 15 - Thermal Insulation for Piping and Equipment.

.3 Recovering to be as specified in Section 27 07 15, with transition sections for joints between valve insulation and pipe insulation.

.4 Insulation to be removable and reusable without destroying insulation or recovering.

2.13 PROTECTIVE COATINGS

.1 Provide valves coated in accordance with Section 40 46 16 – Protective Coating and Lining for Steel Pipe unless otherwise specified.

2.14 SPARE PARTS

.1 Provide spare parts in accordance with Section 01 78 24 – Spare Parts and Maintenance Materials.

.2 Provide one spare valve including the appropriate operator for each valve type and size equal to or less than 250 mm in diameter.

.3 Provide a list of all spare parts which would be expected to be required under normal conditions for a period of five years. At the Engineer's request, provide a price for these parts.

Part 3 Execution

3.1 PREPARATION

.1 Valve and piping arrangement indicated in the drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in piping to allow for discrepancies between valve dimensions shown and those supplied for the work.

.2 Field measure and check all equipment locations, pipe alignments, and structural installation prior to installation of valves. Ensure that valve locations and orientations provide suitable access to manual operators and that sufficient space and accessibility is available for pneumatic and electric actuators.

.3 Where conflicts are identified, inform the Engineer and initiate the necessary piping modifications at no cost to the Owner.

3.2 VALVE INSTALLATION

.1 In horizontal pipe runs, other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.

.2 Mount butterfly valves and trunnion ball valves with shaft in a horizontal orientation.

.3 Do not overtorque bolts to correct for misalignment when joining valves to pipe or fittings,

.4 Support valves in position using temporary supports until valves are fixed in place.

.5 Permanently support valves to prevent transmission of loads to adjacent pipework and/or equipment.

.6 Where valves are installed in PVC pipework greater than 100 mm diameter, support valves independently and brace against operating loads and torque to prevent transmission of stresses to adjacent pipework.

.7 Generally pipe supports and hangers are not shown for indication purposes.

.8 Install gate valves in the closed position.

.9 Install valves which are bubble tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Engineer.

.10 Unless otherwise specified, install single seated ball valves and knife gate valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.

.11 Install all valves in accordance with manufacturer's recommendations.

.12 Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tapewrap.

3.3 VALVE EXTENSIONS

.1 Install valve stem extensions where necessary to provide clearance from insulation.

.2 Install valve stem extensions where indicated on drawings.

3.4 INSULATION

.1 Install insulation and recovering as specified in Section 27 07 15 - Thermal Insulation for Piping and Equipment.

3.5 VALVE TESTING

.1 Operate valves under simulated and/or real process conditions to ensure operation as intended.

.2 Valves to be pressure tested in conjunction with the pipes in which the valves are installed.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section contains detailed piping specifications.

1.2 PIPING IDENTIFICATION

.1 The drawings designate the size and line service specification of pipe to be supplied by the Contractor in the following manner:

.1 Line Identification: Line identification is placed on each line in the following manner:

150 - PW - A1 - A - D

Where:

150	Line Size
PW	Commodity
A1	Piping Line Code
A	Internal Lining
D	External Pipe Coating

.2 Commodity Symbols for Line Identification

SYMBOL	COMMODITY
AAS	Aeration Air Supply
EFF	Effluent
PSW	Plant Service Water (non potable)
RWW	Raw Waste Water (Sewage)

.3 Line Codes: The following is a description of the general line code classifications. For specifics, refer to the appropriate commodity sheet.

Pipe or Line Codes	Flange Ratings	Basic Material	Maximum Design Pressure	Maximum Design Temp.	Suitable Services
A1	ANSI 150	Steel	1034 kPa	100°C	AAS, EFF
H1	ANSI 150	Stainless 304	1034 kPa	100°C	AAS, EFF

.4 Special Treatment Code

SYMBOL	DESCRIPTION
(A)	Cement mortar lining
(B)	Internal hot applied coal tar lining
(C)	Internal epoxy lined
(D)	Yellow jacket coated
(E)	External hot applied coal tar lining
(F)	External epoxy coated
(G)	Insulated

(H) Flexible elastomeric insulation
(I) Insulation c/w jacket (high temperature)

Part 2 Products

.1 As follows:

SERVICE: AAS, EFF		LINE CODE: A1
PRIMARY FLANGE RATING:	CLASS 150 ANSI B16.5	DESIGN PRESSURE: 1034 kPa
TEMPERATURE (MAX): 100°C		CORROSION ALLOWANCE: 1.3 mm

ITEM	SIZES	GENERAL DESCRIPTION
Pipe	750 to 900 mm	Steel, ASTM A139 Grade B, or API 5L Grade B, seamless or welded, 9.5 mm wall.
	80 mm to 600 mm	Steel, ASTM A53 or ASTM A106 Grade B, seamless or welded, standard weight.
	40 mm to 65 mm	Steel, ASTM A53 Grade B, seamless or welded, Sch. 40.
	30 mm or smaller	Steel, ASTM A53 Grade B, seamless or welded, Sch. 80.
Fittings	750 to 900 mm	Steel, ASTM A234 Grade WPB, butt weld, 9.5 mm wall.
	80 mm to 600 mm	Steel, ASTM A234 Grade WPB, standard weight, butt weld. Dimensions to ANSI B16.9.
	65 mm or smaller	Steel, ASTM A197 Class 300, malleable iron, screwed.
NOTE: Elbows to be long radius unless otherwise specified.		
Coatings / Linings	All sizes	Refer to spec. 404616.
Flanges	750 mm	Steel, ANSI B16.47 Series A Class 150 or AWWA C207 Class E, slip-on, flat faced with serrated finish.
	80 mm to 600 mm	Steel to ANSI B16.5 Class 150, or AWWA C207 Class E, slip-on or weld-neck, raised face. Orifice Flanges to be Class 300 Carbon Steel to ASTM A105, slip-on, raised face. Flanges mated to equipment with cast iron flat faced flanges or rubber seated butterfly valves to be flat faced.

NOTE: Flanges attached to fittings to be weld neck type equal in material, dimensions and rating to the Class E flange.

SERVICE: AAS, EFF		LINE CODE: A1
PRIMARY FLANGE RATING:	CLASS 150 ANSI B16.5	DESIGN PRESSURE: 1034 kPa
TEMPERATURE (MAX): 100°C		CORROSION ALLOWANCE: 1.3 mm

ITEM	SIZES	GENERAL DESCRIPTION
Bolts	All sizes	ASTM A193 Grade B7 hex head.
Nuts	All sizes	ASTM A194 Grade 2H, hex head semi-finished.
NOTE: Buried flanges to come with 316SS bolts and nuts.		
Flange Gaskets	All sizes	EPDM, ring type for RF flanges, full face for FF flanges, to ASTM B16.21
Unions	80 mm & larger	Use flanges.
	65 mm & smaller	Class 300, malleable iron, ground joint, bronze to iron seat.
Pipe Couplings	65 mm & smaller	Use unions.
	80 mm & larger	The coupling type to be as shown on the drawings and to suit outside diameter of pipe. Flanged adaptor couplings to be Dresser Style 128 with AWWA C207 Class E flange. Flexible couplings to be Dresser Style 38, Robar or Viking Johnson. Flanged adaptor and flexible couplings to be internally lined as specified for pipe.
	80 mm to 300 mm	Victaulic Style 07 and 77 standard weight.
	350 mm to 750 mm	Victaulic Style W07 and W77, per pipe schedule.
	750 mm to 900 mm	Victaulic Style 232, epoxy coated.
NOTE: Gaskets for pipe couplings rated for line code maximum temperature and intended service.		
NOTE: For buried service, pipe couplings rated/approved for buried service, fasteners to be 316SS.		
Victaulic Gasket	All Sizes	To match Couplings and intended service.
Thread Compound	As required	Teflon tape.
Plug Valves	80 mm to 150 mm	Class 150, cast iron or ductile iron body w/ epoxy coating external and internal wetted areas, resilient plug, Buna-N or Nitrile seal, nickel seat, flanged, 100% port. Dezurik PEF or approved equivalent.

SERVICE: AAS, EFF		LINE CODE: A1
PRIMARY FLANGE RATING:	CLASS 150 ANSI B16.5	DESIGN PRESSURE: 1034 kPa
TEMPERATURE (MAX): 100°C		CORROSION ALLOWANCE: 1.3 mm

ITEM	SIZES	GENERAL DESCRIPTION
Ball Valves	40 mm and smaller	2000 PSI WOG, cast steel body, TFE seat and seal, SS ball & stem, screwed. W-K-M Dynaseal 310 or approved Bray or FlowTek equivalent.

SERVICE: AAS, EFF		LINE CODE: H1
PRIMARY FLANGE RATING: Class 150		DESIGN PRESSURE: 1034 kPa
TEMPERATURE (MAX): 100°C		CORROSION ALLOWANCE: N/A
ITEM	SIZES	GENERAL DESCRIPTION
Pipe	All sizes	Austenitic stainless steel to ASTM A312 Grade TP304/304L, Sch. 10S.
NOTE: All pipes must be pickled & passivated as per ASTM A380.		
Fittings	50 mm & less	Forged stainless steel to ASTM A182, F304/304L, ANSI B16.11, Class 3000, socket weld.
	80 mm and up	Austenitic stainless steel to ASTM A403, WP304/304L-S, ANSI B16.9, Sch. 10S, Butt-weld.
Flanges	15 mm to 50 mm	Forged stainless steel to ASTM A182 F304/304L, ANSI B16.5
	80 mm to 600 mm	Austenitic stainless steel, A182 F304/304L, to ANSI B16.5 Class 150, or AWWA C207 Class E, slip-on or weld-neck, raised face.
	750 mm	Austenitic stainless steel, A182 F304/304L, ANSI B16.47 Series A Class 150 or AWWA C207 Class E, slip-on, flat faced with serrated finish.
NOTE: Flanges mated to equipment with cast iron flat faced flanges or rubber seated butterfly valves to be flat faced.		
Bolts	All sizes	To ASTM A193 Grade B8, Cl.2.
Nuts	All sizes	Semi-finished, hex head to ASTM A194, Grade 8.
Flange Gaskets	All sizes	EPDM, ring type for RF flanges, full face for FF flanges, to ASTM B16.21
Pipe Couplings	80 mm & larger	The coupling type to be as shown on the drawings and to suit outside diameter of pipe.
	80 mm to 300 mm	Victaulic Style 89 and 77S, stainless steel
	350 mm to 750 mm	Victaulic Style W07 and W77.
	300 mm to 400 mm	Victaulic Style 231S (Non-restrained flexible expansion), Style 232S (Restrained).
NOTE: Gaskets for pipe couplings rated for line code maximum temperature and intended service.		
Victaulic Gasket	All Sizes	To match Couplings and intended service.
Thread Compound	As required	Teflon tape.
Butterfly Valves	80 mm to 500 mm	Class 150, resilient seated, D.I. body w/ epoxy coating external and internal wetted areas, lugged to ANSI B16.5, 304 SS disc, EPDM seats, SS shaft, Keystone GR series, Bray 31H series or approved equivalent.

SERVICE: AAS, EFF		LINE CODE: H1
PRIMARY FLANGE RATING: Class 150		DESIGN PRESSURE: 1034 kPa
TEMPERATURE (MAX): 100°C		CORROSION ALLOWANCE: N/A
ITEM	SIZES	GENERAL DESCRIPTION
Ball Valves	40 mm and smaller	2000 PSI WOG, threaded to ANSI B1.20.1, 316 SS body and ball, 316 SS stem, RPTFE seats, FP, W-K-M Dynaseal 310 or approved Bray or FlowTek equivalent.
Knife Gate Valves	80 mm to 750 mm	Class 150, flanged or lugged to ANSI B16.5, bi-directional, D.I or C.S. body w/ epoxy coating external and internal wetted areas, 304SS gate, externally replaceable EPDM resilient seat, 300 mm and above c/w bevel gear operator. Wey VM series, Bray 740 series, Dezurik or approved equivalent.

Part 3 Execution

.1 Not applicable.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This Section covers the design, supply and installation and testing of materials to provide flow assurance for process pipes

.2 This Specification describes the requirements for the design, fabrication, testing, and commissioning of electrical heat tracing, engineered to suit application.

.3 The heat tracing system will include self-regulating electrical heat tracing cables, temperature controllers, contactors, field power connection kits, junction boxes, indicating lights, conduit, wires, tape, warning labels and all necessary auxiliary equipment and controls.

.4 Provide all labour and materials and make all necessary arrangements, except as specifically noted herein so that when finished a fully working system is turned over.

.5 Heat tracing for flow assurance is required in the locations shown on the drawings.

.6 Refer to the civil and process mechanical drawings and specifications for details about the pipes to be heat traced.

1.2 SUBMITTALS

.1 Submittals to be in accordance with Section 01 33 00 – Submittals.

.2 Submit a complete electrical heat tracing design including the following:

- .1 Heater type, manufacturer and general description.
- .2 Data sheet for each type of electrical tracing cable, temperature controller, contactor.
- .3 Power requirements, voltage, maximum CB load.
- .4 Maintained temperature.
- .5 Insulation K Factor at maintained temperature.
- .6 Maximum heater exposure temperature.
- .7 Wiring diagrams and termination details.
- .8 Location of power connection points.
- .9 Installation instructions and typical details.
- .10 Performance guarantees.

.3 Submit operation and maintenance data in accordance with Section 01 78 23 – Operating and Maintenance Data.

1.3 STANDARDS

.1 Products provided under this specification must comply with all regulations and codes in effect in the Province of British Columbia.

.2 Electrical work to be in accordance with the latest applicable editions of the following codes and standards:

.1 Canadian Electrical Code (CEC).
.2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
.3 Canadian Standards Association (CSA).
.4 Factory Mutual (FM), applicable codes.
.5 National Fire Protection Association (NFPA), applicable standards.
.6 Institute of Electrical & Electronic Engineers (IEEE), applicable standards.
.7 All applicable provincial amendments to the CEC and local municipal codes.

.3 Equipment shall carry a factory installed CSA label or approval label or nationally accepted testing Laboratory.

.4 If this Specification conflicts with any of the codes and standards listed above, notify the purchaser of the variance in writing prior to beginning design.

1.4 PERMITS

.1 Obtain all the necessary permits and coordinate inspections.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver products to the site, and handle and store them to avoid damage to any components in accordance with Section 01 61 00 – Basic Product Requirements

.2 Provide dry storage areas and follow the manufacturer's recommendations for storage and handling.

1.6 QUALITY CONTROL

.1 The heat trace equipment and components provided under this Contract are to be the product of a company regularly engaged in the manufacture and supply of this type of equipment and whose equipment is of a design which has been in satisfactory service under similar conditions for not less than five years.

Part 2 Products

2.1 HEAT TRACING SYSTEM

.1 The heat tracing system will consist of the following materials and equipment to provide a complete heat traced system:

.1 Ground fault equipment protection breaker.
.2 CSA enclosure type 4X power connection kits.
.3 Conduit and fittings.
.4 Self-regulating electrical heat tracing cables.
.5 Adjustable set point thermostat controller for process temperature maintenance set to 4°C.

.6 304L stainless steel pipe straps (to anchor termination kit onto pipe).

.7 Glass tape to maintain heat tracing cable on pipe.

.8 Round cast aluminum junction boxes c/w blank covers and neoprene gaskets.

.9 Illuminated End Seals mounted above ground on wooden posts for outdoor locations, or visible indoors.

.10 RTD type pipe temperature sensing mounted in accessible locations – not buried underground

.11 Warning labels tagged **"Electric Traced"**.

.12 Lamicoid nameplates.

2.2 SERVICE CONDITIONS

.1 Heat tracing cables are to be suitable for connection and operation on the following low voltage electrical system:

.1 Nominal System Voltage: 120 VAC.

.2 Phase: 1.

.3 Frequency: 60 Hz.

.2 Certify and warrant that the design and the equipment is suitable to deliver rated performance and service life when subjected to the following conditions:

.1 The flow assurance heat tracing system is to be capable of applying sufficient electrical heat to the outside of liquid filled water line pipes to maintain flow and to prevent freezing during exposure to low ambient temperatures. The lowest expected outdoor air ambient temperature is -25°C.

.3 Design the system based on the design parameters, system limits, P&IDs, layout drawings, heat tracing summary, and the following parameters:

.1 Outdoor Temperature:

.1 Summer: 34°C.

.2 Winter: -25°C.

.2 A heat loss safety factor of 10%.

.3 Flow assurance applications on process lines and temperature maintenance on domestic tempered lines shall be as indicated above and as shown on the Drawings.

.4 Estimate the pipe length from the Drawings.

.5 Pipes to be above ground as shown on the Drawings.

.6 Number of valves shall be as shown on the Drawings.

2.3 HEAT TRACING SYSTEM EQUIPMENT

.1 Electric Heat Tracing Cable

.1 Electric heat tracing cable to be self-regulating type heater cable, for use in areas where exposure to corrosive chemicals or corrosives is expected. Use Raychem type BTV-CT or approved equivalent. Estimated cable wattage rating is 20W/m. Contractor to confirm.

.2 The general electrical heat tracing operating voltage to be single phase, 120V or 208 V – refer to panel schedules for power supply allowance for heat tracing in each location.

.3 The heat tracing must be capable of being overlapped on itself without causing localized hot spots or creating any hazards or possibility of burnout.

.4 Should the heater cable design be such that the cable wattage selected is something other than that shown above, then indicate such in design. No contract price extra or credit will be provided for a change in the cable wattage rating.

.5 Electric heat tracing for pipes to include all in-line components. All flanges, pumps, valves, devices, supports every 2 m for 100 mm and smaller pipes and appurtenances to be traced with appropriate additional lengths of heater cable as required.

.2 Temperature Controller

.1 For flow assurance applications, design thermostat for use on outdoor underground heat tracing system with an adjustable set point of 4°C in a Type 4X enclosure.

.2 Controllers to be suitable for installation outdoors.

.3 Power Cable to Heat Tracing Cable

.1 Power cables shall be multi-conductor, 600 V, RW90, FT4 rated wires in conduit. Support cables with 304L stainless steel clamps and ancillaries adequate for the type of cable and the operating environment. Terminate raceways at enclosures with an appropriately sized aluminum connector. Identify cables and all conductors on both ends with markers in accordance with Section 26 05 02 – Electrical: General Requirements. Minimum size not to be smaller than #12 AWG and be sized in accordance with the CEC.

.2 The branch circuit breaker size not to exceed 30 amperes and be based on the operating load at maintained temperature and in accordance with the CEC.

.3 The maximum voltage drop not to exceed three percent (3%).

.4 Power Connection Kit for Heat Tracing Cable

.1 All heater power connections between power cable and heat trace cable to be made in a NEMA 4X stainless steel power connection kit.

.2 Use Pentair Digitrace JBS-100-ECW-A Wall Mounted Digital Electronic Controller or approved equivalent.

.1 Provide 100 ohm Platinum RTD as directed by manufacturer.

.2 Mount controller within fiberglass enclosure or on electrical post as shown on the electrical drawings.

.5 End Seals

.1 Illuminated End Seals mounted above ground on wooden posts for outdoor locations.

Part 3 Execution

3.1 FACTORY TESTING

.1 Factory inspections and tests for self-regulating heater cables to include, but not be limited to, the following:

.1 Check resistance as a function of temperature for every shipped length to ensure maintenance of proper heater characteristics.

.2 Perform hand inspection on every foot of material shipped for visually detectable manufacturing defects.

.2 Provide certification that heat tracing performance compliance to the Specifications and that all deficiencies discovered during testing have been corrected prior to shipment.

3.2 UNLOADING AND STORAGE

.1 Unload the heat tracing equipment upon delivery to the Work Site. Inspect and inventory the equipment, and any loose components shipped, with the bill of materials to verify that all components are accounted for and are undamaged.

3.3 HEAT TRACING SYSTEM INSTALLATION

.1 Install the heat trace and system components as per the manufacturer's instructions and recommendations and in accordance with the applicable codes and standards listed herein.

.2 Provide the full integration of the heat tracing system with the power and controls system, including all necessary conduit, wiring, terminations, and connections. Install the heat trace without trapping any piping system components and to allow removal of piping system components without cutting or damaging the heat trace.

.3 Install the self-regulating heat tracing cable so that it is continuously covered by the piping insulation. Do not install the heat tracing cable in such a manner that there are exposed sections outside the insulation.

.4 Attach the heat tracing cable to the pipes at a maximum of 600 mm on centre by means of pressure sensitive glass cloth tape having thermosetting electrical grade adhesive. Heat tracing cable to be self-supporting and in such a manner that insulation can be installed and removed without the need to adjust the cable. Do not use vinyl electrical tape and avoid spiraling.

.5 Terminate the heat tracing cable at either end in an EEMAC 4X stainless steel power connection kit enclosure, mounted outside of pipe insulation and jacketing. Install the power connection kits on mounting brackets, fastened to the pipe with screw-down 304L stainless steel straps.

.6 Supply an indicating light for "Power On" and install at the end of each heat tracing cable run in such a manner that they are highly visible and can be easily monitored.

.7 Install and terminate the indicating light at a round cast aluminum junction box, mounted outside of pipe insulation and jacketing at the end of the heat trace cable run. Install a

transformer inside the junction box, as required. Size the junction box in accordance with the CEC.

.8 Install **"Electric Traced"** labels at either end and at intervals not greater than 6 m and more at key access areas and at traced devices such as valves, similar to Raychem ETL or equivalent.

.9 Supply and install nameplates on the front of each power connection kit enclosure at both ends of the heat tracing system in accordance with Section 16010 – Electrical: General Requirements.

.10 Design, supply and install complete heat tracing systems for flow assurance and freeze protection for the process raw water lines and the wells, the water supply line and the well head.

.11 Design, supply and install complete heat tracing systems for temperature maintenance for the domestic tempered water lines.

3.4 INSTALLATION CHECK

.1 A representative of the heat trace equipment manufacturer to visit the Work Site to inspect, check, adjust, and approve the installation of equipment. Notify the Owner at least 14 days prior to the date of the installation check. Coordinate with the equipment manufacturer and correct all deficiencies identified per the recommendations of the equipment manufacturer.

.2 In the field, all heat tracing cables shall be meggered with a minimum 1000 VDC. The following separate field megger readings shall be taken on each self-regulating cable:

.1 Heater cable shall be meggered when received at job site before installation.

.2 Heater cable shall be meggered after installation, but prior to insulation being applied.

.3 Heater cable shall be meggered after insulation has been installed.

.3 All three of the above field megger readings shall be at least one megohms; otherwise the heater cable is not acceptable and must be replaced.

.4 Record field megger tests for each heater cable and submit certified reports to the Owner's Field Representative.

.5 Permit the Owner's Field Representative to inspect the freeze protection system and maintenance temperature heating equipment and electrical heat tracing cables for compliance with the purchase order, this specification, industry standards, the manufacturer's standards and the seller's drawings, prior to application of piping or tank insulation systems.

.6 Verification of performance will provide the basis for acceptance of the heat trace equipment installation. Coordinate written certification with the Manufacturer's Representative outlining the tests carried out and results for each heat trace system.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Apply protective coatings and linings to all exposed surfaces of all steel pipe in accordance with the requirements of this specification.

1.2 SAFETY

.1 Safety of the public, workers and the environment is the responsibility of all parties directly or indirectly related to this project as described above.

.2 All work relating to this project must be in accordance with WorkSafe BC regulations.

.3 It is expected that the all workers be properly trained, all equipment and facilities be in good repair, and safe work practices be followed throughout the duration of this project.

1.3 PRE-JOB MEETING

.1 A pre-job meeting shall be held to verify project requirements, manufacturer's application instructions, manufacturer's warranty requirements and quality control procedures and requirements. The Contractor and/or his QC representative, the shop coating applicator, and the Owner's Coating Inspector (CI) shall be present at the pre-application meeting.

1.4 REFERENCES

.1 The Society for Protective Coatings SSPC-SP1, Solvent Cleaning.

.2 The Society for Protective Coatings SSPC-SP10, Near White Blast Cleaning.

.3 The Society for Protective Coatings SSPC-VIS 1, Pictorial Surface Preparation Standards for Painting Steel Surfaces.

.4 SSPC-PA COM - Commentary on Paint Application.

.5 SSPC-Guide 15 - Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.

.6 ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.7 ANSI/AWWA C222 (Latest Edition) Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.

.8 ANSI/AWWA C210 (Latest Edition) Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

.9 ANSI/AWWA C209 (Latest Edition) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.

.10 ANSI/AWWA C216 (Latest Edition) Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.

Part 2 Products

2.1 GENERAL

.1 Coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Products must have five (5) years of case histories on similar steel pipe coating projects.

.2 Pipeline coating materials shall be the products of a single manufacturer, unless otherwise noted in this specification. Product substitutions during the project will not be considered or permitted.

.3 Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test and other parameters applicable to the type of coating.

2.2 SURFACE PREPARATION

.1 All products used for the preparation and application of the work shall be new and purchased from the same Manufacturer. Materials provided shall meet the provisions of this specification. Materials that fail to meet the requirements at any time during the work may be rejected at any time prior to final acceptance of the work.

.2 Blasting material: All blasting material shall be WCB accepted. The following blast cleaning abrasives are pre-accepted:

- .1 Lane Mountain 20/30 Silica Sand (shop only)
- .2 Steel shot with minimum 15% steel grit content
- .3 Garnet - Emerald Creek and Ruby Creek Garnet
- .4 Copper Slags - Kleenblast, Tuf-Cut or Tru-Grit
- .5 Nickel Slags - Green Diamond
- .6 Coal Slags - Black Pearl
- .7 Recycled Glass

.3 The blasting material shall be in accordance with AWWA specification for the particular coating system.

.4 The Engineer may approve other combinations, provided the proposed materials are shown to perform as well or better than those stipulated in this Section.

2.3 COATING SYSTEMS

.1 Shop coating (Exterior)

.1 The pipe coating shall be liquid-epoxy meeting the requirements of AWWA C210 (Latest Edition) Liquid-Epoxy Coating Systems for the Exterior of Steel Water Pipelines. Approved epoxy paint includes BarRust 233H or approved alternate.

.2 Shop Lining (Interior)

.1 The pipe lining shall be liquid-epoxy meeting the requirements of AWWA C210 (Latest Edition) Liquid-Epoxy Coating Systems for the Interior of Steel Water Pipelines. Approved epoxy paint includes BarRust 233H or approved alternate.

.3 Field coating (Exterior). The field applied exterior girth weld coatings shall be one of the following systems:

.1 ANSI/AWWA C216 (Latest Edition) Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines. The following products are acceptable:

.1 Canusa-K-60 Canusa Wrap. Wrap Around Girth Weld Sleeve

.4 Field Lining (Interior)

.1 The field applied lining shall be liquid-epoxy meeting the requirements of AWWA C210 (Latest Edition) Liquid-Epoxy Coating Systems for the Interior of Steel Water Pipelines and shall have NSF 61 certification for potable water.

.2 The field applied lining product shall be the same product as the shop applied lining.

2.4 REPAIR COATINGS

.1 The coating manufacturer for the shop applied coating and lining shall recommend a suitable field repair coating system for the coating and lining systems.

.2 The manufacturer shall provide written application procedures for field repairs.

.3 Coating Schedule

.1 Pipe segments shall be supplied in 20 m (60 ft.) segments (maximum).

.2 The coating cut-back at each end of each pipe segment, interior and exterior, shall be 200 mm.

2.5 SHIPPING AND STORAGE OF MATERIALS

.1 All coating material shall be delivered to the coating Applicator's shop or project site in the original factory-sealed containers bearing the coating Manufacturers' labels identifying the product number, batch number, name, color, instructions for use and WHMIS requirements.

.2 Material Safety Data Sheets shall accompany the material and remain in the shop or on site at all times.

.3 All coating materials shall be stored in an area which shall protect the materials from weather and temperature extremes, as recommended by the coating manufacturer.

Part 3 Execution

3.1 SURFACE PREPARATION

.1 Any areas on the pipe surface that are contaminated with oil and/or grease shall be solvent cleaned prior to abrasive blast cleaning.

.2 Steel surfaces to be coated are to be tested for the presence of soluble chemical salts prior to abrasive blast cleaning. A suitable CSN Salt Test Kit shall be utilized to test for chlorides, sulfates and nitrates. If soluble salts are found to be present then the surface shall be washed with a suitable salt removal product such as Chlor-Rid®. One (1) of every five (5) pipe segments shall be randomly tested on the interior and exterior for soluble salts.

.3 All steel surfaces, prior to coating shall be abrasive blast cleaned to Near White Blast Cleaning and the appearance shall be in accordance with appropriate visual standards.

.4 The achieved surface profile shall be as specified by the coating manufacturer.

.5 All traces of abrasive materials shall be removed from the surface by blowing clean, dry compressed air onto the surface, or using clean bristle brushes or vacuum.

.6 The compressed air shall have water/oil traps on the line to prevent contamination of the steel by oil or water.

3.2 SHOP COATING (EXTERIOR)

.1 All coating application shall be done in accordance with the coating manufacturer's recommendations and in conformance with the principles of good workmanship.

.2 The coating application shall conform to the requirements of ANSI/AWWA C210 (Latest Edition) and the coating manufacturer's recommendations.

.3 All steel must be clean and dry prior to coating application. Any cleaned steel not coated within eight hours shall be blast cleaned again.

.4 No coating applications work shall be performed under unfavorable weather conditions unless a suitable enclosure is provided which shields the steel from precipitation.

.5 No coatings shall be applied if the conditions for relative humidity, ambient temperature and steel temperature do not satisfy the coating manufacturer's requirements.

.6 All products shall be thoroughly mixed as per the coating manufacturer's recommended procedures.

.7 Thinning shall not be allowed except as recommended by the coating manufacturer.

3.3 SHOP LINING (INTERIOR)

.1 All lining application shall be done in accordance with the coating manufacturer's recommendations and in conformance with the principles of good workmanship.

.2 The lining application shall conform to the requirements of ANSI/AWWA C210 (Latest Edition) and the coating manufacturer's recommendations. In the event of a difference between the two, the more stringent requirement shall be followed.

.3 All steel must be clean and dry prior to coating application. Any cleaned steel not coated within eight hours shall be blast cleaned again.

.4 No coating applications work shall be performed under unfavourable weather conditions unless a suitable enclosure is provided which shields the steel from precipitation.

.5 No coatings shall be applied if the conditions for relative humidity, ambient temperature and steel temperature do not satisfy the coating manufacturer's requirements.

.6 All products shall be thoroughly mixed as per the coating manufacturer's recommended procedures.

.7 Thinning shall not be allowed except as recommended by the coating manufacturer.

3.4 FIELD COATING (EXTERIOR)

.1 Field coating procedures will depend on the specific product selected and shall be provided by the coating manufacturer.

.2 Exposure to UV must not exceed manufacturer’s recommendation.

3.5 FIELD LINING (INTERIOR)

.1 The lining application shall conform to the requirements of ANSI/AWWA C210) and the coating manufacturer's recommendations.

3.6 REPAIR COATINGS

.1 The coating and lining system on the steel pipe shall be repaired if damaged prior to installation. After field repairs are made, the Contractor shall ensure that the coated and lined pipe is protected from any damage caused by Contractor's forces and construction activities.

.2 The coating manufacturer shall recommend a suitable field repair coating for the specific applied coating system. The manufacturer shall provide written application procedures for field repairs.

.3 Repairs to the coatings and linings shall be performed by tool cleaning the repair area to remove rust and loose coating. Edges of intact coating shall be feathered and new coating applied as specified herein or in accordance with the manufacturer's recommendations.

3.7 QUALITY CONTROL/ASSURANCE

.1 Arrange and pay for third party National Association of Corrosion Engineers (NACE International) CIP (Coating Inspection Program) Level 2 (minimum) - Certified, Quality Control inspection and provide certified reports showing compliance with specified performance characteristics and physical properties of the specified coating and lining systems. Reports should include, at a minimum but not limited to, ambient environmental conditions, achieved surface profile, achieved surface cleanliness, dry film thickness (DFT) measurements after each coat, holiday testing results and verification of any repairs.

.2 The Owner may retain the services of an independent, third party, NACE certified CI to verify conformance with all of the specification requirements for the lining and coating.

.3 Submit a Quality Control Inspection and Testing Plan (ITP), detailing the type and frequency of inspection and testing to be performed by the Contractor's QC representative. The ITP plan shall conform to the requirements of this section and shall be prepared in coordination with the Owners CI. The ITP shall include a work plan schedule so the CI can carry out his function without delay.

.4 Holiday testing shall be conducted on the coating and lining and all holidays shall be appropriately repaired prior to acceptance.

.5 Measurement of Dry Film thickness shall be conducted and shall comply with the requirements on the applicable ANSI/AWWA coating system standard.

.6 Coating and lining tensile adhesion testing in accordance with ASTM D4541 shall be conducted by the Contractors QC on representative sample plates. The Owner's CI shall be present to witness the adhesion testing.

.7 Exterior Epoxy Coating: Two sample plates shall be prepared over the course of the shop coating operation. A minimum of three separate ASTM D4541 pull-off adhesion tests shall be conducted on each sample plate. The average adhesion for each sample plate shall exceed 3.44 MPa (500 psi).

.8 Interior Epoxy Coating: Two sample plates shall be prepared over the course of the shop coating operation. A minimum of three separate ASTM D4541 pull-off adhesion tests shall be conducted on each sample plate. The average adhesion for each sample plate shall exceed 3.44 MPa (500 psi).

.9 The shop coating applicator shall monitor the wet film thickness of the coatings during application to ensure the proper thickness is attained as recommended by the coating manufacturer for each specific product.

.10 The Owner's CI will inspect the steel for the degree of cleanliness prior to any coating or lining application. No coating work shall be allowed until the Owner's CI has inspected and approved the surface preparation.

.11 The Owner's CI will measure and verify the DFT of the coatings and linings on the painted items to ensure that the thickness conforms to these specifications, prior to the

pipe leaving the coating shop. Notify the CI when painted items are ready for measurement.

3.8 SHIPPING AND HANDLING OF COATED PIPE

.1 Ensure the coating system has dried hard prior to handling and transporting the coated items.

.2 Coated pipe shall be shipped and stored on wood dunnage covered with carpet to minimize damage to the coating.

.3 Coated pipe shall be handled with appropriate cloth slings to minimize damage to the coating during handling and installation.

3.9 DOCUMENTATION AND SUBMITTALS

.1 Proposed coating product literature, including product data sheets, recommended application instructions and/or requirements as well as MSDS sheets, shall be submitted to the Owner's representative for Owner's approval prior to application of shop, field and repair coatings.

.2 A Quality Control Inspection and Testing Plan (ITP) shall be submitted to the Owner's CI for Owner's approval prior to application of the coatings.

.3 Quality Control Inspection reports shall be submitted to the Owner's CI by the Contractors QC representative upon request during the course of the shop coating and lining application. Following completion of the shop coating and lining application a complete set of QC inspection reports shall be provided for review prior to final acceptance of the coated and lined pipe. No pipe will be installed before final acceptance of coated and lined pipe by Owner’s CI and Engineer.

.4 Manufacturer's recommended repair product literature, application procedures, and MSDS sheets shall be submitted to the Owner's representative for Owner's approval prior to application of the repair coatings. Ensure the coating system has dried hard prior to handling and transporting the painted items.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section refers to the hydrostatic and pressure testing of all water retaining structures and piping.

.2 All new water retaining or carrying pipes shall be tested for leakage.

.3 All testing shall be as specified herein or elsewhere in these specifications or as directed by the Engineer's representative.

.4 Furnish suitable temporary service connections, testing plugs or caps, pressure pumps, pipe connections, gauges, thrust supports, and all other required equipment and labour necessary for filling the structure, expelling air, and dewatering the structure without additional compensation.

.5 Coordinate with local utility personnel during testing.

1.2 MEASUREMENT AND PAYMENT

.1 There shall be no additional payment for items specified in this section. Payment shall be included in relevant bid items. Priced as lump sum.

Part 2 Products

2.1 WATER

.1 Owner will provide all water used for the initial hydrostatic and pressure testing at no cost to the Contractor. However, all water required for re-testing, following failure of their initial test, will be supplied by Owner at the Contractor's expense.

.2 Supply and install all temporary pipework, pumps and other equipment required to transport the water from Owner's point of supply at the existing structure or piping to be tested.

.3 Provide the Engineer and Owner with at least seventy-two (72) hours of notice of his requirement for water for testing.

Part 3 Execution

3.1 CLEANING

.1 Prior to hydrostatic or pressure testing, thoroughly clean all water pipework. Remove all dirt and loose material.

.2 Cleaning to include all necessary provisions to thoroughly wash down interior surfaces, and to remove all wash down water and solids from the pipe.

.3 Leave all systems operating with work areas clean to the satisfaction of the Engineer and Owner.

3.2 DISPOSAL OF TESTING WATER

.1 Dispose of water used for the initial testing of the piping and chambers into the lagoon at a rate that will not cause hydraulic overloading. The Contractor is responsible for the necessary equipment required to pump the test water to the lagoon.

3.3 INSTRUMENTATION PROTECTION

.1 Remove or isolate all instruments that have a maximum range of less than the hydrostatic or pneumatic test pressure during the pressure test. On successful completion of the system test, lower the pressure and re-pressurize if required, to a pressure within the range of the instruments to test the isolated or removed instruments in accordance with other sections of these specifications.

3.4 PRESSURE TESTING OF PIPING

.1 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least five (5) days after placing concrete or two (2) days if high early strength concrete is used.

.2 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.

.3 Pipeline should be left at low pressure for a period of forty-eight (48) hours prior to testing to saturate concrete lining where applicable.

.4 Thoroughly examine exposed parts while under pressure and correct for leakage as necessary. Remove joints, fittings, and appurtenances found defective and replace with new sound material and make watertight.

.5 The amount of leakage during the test period shall be zero. Repeat pressure test until all defects have been corrected and no loss of water is observed.

.6 Pressure testing shall be conducted on the pipelines to the pressures and durations as follows (or the maximum rated pressure of the pipeline whichever is less):

Pipe Description	Test Pressure (kPa)	Duration (hours)
Steel Piping, Class 150	1030	4
Stainless Steel Piping, Class 150	1030	4
Standpipe	1030	4

3.5 HYDROSTATIC AND LEAKAGE TESTING

.1 General

.1 All water retaining structures, water retaining process tanks and chemical tanks shall be subjected to hydrostatic testing upon completion.

.2 Provide labour, equipment, and materials required to perform hydrostatic and leakage tests hereinafter described.

.3 The Contractor shall protect the structures during the hydrostatic test from freezing in order to achieve an effective hydrostatic test and prevent any damage caused by low ambient temperatures. If required by the Engineer's Representative, the Contractor shall provide, for the Engineer's Representative's approval, measures to protect the structures from freezing temperatures. Show drawings, including any backup calculations, stamped by a Professional Engineer's Representative shall be provided to the Engineer's Representative for approval, if requested.

.4 The Contractor shall ensure that the exterior surface of the water retaining structures which are being hydrostatically tested are maintained at a minimum temperature of 5°C during the entire testing period. The cost of heating (if required) to achieve this minimum testing temperature shall be borne by the Contractor.

.5 Hydrostatic testing shall be carried out prior to backfilling after the structures have been completely constructed and structural concrete has achieved a fifty-six (56) day compressive strength. Should the Contractor request extra test cylinders to be cast at the time of concrete placements for the purpose of determining when the design strength has been obtained, these extra cylinders shall be cast and cured on site under the same conditions as the concrete which they represent. The cost of casting, curing and testing the extra cylinders shall be borne by the Contractor.

.6 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least 5 days after placing concrete or 2 days if high early strength concrete is used.

.7 Prior to commencing the hydrostatic testing of structures, the Contractor shall repair all visible cracks in the walls and floors. Cracks shall be repaired by the methods outlined in Section 03 30 00 - Cast-In-Place Concrete.

.8 The Engineer's Representative shall be notified at least seventy-two (72) hours before any testing begins, and the procedures and leak detection method shall be submitted in writing to the Engineer's Representative for his approval. Perform tests in the presence of the Engineer's Representative. The Contractor shall provide a responsible representative full-time during the filling operation.

.9 All tests are to be witnessed by the Engineer Representative.

.10 Repeat test until leakage is within the specified allowance.

.11 The Contractor shall mitigate any delays caused by repeated hydrostatic tests.

.12 The Contractor shall supply, install, and remove a suitably accurate liquid level measuring device for the purpose of test measurements.

.2 Testing Sequence

.1 Hydrostatic testing shall be done after:

.1 All concrete has adequately cured.

.2 Completion of all repairs and finishing work.

.3 Completion of application and curing of sealants and waterproofing.

.2 Tests for each tank will be conducted in the manner outlined in these specifications. The test procedure for tanks containing Sikagard epoxy waterproof coating differs from those containing a cementitious waterproof coating.

.3 Process Tanks and Chemical Tanks

.1 Cap and seal all pipe penetrations, pipe sleeves, and other openings below test water level.

.2 Completely fill tank until water surface is flush with the top of the tank and allow water to stand for a period of 1 hour to check for leakage through all capped and sealed openings. If leakage is detected through said openings, repair and retest.

.3 Top-up the water in the tank until water surface is flush with the top of the tank after all sealed openings have been confirmed to show no leakage, and begin the leakage test.

.4 Measure the drop in liquid over the next 72 hours to determine the liquid volume loss for comparison with allowable leakage. Evaporative losses shall be measured and deducted from the measured loss to determine net leakage of the tanks. The allowable volume loss for a period of 24 hours shall not exceed the measured evaporative losses. The Engineer's Representative shall provide the sole determination for evaporation allowances.

.5 Inspect the tank for visible leakage. There shall be no persistently damp areas on the exterior walls or visible leakage at any point on the structure. The allowable visible leakage during the test shall be zero.

.6 Continue the test for an additional 48 hours if the volume loss and/or visible leakage exceed the allowable. If the test shows leakage, or if leaks or persistently damp patches are visible, the structure shall be emptied, carefully examined, and all defects repaired by the method outlined elsewhere in these specifications or by other means approved by the Engineer's Representative. Hydrostatic test shall be repeated until no leak or persistently damp patches are present. The cost and delays for repeated tests (if required) shall be borne by the Contractor.

.7 Leakage, which is grounds for test failure, includes the following:

.1 Persistent dampness on dry side of walls.

.2 Visible leakage.

.3 A drop of water level exceeding the measured evaporative loss.

.4 Concrete Chambers and Channels

.1 Cap and seal all pipe penetrations, pipe sleeves, and other openings below test water level.

.2 Fill concrete tanks to overflow level and allow water to stand for a period of 72 hours to saturate the concrete.

.3 Top-up the water in the tanks to the original level at the end of the 72 hours saturation period and begin the leakage test.

.4 Measure the drop in liquid over the next 48 hours to determine the liquid volume loss for comparison with allowable leakage. Evaporative losses shall be measured or calculated and deducted from the measured loss to determine net leakage of the tanks. These shall be no persistently damp areas on the exterior walls or visible leakage at any point on the structure. The maximum allowable leakage over the duration of this test, after allowance for evaporation losses, is limited to 0.05% of the total liquid volume. The Engineer's Representative shall provide the sole determination for evaporation allowances.

.5 If the test shows leakage, or if leaks or persistently damp patches are visible, the structure shall be emptied, carefully examined, and all defects repaired by the method outlined elsewhere in these specifications or by other means approved by Engineer's Representative. Hydrostatic test shall be repeated until no leak or persistently damp patches are present. The cost and delays for repeated tests (if required) shall be borne by the Contractor.

.6 Significant leakage, which is grounds for test failure, includes the following:

.1 Persistent dampness on the dry side of walls.

.2 Visible leakage.

.3 A drop of water level exceeding the allowable limit (0.05% of the total water volume) during the hydrostatic test.

3.6 DEFECTS AND REPAIRS

.1 Defects disclosed in the work shall be made good and retested or the work replaced without additional cost to the Owner.

.2 Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Where it becomes necessary to replace pieces or pipe, such replacements shall be the same lengths as the defective pieces. Where repairs are required to PVC pipe, the pipe shall be replaced as far as the first detachable fitting in each direction from the defect. Under no circumstances shall a new section of pipe be installed with solvent welded couplings.

.3 Tests shall be repeated after any work has been replaced if, in the judgement of the Engineer's Representative, it is necessary.

.4 All pressure testing shall be done in the presence of the Engineer's Representative.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section refers to supply, testing, delivery, off-loading, installation, start-up and commissioning of a new trash screen to be installed in the existing Emergency Overflow structure.

1.2 EQUIPMENT LIST

Equipment Name	Equipment No.
Emergency Overflow Trash Screen 1	SCR - 351
Emergency Overflow Trash Screen 2	SCR - 352

Part 2 Products

2.1 SCREEN PERFORMANCE

.1 The contractor shall furnish and install two (2) manually cleaned trash screens.

.2 Screen Requirements:

.1 Number of units: 2
.2 Existing channel width: 76 mm
.3 Existing channel depth: 64 mm
.4 Clear opening of bar rack: 50 mm
.5 Screen length: 3608 mm
.6 Screen width: 2546 mm

.3 All dimensions to be field verified by contractor prior to fabrication.

2.2 SCREEN

.1 The trash screen shall consist of side and base frames.

2.3 BAR RACK

.1 The bar rack shall be constructed of type 304 stainless steel. The bar rack shall consist of rectangular bars and have a clear bar spacing of 50 mm. The bars shall span the full width of the channel and shall extend to the top of the overflow structure.

.2 The bar rack shall be securely mounted to the channel floor using stainless steel anchor bolts, equally spaced. If required, the bar rack shall have additional horizontal supports anchored to the channel walls to control deflection. The bar rack shall be securely fastened at the top and bottom.

2.4 FRAMES

.1 The base frame shall be constructed of type 304 stainless steel and shall be suitably sized and reinforced to support the required loads. The base frame shall be mounted to the operating floor with type 304 stainless steel anchor bolts and shall be bolted to the side frames.

.2 The side frames shall be 9.5mm thick type 304 stainless steel plate construction. The side frames shall be mounted in the channel at an angle and fastened securely to the channel walls with type 304 stainless steel anchor bolts. A full top plate consisting of 6.3mm (1/4") thick type 304 stainless steel shall connect the two side frames at the top of the screen, by means of a bolted connection.

2.5 MATERIALS

.1 All parts of the bar screen shall be amply proportioned for all stresses that may occur during operation and for any additional stresses which may occur during the fabrication and erection. Lifting lugs shall be provided on all assemblies over 100 lbs.

.1 All structural steel shall meet the requirements of ASTM A-36.

.2 All stainless steel shall be type 304.

.3 All anchorage hardware shall be type 304, assembled with anti seize coating.

Part 3 Execution

3.1 FIELD TESTING

.1 Upon completion of installation and adjustment, the contractor under supervision of the equipment supplier shall perform a dry test on the bar screen equipment. All necessary repairs and adjustments should be made at this time, prior to the wet test. Perform wet test and check equipment for same as above and make any necessary repairs of adjustments. Additional testing may be performed when required.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section specifies shop drawing preparation, manufacture, delivery, testing, training, start-up and system support services for two perforated-plate screens, including integrated washer/compactor (see Section 46 21 73 – Screenings Compactor) and all necessary components and appurtenances required to provide a complete screening system.

.2 The perforated plate screen equipment supplier will provide the wash water solenoid valves and the ultrasonic level transmitters required for the operation of the screen. The General Contractor will install the screen unit, the starter and control panels, and wash water piping.

.3 Refer to the drawings in Section 00 01 15 – List of Drawings for the screening channel dimensions and layout. Drawings show a typical screen and compactor layout within the screen channels. The screens with integrated washer and compactor must fit the channel and building layout and dimensions.

.4 The band screen will be a centre-flow type.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 AGMA 6010 E, Spur, Helical, Herringbone, and Bevel Enclosed Drives.
.2 AISI, Pocketbook of AISI Standard Steels.
.3 ASTM A480, General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
.4 AWS-D1.1, Structural Welding Code-Steel.
.5 CSA C22.1, Canadian Electrical Code.
.6 JIC EMP-1, Electrical Standards for Mass Production Equipment.
.7 NEMA ICS 2, Industrial Control Devices, Controllers and Assemblies.
.8 NEMA ICS 6, Enclosure for Industrial Controls and Systems.
.9 NFPA 820, Fire Protection in Wastewater Treatment and Collection Facilities.

1.3 EQUIPMENT LIST

Equipment Name	Equipment No.
Channel 1 Screen	SCR-205
Channel 2 Screen	SCR-215

1.4 SUBMITTALS

.1 Provide the following information in one complete submittal in accordance with Section 01 33 00 - Submittals. Shop drawings must be for the specific unit which is being supplied. Drawings or information which shows multiple options will not be accepted.

.1 Manufacturer's data including equipment weight, dimensions, materials, and construction details. Clearly identify equipment model number.

.2 Shop drawings showing the arrangement and, particularly, indicating screen section views, dimensions and layout; screen cleaning mechanism details; size and location of discharge chute; size and location of spray wash system connections; details of the structural connections; and location of all electrical and instrumentation connections.

.3 Description of operation including automatic starting, manual starting, and automatic shut down and alarm features.

.4 A headloss curve showing the headloss across the screen for a range of flows when the screen is 30% and 50% blinded. Headloss curve to include average day flow and peak daily flow. The flow range on the headloss curve shall extend up to 80 ML/d.

.5 Catalogue data on all ancillary electrical components including limit switches.

.6 Range and setting of indicators, instruments, timers and other related devices.

.7 Required ancillary services including, but not limited to, spray wash and drains.

.8 Details of coating systems to be applied.

.9 Motor data including makes and models, motor frame sizes and dimensions, motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, and description of construction, complete with illustrative drawings.

.10 Include statement confirming the Class 1, Zone 2 service rating for the screen and local control station.

.11 Details of insulation provided to prevent galvanic corrosion between mating surfaces constructed of dissimilar metals.

.12 A copy of the related specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

.13 Installation instructions indicating assembly, mounting and anchorage requirements, alignment and assembly tolerances, and points of connection for ancillary services.

.14 Detailed control requirements including I/O, Start-up, Shutdown, alarm, and operating logic to enable the purchaser's engineer to configure the DCS and operator interface.

.15 Testing reports after completing factory testing.

.16 Testing reports after completing field testing.

1.5 COORDINATION

.1 Review design drawings provided. Promptly advise Engineer of any modifications required to suit screen equipment.

.2 Work with Engineer and Owner to resolve any conflicts with new or existing equipment. Some modifications to screen equipment may be required to accommodate attachment to compactor equipment or maintain clearances to existing equipment.

1.6 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for the perforated-plate screen for incorporation into an Operation and Maintenance manual as specified in Sections 01 33 00 - Submittals and 01 78 23 – Operating and Maintenance Data.

1.7 ELECTRICAL, INSTRUMENTATIONS & CONTROLS

.1 Refer to Division 26 for requirements.

Part 2 Products

2.1 FUNCTION

.1 Provide perforated-plate screen to collect and remove plastics, condoms, tampons, pieces of wood, metal objects, rags, rocks, garbage, paper, glass, stringy material, coarse waste solids, organic waste solids, and other debris from raw wastewater. There is no pre-screening or influent pump station upstream of the perforated plate screen.

.2 Provide screen capable of automatic operation and that is continuous travelling.

.3 Screens with slotted openings are not acceptable.

.4 Operation: The continuous band of perforated panels trap and transport debris out of the wastewater flow. Lifting tines or ledges capture any solids that fall off the perforated panels, and lift and transport the screenings out of the wastewater flow. Screenings fall into a chute, which discharges to a screenings compactor. The spray wash aids to remove any screenings remaining on the perforated panels and lifting tines.

.5 The screening system is to be fully compatible with the screenings compactor described in Section 46 21 73 – Screenings Compactor.

2.2 ACCEPTABLE PRODUCTS

.1 Design Standard: Hydrodyne Engineering

.2 JWC Environmental

2.3 DESIGN CRITERIA

.1 Supply perforated-plate screen, designed for continuous duty screening of municipal raw wastewater, per the following specifications:

	Screen IS-215A
Peak design flow	80 ML/d
Average annual flow	20 ML/d
Channel dimensions	See drawings
Maximum upstream hydraulic head (note 1)	2.30 m
Minimum downstream hydraulic head (note 2)	0.5 m
Maximum head loss across screen (note 3)	0.7 m
Screen opening size	6 mm

Notes:
1. Liquid level above floor of concrete channel at screen.
2. Liquid level above floor of concrete channel at average annual flow. Note that depending on flows and lagoon level, downstream water level can drop to zero at certain times.
3. Maximum head loss during operation at peak daily flow, prior to raking/screenings removal, assuming 50% blinding.

2.4 MATERIALS

.1 Design screen for passively resisting corrosion from free and combined chlorine residuals, chlorides, hydrogen sulphide fumes, condensation containing sulphuric acid residual, sulphates and any other constituents normally found at the headworks of a facility treating municipal sewage.

.2 Isolate or carefully select dissimilar metals to prevent galvanic corrosion.

.3 Provide stainless steel ASTM A276 Type 304 components, unless otherwise noted.

Component	**Material**
Frame and support	Stainless Steel ASTM A276 Type 304
Perforated panels	Stainless Steel ASTM A276 Type 304
Lifting tines	Stainless Steel ASTM A276 Type 304
Guide rails	Stainless Steel ASTM A276 Type 304
Shafts	Stainless Steel ASTM A276 Type 304
Side plates	Stainless Steel ASTM A276 Type 304
Conveyor chain	Stainless Steel ASTM A276 Type 304
Sprockets	Stainless Steel ASTM A276 Type 304
Chain pins and bushings	Stainless Steel ASTM A276 Type 304
Covers	Stainless Steel ASTM A276 Type 304
Seals	Nylon Brush, Polypropylene Brush, Neoprene
Brush	Nylon or Polypropylene
Discharge chute or trough	Stainless Steel ASTM A276 Type 304

Component	Material
Spray wash piping	Stainless Steel ASTM A276 Type 304, Schedule 40
Spray wash nozzles	Stainless Steel ASTM A276 Type 304, Schedule 40
Supports for local control station	Stainless Steel ASTM A276 Type 304 or Type 304L
Fasteners	Bolts: ASTM F593 GR2 for Type 316 Nuts: ASTM F594 GR2 for Type 316
Anchor bolts and miscellaneous hardware	Stainless Steel ASTM A276, Type 316

.4 Contractor to note in shop drawing which components listed herein are available in stainless steel type 316 or 316L instead of type 304. Provide cost difference for changing to type 316 components if requested by Engineer.

2.5 EQUIPMENT COMPONENTS

.1 General

.1 Screen will be located in concrete channels, as shown in the drawings. Screen channels are located within Screen building. The Screen building interior is continuously ventilated.

.2 The screen will have a continuous stainless steel belt that automatically rotates within the internal guide system of the static frame.

.3 The screen specified will be of the center flow type. The flow enters the inside of the continuous belt and exits through both sides and the bottom of the belt.

.4 Design screen, including the support frame, to operate and fit within the physical constraints of the Screen building as shown on drawings listed in Section 00 01 15 – List of Drawings.

.5 Avoid channel obstructions in the flow stream except for the screen.

.6 Locate all structural supports and fasteners above the channel; do not use anchor bolts within concrete channel.

.7 Design screen to permit routine service, repair or replacement of parts from the operating floor, with the screen in the channel.

.8 The screen manufacturer will supply the stainless steel angled filler plates to connect from the upstream corners for the support frame to the channel walls.

.2 Welding

.1 Field welding of components will not be permitted.

.2 Weld to AWS-D1.

.3 Prevent weld splatter by the use of splatter-prevention paste at welded joints.

.4 Remove weld slag.

.5 After welding operations, clean stainless steel components of organic contamination using a solvent that is free of chlorides.

.6 Remove embedded iron from the stainless steel by pickling with nitric or hydrofluoric acid.

.7 Provide welded ferrous or steel components with continuous seal welds between full penetration skip welds or sealed with a paintable silicone caulk.

.8 Pickle stainless steel and wash all components.

.3 Frame

.1 Structurally design screen frame to withstand loads imposed by a blocked flow condition with a water surface differential across the screen of at least 2.3 m when operating at maximum water surface elevation.

.2 Design frame to support perforated panels and all screen appurtenances.

.4 Perforated Panel

.1 Continuously join perforated-panel elements together on heavy duty conveyor chains.

.2 Structurally design perforated panels to withstand imposed loads.

.3 Provide sealing strip between perforated panels to prevent screenings from passing through screen.

.4 Provide interchangeable perforated panels.

.5 Attach each side of the perforated panels to the conveyor chain.

.5 Lifting Tines

.1 Provide lifting tines or ledges on the perforated panels.

.2 Lifting tines capture and lift screenings up out of the wastewater, and discharge screenings to the discharge chute, into the screenings compactor.

.6 Conveyor Chains

.1 Provide two (2) parallel, heavy duty, continuous, conveyor chains.

.2 Conveyor chain travels over top and bottom sprockets.

.3 Top sprockets are to be fitted onto the main drive shaft, which are supported by maintenance-free bearings.

.4 Bottom sprockets are to be carried on stub shafts incorporating a sealed bearing with facility for re-greasing.

.5 Provide external, easily accessible device for adjusting chain tension.

.6 Screens with wheels submerged in the wastewater are not acceptable.

.7 Spray Wash System

.1 Provide spray wash system to clean perforated panels from the inside. Spray wash system will be automatically activated using a solenoid valve.

.2 Provide spray wash system that washes debris into the discharge chute. Spray wash systems that can potentially wash debris into the effluent channel are not acceptable.

.3 Provide spray wash system using plant service water system. Plant service water system supplies treated secondary effluent water. Connection to plant service water system will be from a 20 mm pipe, operating at a pressure of 414 kPa. Screen manufacturer to provide water strainer as necessary to prevent plugging of spray wash nozzles.

.8 Discharge Chute/Trough

.1 Screenings to discharge into a totally-enclosed discharge chute/trough.

.2 Suitably reinforce discharge chute/trough to withstand impacts from all materials removed.

.3 Screen discharge chute to be integrated within the screen housing.

.9 Side Plates

.1 Suitably reinforce to support all loads.

.10 Seals

.1 Provide seals for the side and bottom of the screen to prevent screenings from bypassing screen panels.

.11 Bearings

.1 Above water: maintenance-free.

.2 Under water: sealed bush bearings.

.12 Covers

.1 Screen will be totally enclosed designed to prevent leakage and contain spray wash.

.2 Provide a cover for all portions of the screen above the channel.

.3 Design cover to be lightweight and easily removed for maintenance.

.4 Provide hinged front cover to permit inspection.

.13 Parabolic Proportional Weir

.1 Screen manufacturer to confirm if a parabolic proportional weir is required. If required, the weir will be supplied by the manufacturer and installed by the contractor downstream of the screen.

.2 The weir will be designed to maintain a grid velocity of no more than 1.2 m/s with a screen blinding factor of 50% for the full range.

.3 The weir will be designed to maintain a downstream water depth that will increase screen performance during periods of high flow and maintain a maximum upstream water depth of 0.6 meters during periods of low flow.

.4 The weir will be anchored to the sides of the channel with no horizontal supports across the channel to prevent the accumulation of solids.

.5 Weir will allow incremental height adjustment and shall have the capability to be safely removed during live flow conditions.

.14 Drive Units and Motors

.1 Provide worm gear drive units for the screen, cleaning brush and other components as required.

.2 Drive Units: hollow shaft, worm reduction gear directly mounted to the headshaft, to AGMA 6010.

.3 Provide motors suitable for continuous duty, constant speed operation.

.4 Provide 1760 rpm, totally-enclosed, fan-cooled (TEFC), suitable for 600 V, 3 phase power supply. Provide motors suitable for installation in Class 1, Zone 2 hazardous location, in accordance with NFPA 820 and CSA C22.1, and as specified in Section 16010 – Electrical: General Requirements.

.5 Service Factor: 1.15.

.15 Control Panels

.1 Provide a single main control panel for the screen and compactor unit. The main control panel to contain the Yokogawa remote I/O node and Operator Interface Panel. In addition, provide an uninterruptible power supply (UPS), located either within the main control panel or in a separate panel.

.2 Control panel shall communicate with the Owner's DCS system and send the following signals and alarms:

.1 Screen run status.

.2 Screen fault.

.3 Upstream water level.

.4 Upstream high level alarm.

.5 Compactor run status.

.6 Compactor fault.

.3 Control panel to contain the following components:

.1 Panel main disconnect switch.

.2 Motor starters and disconnect switches for screen drives.

.3 Elapsed-time meters for screen operation.

.4 Single amber pilot light for all faults on screen.

.5 Status pilot lights to indicate run (red) and ready (green) conditions.

.6 Status signal contacts that send screen operating information and alarm faults to the DCS.

.7 Yokogawa remote I/O module, chassis and I/O cards as needed.

.8 Status signal contacts for all selector switches (HAND-OFF-AUTO, Reverse-Off-Forward) which send operating status to the DCS.

.9 Overload reset buttons.

.4 Provide a manual Control Station (CS) for the screen unit in the control panel. The CS allows the operator to manually operate the screens independent of the DCS. CS is to contain the following components:

.1 Emergency stop button for screen.

.2 Single combined HAND-OFF-AUTO (H/O/A) switch for operation of screen drives (including screen, brush, and screen roller drives).

.5 All control panels and control stations to meet the requirements of Division 16.

.6 Control panel to be suitable for wall mounting.

.7 Terminate all panel wiring on terminal blocks to allow the panels to be shipped separately. Wiring between the panels will be terminated by the site Contractor.

.8 Refer to Section 26 29 03 – Control Panel for control panel details.

.16 Screen Controls

.1 Provide the following controls for manual and automatic control of the screening system.

.2 In automatic mode, the screen system is to be controlled by a single distributed control system (DCS), as further specified in 262903. In automatic mode, the screen system is to be started by the following conditions, through the DCS:

.1 Differential water level upstream and downstream of the screen equal to 150 mm (adjustable through DCS), as measured by ultrasonic level elements.

.2 Upstream water level reaches the high water level. Screen continues to operate until the differential level is less than the preset value.

.3 The screen has not operated for a preset time (adjustable through DCS).

.3 Once activated, the screen operates for an adjustable period of time, set through the DCS (initially set at five (5) minutes).

.4 In automatic and manual mode, activation of the screen to activate the brush, roller scraper drive, and elapsed time meter.

.5 Provide an elapsed time meter for screen unit. Locate meter in local control panel door so that it can be read from the outside without opening panel.

.6 Provide electrical overload, high temperature and torque overload protection for all motors. In the event of an overload, the screen and compactor to shut down, and an alarm to be registered at the local control panel (light) and at the DCS.

.7 Alarms to be resettable using a general alarm reset button on the local control panels.

.8 In manual (HAND) mode, all features, including safety and overload features, to be functional independent of the DCS except:

.1 Level control.

.2 Time control.

.17 Maintenance and Accessibility

.1 Provide maintenance access to ensure that all maintenance to the screen mechanisms is accomplished at or above operating floor level.

.2 Provide the screens such that they may be dismantled into sections, removable with an overhead crane.

.18 Lubrication

.1 Conveniently locate lubrication points and grease fittings so that they are accessible from the operating floor.

.2 Provide oil lubricated gear reducers with sight tubes to indicate oil levels.

2.6 PIPING, FITTINGS AND ISOLATION VALVE

.1 Provide pipe, fittings and isolation valve, flexible hose connections per the specifications of Section 40 23 24 – Detailed Piping Specifications.

2.7 SPARE PARTS

.1 Provide the following spare parts.

.1 One (1) set of commissioning spare parts for each screen
.2 One (1) set of 2 years operational spare parts for each screen.
.3 Electrical items as specified in Division 26.
.4 Touch-up paint, two (2) 750 mL aerosol cans.
.5 Special tools, if any, for unit servicing.
.6 Any other additional components which the Contractor recommends be kept as spares.

Part 3 Execution

3.1 FABRICATION

.1 Verify all dimensions prior to fabrication.

3.2 FACTORY TESTING

.1 Factory shop test perforated-plate screens.

.2 Factory assemble and test each screen and controls before shipping.

.3 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:

.1 Date.
.2 Equipment serial number.
.3 Motor, make, model, serial number.

.4 Mark check sheet and record data on forms in duplicate as test proceeds.

.5 Sign completed forms to certify results of test.

.6 After completion of two (2) hour run, conduct:

.1 Operational test of alarm and control circuits. Create actual fault conditions.
.2 Automatic starting of screen.

3.3 INSTALLATION

.1 General Contractor will install perforated-plate screen in accordance with the manufacturer's written instructions.

.2 Provide a qualified manufacturer’s technical representative for a minimum of one trip of three days duration to supervise installation and adjustment, certify correct installation, train operating and maintenance staff and undertake testing of the system for all components of both the perforated-plate screens and integral compactors.

3.4 PIPING, FITTINGS AND VALVES

.1 Adequately support pipes during construction to prevent abnormal stress from being imposed on equipment.

.2 Correct unsatisfactory workmanship by readjustment of supports, anchor points or re-fabrication, at no additional cost.

.3 Install valves in accordance with the manufacturer's recommendations.

.4 Thoroughly clean bolted connections, pipe ends and gaskets before installation.

.5 Lubricate gaskets with soapy water and bolts with thread lubricant.

.6 Tighten bolts progressively by cross-over method and by rotation around the joint.

.7 Torque bolts to manufacturer's requirements. Use wrenches which are in good condition and are properly sized, to prevent rounding of nut and bolt heads.

.8 Project piping from damage throughout construction. Cap or plug openings to prevent debris from entering. Replace damaged work to the satisfaction of the Engineer.

3.5 FIELD TESTING

.1 Coordinate testing with General Contractor.

.2 Provide qualified manufacturer's technical representative for a minimum of one trip of three (3) days duration on site to supervise testing of the screen in the channel to ensure proper operation.

.3 In coordination with the Purchaser's staff, create conditions in the field to test all operating features and alarms.

.1 The screen shall be operated for a minimum of 48 hours with raw sewage during field testing.

.2 During field testing, the screen shall be operated over the full range of flows specified, up to the peak flow of 80 ML/day to ensure that the screen and compactor unit are operating correctly.

.4 Provide Engineer with at least two (2) weeks' notice prior to scheduled start-up.

.5 Start-up procedures are in accordance with Section 01 75 01 – Pre-start-up, Start-up and Commissioning.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section specifies shop drawing preparation, manufacture, delivery, and off-loading, testing, training, start-up and system support services for the screen with integrated screening compactor, complete with spray wash system, supports, inlet hopper, discharge pipe, electric motors and all appurtenances required to provide a complete compaction system for screenings from a 6 mm perforated plate screen treating raw municipal wastewater.

.2 Refer to the drawings listed in Section 00 01 15 – List of Drawings for the screen channel dimensions and layout. Drawings show a typical screen and compactor layout within the screen channel.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 AFBMA 9, Load Ratings and Fatigue Life for Ball Bearings.

.2 AGMA 6010-E, Spur, Helical, Herringbone, and Bevel Enclosed Drives.

.3 AISI C-1020, Carbon Steel.

.4 ASTM A36, Structural Steel.

.5 ASTM A53, Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.6 ASTM A276, Stainless Steel and Heat-Resisting Steel Bars and Shapes.

1.3 EQUIPMENT LIST

Equipment Name	Equipment No.
Channel 1 Compactor	CMP-207
Channel 2 Compactor	CMP-217

1.4 SUBMITTALS FOR REVIEW

.1 Provide the following information in one complete submittal in accordance with Section 01 33 00 - Submittals. Shop drawings must be for the specific unit which is being supplied. Drawings or information which shows multiple options will not be accepted.

.2 Manufacturer's data including equipment weight, materials, dimensions, and construction details. Clearly identify equipment model number.

.3 Shop drawings showing the arrangement and dimensions of the entire assembly and descriptions of all major components. Indicate compactor section views, dimensions and layout; size and location of inlet hopper, discharge pipe, and bagger; size and location of spray wash system connections; details of the structural connections; and location of all electrical and instrumentation connections.

.4 Description of operation including automatic starting, manual starting, and automatic shut down and alarm features.

.5 Motor data including make and model, motor frame size and dimensions, motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, and description of construction, complete with illustrative drawings.

.6 Catalog data on all ancillary electrical components, including limit switches.

.7 Range and setting of indicators, instruments, timers and other related devices.

.8 Statement confirming the unit's Class 1, Zone 2 service rating.

.9 Required ancillary services including, but not limited to, spray wash and drains.

.10 Details of coating systems to be applied.

.11 Details of insulation provided to prevent galvanic corrosion between mating surfaces constructed of dissimilar metals.

.12 A copy of the related specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

.13 Installation instructions indicating assembly, mounting and anchorage requirements, alignment and assembly tolerances, and points of connection for ancillary services.

.14 Testing reports after completing factory testing.

.15 Testing reports after completing field testing.

1.5 COORDINATION

.1 Coordinate with the Engineer and General Contractor during detailed design, delivery, testing, and training.

.2 Review shop drawings of the screens to ensure compatibility of the compactor’s discharge chute with the layout of the Screen building. Promptly advise Engineer of any conflicts.

1.6 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for the screenings compactor for incorporation into an Operation and Maintenance manual as specified in Sections 01 33 00 - Submittals and 01 78 23 – Operating and Maintenance Data.

1.7 ELECTRICAL, INSTRUMENTATION & CONTROLS

.1 Refer to Division 26 for requirements.

Part 2 Products

2.1 FUNCTION

.1 Design the screenings compactor to wash, dewater, and compact solids removed by the perforated-plate screen, and transport compacted screenings to the screenings storage bins.

.2 Provide screenings compactors capable of automatic operation in sequence with perforated plate screen described in Section 46 21 43 – Band Screen.

.3 Operation

.1 Screenings fall into the inlet hopper from the discharge chute of the perforated-plate screen. From the inlet hopper, screenings enter the screw conveyor. Screenings are washed and agitated to liquefy fecal matter. Wastewater exits the compactor through a drain that discharges to the screening channel. The screw conveyor then dewaters and compacts the wet screenings as it transports the screenings toward the discharge piping. Washed and compacted screenings fall into the storage bins.

2.2 ACCEPTABLE PRODUCTS

.1 Supply products modified as necessary to provide the specified features and to meet specified operating conditions.

2.3 CAPACITIES AND PERFORMANCE

.1 Provide screenings compactor capable of continuous-duty washing, dewatering and compacting of screenings removed from raw wastewater and fit within the Screen housing.

.2 Materials to be dewatered include rags, stringy material, pieces of wood, metal objects, garbage, paper, rocks, glass, plastics, coarse waste solids, organic waste solids, and other debris found in raw wastewater.

.3 Provide equipment which achieves a minimum of 35% dry solids content and 60% reduction in volume.

2.4 MATERIALS

.1 Design the screenings compactor for passively resisting corrosion from free and combined chlorine residuals, chlorides, hydrogen sulphide fumes, condensation containing sulphuric acid residual, sulphates and any other constituents normally found at the headworks of a facility treating municipal sewage.

.2 Isolate or carefully select dissimilar metals to prevent galvanic corrosion.

.3 All components to be stainless steel ASTM A276 Type 304 unless otherwise noted.

Component	Material
Connecting chute between screen and compactor	Stainless steel, ASTM A276, type 304
Inlet hopper	Stainless steel, ASTM A276, type 304, 12 gauge minimum
Compactor screw	Stainless steel, ASTM A276, type Hardox 400
Compactor screw shaft	Hardox, or equal, with minimum Brinell Hardness of 440
Compactor housing	Stainless steel, ASTM A276, type 304, Schedule 40 (minimum)
Compactor support structure	Stainless steel, ASTM A276, type 304
Underdrain pan	Stainless steel, ASTM A276, type 304, 12 gauge minimum
Spray wash piping	Stainless steel, ASTM A276, type 304, Schedule 40
Spray wash nozzles	Stainless steel, ASTM A276, type 304, Schedule 40
Discharge piping	Stainless steel, ASTM A276, type 304, Schedule 40
Fasteners	Bolts: ASTM F593 GR2 for Type 316 Nuts: ASTM F594 GR2 for Type 316
Anchor bolts and miscellaneous hardware	Stainless steel, ASTM A276, type 316

.4 Contractor to note in shop drawings which components listed in 2.4.3 are available in stainless steel type 316 or 316L instead of type 304. Provide cost difference for changing to type 316 components if requested by Engineer.

2.5 EQUIPMENT COMPONENTS

.1 Inlet Hopper

.1 Provide an inlet hopper, bolted to compactor with sides sloped at a minimum angle of 60° to the horizontal, to prevent screenings build up.

.2 Design inlet hopper to connect to discharge chute of the screen to prevent any screenings from escaping.

.2 Compactor

.1 Provide removable panels which allows full access to the compacting screw for cleaning and maintenance.

.2 Provide single-flight Archimedean design screw having a maximum pitch equal to its diameter. Shaftless conveyors not acceptable.

.3 Diminishing pitch screws are not acceptable.

.4 Design torque of compactor equipment to exceed that which overloads the motor by a safety factor of at least 3.0.

.5 Screw compactors equipped with a shear pin design to fail at the overload torque are not acceptable.

.6 Design supports to be integral with the screen housing.

.7 Equip compactor with an underdrain pan which runs the length of the compactor barrel. Underdrain pan to be easily removable for maintenance.

.8 Provide drainage to drain the wastewater back to the screen channel. Screenings compactor shall be properly sealed to direct all water to the drain and prevent leaks to the operating floor.

.9 All components of the screenings compactor to be totally enclosed.

.3 Discharge Piping

.1 Provide discharge piping to the configuration as shown on the drawings or approved by the Engineer.

.2 Design discharge piping to avoid jamming of compacted screenings inside pipe. Discharge piping to be of sufficient diameter to easily accommodate discharged solids at compactor with continually expanding diameter along length to discharge hopper.

.3 Design and provide support legs for discharge piping to attach to concrete floor.

.4 Spray Wash System

.1 Design spray wash piping to spray water onto the screenings to clean the screenings of organic material prior to compaction. Design washing system to clean the underdrain pan to prevent accumulation of material.

.2 Compactor spray washwater will be controlled by a fail-closed, direct-acting (no pilot) solenoid valve 120 VAC coil that is energized open by the PLC when the screenings compactor is in use.

.3 Spray wash system will use plant service water. Vendor to provide strainer as required to prevent clogging of spray nozzle.

.5 Drive Units and Motors

.1 Provide each screenings compactor with a drive motor in accordance with the requirements of Section 26.

.2 Drive the equipment with a shaft-mounted, helical bevel gear reducer.

.3 Gear reducer: in accordance with AGMA 6010, rating Class II.

.4 Provide totally-enclosed, fan-cooled (TEFC), motors suitable for 600 V, 3 phase power supply. Provide motors suitable for installation in Class I, Zone 2 hazardous location, in accordance with NFPA 820 and CSA C22.1, and as specified in Section 16010 – Electrical: General Requirements.

.5 Service Factor: 1.15.

.6 Bearings

.1 Designs featuring a bearing supporting the discharge end of the screw or anywhere in the path of the dewatered screenings are unacceptable.

.2 Design screw compactor bearings, when used, for an AFBMA L-10 life of at least 50,000 hours.

.3 Provide totally-enclosed, oil-filled bearing housing.

.4 Design bearings to sustain all radial and axial loads from screw to ensure that screw does not contact the housing at any time.

.5 Isolate housing using bearing seals.

.7 Compactor Controls

.1 Provide controls for manual and automatic operation of each screenings compactor per the requirements below and Sections 46 21 43 - Band Screen and 26 29 03 – Control Panel.

.2 In automatic mode, the screening compactor and compactor wash water system to start when the perforated-plate screen starts. During an operating cycle, to completely evacuate screenings from the compactor, screening compactor to continue to run for an adjustable period of time after perforated-plate screen stops. The runtime period to be adjustable through the PLC.

.3 Provide electrical overload, high temperature and torque overload protection. In the event of an overload, the compactor shall shut down and an alarm will register at the local control panel (light), and at the PLC.

.4 Alarm to be resettable using a general alarm reset button on the local control panel.

.5 Provide compactor with an emergency stop pull cord located at the unit.

.6 In manual (HAND) mode, all features, including safety and overload features, to be functional independent of the PLC except time control.

.8 Control Panels

.1 Controls for the screenings washer and compactor to be located in the screen control panel.

.2 Refer to Section 46 21 43 – Band Screen for requirements.

.3 In addition to specifications contained herein, refer to Division 26 for control panel requirements.

2.6 PIPING, FITTINGS AND ISOLATION VALVE

.1 Provide pipe, fittings and isolation valve, flexible hose connections per the specifications of Section 40 23 24 – Detailed Piping Specifications.

2.7 SPARE PARTS

.1 Provide the following spare parts:

.1 Two (2) - sets of bearing assemblies.

.2 Two (2) - sets of shaft seals.

.3 Electrical items as specified in Division 26.

Part 3 Execution

3.1 FABRICATION

.1 Verify all dimensions prior to fabrication.

3.2 FACTORY TESTING

.1 Factory shop test screenings compactor.

.2 Factory assemble and test each compactor and controls before shipping.

.3 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:

.1 Date
.2 Equipment serial number
.3 Motor, make, model, serial number.

.4 Mark check sheet and record data on forms in duplicate as test proceeds.

.5 Sign completed forms to certify results of test.

.6 After completion of two (2) hour run, conduct:

.1 Operational test of alarm and control circuits. Create actual fault conditions.
.2 Automatic starting of screen.

3.3 DELIVERY

.1 Provide a qualified manufacturer's technical representative for a minimum of one (1) trip of one (1) day duration to supervise unloading of the equipment.

3.4 INSTALLATION

.1 Provide a qualified manufacturer’s technical representative for a minimum of one trip of three days duration to supervise installation and adjustment, certify correct installation, train operating and maintenance staff and undertake testing of the system for all components of the screenings compactor.

.2 General Contractor will install screenings compactor in accordance with the manufacturer's written instructions.

3.5 PIPING, FITTINGS AND VALVES

.1 Adequately support pipes during construction to prevent abnormal stress from being imposed on equipment.

.2 Correct unsatisfactory workmanship by readjustment of supports, anchor points or re-fabrication, at no additional cost.

.3 Install valves in accordance with the manufacturer’s recommendations.

.4 Thoroughly clean bolted connections, pipe ends and gaskets before installation.

.5 Lubricate gaskets with soapy water and bolts with thread lubricant.

.6 Tighten bolts progressively by cross-over method and by rotation around the joint.

.7 Torque bolts to manufacturer's requirements. Use wrenches which are in good condition and are properly sized, to prevent rounding of nut and bolt heads.

.8 Project piping from damage throughout construction. Cap or plug openings to prevent debris from entering. Replace damaged work to the satisfaction of the Engineer.

3.6 FIELD TESTING

.1 Coordinate testing with General Contractor.

.2 Provide qualified manufacturer's technical representative for a minimum of one (1) trip of three (3) days duration on site to supervise testing of the compactor in the channel to ensure proper operation.

.3 Compactor testing will take place in conjunction with perforated plate screen testing.

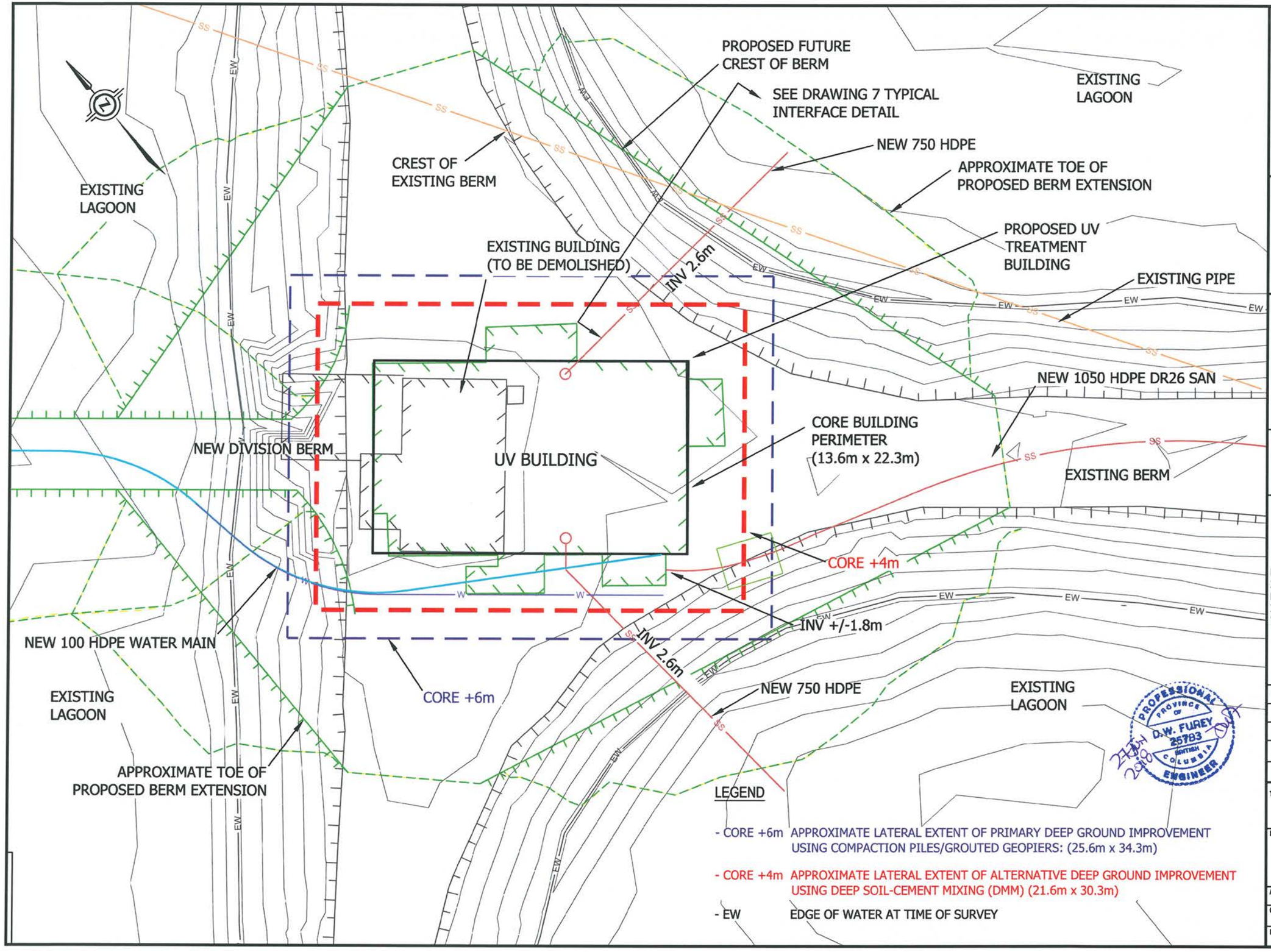
.4 In coordination with the Owner's staff, create conditions in the field to test all operating features and alarms. This will include duration of operation and flow rates as specified in Section 46 21 43 – Band Screen.

.5 Provide Engineer with at least two (2) weeks' notice prior to scheduled start-up.

.6 Start-up procedures are in accordance with Section 01 75 01 – Pre-start-up, Start-up and Commissioning.

END OF SECTION

Appendix A – Ground Improvements Design



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SCALE: 0 5 10m

NOTES:

BASE PLAN: DRAWING 2972-00-C-103 REV B 2018-03-02 (ISSUED FOR PROGRESS REVIEW) PREPARED BY ASSOCIATED ENGINEERING. INTERNAL VERSION DRAWING RECEIVED BY WSP ON MAY 3, 2018.

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — D.W. FUREY 25783 — 27 JUN 2018

TITLE: APPROXIMATE EXTENT OF GROUND IMPROVEMENT AREA - UV BUILDING

PROJECT: PORT ALBERNI WWTP

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	GI-1

NEW 1050 HDPE DR26
SANITARY LINE

CREST OF
EXISTING BERM

EXISTING
LAGOON

CORE +6m

CORE +4m

CORE BUILDING PERIMETER
(9m x 12.6m)

NEW 1050 HDPE DR26
SANITARY LINE

SCREENING
BUILDING

EXISTING BERM

NEW 100 HDPE
WATER MAIN

CREST OF
FUTURE BERM
SLOPE

APPROXIMATE EXTENT OF NEW FILL
(+/-0.3m MAX. THICKNESS)

EXISTING
LAGOON

LEGEND

- CORE +6m APPROXIMATE LATERAL EXTENT OF PRIMARY DEEP GROUND IMPROVEMENT USING COMPACTION PILES/GROUTED GEOPIERS: (21m x 24.6m)

- CORE +4m APPROXIMATE LATERAL EXTENT OF ALTERNATIVE DEEP GROUND IMPROVEMENT USING DEEP SOIL-CEMENT MIXING (DMM) (17m x 20.6m)

- EW EDGE OF WATER AT TIME OF SURVEY

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SCALE: 0 5 10m

LEGEND:

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NOTES:

BASE PLAN: DRAWING 2972-00-C-101 REV B 2018-03-02 (ISSUED FOR PROGRESS REVIEW) PREPARED BY ASSOCIATED ENGINEERING. INTERNAL VERSION DRAWING RECEIVED BY WSP ON MAY 3, 2018.

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE:
APPROXIMATE EXTENT OF GROUND IMPROVEMENT AREA - SCREENING BUILDING

PROJECT:
PORT ALBERNI WWTP

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	GI-2

NEW 750 HDPE

1.4m

1.4m

CORE BUILDING PERIMETER
(13.6m x 22.3m)

EXISTING BUILDING
(TO BE DEMOLISHED)

UV BUILDING

6m

NEW 100 HDPE
WATER MAIN

NEW 750 HDPE

NEW 900 HDPE DR26
SANITARY LINE

0.3ø PILE
(CONCEPTUAL)

CORE +6m

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D.W. FUREY
25783
27 JUN 2018

LEGEND

- CORE +6m APPROXIMATE LATERAL EXTENT OF PRIMARY DEEP GROUND IMPROVEMENT USING COMPACTION PILES: (25.6m x 34.3m)

- EW EDGE OF WATER AT TIME OF SURVEY

WSP CANADA INC.
1935 BOLLINGER ROAD, NANAIMO, BC V9S 5W9 CANADA
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CONSULTANT:
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TEL.: 604-293-1411 FAX: 604-291-6163
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OWNER:
THE CITY OF Port Alberni
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PORT ALBERNI, BC V9Y 1V8
TEL.: 1-250-723-2146 | FAX: 1-250-723-1003
WWW.PORTBERNI,CA

SCALE: 0 2.5 5m

NOTES:

BASE PLAN: DRAWING 2972-00-C-103 REV B 2018-03-02 (ISSUED FOR PROGRESS REVIEW) PREPARED BY ASSOCIATED ENGINEERING. INTERNAL VERSION DRAWING RECEIVED BY WSP ON MAY 3, 2018.

SPACING SHALL BE DETERMINED BY THE CONTRACTOR TO ACHIEVE THE REQUIRED DENSIFICATION. (REFER TO SPECIFICATIONS)

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: CONCEPTUAL COMPACTION PILE LAYOUT - UV BUILDING PRIMARY DEEP GROUND IMPROVEMENT

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	GI-3

NEW 750 HDPE

1.6m

1.6m

CORE BUILDING PERIMETER
(13.6m x 22.3m)

EXISTING BUILDING
(TO BE DEMOLISHED)

UV BUILDING

NEW 100 HDPE
WATER MAIN

NEW 750 HDPE

NEW 900 HDPE DR26
SANITARY LINE

CONCEPTUAL
GROUTED
GEOPIER

CORE +6m

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D.W. FUREY
25783
27 JUN 2018

LEGEND

- CORE +6m APPROXIMATE LATERAL EXTENT OF PRIMARY GROUND IMPROVEMENT USING GROUTED GEOPIERS: (25.6m x 34.3m)

- EW EDGE OF WATER AT TIME OF SURVEY

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WWW.PORTBERNI,CA

SCALE: 0 2.5 5m

NOTES:

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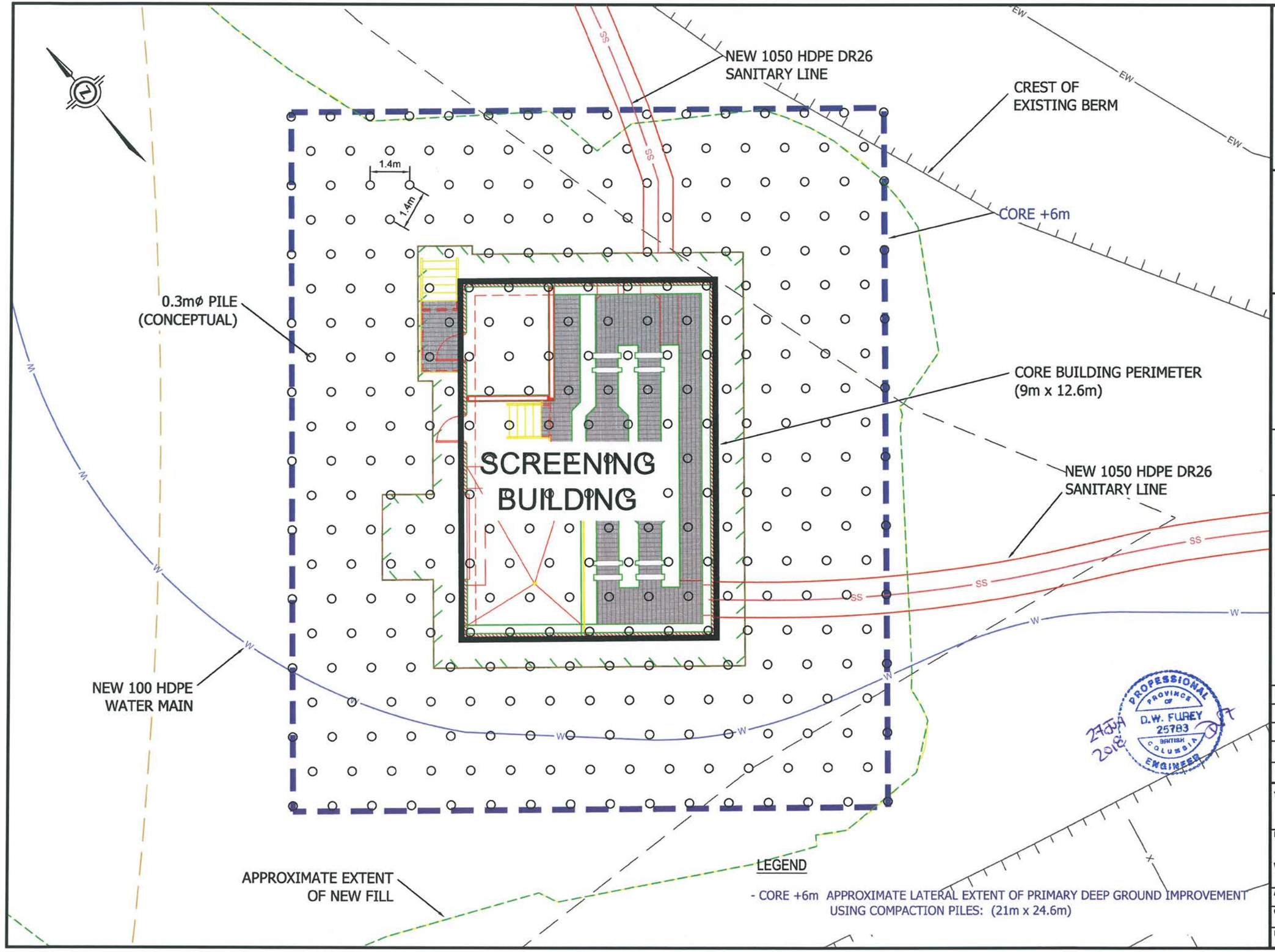
SPACING SHALL BE DETERMINED BY THE CONTRACTOR TO ACHIEVE THE REQUIRED DENSIFICATION. (REFER TO SPECIFICATIONS)

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: CONCEPTUAL GROUTED GEOPIER LAYOUT - UV BUILDING PRIMARY DEEP GROUND IMPROVEMENT

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	MAY 2018
FILE NO.	171-04753-00	FIG. NO.	GI-4



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SCALE: 0 2.5 5m

NOTES:

BASE PLAN: DRAWING 2972-00-C-101 REV B 2018-03-02 (ISSUED FOR PROGRESS REVIEW) PREPARED BY ASSOCIATED ENGINEERING. INTERNAL VERSION DRAWING RECEIVED BY WSP ON MAY 3, 2018.

SPACING SHALL BE DETERMINED BY THE CONTRACTOR TO ACHIEVE THE REQUIRED Ddensification. (REFER TO SPECIFICATIONS)

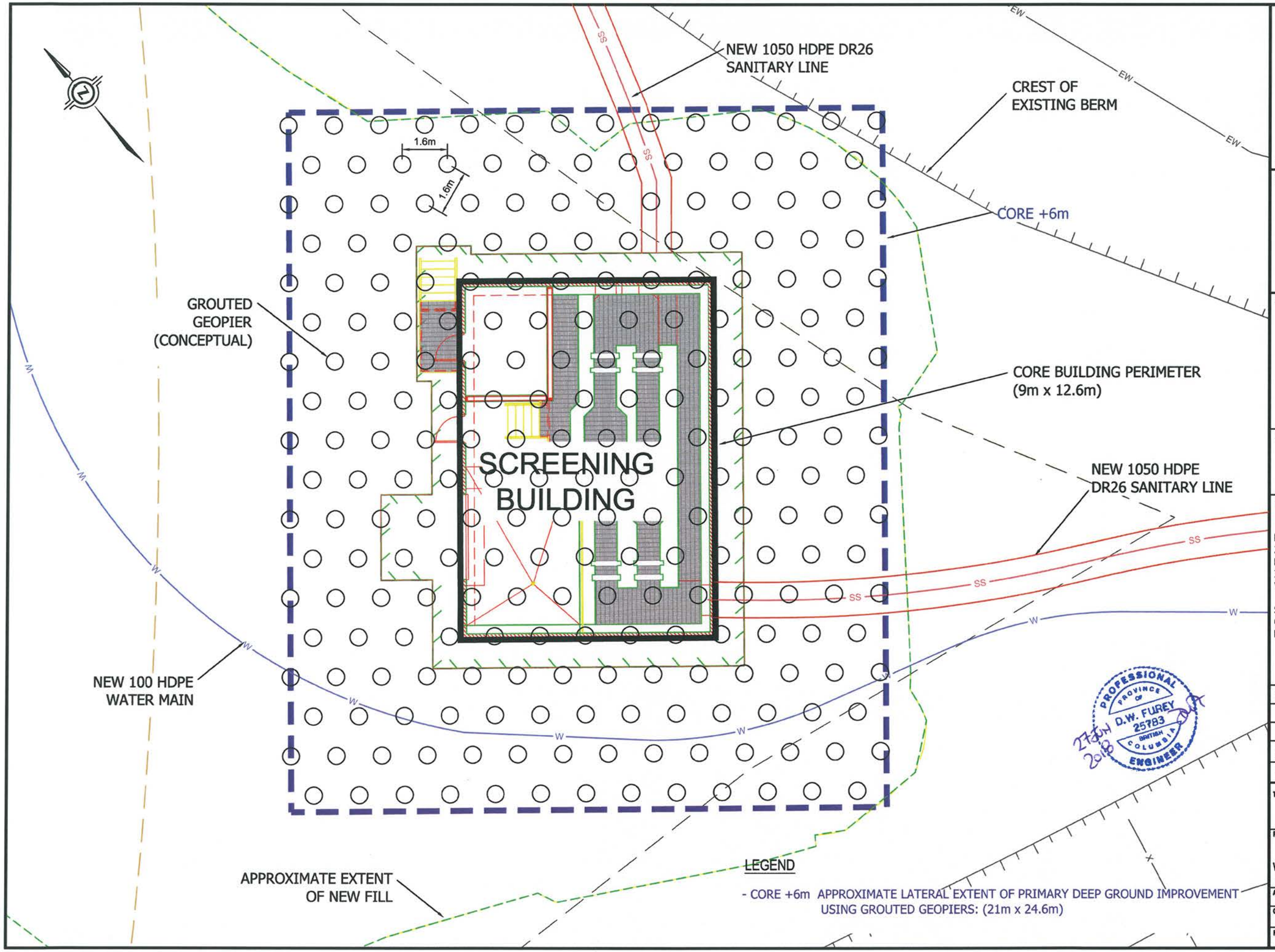
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783 27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: CONCEPTUAL COMPACTION PILE LAYOUT - SCREENING BUILDING
PRIMARY DEEP GROUND IMPROVEMENT

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CHK.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	GI-5



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SCALE:
0 2.5 5m

NOTES:

BASE PLAN: DRAWING 2972-00-C-101 REV B 2018-03-02 (ISSUED FOR PROGRESS REVIEW) PREPARED BY ASSOCIATED ENGINEERING. INTERNAL VERSION DRAWING RECEIVED BY WSP ON MAY 3, 2018.

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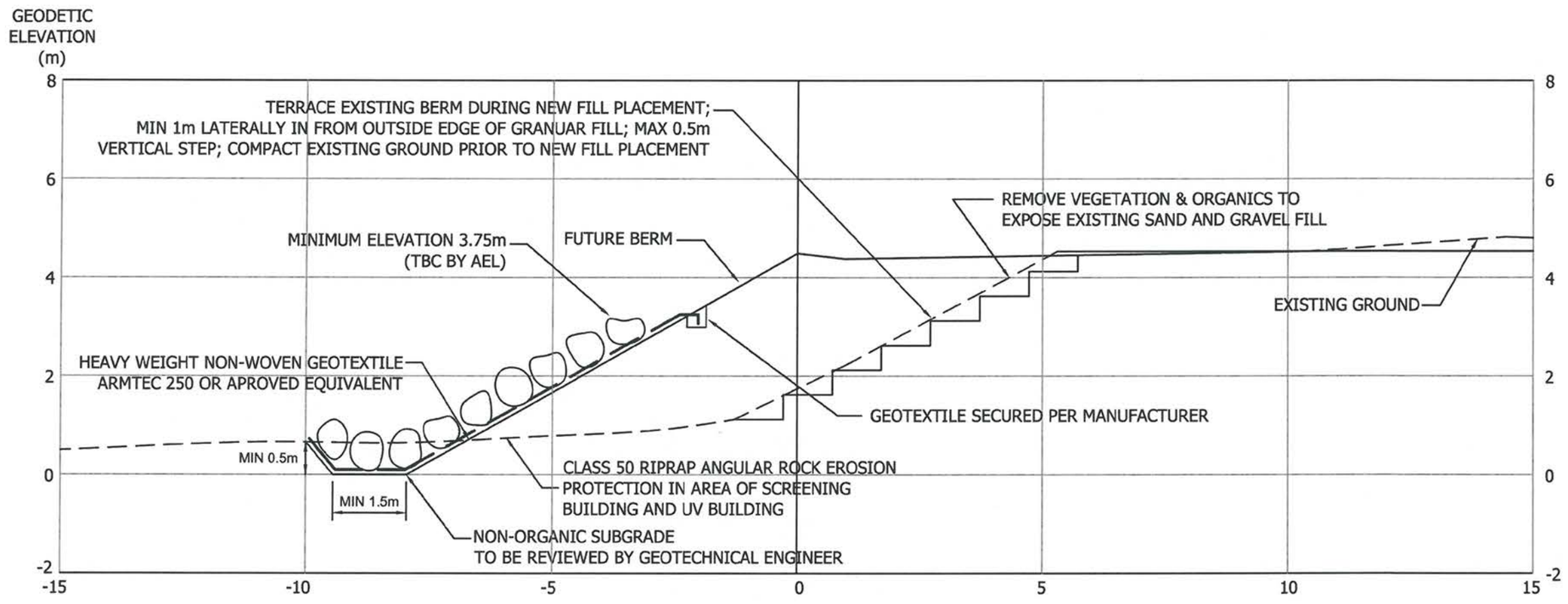
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783 27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: CONCEPTUAL GROUTED GEOPIER LAYOUT - SCREENING BUILDING
PRIMARY DEEP GROUND IMPROVEMENT

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	GI-6



TYPICAL NEW BERM - EXISTING BERM INTERFACE DETAIL

(DIVISION BERM, BERM ENTENSION AT UV TREATMENT AND SCREENING BUILDING AREAS)

1:100

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SCALE:

NOTE:

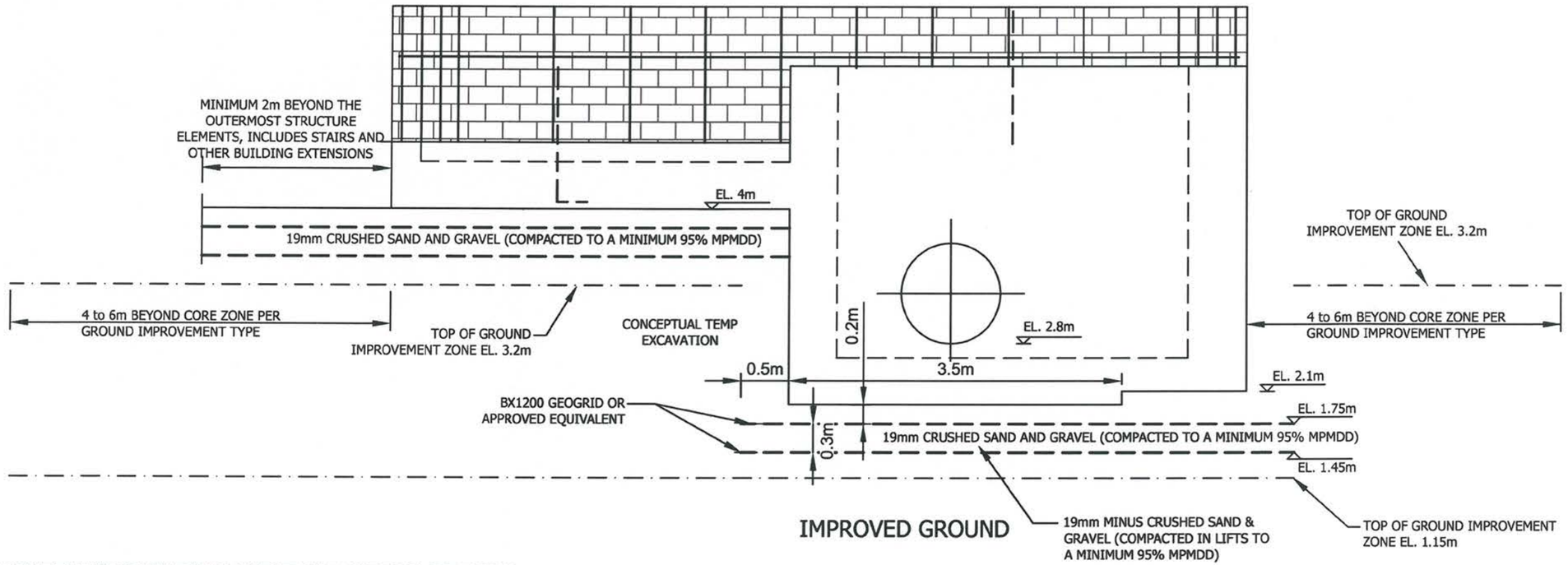
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783
27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

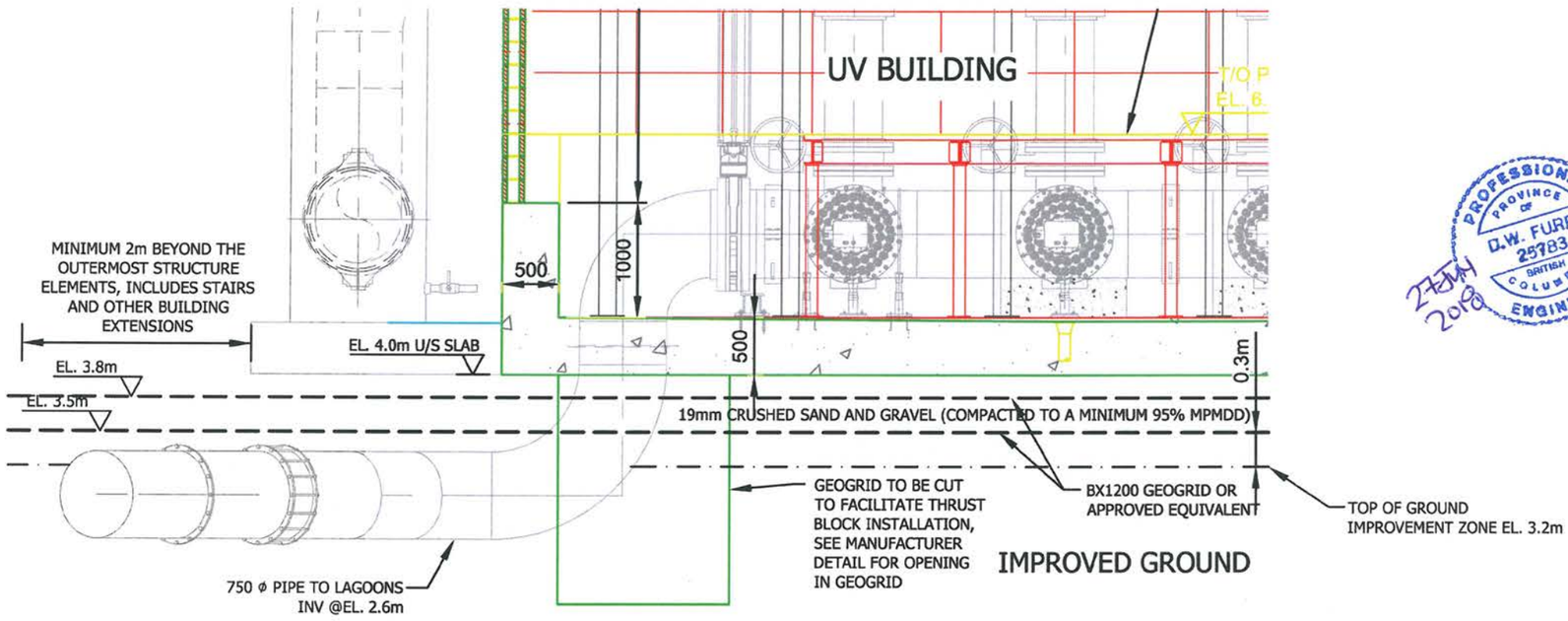
TITLE: EXISTING BERM WIDENING

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	GI-7



SCREENING BUILDING WEST ELEVATION DETAILS
1:50



UV BUILDING ELEVATION DETAIL
1:50

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783 27 JUN 2018

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SCALE: 0 1 2m

NOTE:

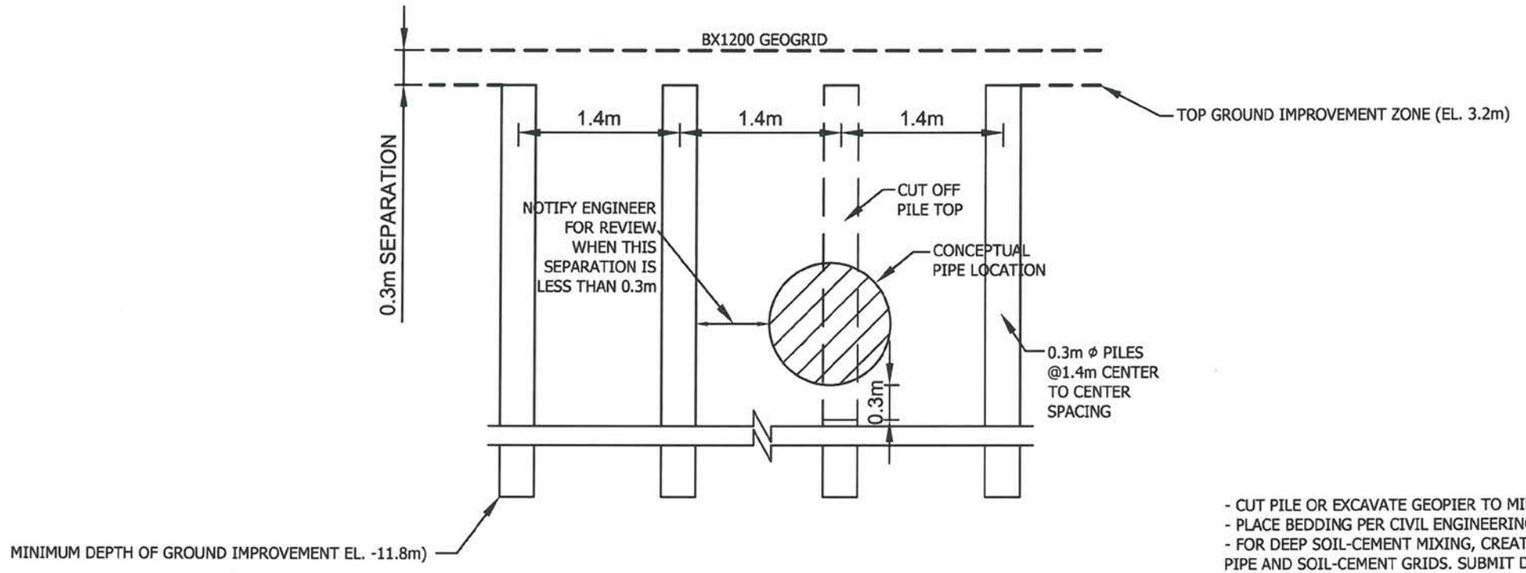
BASE PLAN: DRAWINGS 2972-00-S-201 AND 2970-00-S-301 REV D 2018-04-25 (ISSUED FOR 99% REVIEW) PREPARED BY ASSOCIATED ENGINEERING

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: GEOGRID DETAILS

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUNE 2018
FILE NO.	171-04753-00	FIG. NO.	GI-8



BURIED PIPES WITHIN GROUND IMPROVEMENT ZONE CONCEPTUAL

1:50

- CUT PILE OR EXCAVATE GEOPIER TO MINIMUM 0.3m BELOW PIPE INVERT
- PLACE BEDDING PER CIVIL ENGINEERING
- FOR DEEP SOIL-CEMENT MIXING, CREATE 0.3m SEPARATION BETWEEN PIPE AND SOIL-CEMENT GRIDS. SUBMIT DETAIL AND DESCRIPTION OF PROPOSED PROCEDURE TO GEOTECHNICAL ENGINEER FOR REVIEW PRIOR TO CONSTRUCTION.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783

27 JUN 2018

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WWW.PORTBERNI.CA

SCALE: 0 1 2m

NOTE:

BASE PLAN: DRAWINGS 2972-00-S-201 AND 2970-00-S-301 REV D 2018-04-25 (ISSUED FOR 99% REVIEW) PREPARED BY ASSOCIATED ENGINEERING

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: BURIED PIPE DETAIL

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	GI-9

GROUND IMPROVEMENT

1) GENERAL

A) DESCRIPTION

i) This section describes the requirements of Ground Improvement for mitigation of seismic liquefaction-induced bearing soil strength loss and displacements by densification of granular layers and soil reinforcement as specified herein.

ii) Ground Improvement shall consist of furnishing and installing a combination of deep ground components extending from Geodetic Elevation 3.2 m to (-11.8 m) (i.e. 15 m thick) capped with a 0.8 m thick geogrid reinforced soil platform that will serve to transfer structure raft slab loads to the grid of cemented soil panels/barrettes and/or individual compaction points. For the locally deeper portion of the Screening Building, the geogrid reinforced platform extends from Geodetic Elevation 1.15 to 2.05 m.

(1) Primary Deep Ground Improvement Method

(a) **Grouted Displacement Aggregate Piers**: constructed by installing stone columns that displace the adjacent soil and are densified with compactive effort during construction with space between stone particles filled with grout to maintain the containment function of the existing lagoons. To be Grouted Rammed Aggregate Pier® (GRAP) system or a similar method that demonstrates the same level of end performance, as approved by the GER; or,

(b) **Compaction Piles –** constructed by installing treated timber compaction piles or precast concrete piles by driving.

(2) Alternative Deep Ground Improvement Method

(a) Alternative methods to be used only if approved by the City after a cost-benefit review in relation to the primary deep ground improvement method.

(b) **Deep Soil-Cement Mixing Method (DMM) –** constructed by mixing a binder slurry with in situ soil to create a continuous perimeter infilled with an interlocking grid of cemented soil panels.

B) DEFINITIONS

i) **Grouted Displacement Aggregate Piers** – dense columns of a stone and grout mixture used to densify soils for the purpose of mitigating soil liquefaction and related movements.

(1) **Grouted Rammed Aggregate Piers** - a patented displacement mandrel is driven into the ground with a sacrificial cap followed by installation of gravel and compaction with a tamper foot as the mandrel is incrementally raised. Grout is typically added after mandrel installation and prior to gravel placement. Subject to review by the GER, an appropriate equivalent may also be acceptable.

ii) **Compaction Piles** – a series of treated timber piles driven into the ground by impact driving.

iii) **Deep Soil-Cement Mixing Method (DMM) -** a method of soil densification where a drill advances a mixing tool as binder slurry is pumped through the connecting drill steel, mixing the in situ soil and binder to the target depth. Additional mixing of the soil is completed as the mixing tool is withdrawn to the surface. The process employs the effects of both hydration and bonding of soil particles to increase the soil strength.

iv) **Geotechnical Engineer of Record (GER) –** WSP Canada Inc.

v) **Structural Engineer of Record (SER)** – Associated Engineering (BC) Ltd.

vi) **Owner–** City of Port Alberni

vii) **Installer** Contractor who is responsible for furnishing and installing the ground improvement

(1) **Installer –** Contractor who is responsible for furnishing and installing compaction piles or grouted displacement aggregate piers.

(2) **Alternative DMM Installer** – Contractor who is responsible for the installation of deep soil-cement mix panels.

viii) **Geotechnical Design Report** – Report prepared by WSP Canada Inc for Associated Engineering (BC) Ltd. For the Port Alberni WWTP project, dated 19 January 2018 (File Ref: 171-04753-00) that describes soil conditions encountered at the test hole locations (including logs and cone penetration test results) and is appended to the Contract Documents for reference purposes. Refer to Section C below.

ix) **Trial Area** – (Mainly For Primary Method) Local area within each ground improvement zone to be installed prior to full-scale ground improvement works. Installer will be required to incorporate the scheduling of the Field Validation Program within their schedule. Allow 2 days for vibrating wire piezometers to establish equilibrium prior to commencement of the Field Validation Program and a minimum of 3 days between ground improvement and QA CPTu testing.

C) QUALIFICATIONS

i) Installers shall have a minimum of 5 years of experience with the installation of the system referenced and shall have successfully completed at least 5 similar ground improvement projects.

ii) Provide a minimum of 2 References with a description of services provided, contact name, position, and current phone number. References will be contacted at the discretion of the Owner.

D) GEOTECHNICAL INFORMATION

i) Subsurface test holes, and Cone Penetration Tests (CPTu) have been completed and are located at or near the treatment areas as shown in the Geotechnical Design Report

ii) Geotechnical information is not guaranteed to be accurate, nor is it necessarily comprehensive or exhaustive. The Owner provides no representation or warranty on matters affecting the construction or placement of the soils to meet the design requirements.

iii) The subsurface investigation methods used indicate subsurface conditions only at the specific locations where samples were obtained or where in-situ tests would infer, only at the time they were obtained, and only to the depths penetrated. The samples and tests cannot be relied on to accurately reflect the nature and extent of strata variations that usually exist between sampling or testing locations.

iv) The Owner, its servants, agents and consultants expressly disclaim any and all liability for representations or warranties, expressed or implied, or contained in, or for omissions from this Contract Document.

v) Nothing in this Contract Document Package is intended to relieve the Installer from forming their own opinions, interpretations and conclusions in respect to the matters addressed in these Contract Documents.

vi) No responsibility will be assumed by the Owner, for any interpretation which the Installer may make in using the information contained in any of the Reference Documents mentioned in the Contract Document.

E) DENSIFICATION REQUIREMENTS

i) **Primary Deep Ground Improvement Method**

(1) The two areas to be densified include an approximately 900 m^2 area at the UV building location and an approximately 500 m^2 area at the screening building location (i.e., minimum of 6 m extending laterally beyond the core foundation zone of the buildings as shown on the drawings).

(2) The densification work must achieve a minimum $(N_1)_{60cs}$ value of 22 blows per 300 mm as determined by Cone Penetration Testing (CPTu – ASTM D5778-12) throughout the ground improvement area to 1.5 m below the elevation of the bottom of the ground improvement zone noted in Section 1A above.

(a) If CPTu refusal is encountered, drill-out a maximum depth of 300 mm at a time and continue with the CPTu work. Drilling out to more than 300 mm at a given depth will not be permitted without review by the GER.

(b) Backfill the drilled out portion of the CPTu with grout, or other materials approved by the GER, immediately following completion of the CPTu.

(c) For CPTu testing during the Field Verification Program refer to Section 3A below. As part of assessing overall compliance of the main production program, similar CPTu testing work may be conducted during or after the production pier/pile installation at the direction of the GER at the cost of the Owner with co-operation from the Installer. Allow for testing at two locations per building and related data review time in the schedule.

(d) Any additional CPTu testing that is required to determine the limits of areas which are not in compliance will be coordinated and observed by the GER with costs (including related Owner engineering fees) covered by the Installer.

(3) Minimum diameters and maximum center to center spacing of piers / piles is provided below. Conceptual layout for the densification points is shown on Ground Improvement Drawings GI1 to GI6. If a wider spacing is preferred, the Installer must demonstrate at their cost (inclusive of related Owner engineering review fees) that the minimum targeted densification can be achieved using the revised spacing within a test area prior to production installation as verified with CPTu testing as described above.

(a) **Grouted Displacement Aggregate Piers (GDAP)** – Minimum Diameter: 0.6 m, as measured 1 m below installed surface; Maximum Spacing: 1.6 m (Estimated 570 Piers Total).

(b) **Compaction Piles** – Minimum butt diameter of 300 mm, treated, tapered timber piles; Maximum Spacing: 1.4 m (Estimated 1012 Piles Total).

(c) **Other Methods** – Should alternative methods be considered, the dimensions and method will need to be submitted prior to award of contract such that a spacing can be determined.

ii) **Alternative Deep Soil-Cement Mixing Method (DMM)**

(1) The two areas to be strengthened using soil-cement mixing include an approximately 650 m^2 area at the UV building location and an approximately 350 m^2 area at the screening building location (i.e., minimum of 4 m extending laterally beyond the core foundation zone of the buildings as shown on the drawings).

(2) The work must achieve a minimum equivalent average shear strength of 250 kPa to the elevations noted in Section 1A above as determined by compressive strength testing on samples from various depths and potentially CPTu testing of soil between soil-cement mixed columns.

(3) The Installer is responsible for selecting the target Unconfined Compressive Strength (UCS) and area replacement ratio (i.e. width and spacing of DMM panels) to achieve the specified minimum equivalent average shear strength. Preliminary guidelines of anticipated strengths, panel width, and area replacement ratio are presented in the Geotechnical Design Report. The proposed design is to be presented to GER for review prior to equipment mobilization.

F) SUBMITTALS

i) Submit the following in accordance with Specification Section 013300

(1) Manufacturer's data sheets for ground improvement equipment.

(2) Details of operational pad construction, water containment and disposal process systems.

(3) Details of construction procedures to be used by all operators, including all steps for achieving the specified tolerances. Provide within ten (10) working days of receipt of Notice to Proceed.

(4) Details of the quality control program which will be implemented to ensure the construction procedures are followed.

(5) Methods for pre-drilling and removing obstructions.

(6) Planned work sequence.

(7) Any other information as reasonably requested by the Owner.

(8) Specific information unique to each ground improvement method as follows:

(a) **Grouted Displacement Aggregate Piers**:

(i) Design minimum pier diameter.

(ii) Minimum and maximum unit weights of stone backfill material.

(iii) Proposed grout mixture.

(iv) Calibrated loader bucket weights and calibration test method.

(v) A 20 kg sample together with a gradation curve of the proposed Aggregate Pier backfill material for review and approval at least five (5) working days before work begins.

(vi) If the backfill material source changes, resubmit backfill samples and sieve analyses for approval at least five (5) working days before using new fill source.

(vii) Proposed Area Replacement Ratio for general comparison purposes (i.e. not as primary means of approval).

(b) **Compaction Piles**

(i) Source of piles, production schedule and method of inspection for ensuring compliance prior to shipping to site

(ii) Nature of treatment.

(iii) Method for installation of piles and means to protect the piles from damage.

(iv) Hammer Information sufficient to evaluate its capability for advancing the piles.

(c) **Alternative Deep Soil-Cement Mixing Method (DMM)**

(i) Proposed binder slurry mix design and method of inspection for ensuring compliance on site.

(ii) Design minimum binder unconfined compressive strength (28 day);

(iii) Design minimum binder slurry mixture unconfined compressive strength (28 day);

(iv) Target specific gravity of binder slurry;

(v) Anticipated Binder injection rate per vertical meter of column

(vi) Anticipated mixing tool rotational speed and penetration/withdrawal rates;

(vii) Proposed bottom mixing time (if applicable);

(viii) Anticipated volume of spoil per lineal meter of installation (to assist with preliminary reuse considerations).

G) EXISTING LAGOON BERM STABILITY (PORE PRESSURES, SETTLEMENT, LATERAL MOVEMENT)

i) The Installer is to remain fully responsible to maintain lagoon berm stability during the installation of ground improvement works. Due diligence QA review by the GER and establishment of a threshold value for pore water pressures, is in no way intended to relieve the contractor from that responsibility.

ii) Pore Pressure Monitoring

(1) Vibrating wire piezometers are to be installed prior to ground improvement installation to monitor pore pressures to assist the Installer with maintaining existing berm stability during ground improvement installation.

(2) Piezometers are to be installed at the edge of the ground improvement zone at the nearest point of each berm (i.e., 3 near the UV Building and 2 near the Screening Building). The Installer is to propose a piezometer layout that is both compatible with the proposed ground improvement installation sequencing and that is compliant with the intent of the pore pressure monitoring program. Final piezometer layout is to be approved by the GER.

(3) The cost for installation and QA monitoring of piezometers will be covered by the Owner. The Installer shall be responsible for on-going QC monitoring and minimum daily reporting to the GER. The GER shall be provided access to the piezometer data for QA review.

(4) Tolerance Criteria. The GER shall identify a threshold value for pore water pressures to maintain the stability of the existing berms. The intent is that ground improvement work would be temporarily suspended adjacent to the berm if pore water pressures approach the threshold value. In such an event, the Installer would continue installations away from the berm. The threshold pore pressure value is to be established prior to commencement of ground improvement works (including the trial areas, if applicable).

(5) To reduce the potential for adverse pore pressure build up, the Installer's construction sequencing is to allow for installation of a buffer zone of improved ground in the vicinity of each of the berms with a down period to allow for pore pressure dissipation prior to production ground improvement work adjacent to the buffer zone. In addition, as much as possible, ground improvement is to progress in a direction away from the crests of the berms. Conceptually, the buffer zone would be the perimeter row of ground improvement or 2 to 3 rows of compaction points for compaction piles or Geopiers. The Installer is to identify the buffer zone area and installation timing on their construction sequencing plan submission. It is anticipated that the DMM approach will generate less pore pressures than with the alternative compaction point methods.

iii) Lateral & Vertical Movement Monitoring

(1) Installer shall install and maintain survey monuments on the ground surface along the top and/or sides of the existing lagoon embankments closest to the ground improvement zones to monitor lateral movement and ground settlement or heave due to ground improvement installation.

(2) Survey monuments shall consist of steel bars driven at least 600 mm into the ground. Immediately replace all survey monuments damaged or destroyed during the work.

(3) A minimum of four survey monuments shall be installed along the crest of each berm in the vicinity of the ground improvement works. The survey method shall have an accuracy of ± 3 mm.

(4) Survey the monument elevations and lateral displacements at daily intervals for the duration of the ground improvement installation program. The frequency of readings will need to increase as the work zone approaches the crest of the berms.

(5) The proposed layout of monuments and monitoring frequency shall be presented to the GER for QA review prior to installation.

(6) Submit data files to the GER on a weekly basis, daily when ground improvement work is within 5 m of the crest of the berms.

(7) Co-ordination and cost of installation and QC monitoring of the survey points is to be borne by the Installer. GER QA review costs will be carried by the Owner.

H) MEASUREMENT AND PAYMENT

i) Method and Basis of payment covered in Main Contract.

GROUND IMPROVEMENT

I) OWNER'S QUALITY ASSURANCE

i) The GER will monitor the progress and performance of the work. Observations may include, but are not limited to, any or all of the following: observance of the Installer's procedures, recording of quantities, recording of applied energy readings, rates, etc., and depth of treatment. Observations by the GER do not relieve the Installer of any responsibility for submittal of information specified and the Installer retains sole responsibility for proper execution of the work.

ii) WSP is to provide Quality Assurance services on behalf of the Owner.

iii) WSP shall monitor the Field Validation Test Program.

iv) WSP shall monitor the installation of ground improvement works to verify that the production installation practices are similar to those used during the installation of the trial test elements.

v) WSP shall report any discrepancies to the Installer and General Contractor immediately.

J) RESPONSIBILITY OF THE GENERAL CONTRACTOR

i) Site Preparation and Protection

(1) The General Contractor shall locate and protect underground and above ground utilities and other structures from damage during installation of the ground improvement.

(2) Where practical, site grades for ground improvement shall be within 300 mm (1 foot) of the top of the ground improvement zone. Ground elevations shall be provided to the Installer in sufficient detail to estimate installation depth elevations to within 75 mm (3 inches). For the Screening Building, two different elevations for the top of ground improvement are present. Refer to drawings.

(3) The General Contractor will provide site access to the Installer. A working surface shall be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the ground improvement installation work.

(4) Prior to, during and following ground improvement installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.

(5) If spoils are generated by the ground improvement work, the General Contractor shall remove spoil from the work area in a timely manner to prevent interruption of ground improvement installation. Subject to the properties of the spoil produced and review by the GER, it may be possible to reuse the spoil in designated areas on site (such as the area of permanent berm raising and/or berm widening). Reuse will need to occur prior to significant set-up of the spoil mixture.

(6) The General Contractor is to provide sediment and erosion control measures compatible with the Installer's methodology;

(7) Protect existing ground from contamination by other materials. Ensure that at no time the gradient of any temporary slope (comprising sand, stone or other materials), above the groundwater level becomes steeper than 1.5H:1V unless previously reviewed and approved by a qualified geotechnical engineer and a quality assurance review by the GER. Any excavations below the groundwater level (e.g., possibly for the Screening Building) should be approved by GER.

(8) Progress Drawing: Maintain at the site office an up-to-date progress drawing(s) showing the work completed. Update this progress drawing daily. The progress drawing(s) must show the scope of work completed on each shift not more than one working day following completion of the shift. Where two or more pieces of primary equipment are used on any shift, identify the work completed by each piece of equipment.

ii) Layout

(1) The General Contractor shall survey the location of the ground improvement areas, future deep utility pipes and, as appropriate, the center of individual piles or aggregate piers. These points shall be marked in the field using survey stakes or similar means at locations shown on the as-built drawings.

(2) Aggregate piers, compaction piles, or DMM grid lines shall be identified on plan and in the field with each compaction point or DMM line having a separate number/identification label.

2) PRIMARY DEEP GROUND IMPROVEMENT METHOD

A) FIELD VALIDATION TESTING PROGRAM

i) Prior to production work for a primary deep ground improvement method, a Field Validation Testing Program will begin with two Trial Areas: one at each of the UV Building and Screening Building. Trial Areas may be located within the production work areas. The final location of each Trial Area is subject to the approval of the GER. Each Trial Area shall include a minimum of 13 piles or aggregate piers installed in a pattern/spacing approved by the GER.

ii) Installation of production ground improvement works will not be allowed until the results of the Field Validation Testing Program have been approved by the GER.

iii) Vibrating wire piezometers are to be installed at the cost of the Owner to monitor pore pressures to facilitate scheduling of QA/QC testing within the Trial Areas and to facilitate assessment of the potential implications of pore pressure accumulation. Two piezometers are to be installed for each Trial Area (i.e. one inside and one outside the Trial Area). Piezometers are to be installed at a minimum of two elevations at each piezometer location. Geodetic Elevations are to be confirmed by the GER prior to installation based on the actual vibrating wire piezometer location.

iv) After pier/pile installation in the Field Validation Test Areas, CPTu and auger testing is to be performed once pore pressure dissipation indicates testing can be conducted.

(1) For tendering, allow for a minimum of 3 days after the trial columns are installed for CPTu Testing to determine the density achieved in each of the two trial areas.

(2) Allow an additional 3 working days after CPTu testing for data reduction (by driller) and subsequent engineering review.

(3) The coordination and cost for CPTu testing during the initial Field Validation Test Program and related geotechnical engineering review will be covered by the Owner.

(4) A minimum of five test holes are to be advanced in each Trial Area:

(a) Two coupled auger sampling and CPTu test holes shall be carried out:

(i) In the middle (centroid) of the Trial Areas between the spaced ground improvement elements (i.e., grouted displacement aggregate piers or compaction piles); and,

(ii) In the middle of an adjacent element;

(b) A third CPTu test shall be conducted between the centroid and the element, in the direction of the element.

(5) At the discretion of the GER, the second auger hole may be replaced with an additional CPTu test.

v) If the CPTu indicate the Trial Area meets the specified density, the compaction procedures shall be used to install piles or construct grouted aggregate piers.

vi) If the Trial Area fails to meet the densification requirement, at the discretion of the GER:

(1) additional CPTu testing shall be conducted to confirm the benefits of additional pore pressure dissipation;

(2) an updated pier/pile spacing shall be determined and the trial shall be conducted again; or,

(3) the results will be reviewed with the SER and accepted.

(4) All Trial Areas which fail to meet the specification shall be remediated as directed by the GER.

vii) Refinements in compaction procedures may be required during the course of the work depending on the soils encountered. Refinements in compaction procedures may, at the discretion of the GER, require verification in an additional Trial Area with post-densification CPTu testing to assess specification compliance prior to implementation of the revised procedures.

B) GROUTED DISPLACEMENT AGGREGATE PIERS

i) Aggregate

(1) Aggregate used for Grouted Displacement Aggregate Piers shall be pre-approved by the GER. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, or other graded aggregate with a maximum nominal particle size that is reviewed and approved by the GER. The aggregate must have the ability to flow to the bottom of the mandrel to construct the aggregate pier without delay.

ii) Grout

(1) The grout mixture used in the installation of the aggregate piers shall be pre-approved by the GER. For grouted elements, grout shall consist of a homogeneous mixture of Type II Portland Cement and clean, potable water. Documentation for other additives shall be submitted for review.

(2) For elements constructed with cement-treated aggregate (CTA), the CTA shall consist of a mixture of Type II Portland Cement and well-graded aggregate. The minimum cement content shall be 6% by weight.

(3) Clean, potable water or other suitable source shall be used to mix grout and increase aggregate moisture content where required. The General Contractor shall provide such water to the Installer.

iii) Approved Installation Procedures - Grouted Displacement Aggregate Piers

(1) The following sections provide general criteria for the construction of the Grouted Rammed Aggregate Piers. Unless otherwise approved by the GER, the installation method used for Grouted Rammed Aggregate Pier construction shall be that as used in the construction of the successful trial areas.

(2) Grouted Rammed Aggregate Pier systems shall be constructed by advancing a specially designed mandrel with a minimum 15 ton static force augmented by dynamic vertical ramming energy to the full design depth. The hollow-shaft mandrel, filled with aggregate and grout, is incrementally raised, permitting the mixture to be released into the cavity, and then lowered by vertically advancing and/or ramming to densify the column and force it laterally into the adjacent soil. The cycle of raising and lowering the mandrel is repeated to the top of pier elevation. The cycle height (distance) shall be determined by the GER based on results in the trial area and may be varied as different ground conditions are encountered.

(3) Special high-energy impact densification apparatus shall be employed to vertically densify the Grouted Rammed Aggregate Pier elements during installation of each approximate 300 mm (1-foot) thick constructed lift.

(4) Densification shall be performed using a mandrel/tamper. The mandrel/tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation. The tamper diameter shall be at least 50% of the Grouted Rammed Aggregate Pier design diameter.

(5) Downward pressure shall be applied to the mandrel during installation. Means of measuring or monitoring the variation in downward pressure are to be provided for real-time review by the GER, preferably at a location separate from the equipment operator.

(6) A system shall be provided by the Installer for monitoring the incremental and total volume of aggregate and grout introduced into each Grouted Rammed Aggregate Pier. The system shall allow for volume of stone for each batch vs depth to be recorded and records shall be provided to the GER on a daily basis.

(7) Crushed stone stockpiles greater than 2 m in height shall not be established on the existing lagoon berms and stockpiles are to be set-back from the crest of the lagoon berms a minimum of 2 m. Any stockpiling proposed on the berms is to be reviewed and approved by the GER prior to placement for consideration of stability of the existing lagoon berms. Crushed stone stockpile heights at other locations must be limited to maximum of 5 m above adjacent grade. Flatter slopes and/or reduced grades may be required to maintain the stability of the stockpiles.

(8) Refusal criteria to advancement of the aggregate pier must be presented to the GER prior to carrying out the trial or production ground improvement work. Should refusal be encountered prior to achieving the design elevation, predrilling or loosening of dense strata at the column location may be required for the aggregate pier to penetrate to the design elevation. The Installer shall have at the jobsite continuous helical auger equipment capable of pre-augering to the maximum ground improvement depth.

(9) The aggregate pier mandrel must be of sufficient length to reach to the elevation of treatment shown on the Drawings. Clearly mark the mandrel in 0.3 m intervals on two opposite sides to enable visual observation of the depth of aggregate pier construction from a safe distance. Replace damaged or obscured depth markings if requested by the GER.

(10) Each pier shall be constructed from top to bottom within the same work day. Piers that are completed more than 4 hours after commencing grout installation shall be rejected and, at the discretion of the GER be replaced with one or more piers if necessary.

iv) Acceptance Criteria - Grouted Displacement Aggregate Piers

(1) The as-built center of each pier shall be within 150 mm (6 inches) of the locations indicated on the plans. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

(2) The installation procedure shall be as established during the trial program and/or approved modifications.

(3) CPTu test results shall meet the criteria described in Section 1E above

GROUND IMPROVEMENT

v) Rejected Aggregate Piers

(1) Grouted Displacement Aggregate Pier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the GER approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

vi) Installer Quality Control - Grouted Displacement Aggregate Piers

(1) The Installer shall have a full-time, on-site Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the GER, the General Contractor, and to the Contract Administrator.

(2) Quality control procedures shall include the preparation of Grouted Displacement Aggregate Pier Progress Reports completed during each day of installation containing the following information:

(a) Grouted Displacement Aggregate Pier location.

(b) Pre-auger diameter and soil conditions encountered during drilling (if required).

(c) Planned and actual Grouted Displacement Aggregate Pier elevations at the top and bottom of the pier and pier length.

(d) Average lift thickness (diameter) of each Grouted Displacement Aggregate Pier.

(e) Volume of aggregate and grout used in each Grouted Displacement Aggregate Pier.

(f) Plumb and drift from specified center (a means of verification of plumb is to be employed, such as inclinometers or other methods approved by the GER).

(g) Documentation of any unusual conditions encountered.

(h) Type and size of densification equipment used.

(i) Power consumption or other equipment specific parameters that are a measure of energy output during construction of each aggregate pier lift and during repenetration and variations with depth.

C) COMPACTION PILES

i) Timber Piles

(1) Piles shall be treated.

(2) Species of piles to be either Pacific Coast Douglas Fir, Pacific Coast (Western) Hemlock with minimum 0.3 m diameter butt diameter;

(3) Pile design lengths shall be equal to the difference between the design collar and tip elevations.

ii) Approved Installation Procedures – Compaction Piles

(1) The following sections provide general criteria for the installation of treated timber piles. Unless otherwise approved by the GER, the installation method used for installation shall be that as used in the construction of the successful trial areas.

(2) Pile installation equipment shall be capable of installing the pile to the prescribed design pile tip elevation shown on the Drawings without damaging the piles. Selection of suitable equipment to achieve the design requirements is the responsibility of the Installer.

(3) Pile drivers with fixed leads or with hanging or swinging leads that can be held in a fixed position during driving shall be used to drive piles.

(4) The heads of timber piles shall be protected by suitable driving caps preferably having a rope or other suitable cushions next to the pile head and fitting into a casting which in turn supports a timber shock block. Alternatively, the pile head may be banded with a ring and covered with a steel wire mat.

(5) The head of the pile shall be clearly marked to indicate pile length and the pile shall be marked at regular intervals in a manner that can be observed from a safe distance. Typically this is 0.3 m increments.

(6) Practical refusal shall be defined as 30 blows for the last 300 mm of driving with 50 kJ of transferred energy without pile damage.

(a) For piles encountering practical refusal more than 1 m above the design tip elevation, the Installer is to seek direction from the GER which could include:

(i) Leave as is;

(ii) Install an additional pile;

(iii) Remove, pre-drill through obstructing layer with maximum 200 mm diameter drill tool and reinstall the pile;

(iv) Continue driving under supervision of the GER (in which case pile damage clauses are waived)

(b) If two adjacent piles encounter practical refusal prior to reaching design tip elevation, uninstalled piles within a 10 m radius of the piles that refused shall be placed on hold and the Installer shall seek direction from the GER

GROUND IMPROVEMENT

iii) Acceptance Criteria – Compaction Piles

(1) The as-built center of each pile shall be within the following tolerances:

(a) Tip elevation if practical refusal is not encountered	+/- 100 mm
(b) Tip elevation if practical refusal is encountered	+1000 mm
(c) Cut off elevation	+/- 100 mm
(d) Total horizontal deviation at cut-off elevation	+/- 150 mm
(e) Maximum deviation from plumb	20 mm per m (i.e. 2%)

(2) CPTu test results shall meet the criteria described in Section 1E above

(3) Piles that heave (uplift) during advancement of adjacent piles shall be re-driven to completion depth.

iv) Rejected Compaction Piles

(1) If a compaction pile fails to meet the acceptance criteria described above, the Installer may be required to remove such pile and install a new pile, or install a new pile adjacent to the failed pile. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

v) Installer Quality Control – Compaction Piles

(2) For each pile installed the Installer shall maintain accurate records by unique pile identifier recording the following information:

(a) Date of Installation

(b) Type, make and rated energy of hammer;

(c) Other installation equipment details including pile cushion

(d) Pile identifier and location.

(e) Pre-auger diameter and soil conditions encountered during drilling (if required).

(f) Pile butt and tip diameter, and length as supplied;

(g) Blow counts in number of blows/ 300 mm for the full length driven;

(h) Observed stroke and blow rate (blows/minute) of hammer

(i) Final tip and head elevation after cut-off

(j) Plumb and drift from specified center

(k) Observations of surrounding piles to check for heave or displacement;

(l) Documentation of any unusual conditions encountered, such as interruption of continuous driving, pile damage, etc.

2) ALTERNATIVE DEEP GROUND IMPROVEMENT METHOD

A) DEEP SOIL-CEMENT MIXING METHOD (DMM)

i) Approved Installation Procedures - DMM

(1) The soil-cement mixing equipment shall be capable of installing the panels to the prescribed design elevations shown on the Drawings. The mixing and injection equipment should be sufficient to adequately blend and distribute the binder with the in situ soils to provide the required strength. Selection of suitable equipment, unconfined compression strength, spacing and width of the panel to achieve the design requirements is the responsibility of the Installer.

(2) The binder production equipment must be capable of providing slurry with consistent and verifiable quality. If ratios are not determined by weight, the Installer must demonstrate that the equipment can deliver a consistent product similar to that measured and delivered with a weight based system;

(a) Equipment for proportioning used during binder production shall be calibrated each time the batch plant is relocated.

(b) Cement binder materials should conform to ASTM C150 low-alkali type II PCC. Type III PCC should not be used.

(c) Water used in drilling, mixing cement grout, and other applications should be potable.

(d) Admixtures will not be allowed unless the contractor submits documentation demonstrating the effects of the admixture and the admixture is approved by the engineer.

(e) Binder slurry should be a stable homogeneous mixture of approved binder, approved admixtures, and water.

(f) The Installer shall measure the specific gravity of the binder slurry at least twice per shift per slurry plant using the methods outlined in ASTM D4380 and the results are to be recorded. The specific gravity of the binder slurry measured during production may not deviate by more than 3 percent from the established specific gravity. If the specific gravity is lower than that required by the mix design, the Installer shall add additional cement, remix, and retest the slurry.

(g) Mix design should be consistent throughout the installation. Modifications shall be documented and brought to the attention of the GER with reasons for the variations noted.

(h) Binder slurry shall be held in the agitation tank for a maximum holding time of 4 hours, calculated from the beginning of the initial mixing.

(3) All equipment should have monitoring equipment to permit accurate and continuous monitoring, recording, and controlling of mixing tool depth, location, binder volume flow rates and factors, binder injection pressures and quantities, tool rotational speeds, tool advancement, bottom mixing time and withdrawal rates on a real-time basis and recorded on production reports. These records should be submitted to the GER daily for QA purposes.

(a) The binder injection rate per vertical meter of column is to be monitored and controlled on a real-time basis and recorded on production reports. In areas where the binder slurry injection per vertical meter is low (as determined by unconfined compressive strength testing), additional binder must be injected at the design binder injection rate to a depth of at least 1 m below the deficient zone;

(b) The mixing tool rotational speed and penetration/withdrawal rates shall be consistent within the various soil zones.

(c) The equipment operator should monitor and control the vertical alignment of the mixing tool stroke in two directions. Vertical alignment should be maintained within 1 percent of plumb during the element installation.

(4) Each DMM column is to be installed without interruption. If installation is interrupted for more than 1 hour, the element must be remixed while injecting binder at the design rate for the entire length of the element. The DMM equipment shall be capable of remixing the element with additional binder within 24 hours;

(5) The mixing equipment shall be adequately marked to allow QA personnel to confirm the depth of penetration to within 0.3 m from a distance during construction. The depth may also be determined by instruments and displayed in real-time. Top and bottom elevations are to be recorded by the Installer.

(6) The Owner's team shall have access to the Installer's monitoring equipment.

(7) Refinements in mixtures and procedures may be required during the course of the work depending on the soils encountered. The GER is to be notified immediately of such changes and such changes clearly documented by the Installer.

(8) Refusal criteria to advancement of the DMM installation equipment must be presented to the GER prior to carrying out the ground improvement work. Should refusal be encountered prior to achieving the design depth due to boulders or other obstructions, Installer will be responsible for removing such obstructions using an appropriate method, without any additional cost to the Owner. If the removal of large-size obstructions becomes impractical, GER will review the condition and provide instructions that will include, but not be limited to, allowing a slight deviation in the panel alignment to avoid the obstruction or accepting the current depth of the panel.

ii) Acceptance Criteria – DMM

(1) The installation procedure shall be as consistent as possible throughout the production work.

(2) Unconfined compressive strength tests on wet samples of both binder and binder slurry mixtures obtained during installation shall meet the criteria described in Section 1E above.

(a) The purpose of this sampling will be to provide an indicator of the condition of the mixed soils to identify potentially weak zones and facilitate modification of the mix design.

(b) For the first week of production within each building footprint, wet samples shall be obtained at a minimum of 3 depth intervals within a single vertical "column" installation each day for each installation technique. It is anticipated that additional sampling will occur during the first couple days as well. During the first week of production, additional cylinders shall be taken to allow for 56 day testing.

(c) For subsequent production work, wet samples shall be obtained at a minimum of one sample for every two days of production or 1500 cubic meters of treated soil, whichever produces the higher sampling frequency. Additional samples shall be obtained from depths where soil conditions were notably different based on observations during mixing;

(d) Sample locations should be determined through co-operative interaction of the GER and the Installer and should generally be distributed laterally and vertically within the deep mixed zone. Sampling depths shall be selected to obtain samples from every main soil stratum identified;

(e) All successful and unsuccessful attempts to obtain wet samples shall be documented;

(f) Wet grab samples shall be placed in 150 mm long molds in several lifts within 30 minutes of sampling. Each lift shall be rodded or tapped to remove air bubbles and air pockets while limiting the potential for segregation of modifying the actual mixed slurry conditions. Specimens should not vary by more than 3 percent from the average weight of all samples.

(g) Measure and describe the volume and composition of oversized lumps;

(h) Specimens should be sealed to prevent moisture from entering or leaving, stored in a humid environment (i.e. 100% relative humidity, temperature between 20 and 25 degrees Celcius), and left undisturbed for as long as possible prior to relocation to the testing facility (minimum 24 hours, subject to confirmation at the time of construction);

(i) Unconfined compressive strength testing shall be conducted on the wet grab samples at 7 and 28 days in accordance with ASTM D2166, except that loading should continue on all specimens until the cylinders break sufficiently to examine the interior of the specimen. The broken specimens should be photographed. Subject to the test results, additional samples may be held for testing at 56 days.

(3) At the discretion of the GER, continuous core samples shall be obtained with standard triple tube (or equivalent) coring techniques at 21 to 28 days after installation. The intent of the cores would be to verify the thoroughness of mixing and if possible, measure unconfined compressive strengths in relation to the criteria described in Section 1E above.

(a) The Owner shall pay for up to one core at each building location with acoustic televiewer survey of each hole. Subject to the conditions of those cores and results of the acoustic survey, additional coring and acoustic survey may need to be considered. Additional cores would be advanced at the cost of the contractor.

(b) Cores should have a diameter of at least 65 mm and each core run should be at least 1 m.

(c) Fill core holes with cement grout with a 28-day unconfined compressive strength equal to or greater than that of the deep mixed material with a PVC pipe suitable for acoustic survey equipment.

(d) Core recovery percentage should be reported for each run (total length of recovered core divided by the total core run length). Length of recovered core includes lengths of treated and untreated soil

(e) Percent treatment is calculated as the total length of recovered core minus the sum of the lengths of unmixed or poorly mixed soil regions or lumps that extend across the entire diameter of the core divided by the total core run length. Percent treatment shall be at least 80 percent for every 1.5 m core run.

(4) 80 percent of unconfined compressive strength tests from each tested deep mixed element should equal or exceed the specified strength.

(5) To prevent a weak layer at one elevation in the DMM foundation system, strengths below the specified strength are not permitted within 3 m of the same elevation in more than two nearby cored elements.

(6) 90 percent of all the test results across the site should equal or exceed the specified strength.

iii) Rejected works - DMM

(1) DMM installed beyond the maximum allowable tolerances shall be abandoned and replaced, unless the GER approves the condition or provides other remedial measures. All material and labor required to replace rejected a DMM area shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation. If the design requirements are not satisfied, additional panels may be requested by the GER, and such panels should be constructed by the Installer at no additional cost to the Owner.

iv) Installer Quality Control - DMM

(1) The Installer shall have a full-time, on-site Control Technician to verify and report all installation procedures in real-time to ensure the DMM operation follows the predetermined procedures approved during the trial program.

(2) The Installer shall immediately report any unusual conditions encountered during installation to the GER, the General Contractor, and to the Testing Agency.

(3) The Installer shall provide all personnel and equipment necessary to implement the QC/QA requirements of the project. Daily reports shall be available to the GER for review of compliance with the QC/QA requirements.

(4) The quality control procedures shall include the preparation of Progress Reports completed during each day of installation containing the following information. A computer-based, real-time QC monitoring device that indicates instantaneous installation parameters of the DMM elements is recommended

(a) Completed area locations.

(b) Pre-auger diameter and soil conditions encountered during drilling (if required).

(c) Planned and actual DMM elevations at the top and bottom of the improved zones.

(d) Penetration and withdrawal rates of the mixing tool (min/m) and associated mixing speed (revolutions/min), binder pressure and injection rates per vertical meter installation, soil-binder mixture;

(e) Type and size of equipment used.

(f) Volume of binder used.

(g) Power consumption or other equipment specific parameters that are a measure of energy output during construction;

(h) Element verticality;

(i) Specific gravity measurements of binder slurry mixture;

(j) Bottom mixing;

(k) Documentation of any unusual conditions encountered

(l) For both wet grab samples and coring, provide collection date, time, plan location, elevation, and identification numbers of all deep mixed samples, including unsuccessful attempts to retrieve samples. Include results of compressive strength testing when it becomes available.

(m) The Installer should make simple routine checks of material quantities such as counting the number of bags or truckloads of binder materials that have been used. These quantities should be recorded in the daily production report.

(5) After completion of the project, the Installer and General Contractor shall submit as-built field measurement data indicating surveyed as-built plan locations of each DMM element, including the element center (per site specific coordinates), the element dimension, the column verticality, and the top and bottom elevations of each element to the accuracy required by the project specifications.

END OF SECTION

DIVISION BERM CONSTRUCTION AND PRELOAD DESIGN NOTES

1. SITE PREPARATION

1. Confirm location of existing utilities. Contractor is to be fully responsible for identifying existing utilities and notifying the Owner if any existing utilities are present within the preload area (including a 10m buffer) prior to placement of the preload. If utilities are encountered within 10m of the preload footprint, monitoring displacement throughout program. This may require installation of a survey marker/reference point.
2. Conduct a pre-construction survey of any utilities within 5 m of the preload;
3. Implement sediment and erosion control plans;
4. Dewater diversion berm area in advance of earthwork operations over the entire preload area.
5. Remove sludge, surficial organics, loose/soft soils or other geotechnically unsuitable materials to expose the underlying sand over the entire preload area.
6. Geotechnical Engineer to review and approve subgrade prior to placement of geotextile and engineered fill.
7. Protect approved subgrade from degradation.
8. Install settlement gauges on approved subgrade at the locations shown in drawings. Settlement plates are to be placed at top of natural soil (i.e., at new fill/natural soil interface). As noted in drawings and subject to approval by Geotechnical Engineer, if complete dewatering is not possible, settlement plates may be installed at a higher elevation.

2. MATERIALS

1. All fill materials shall be reviewed for acceptance by the Geotechnical Engineer prior to placement.
2. The Contractor shall provide the engineer with a representative sample of the proposed granular fill for testing at least five (5) days prior to fill placement. Alternatively, grain size analysis results for the proposed granular fill material less than two months old may be supplied. Final approval of granular fill will be based on testing of material delivered to site;
3. Granular fill shall consist of non-frost susceptible, well graded, 75 mm minus sand and gravel with not more than 5% passing the 0.075 mm sieve. Granular fill materials shall meet the following gradation requirements:

Table 1. Recommended Grain Size Distribution for Granular Fill

Type P1
25 mm Crushed Rock (MMCD)

Sieve (mm)	Percent Passing (%)	
	High	Low
25	100	100
12.5	100	75
9.5	90	60
4.75	70	40
2.36	55	27
1.18	42	16
0.6	30	8
0.3	20	5
0.075	8	2

Type P2
75 mm Crushed Rock (MMCD)

Sieve (mm)	Percent Passing (%)	
	High	Low
75	100	100
37.5	100	60
19	80	35
9.5	60	26
4.75	40	20
2.360	30	15
1.180	20	10
0.600	15	5
0.300	10	3
0.075	5	0

Type P3
150 mm Crushed Rock (MMCD)

Sieve (mm)	Percent Passing (%)	
	High	Low
150	100	100
75	100	40
37.5	65	20
9.5	40	5
2.36	25	0
0.075	5	0

Type P4
Class 10 RIP RAP (MoTT)

Rock Gradation (% Larger Than Given Rock Mass (kg))		
85%	50%	15%
1	10	30

Approximate average dimension of an angular rock = 200mm.

4. Fill material shall not contain organic matter, frozen lumps, snow, ice, weeds, roots, logs, stumps, or any other objectionable matter.

3. FILL PLACEMENT

1. Engineered fill shall be placed in loose layers not exceeding 300 mm and compacted to at least 95% Modified Proctor Maximum Dry Density to El. 4.5 m. The temporary preload fill (i.e., Fill above the final berm configuration and 4.5m) may be placed in loose layers not exceeding 300 mm and then nominally compacted to the final preload elevation shown on drawings. Additional compaction may be needed,particularly on the outside face, to promote embankment stability for the duration of the preload.
2. Geotechnical Engineer to approve compaction of each lift prior to placement of subsequent lifts.
3. Engineered fill shall be moisture conditioned to within ±2% optimum moisture content prior to compaction as necessary.
4. Fill placement shall be done using methods which do not lead to segregation or degradation of aggregate. Remove and replace portion of any layer in which material has become segregated during spreading.
5. Trim final slopes to configuration show on the drawings. Maximum temporary slope 1.5H:1V for the preload duration.
6. Implement sediment and erosion control measures in accordance with the Sediment and Erosion Control plans.

4. INSTRUMENTATION AND MONITORING

1. Supply and install surface settlement gauges at the approximate locations shown on the drawings.
2. Surface settlement gauges installed by the contractor shall consist of a 37.5 mm diameter threaded steel pipe affixed to a 25 mm thick plywood base with approximate dimensions of 600 x 600 mm, as shown on the drawings.
3. Extensions shall be available to raise settlement gauges to at least 1.5 m above the design preload height.
4. The Contractor shall make every effort to avoid damaging and destroying settlement gauges. Damaged gauges shall be immediately repaired/reinstated and new survey readings taken at the Contractor's expense.
5. Survey all settlement gauges to an accuracy of +/- 0.001 m immediately prior to fill placement and upon completion of fill placement every day during fill placement. Document the time, date and amount of fill placed. Subsequent readings shall be taken every day for the first week after fill placement, three times a week for the next month, weekly for the following months. A schedule of proposed reading dates is to be provided to the Geotechnical Engineer for review and approval within 24 hours of completion of placement of fill lift of preload material. Subject to actual conditions, the Geotechnical Engineer may add measurements or relax these requirements based on the initial settlement results.
6. Base readings shall consist of three (3) independent sets of readings. Successive base readings shall not vary by more than 10 mm.
7. The Contractor shall provide survey data to the Geotechnical Engineer within 48 hours of the measurements.

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SCALE:

LEGEND:

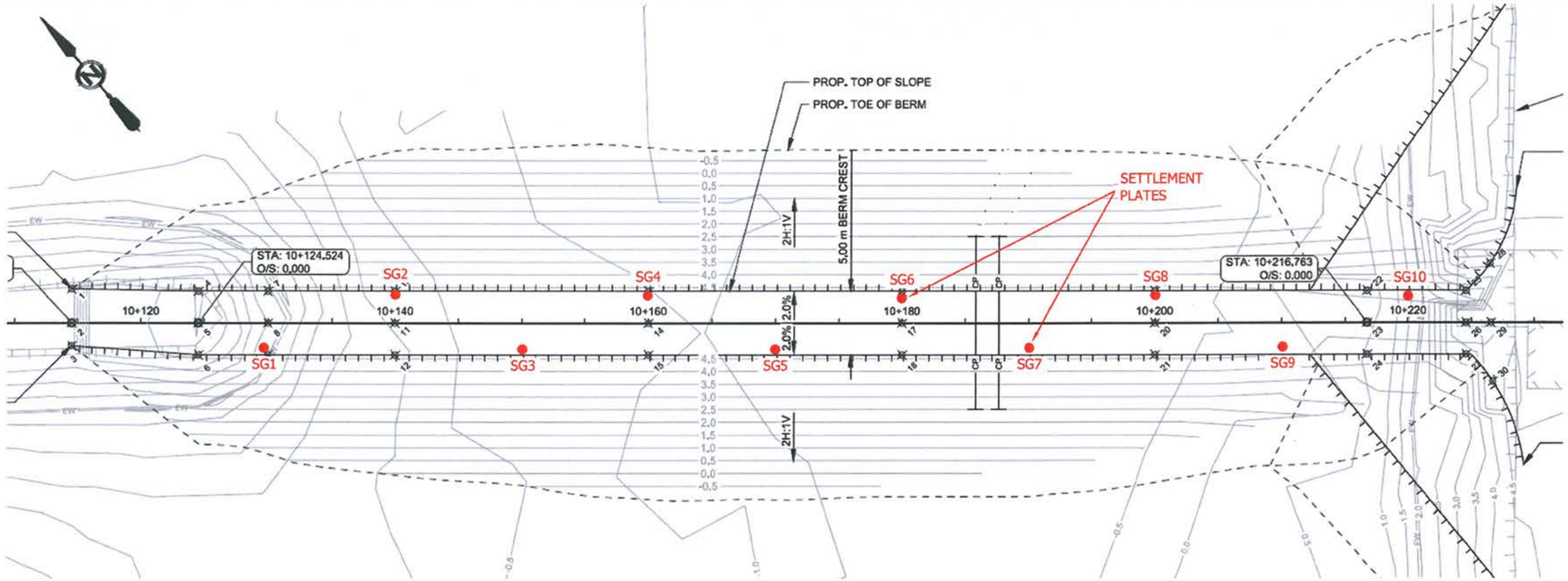
PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D.W. FUREY
25783
27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

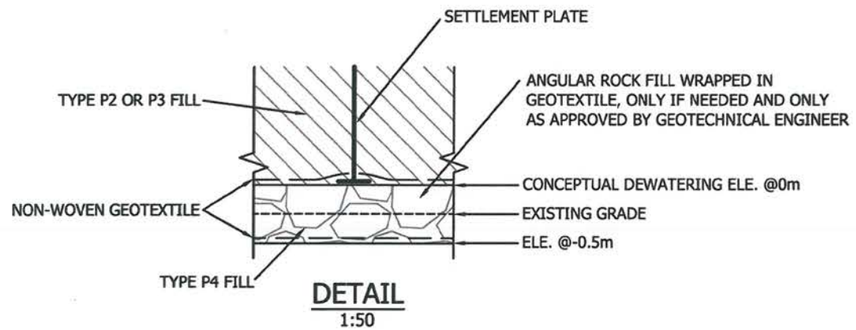
TITLE:
DIVISION BERM CONSTRUCTION AND PRELOAD DESIGN NOTES

PROJECT:
City of Port Alberni
Wastewater Lagoon Expansion Upgrades

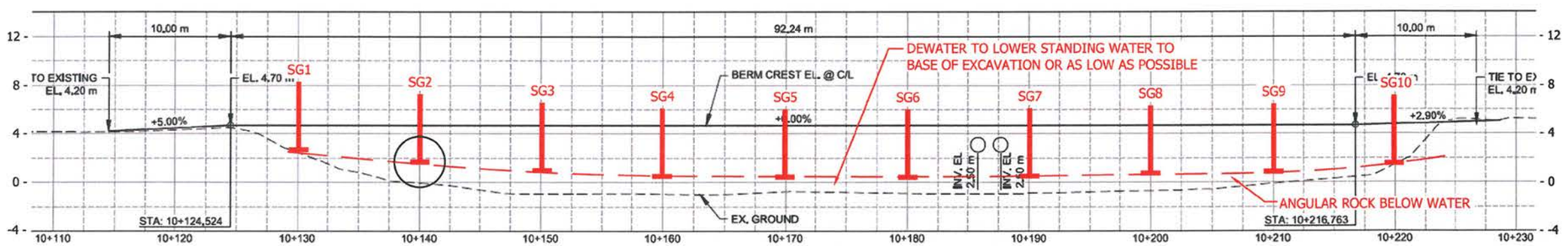
APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-1



SETTLEMENT PLATE LOCATIONS
1:400



DETAIL
1:50



PROFILE
1:400

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WWW.PORTBERNI.CA

SCALE:

NOTE:

BASE PLAN: DRAWING 2972-00-C-102
REVISION B ISSUED FOR PROGRESS REVIEW
DATED 2018-03-02, PREPARED BY
ASSOCIATED ENGINEERING

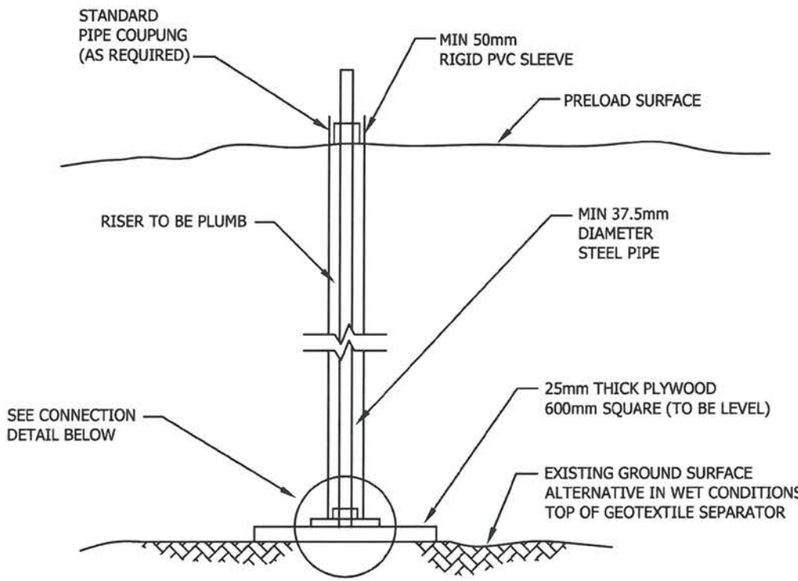
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783 27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

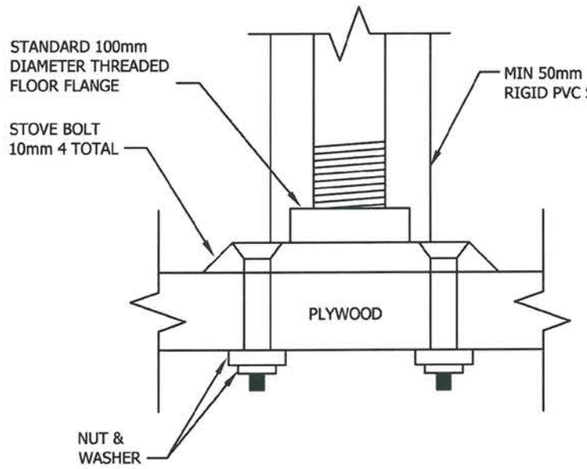
TITLE:
DIVISION BERM
SETTLEMENT PLATE LOCATIONS

PROJECT:
City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-2



TYPICAL SETTLEMENT GAUGE DETAIL
NTS



CONNECTION DETAIL
NTS

WSP CANADA INC.
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SCALE:

LEGEND:

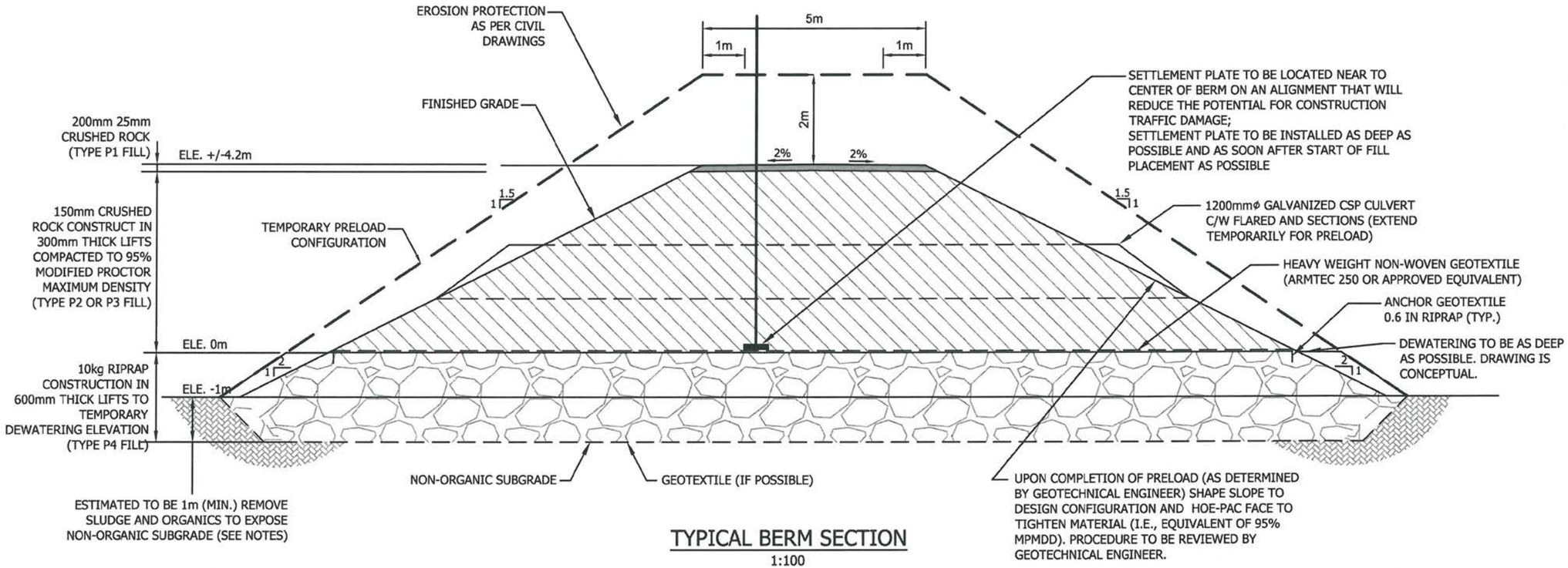
PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D.W. FUREY
25783
27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE:
SETTLEMENT GAUGE DETAILS

PROJECT:
City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-3



TYPICAL BERM SECTION

1:100

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SCALE:

LEGEND:

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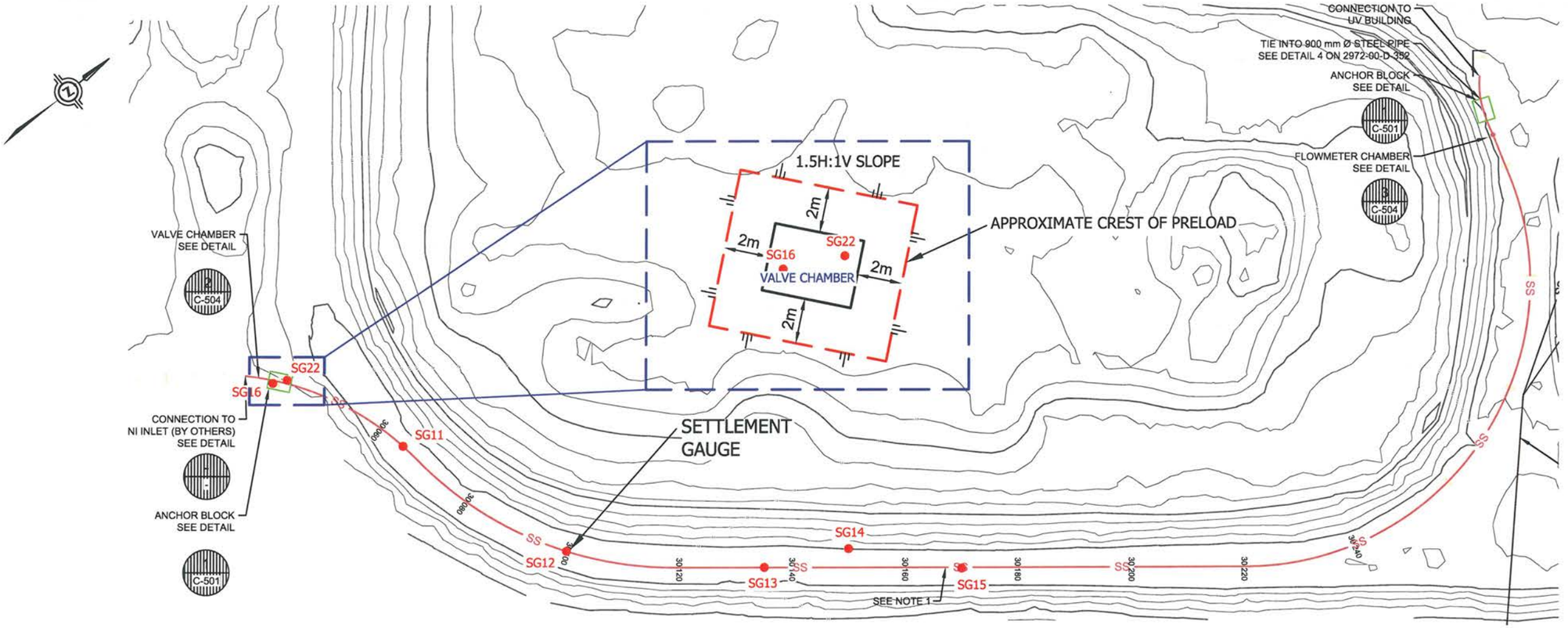
27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE:
DIVISION BERM SECTION

PROJECT:
City of Port Alberni
Wastewater Lagoon Expansion Upgrades

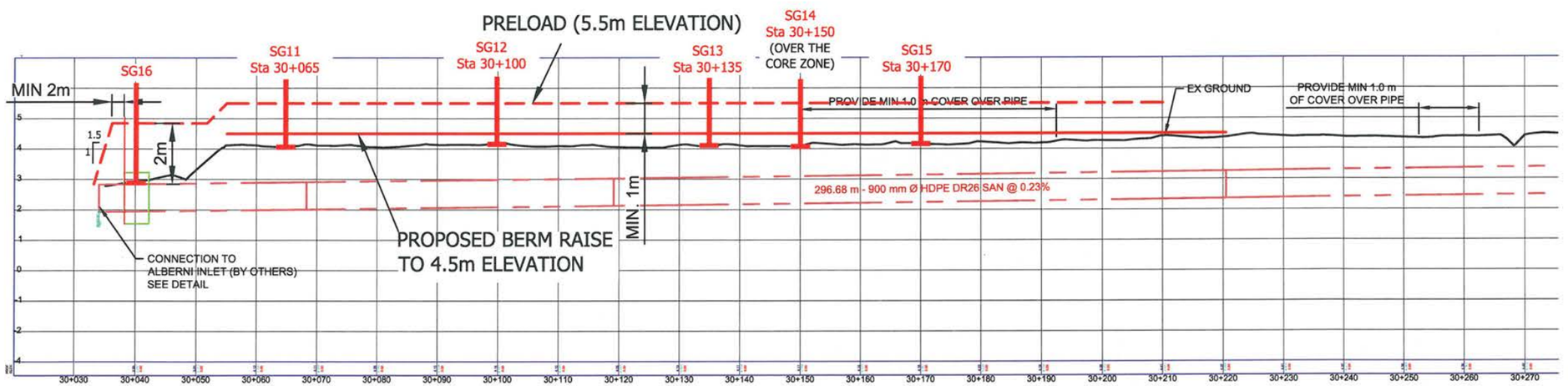
APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-4



PLAN
1:800

VALVE CHAMBER NOTES:

1. Remove organics poor soil within foundation support zone of valve chamber per Geotechnical Engineer prior to preload fill placement.
2. Place and compact engineered fill in lifts to pipe invert elevation to minimum 95% MPMDD.



PROFILE
HZ: 1:800 VT: 1:160

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SCALE:
0 10 20 30m (HORIZONTAL)
0 2 4 6m (VERTICAL)

NOTES:

BASE PLAN: DRAWING 2972-00-C-106 REV A 2018-03-02 (ISSUED FOR PROGRESS REVIEW) PREPARED BY ASSOCIATED ENGINEERING

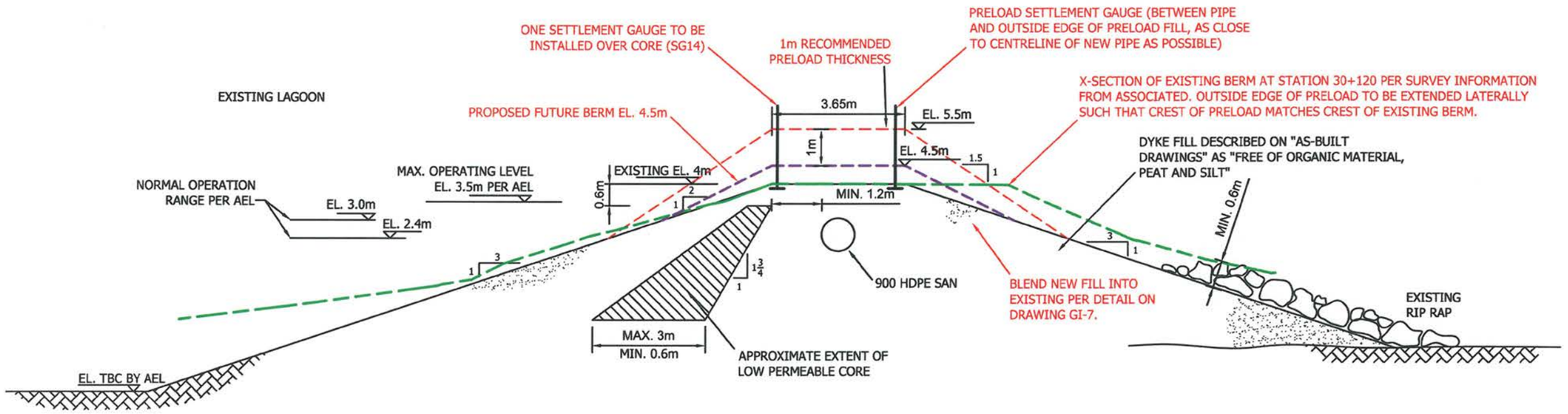
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783 27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE:
EFFLUENT PIPE ROUTE
SETTLEMENT GAUGE LOCATIONS

PROJECT:
City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-5



TYPICAL PERIMETER BERM PRELOAD DETAIL

(STATION 30+055 TO 30+220 INSERT AS SECOND LINE)

1:125

NOTES:

1. Confirm location of existing utilities per Notes 1.1 and 1.2 on Drawing Preload-1.
2. Implement Sediment & Erosion Control Plans.
3. Remove surficial organics to satisfaction of Geotechnical Engineer.
4. Geotechnical Engineer to review and approve subgrade prior to placement of geotextile and engineered fill.
5. Protect approved subgrade from degradation.
6. Fill to be well graded, 75mm minus sand and gravel. Subject to review at the time of construction, granular fill from other parts of site may be used (i.e., building excavations).
7. Blend new fill into existing per detail on Drawing GI-7.
8. Place and compact fill to elevation 5m. Compact preload fill above this elevation sufficiently to support construction traffic as needed.
9. Install instruments per Note 4.1 to 4.7 on Drawing Preload-1.
10. Preload shall be placed as early as possible in construction program. Allow for a minimum duration of 3 months, preferably longer.
11. Replace damaged settlement gauges immediately under observation of Geotechnical Engineer at no cost to owner.
12. Do not install HDPE Sanitary pipe until approved to do so by Engineer. Pipe installation to be determined by Geotechnical Engineer based on results of preload settlement monitoring.
13. Contractor to submit proposed methodology of excavation and HDPE pipe installation to Geotechnical Engineer for review prior to construction. Procedure to clearly indicate measures that are proposed to avoid impacts to low permeable core zone.
14. Make good any core damage with methodology approved by Engineer.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783

27 JUN 2018

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SCALE: 0 1 2 3 4 5m

NOTE:

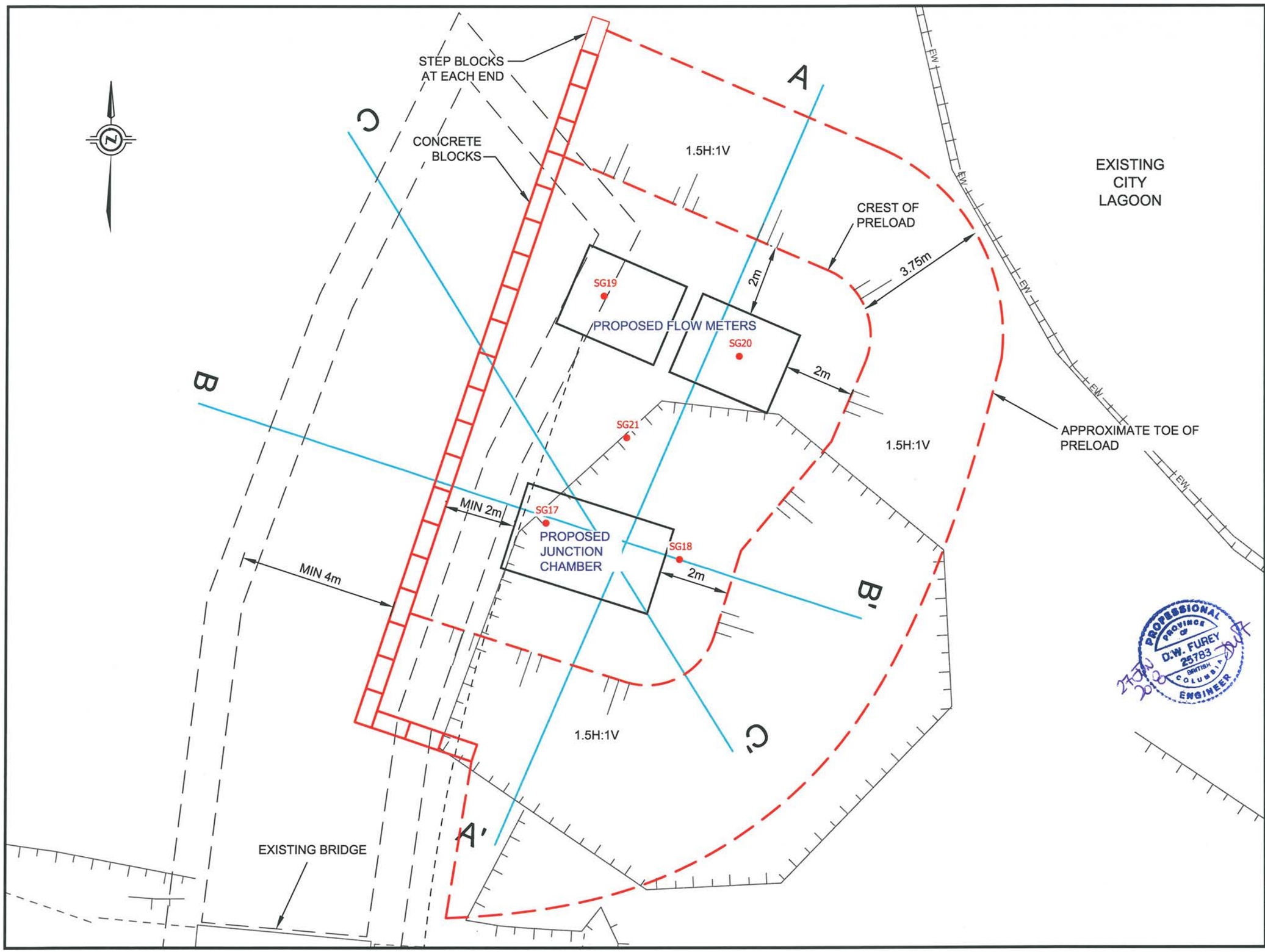
As-Built Section based on Section A-A (Typical Enclosing Dyke), Drawing E-13.007 Revision H 14 Jan1971 "General Revision - As Built" - Aeration Reservior Sections and Details.

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: PERIMETER BERM PRELOAD DETAIL EFFLUENT PIPE ROUTE

PROJECT: City of Port Alberni Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-6



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SCALE:
0 1 2 3 4m

NOTE:
BASE PLAN: INTERNAL VERSION DRAWING: JUNCTION-FLOW METER CROSS SECTION.DWG
RECEIVED BY WSP ON MAY 14, 2018.

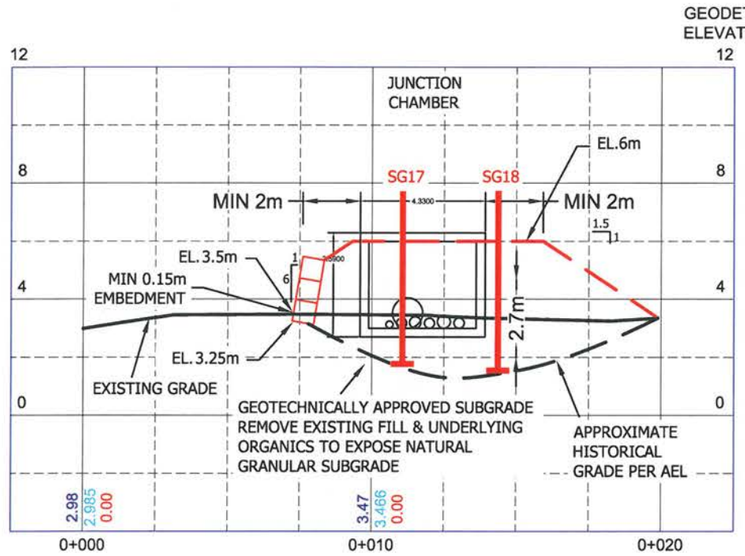
PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D.W. FUREY
25783
27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

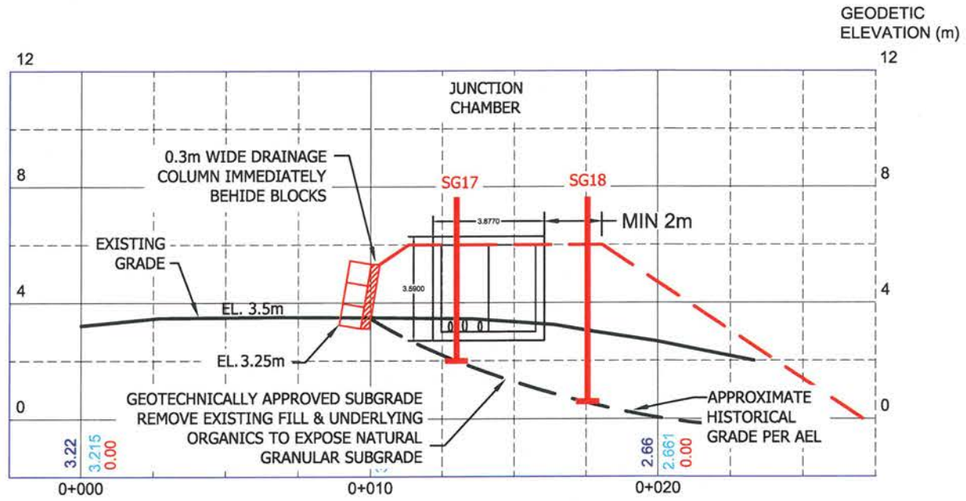
TITLE:
FLOW METERS AND JUNCTION CHAMBER LOCATIONS

PROJECT:
City of Port Alberni
Wastewater Lagoon Expansion Upgrades

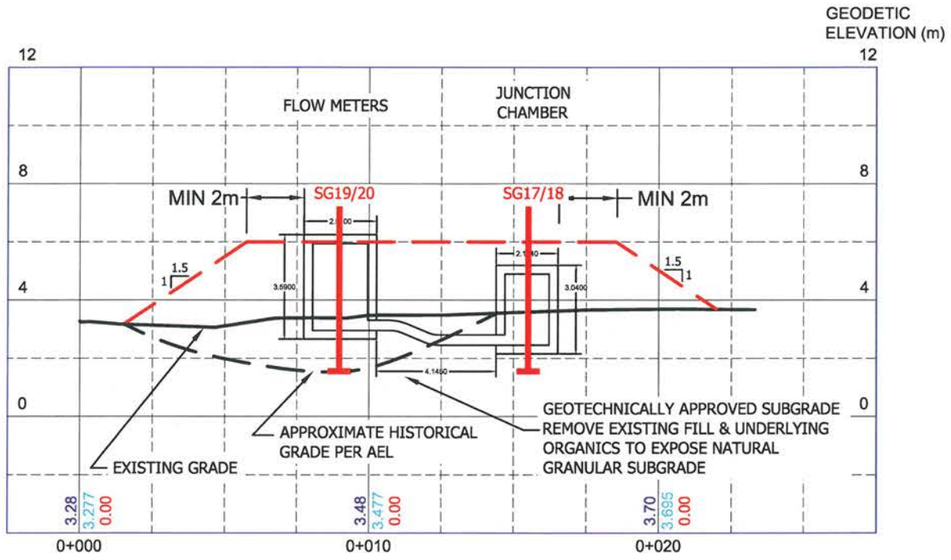
APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-7



B-B'



C-C'



A-A'

NOTES:

1. Install preload as soon as possible during construction.
2. Prior to preload construction, establish a minimum of three survey monitoring points on the existing bridge and abutment. Locations to be reviewed by Geotechnical Engineer prior to installation. Monitor vertical and two lateral directions prior to and throughout preload. Advise Geotechnical Engineer as soon as possible at first sign of potential movement.
3. Remove existing fill, vegetation and organic within preload area.
4. Install settlement gauges at locations shown. To be level on undisturbed ground at time of installation.
5. Place and compact engineered fill on geotechnically approved subgrade and adjacent to settlement gauges. Compact to minimum 95% MPMDD to Geodetic Elevation 4.0m.
6. Place fill above Geodetic Elevation 4m in lifts, nominally compact for stability.
7. Install concrete blocks as shown to maintain equipment access to main lagoon site as necessary. Place on existing sand and gravel fill subgrade approved by Geotechnical Engineer. May be place on a levelling coarse of 19mm minus base coarse gravel. Batter relative to vertical at 1H:6V.
8. Survey settlement gauges as described on Drawing Preload-1.
9. Replace any damaged settlement gauges at no cost to owners.
10. Remove preload only when approved by Geotechnical Engineer. Allow minimum 3 months.
11. Unthread settlement gauges or cut-off at minimum 0.3m below underside slab.

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TEL.: 1-250-723-2146 | FAX: 1-250-723-1003
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SCALE: 0 2 4 6 8m

NOTE:

BASE PLAN: INTERNAL VERSION DRAWING: JUNCTION-FLOW METER CROSS SECTION.DWG
RECEIVED BY WSP ON MAY 14, 2018.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.W. FUREY 25783 27 JUN 2018

REV.	DATE	DESCRIPTION	INT.
1	27 JUN 18	Issued for Tender	DF
0	15 MAY 18	Issued for Client Review	

TITLE: FLOW METERS AND JUNCTION CHAMBER DETAILS

PROJECT: City of Port Alberni
Wastewater Lagoon Expansion Upgrades

APP.		DR.	JL
CH.	DF	DATE	JUN 2018
FILE NO.	171-04753-00	FIG. NO.	PRELOAD-8

Appendix B - Geotechnical Report

PORT ALBERNI WWTP

GEOTECHNICAL DESIGN REPORT

ASSOCIATED ENGINEERING LTD.

PROJECT NO.: 171-04753-00
DATE: 19 JANUARY 2018

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WSP.COM

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16 January 2018

Associated Engineering Ltd (AEL).
Suite 300 - 4940 Canada Way
Burnaby, BC V5G 4M5

Attention: Christian Brumpton, M.Eng., P.Eng.

Subject: **Port Alberni WWTP – Geotechnical Design Report**

WSP Canada Inc (WSP) is pleased to submit the attached geotechnical design report to Associated Engineering Ltd. (AEL) in support of design of upgrades to the Port Alberni Wastewater Treatment Plant.

This report summarizes our understanding of the project, and provides details of the site, the results of field and laboratory testing and detailed seismic analyses. Geotechnical recommendations are provided related to civil and structural design and construction including discussion on deep ground improvement measures intended to meet the seismic performance requirements.

This report supersedes interim project updates and a draft version that was presented for client review on 8 December 2017. This final version incorporates client feedback received in late December/early January 2018.

We look forward to the next phases of the project. If you have any questions or comments relating to this report, please do not hesitate to contact the undersigned.

Sincerely,

WSP Canada Inc.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D.W. FUREY
25783

Darryl Furey, M.Eng., P.Eng.
Senior Geotechnical Engineer

Encl. Geotechnical Design Report

WSP Ref.: 171-04753-00

SIGNATURES

PREPARED BY

Darryl Furey, M.Eng., P.Eng.
Senior Geotechnical Engineer

REVIEWED BY

Don Kaluza, P.Eng.
Senior Geotechnical Engineer

The work outlined herein was carried out in accordance with our current contract with Associated Engineering Ltd. and the attached Terms or Reference for Geotechnical Reports. The City of Port Alberni is an approved user of this report subject to the terms under which it was prepared.

We trust that the information presented herein meets your current requirements. If you have any questions, or require further information, please contact the undersigned.

The original of the technology-based document sent herewith has been authenticated and will be retained by WSP for a minimum of ten years. Since the file transmitted is now out of WSP's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

TABLE OF CONTENTS

TABLES

FIGURES

PHOTOGRAPHS

APPENDICES

EXECUTIVE SUMMARY

WSP Canada Inc. (WSP) conducted a geotechnical assessment at the former industrial sewage treatment plant in Port Alberni, BC in support of detailed design of proposed upgrades to the City of Port Alberni's (the City) wastewater treatment plant (WWTP) by Associated Engineering Ltd. This report discusses geotechnical aspects of each component of the project including: a new Screening Building, UV/Aeration Building, floating pump stations, approximately 100 lineal meters of new division berm with an overflow apron, and supply and outfall piping. New HDPE pipes are proposed at the inside edge of the berms extending between the supply main and the screening building, between the two new buildings and from the UV building towards a new outfall. Plans include raising the existing berm to a common elevation with filling primarily occurring in the southeast part of the berm with a preliminary final berm elevation of approximately 4.5 m (Geodetic) under consideration. This would involve potentially in the order of 1 m of fill in places.

The project risk-based design philosophy is described in a separate Technical Memorandum prepared by AEL (dated March 2017) and is summarized as follows:

- The current BC Building Code applies (2012);
- Structures are to be designed as "post-disaster" but moderate damage related to the 1:2475 year earthquake is acceptable provided the structures can be operational within a reasonable time period;
- Tsunami impacts are to be considered (forces by others); and,
- The performance of existing lagoon berms are excluded.

A subsurface assessment was carried out which involved the advancement of two test pits, five sonic boreholes and four cone penetration test (CPT) holes. The CPT holes and two of the boreholes were advanced relatively deep to 20 to 30 m below ground surface. The depth to firm ground was not confirmed. The general subsurface conditions about 22 m of loose/soft interbedded silts and sands underlain by intermediate plastic silt/clay.

Two dimensional FLAC analyses were conducted to assess seismic ground deformations and impacts of ground improvement. Based on these analyses liquefiable layers with a cumulative thickness ranging from about 9 to 12.5 m are present in the upper 22 m and the underlying soft silt/clay is moderately susceptible to strain-softening. Without ground improvement, seismically induced movements are larger than can be accommodated in the civil and structural design (i.e. 0.4 to 0.8 m vertically and 1 to 3 m laterally) and ground improvement is necessary to mitigate liquefaction and reduce post seismic movements.

Ground improvement in combination with a raft slab foundation is recommended for the two buildings. Design recommendations are provided for two ground improvement concepts: compaction piles (i.e. timber piles, Geopier Grouted Impact® Pier System, or similar) and deep soil-cement mixing (DSM). In general, ground improvement will need to extend to about 15 m below ground surface and 5 to 6 m beyond the perimeter of the building depending on the method selected. The intent of the design is to create an area below each of the buildings that will generally move together and reduce local differential movements to a tolerable level.

Notwithstanding this, deep seated soil strain, local berm movements and/or flow failures in the surrounding ground that cannot be practically mitigated may still occur. These movements are expected to affect infrastructure pipe connections and the functionality of the overall water treatment system. In consideration of all the various elements, the DSM method is more robust and will have greater resistance to impacts

from local berm slope movements, flow failures and/or tsunami forces and as such, is geotechnically preferred.

In addition to seismic considerations, the underlying soils are compressible and the building foundation design includes recommendations to limit new building load. The floor slab elevation required to meet tsunami/flood design criteria (i.e. +/- 1 m above the top of the raft slab) is to be achieved with the use of light weight fill. In other areas where new soil loads are to be applied, such as the new division berm location and parts of the lagoon which are to be raised, use of a preload approach is recommended to generate settlements prior to installation of settlement sensitive elements (such as pipes, splitters, overflow aprons, etc.). Similarly, recommendations include avoidance of the organic core of the existing berm for the outfall pipe layout on the southeast perimeter lagoon.

Construction challenges include restrictions on equipment access that will require careful planning/ sequencing, potential loading limits for a crane on the existing berm that is constructed of variable soils and anticipated groundwater seepage in the area of the proposed division berm. Recommendations for berm construction include alternative materials that allow for placement of fill below water if complete dewatering cannot be achieved.

Conditions at the new screening building location have not been assessed directly as the layout changed after the subsurface drilling program and it is recommended that conditions be verified through further subsurface assessment. Geotechnical input is recommended for preparation of the preload and ground improvement specifications.

1 GENERAL

WSP Canada Inc. (WSP) conducted a geotechnical assessment at the former industrial sewage treatment plant in Port Alberni, BC in support of detailed design of proposed upgrades to the City of Port Alberni's (the City) wastewater treatment plant (WWTP) by Associated Engineering Ltd. The assessment was completed in general accordance with WSP's proposal dated 11 May 2017 (File Reference: P16-11140-76). Comments provided herein are based on the general project risk-based design philosophy outlined in a Technical Memorandum prepared by AEL in March 2017 (summarized in Section 2.2 below). Environmental sampling and analysis of ground water and soils was not part of the scope of this assignment.

In support of an interactive design process, Geotechnical Progress Updates were provided in June and July 2017 that presented a summary of ground conditions, initial results of FLAC analyses to assess seismic ground response and preliminary recommendations for ground improvement and construction of a new section of berm. This final report incorporates the results of further analyses and subsequent design discussions with AEL and supersedes the interim updates.

Presented in the following sections are an overview of the project, a description of the subsurface conditions, a summary of the seismic analyses and results, and geotechnical discussion and recommendations for ground improvement and foundation design for the buildings, design and construction recommendations for the new section of berm that is proposed to divide the existing lagoon into two cells (seismic design excluded). Appended to this report are site and test hole location plans, a Seismic Hazard Calculation, photographs of typical soil conditions, updated concept development plans, borehole logs, laboratory soil test results and CPT summary logs.

2 PROJECT DESCRIPTION

2.1 GENERAL

The City of Port Alberni is proposing to upgrade the former industrial sewage treatment facility to expand their existing facilities, which are located immediately north of the former industrial lagoons. In general, the project includes the construction of a new Screening Building, UV/Aeration Building, floating pump stations, approximately 100 lineal meters of new division berm with an overflow apron, and supply and outfall piping. New HDPE pipes are proposed at the inside edge of the berms extending between the supply main and the screening building, between the two new buildings and from the UV building towards a new outfall. Conceptual design drawings that illustrate the proposed structure layout and building concepts provided by AEL are included in Appendix 1. A summary of the concepts for the UV/Aeration Building, Screening Building and new division berm, an overview of the existing berm conditions, and proposed pipe alignment are provided in Section 2.3 below. Geotechnical comment in relation to outfall piping is to be provided under separate cover.

2.2 PROJECT DESIGN PHILOSOPHY

In summary of AEL's Technical Memorandum that discusses risk (March 10, 2017) we understand that:

- Design of the structures is to be in accordance with BC Building Code 2012;
- Buildings will be designed as "post-disaster" structures, as such moderate damage related to a 1:2475 year earthquake is acceptable with the intent that operations can be resumed within a reasonable time period;
- Foundation design should consider impacts from a tsunami and sloshing associated with a significant seismic event (forces determined by others);
- Review of the condition or performance of the existing lagoons or berms is excluded from the scope; and,
- The new internal berm will not be designed to withstand a seismic event.

2.3 DEVELOPMENT SUMMARY

The proposed design at the time of report preparation included:

2.3.1 UV/AERATION BUILDING

- Proposed in the central area of the lagoon on the existing interior berm;
- One storey, 11.4 m x 17.2 m concrete block structure supported on a raft slab (top of slab at 4.5 m elevation (Geodetic) (i.e. approximate existing grade)).
    - Approximate unfactored structural load of 40 kPa (offset by partial burial of raft slab at 0.5 m below ground surface – net new load of 30kPa);
- Concrete floor slab at 5.5 m elevation to meet tsunami/flood hazard criteria. This is approximately 1 m above current berm elevation in this area and metal entrance stairs will be provided. The interior slab will be supported on lightweight fill (i.e. EPS foam block, or similar) contained within a perimeter upstand concrete wall that extends to 5.5 m elevation;
- Local lateral extension of the crest of the existing berms at the south end of the building to facilitate vehicle traffic around the building to access blower and generator rooms; and,
- Buried pipes connecting from the building to the floating pump stations in each of the two lagoon areas. Concrete pump stations on the edges of the berm in lieu of the pile supported pump stations within the lagoons were considered during the design but ruled out due to complications in relation to construction sequencing, potential dewatering needs, and expansion of the ground improvement footprint.

2.3.2 SCREENING BUILDING

- Proposed at the north-central edge of the existing lagoon berm (i.e. location changed during design);
- One storey, 8.6 m x 12.2 m concrete block structure supported on a split level raft slab foundation and an upstand perimeter concrete wall to 5.5 m elevation (Geodetic).
    - The main area of the Screening Building will have a floor slab elevation of 4.5 m (i.e. top of raft slab);
    - An electrical room (3.6 x 2.7 m in plan) with a floor slab structure similar to the UV/Aeration building with a floor slab elevation of 5.5 m (Geodetic);
    - A reinforced concrete channel with an invert of 2.3 m (Geodetic) (approximate invert of 2 m below existing grade) and a grate elevation of 5.0 m (Geodetic);
- Approximate unfactored structural loads of:
    - 45 kPa for the screen room floor and electrical room (offset by partial burial of raft slab at 0.5 m below ground surface – net new load of 35kPa;
    - 70 kPa in the channel (offset by a buried invert elevation and raft slab at the channel base - net new load of 30 kPa); and,
- Possible expansion of the berm crest toward the north for additional parking.

2.3.3 NEW DIVISION BERM

- A new berm is proposed to divide the existing lagoon into two cells, extending from the north edge of the existing inner berm at the proposed UV/Aeration Building approximately 100 lineal meters towards the north;
- The new berm is to be constructed with a similar configuration to the existing berm (i.e. 2H:1V side slope with an approximate 5 m crest width);
- An approximate 16 m long hard surfaced, overflow apron and a splitter/distribution box are proposed within the new division berm approximately 30 m north of the new UV/Aeration Building; and,
- New pipes to convey fluids between the screening building, UV/Aeration Building and splitter/distribution box are proposed to be installed within the new berm and at the edge of the existing berm.

2.3.4 EXISTING BERMS & PROPOSED GRADE INCREASE

Existing berms vary in elevation from 3.6 m (Geodetic) (south) to 5 m (Geodetic) (north). We understand from AEL that the survey information also indicates that historical, post-construction berm elevation difference of the existing berms is greater than 0.5 m in places (inferred settlement. The base of the existing lagoon ranges from about -1.25 m (Geodetic) in the center to 1 m (Geodetic) in places where sludge has accumulated.

As-built drawings indicate that the existing lagoon berms have been constructed with three configurations:

- **NW/NE Berms** (Section A-A, Drawing 13.030) – sand and gravel berm with 2H:1V interior side slopes and 1.5H:1V exterior side slopes with exterior slopes covered with "organic silt and muck" placed at a 6H:1V side slope (BH17-05);
- **SW/SE Berms** (Section A-A, Drawing 13.007) – variable, non-organic soil (potentially re-worked on site soils) with a lower permeable core of "peat, silt and organic material" on the inside edge of the crest and approximately 3H:1V side slopes (TP17-02, BH17-03 and BH17-04); and,
- **Interior Berms** (Section B-B, Drawing 13.007) - sand and gravel with approximately 2H:1V side slopes (BH17-01, TP17-01).

As built information indicates that where the perimeter berm sections transitioned from one type to another (i.e. Points A and B on Drawing 13.006 in Appendix 2), a continuous water stop was accomplished with the use of polyethylene sheets.

We understand that plans include raising the existing berm to a common elevation. At the time of reporting the final berm elevation was not known. Based on discussions that indicated filling would primarily occur in the southeast part of the berm with a preliminary final berm elevation of approximately 4.5 m (Geodetic) under consideration. This would involve potentially up to 1 m new fill on the existing berms with fill thickness being differential and reducing towards the north. While review of the condition or performance of the existing lagoons or berms is excluded from the scope of our review, the proposed grade change has implications related to building foundation design that are discussed herein.

2.3.5 PIPES

In general, to manage and reduce the impacts of potential on-going settlement on the pipes generated by raising the existing berms to a common elevation, and facilitate post disaster access to pipes that could be damaged by berm movements, pipes are to be installed at or near the existing granular slope surface. The new pipe will be buried at about 1.5 to 2.5 m depth at some locations, such as near the buildings, between the buildings and the floating pump station, and at the overflow apron. Proposed pipes re approximately 800 to 1050 mm diameter HDPE to accommodate potentially large movements. Flexible couplers may be installed in select areas such as near the transition between improved and unimproved ground.

3 SUBSURFACE CONDITIONS

Subsurface conditions were assessed through a combined test pit, sonic drilling and electric cone penetration testing (CPT) program conducted in April 2017. A total of two test pits, five boreholes and four CPT test holes were advanced at the approximate locations shown on the attached Figure 2. Test holes were advanced to depths below ground surface ranging from 1.2 to 3.8 m at the test pit locations 20 to 30.5 m at the borehole and CPT locations. Several shallow boreholes (i.e. 3 to 5 m depth) were also advanced to confirm near surface conditions for the proposed pipes.

The general subsurface conditions encountered during the field program (i.e. boreholes, test pits, and CPT probing) in order of increasing depth near the proposed UV/Aeration Building (i.e. central part of the existing lagoon) includes:

- 3 m thickness of **SAND AND GRAVEL (FILL)** - compact with trace to some fines;
- 12 m thickness of **SAND AND SILT** loose/soft interbedded layers of with variable gravel and silt content, low plastic;
- 7 m thickness of interbedded loose **SANDY SILT/SILTY SAND** with trace gravel, shells, wood debris and organics, low plastic; underlain by,
- Below +/- 22 depth: More than 8 m thickness of soft, intermediate plastic **SILT/CLAY** with variable sand content.

Traces of shells and wood debris typical of deltaic/estuarine deposits were encountered throughout. Firm ground (i.e. till-like deposits or bedrock) was not encountered within the maximum exploration depth of 32.8 m.

Gradation Analyses and Atterberg Limits Testing were conducted on select samples to characterize the soils for seismic analyses, and in the case of shallow soils, potential for reuse. Results are summarized in Tables 1 and 2, below. Borehole logs, gradation analyses test results, and CPT logs are presented in Appendixes 3 and 4.

Table 3.1 Summary of Gradation Analyses

Sieve #	Test Hole	Depth (m)	Gradation per CFEM			Moisture Content %		D50 (mm)	D10 (mm)	Comments
			Gravel %	Sand %	Fines %					
1	BH17-01	4.9	17	69	14	19		0.3	<0.075	Sand seam
2	BH17-01	11.4	33	64	3	13		1.5	0.3	
3	BH17-01	20.5	0	49	51	40		0.07	<0.075	
4	BH17-02	5.3	24	72	4	19		0.6	0.18	
5	BH17-02	8.5	63	33	4	9		3.5	0.5	
6	BH17-02	15.8	2	88	10	19		0.3	0.07	
7	TP17-01	0.8	55	42	3	2		3.1	0.4	Berm fill

Table 3.2 Summary of Atterberg Limits Results

Test Hole	Depth (m)	Atterberg Limits						Comments
		Plastic Limit	Liquid Limit	Plasticity Index	Liquidity Index	Moisture Content %	Classification	
BH17-01	7.9	32	48	16	0.6	41	ML	Shells in Sample
BH17-01	23.5	23	29	5	1.3	30	ML	Shells in Sample
BH17-01	29.3	26	44	18	0.5	35	CI	
BH17-02	26.8	26	47	20	0.5	37	CI	

Soil conditions at the proposed screening building (approximately 200 m northwest of the proposed UV/Aeration building on the north side of the existing lagoon) were similar. At the screening building site, there is a potential greater thickness of firm silt with organics at the inferred fill/natural soil interface, particularly on the northwest edge of the lagoon (Refer to TP17-01 and BH17-05). It is also noted that the underlying natural soils at the north edge of the city lagoon (approximately 400 m north of the UV/Aeration building) were coarser grained with a higher sand and/or gravel content throughout a thicker zone relative to the UV/Aeration Building area. It is not known which of the conditions are representative of the revised Screening Building location.

Based on water level measurements, observations of moisture in the soil samples, and dissipation tests groundwater level was estimated to be approximately 2 to 3 m below ground surface, approximately equal to the water level in the lagoons at the time of drilling. It is anticipated that the groundwater level will be influenced by tides.

4 ANALYSES

4.1 SEISMIC ANALYSES

Two-dimensional (2D) FLAC analyses (Fast Lagrangian Analysis of Continua, Version 8.0; Itasca, 2016) were conducted to identify the global (large scale) ground deformation mechanism, to assess the potential for deep-seated failures, and to quantify the order of magnitude of movements. The Aeration/UV Building is the closest of the proposed facilities to the Somass River and Alberni Inlet, is surrounded by lagoon structures and is at greater risk of being impacted by ground movements relative to the Screening Building. Accordingly, the primary focus of the analyses was the Aeration/UV building. The details of FLAC analyses such as model development, soil characterization, and results are presented in Appendix 5.

Liquefaction potential and movements were assessed considering both localized berm failure and deep-seated, larger scale movements caused by the drop in grade in proximity to the Somass River that may impact a larger area. In general, the results from FLAC analyses were consistent with the results obtained using simplified one-dimensional liquefaction triggering assessment competed using SHAKE2000 (Ordenez, 2011). Results indicate that loose to compact sand-like soil encountered in the upper 20 m to 24 m are potentially liquefiable, with a cumulative thickness of liquefiable layers ranging from about 9 m to 12.5 m. In addition, the underlying soft silt/clay is moderately susceptible to strain-softening. In summary, without ground improvement, seismically induced movements were estimated to be in the order of 0.4 to 0.8 m vertically and 1 to 3 m laterally towards the inlet and/or Somass River. For preliminary design considerations differential settlement may be considered to be about ½ of the total settlement over distance of 10 m. The largest displacements were predicted in relation to the Cascadia subduction earthquake.

Liquefaction of sand-like soil was predicted to occur within a few seconds of shaking with the long duration of the interface motion contributing to the accumulation of permanent ground deformation. The estimated ground displacements were compared against the database of permanent ground displacements compiled by Ishihara et al (1997) for near-shore areas following the 1995 Kobe earthquake. The predictions from FLAC and simplified methods were generally in agreement with these past earthquake observations, and expected to decrease away from the shoreline.

We understand that these movements are larger than can be accommodated in the civil and structural design. Accordingly, ground improvement is necessary to mitigate liquefaction and reduce post seismic movements to a tolerable magnitude.

4.2 GROUND IMPROVEMENT ANALYSES

Two general concepts for ground improvement were analyzed with FLAC to identify a solution that reduces predicted ground movements, namely: Compaction Piles and Deep Soil-Cement Mixing Method (DSM). Conventional, permeable forms of ground improvement are not considered acceptable due to potential negative effects on the containment function of the existing lagoons. Compaction piles could include timber piles, concrete piles or grouted impact piers. DSM is typically achieved with an interlocking panel/cell pattern with panel widths in the order of 1 m wide. For the purposes of the analyses ground improvement was extended 15 m below the proposed building and approximately 5 to 7 m beyond the perimeter of the structure. The lateral extent of improvement will be dependent upon the technique used, and structural/civil ground movement tolerances and will generally be less for DSM.

The results from the modelling indicate that ground improvement will reduce predicted seismically induced ground displacements to in the order of 0.2 to 0.3 m vertically and about 0.5 to 1 m laterally at the UV/Aeration Building. These relatively large lateral displacements were related to the Subduction input motions. Lateral displacements estimated for the Crustal and Inslab motions were less (i.e. in the order of 0.3 m). Based on the FLAC analyses, these movements occur through a slip surface that develops below the ground improved zone which is associated with the larger scale drop in grade at the Somass River. A positive aspect of the ground improvement is that differential movements within the ground improved zone are anticipated to be relatively small (i.e. the building and improved zone will largely move together with predicted movements less than 0.1 m inside a perimeter buffer within the ground improved zone). Extending the depth of the ground improvement zone to cut-off deep slip surfaces to reduce global movements further has technical complications associated with the proximity of the underlying sensitive clay deposit and a reduced cost-benefit ratio tied to large cost implications. It is noted that the DSM method will create a more robust solution that has a significantly reduced potential for differential movements within the improved soil zone.

4.3 SHALLOW SLOPE FAILURES TOWARD LAGOON

Besides the deep-seated global movements estimated using FLAC, shallow slope movements of the berm can also occur towards the lagoon. Simplified limit-equilibrium based analysis were undertaken using the SLOPE/W (GeoStudio 2012) computer program to review two conditions: (1) stability of the new division berm under variable fluid levels on either side of the berm; and, (2) stability of the existing berm in relation to the proposed buildings. Results are discussed below.

4.3.1 NEW DIVERSION BERM

Stability analyses for the new division berm were completed for a potential fluid elevation difference between the two lagoons of approximately 2.4 m (i.e. 4.4 m (Geodetic, peak operating level) and 2 m (Geodetic, lowest operating level) which is similar to the differential fluid elevation anticipated during maintenance activities. The Factor of Safety of stability under variable water level conditions was in the order of 1.5 assuming that the new berm is constructed in accordance with recommendations presented herein.

4.3.2 SEISMIC BERM STABILITY IN RELATION TO BUILDINGS

The slope of the berm material and setback from the building/ground improvement zone were varied in the model that was used to assess stability of the existing berm in relation to the proposed buildings under seismic loading conditions. Based on these analyses, a preliminary set-back of 6 m from the crest of the lagoon berms was provided as a guideline to AEL during facility layout/configuration planning. However, we understand that this setback could not be accommodated without switching to a multi-storey structure which would have introduced other (more adverse) challenges including potentially significant long term settlement. In addition, it is possible that breach of berm and/or sloshing of the liquid contained in the berms may trigger shallow localized flow failures that may encroach into the building footprint.

Accordingly, seismically induced lagoon berm failures near to the structures could result in large differential displacements between the existing berms and the improved ground zone leaving a scarp that could encroach into the improved zone and affect the buildings. Further discussion is provided in Section 5 below regarding mitigation measures that could be considered.In general, the DSM method of ground improvement will be less affected by lagoon berm failures.

4.4 STATIC SETTLEMENT ESTIMATES

The new buildings, new diversion berm, and raising the existing berms will add new load to the ground that will generate settlement under static loading conditions. Based on historical information, settlements could be relatively large and would be expected to be differential. The light-weight fill proposed within each of the structures is intended to reduce the magnitude of settlement at the building locations. Estimated settlement based on one dimensional consolidation theory is in the order of:

Buildings:

- 25 mm total settlement in the main building core area. Settlement is potentially greater at the edges of the UV/Aeration building due to settlements generated by new fill in the vicinity of the new diversion berm and widening of the crest of the existing berms on the south side of the building. The magnitude of total static settlement at those locations could be in the order of 50 mm resulting in some differential settlement across the building footprint;

New Diversion Berm:

- In the order of 300 mm total settlement and 100 mm of differential settlement over a distance of 10 m in the central part of the new diversion berm. Settlements will also be differential due to the variation in new fill thickness across the berm section and at the tie-in points to the existing berms; and,

Berm Raising:

- In the order of 25 to 50 mm of settlement related to 1 m of fill placement on the berm. These settlements would be in addition to settlement generated by the new buildings. Settlement generated by the proposed berm raising will be variable in relation to varying thicknesses of new fill, variations in the existing berm shape and configuration and an inferred variable thickness of compressible soils below the berm. The proposed new fill thickness is in the area of largest inferred historical settlement. Larger settlement could also occur in areas underlain by thicker organic silt.

Preloading to mitigate the impacts of settlement associated with new berm construction and/or raising of the existing berm crest is discussed in Section 5 below.

5 GEOTECHNICAL DISCUSSION & RECOMMENDATIONS

5.1 GENERAL

Ground conditions at the site are geotechnically poor and challenging from both a static and seismic design perspective. The underlying soils are compressible under new loads and/or susceptible to liquefaction and/or strain softening under seismic loading conditions. In particular, the order of magnitude of seismically induced movements is relatively large and ground improvement is recommended in the areas of the proposed buildings to reduce liquefaction and predicted movements to a more tolerable level in relation to structural and civil design (i.e., reduction but not elimination of the impacts). The selection of ground improvement and foundation options is further limited by relatively high fines contents in the underlying soils, environmental considerations, lateral space constraints, and a depth to firm ground greater than 30 m. Based on the assessment described herein, ground improvement coupled with a raft slab appears to be the most viable foundation alternative. Subject to the ground improvement technique selected, piles may also need to be incorporated into the foundation to address other potential hazards such as tsunami erosion and/or post-seismic secondary lagoon berm failures.

Geotechnical recommendations are provided based on the understanding that relatively large seismically induced movements of the buildings and zone of improved ground in relation to berms and civil infrastructure and potentially tilting of structures and/or severed pipe connections are acceptable outcomes. The differential performance of facilities within the areas of improved ground in relation to adjacent elements will need to be considered in overall facility emergency management plans. For example, civil/mechanical details will be needed in the pipe layout to control the location of pipe rupture to protect the buildings.

From a static design perspective, foundation design will need to consider potential impacts of settlement generated by a new lagoon berm, widening of the existing berm and raising of the existing berm height. Settlement will be generated by the new berm construction and recommendations are provided for a staged construction process that will reduce the potential impacts of differential settlement on the overflow apron and pipes.

Geotechnical discussion regarding building siting, construction sequencing, ground improvement, foundation design for the UV/Aeration Building and the Screening Building, and construction of a new division berm are provided below.

We note that ground conditions at the new Screening Building location have been inferred based on test hole information at the UV/Aeration Building and original Screening Building location. Further assessment of the ground conditions at the new building site should be completed to verify that deep ground conditions are similar to those assumed and whether unsuitable fill material for building support is present (i.e. organic silt is shown on the outer edge of the berm on the as-built drawings in this area). The results of this supplementary assessment could affect site preparation in this area (i.e. localized excavation and replacement) and the recommended spacing for densification points.

5.2 BUILDING SITING

Geotechnical recommendations were provided during design in relation to the facility layout. In summary,

- We support the relocation of the Screening Building to its current location due to significant differential settlement in relation to variable new fill thicknesses required below the structure and constructability considerations in relation to in-filling of an active sewage lagoon at its originally contemplated location;
- Buildings should be set-back from the lagoon berm crest to reduce complications related to construction equipment access for ground improvement, differential settlement related to grade increases and seismic ground movements related to post seismic lagoon berm failure. While we recognize there are physical limitations, the set-back should be as large as possible;
- Buildings should not be located in the vicinity of grade changes greater than 0.3 m due to the high potential for settlements to be generated that could affect structure performance; and,
- New structure loads imposed on the ground should be kept to a minimum (i.e. a geotechnical preference towards one storey versus two storey's) to reduce the potential for settlement.

5.3 CONSTRUCTION SEQUENCING

Construction of the various facilities for this project is expected to include a scheduling sequence that accommodates the ground conditions. For example, the proposed new division berm and raising of grade in the vicinity of the new buildings and along the outfall pipe alignment will need to be completed first with preload to generate as much settlement as possible prior to construction of settlement sensitive elements such as buildings, overflow apron and/or pipes. This will necessitate early drainage and dredging of the existing lagoon (at least in the area of the new berm). Similar preload recommendations are provided under separate cover for the land based component of the proposed outfall pipe, particularly in the area of the proposed berm raising and new manhole/vent chamber.

Ground improvement would follow and potentially overlap with the preload. Building construction, pipe installation and overflow apron surfacing would commence based on the ground response to the preload and densification activities.

Supplementary assessment work at the new Screening Building should be completed prior to tendering for ground improvement. Subject to project scheduling, this work could be completed concurrent with or prior to construction of the new division berm.

5.4 GROUND IMPROVEMENT

Ground improvement is recommended to mitigate the seismic displacements to meet the seismic performance criteria described in Section 2.2 above for the two buildings. Several ground improvement alternatives are geotechnically viable including: Compaction Piles (a series of tightly spaced, concrete or treated timber piles), Geopier Grouted Impact® Pier System (Geopier GIS), or similar, and/or a soil-cement mixing technique (Deep Soil-Cement Mixing (DSM)). Comparatively, the DSM method is more robust, stiffer, and will have greater resistance to impacts from local berm slope movements, flow failures and/or tsunami forces. As such, DSM is geotechnically preferred as it is expected to provide the best performance out of the three methods reviewed.

A conventional, permeable form of ground improvement such as stone columns, vibro-densification, etc. is not recommended due to potential negative effects on the containment function of the existing lagoons. Based on the analyses, ground improvement should extend to 15 m below the top of the berm (i.e. to the silty sand/sandy silt zone).

An overview of each option and design details based on the FLAC analyses are presented below. Technical merits and constructability of each method are compared in Table 5.3.1. It should be noted that densification of soils with significant fines content is complex and the final pier/pile spacing will be subject to verification through field trials early in the ground improvement program. Field verification typically requires time between installation and testing to allow for dissipation of pore pressures. While results tend to improve with time, a minimum of 72 hours is often recommended for practical construction considerations. A longer duration is preferred if it can be accommodated in the construction schedule.

Compaction Piles:

- A group of piles, driven in a pattern, to compact a surface layer of loose granular soil through displacement;
- Minimum 0.3 m diameter, treated timber or concrete piles installed on a triangular pattern;
- Minimum SPT $(N_1)_{60,cs}$ value of 22 blows per 300 mm within the ground improvement zone;
- Maximum 1.4 m center to center spacing (Minimum 20% area replacement ratio); and,
- Extending a minimum of 6 m laterally beyond the perimeter of the buildings;

Geopier Grouted Impact® Pier System:

- A patented displacement mandrel is advanced into the ground, filled with cement grout to a prescribed depth, followed by aggregate that is vertically rammed into placed by a series of up and down motions;
- Average 0.6 m diameter grout filled stone columns installed on a triangular pattern with a dry-bottom, displacement method;
- Minimum SPT $(N_1)_{60,cs}$ value of 22 blows per 300 mm within the ground improvement zone;
- Maximum 1.6 m center to center spacing (Minimum 15 % area replacement ratio); and,

- Extending a minimum of 6 m laterally beyond the perimeter of the buildings.

With respect to the spacing of Geopier elements, WSP has experience with ground improvement projects at sites with similar soil type. Although results are expected to vary from site to site, our previous experience has shown that subject to verification through in-situ testing at the time of construction, the spacing of the Geopier elements could potentially increase (i.e. to a maximum of in the order of 1.8 m). Improvements in ground conditions would need to be verified at several test areas prior to endorsement of a wider spacing. In-situ testing is anticipated to include cross-hole shear wave velocity testing and verification that the average diameter of the piers increases due to the ramming action associated with the installation method.

Deep Soil Mixing (DSM):

- A powerful drill advances a mixing tool as binder slurry is pumped through the connecting drill steel, mixing the soil to the target depth. Additional mixing of the soil is completed as the tool is withdrawn to the surface. The process employs the effects of both hydration and the bonding of soil particles to increase the shear strength. DSM structures are typically installed in the form of relatively closely spaced single columns to form walls, blocks or interlocking grids.
- Equivalent average shear strength 250 kPa;
- The contractor will be responsible for selecting the target Unconfined Compression Strength (UCS) and area replacement ratio (i.e., width and spacing of DSM panels) to achieve this equivalent shear strength. At this site, we would anticipate a UCS of treated soil in the order of 0.5 MPa to 1 MPa, a panel width of approximately 0.7 m to 1 m and an area replacement ratio in the order of 0.4 to 0.5; and,
- Extending to a minimum 4 m laterally beyond the perimeter of the buildings.

General Ground Improvement Considerations

In general, the improved soil zone is predicted to behave as a block and differential movements within the improved soil zone associated with deep ground movements are anticipated to be relatively small. Differential movements within the improved soil zone would be least with the DSM alternative.

For the compaction pile and Geopier alternatives the proximity of the existing lagoons introduces some construction challenges (i.e., piles/piers would need to be installed beyond the crest of the existing berm). There is also potential for the structures to be affected by differential movements at the edges of the buildings associated with berm slope failure. Additional ground improvement in the form of tighter densification points, extension of the improved ground area, full depth berm widening, and/or addition of rip rap facing is recommended where new buildings are within 6 m of the crest of the existing berm.

The existing berm may need to be locally upgraded to support the crane for ground improvement.

Ground improvement will generate vibrations that could induce settlement of adjacent ground, initiate local failures in the lower strength portions of the existing berm (i.e. organic silt zones) and/or introduce a breach in the containment aspects. Pre-construction survey of the existing berm and on-going monitoring during construction is recommended (i.e. regular visual reviews, survey hubs readings, in-ground pressure monitoring, and/or vibration measurements).

5.5 RAFT SLAB

Ground improvement coupled with a raft slab appears to be the most viable foundation alternative for support of the UV/Aeration Building and Screening Building in consideration of all design conditions. In the areas of ground improvement, structure design may be based on a Site Class D in accordance with the 2012 BC Building Code for seismic design purposes based on the understanding that the fundamental period of the buildings is less than 0.5 seconds. It is anticipated that a raft slab supported on improved ground can accommodate the settlement described in Section 4.4 above.

For the initial assessment, a modulus of subgrade reaction (MSR) of 25 MPa/m is recommended. It should be noted that, while it is simple in its definition, the MSR is a very difficult parameter to evaluate properly because it is not a unique fundamental property of the soil that is easily measured. Accordingly, design is expected to be an iterative process with the Structural Engineer. Due to local variations in the soil, subgrade disturbance during construction excavation, placement of reinforcing steel, and limitations of the theory itself, only an approximate indication of the magnitude of the MSR can be given based on the subsurface information available at this point. This value is applicable to a 0.3 x 0.3 m area, and for a slab with a width of "B", the equivalent subgrade modulus (k) should be determined using the following equation (CFEM 2016):

$$k = k_{(0.3)} \left(\frac{B + 0.3}{2B} \right)^2$$

A geogrid reinforced soil zone is recommended to facilitate transfer of foundation loads onto compaction piles or rigid ground improvement elements. Reinforcement should consist of biaxial geogrid (BX1200 or approved equivalent) installed in accordance with the manufacturer's instructions to a minimum of 2 m beyond the perimeter of the building at 0.5 m and 0.2 m below underside of concrete. Site preparation is anticipated to consist of:

- Excavation to 0.5 m below raft slab (potential cutting off of densification timber piles);
- Compaction in the presence of the geotechnical engineer;
- Remediation of soft, poor soils locally as needed;
- Placement of geogrid on geotechnical approved subgrade (subject to conditions encountered a medium weight, non-woven geotextile such as Nilex 4553 (or approved equivalent) may need to be installed prior to the geogrid);
- Placement and compaction of 19 mm minus, crushed sand and gravel to a minimum 95% MPMDD to 0.2 m below slab, another layer of geogrid, followed by compacted crushed sand and gravel to underside of slab.

At the Screening Building it is recommended that the geogrid reinforced layer be installed at a common elevation. Engineered fill as described in Section 5.8 below may be used to raise grade below the shallower portion of the building. This will facilitate reworking of the existing fill and/or replacement of poor soils and promote uniform building performance. The upper raft slab should be underlain by a minimum 150 mm thick layer of 19 mm minus crushed sand and gravel compacted to 95% MPMDD.

For sliding resistance, a friction factor of 0.55 may be used.

We understand that final floor slab elevation at both structures is above existing grade and about 0.5 to 1 m above the top of raft slab. To reduce the total new building load, final floor slab elevation is to be achieved through the use of light-weight fill placed on the raft slab surface. We recommend that the surface of the light weight fill be covered with light to medium weight, non-woven geotextile (such as Nilex 4553, or approved equivalent) separator and an approximate 100 mm thick layer of 19 mm minus, crushed sand and gravel compacted to 95% MPMDD to provide a stiff transition layer. The designer should consider the potential for buoyancy and compressibility of the light weight fill.

5.6 SHALLOW FOOTINGS

We understand that a number of shallow footings may be needed to support non-critical structural elements such as stairs. Based on the understanding that these will be located within the area of improved ground design may be based on a serviceability limit states (SLS) bearing pressure of 100 kPa. These areas should be directly underlain by a minimum of 0.3 m thickness of engineered fill placed on geotechnically approved subgrade (i.e. generally expected to be existing granular berm fill) and compacted to a minimum 95% Modified Proctor Maximum Dry Density.

5.7 LATERAL EARTH STRESS

Lateral earth pressures on below grade walls for the concrete channels below the screening building will include both static and seismic components – along with live loading associated with other site activities. It has been assumed that the wall backfill (typically composed of clean, well-graded, sand and gravel) will be maintained in a fully drained condition to avoid hydrostatic pressure. We have also anticipated in our discussion of earth pressures that the surface of the backfill would be approximately horizontal.

The selection of earth pressure parameters for use in lateral load calculations is influenced by the structural design of the wall – in particular, whether the wall is able to yield or whether it should be considered as non-yielding. The following discussion assumes that, in this case, the wall will be non-yielding in the static sense, but that the entire structure will have sufficient capacity to move dynamically to develop active lateral pressures (K_a).

For static design, therefore, a non-yielding (rigid) case is assumed and 'at-rest' (K_o) lateral loading should be applied. Dynamic soil pressures would be calculated using the Mononobe-Okabe (M-O) equation with the full peak ground acceleration (PGA) due to the relatively rigidity/stiffness of the structure (K_{ae}).

The proposed pressure distributions for both static and dynamic lateral loadings are attached (Figures 4&5)

Table 5.7.1 – Preliminary Lateral Earth Pressures – Geotechnical Parameters

ESTIMATED BACKFILL PARAMETERS		EARTH PRESSURE COEFFICIENTS		
SOIL FRICTION (Ø)	UNIT WEIGHT (kN/m³)	ACTIVE (Ka)	AT REST (Ko)	DYNAMIC* (Kae)
35°	20	0.27	0.43	0.78

* based on M-O equation – includes both static (active) and dynamic components, based on 100% of PGA (2012).

Site specific live loads and traffic loads (if any) – along with potential hydrostatic and hydro-dynamic loads - would also have to be included in the calculation of lateral pressures.

5.8 DIVISION BERM

The proposed granular fill berm with 2H:1V side slopes is geotechnically feasible provided the following recommendations are implemented. Berm fill is to be placed on a subgrade of non-organic, silt and sand. This will require removal of accumulated sewage sediment and natural, organic rich silt and sand through excavation or dredging to expose the underlying interbedded silt and sand.

Construction of the new berm is anticipated to generate settlement. Based on historical information, settlements could be relatively large (i.e. +/- 0.5 m) and would be expected to be differential. A preload created by an over-build is recommended to reduce the potential magnitude of future settlement and related negative impacts on the performance of the proposed overflow apron and new intake pipes. Preloading will also help to reduce the differential performance between new and existing berms. This may affect construction schedule. For planning purposes we recommend an approximate 2 m high preload over top of the design finished berm height. The duration of the preload is difficult to predict based on the variation in soil conditions observed at the test hole locations. Initial planning may be based on a minimum of six months subject to the results of settlement monitoring during the preload. We recommend that the preload remain in place during the ground improvement program. We also recommend that the lagoon be maintained in a dewatered condition to reduce pore pressures and facilitate a greater rate of settlement. Provided the preload is left in place for sufficient time to complete primary consolidation, the long-term post construction settlements are estimated to be less than 50 mm. A larger and/or longer preload would be required to reduce estimated long term settlements further.

Conceptual plans indicate that the overflow apron is to be surfaced with concrete. We recommend that a more settlement tolerant surface be considered for the overflow apron. If hard surfacing is used, the City should be aware that there is potential for a higher than normal level of maintenance. With this approach, consideration could be given to incorporating replacement of the apron surface into the operational plans/budget in the event that settlements cause operational issues.

Alternatively, if the order of magnitude of settlement described herein is too large and/or if the preload cannot be left in place a sufficient length of time and the monitor/maintenance approach described above is not acceptable, it is recommended that ground improvement be implemented below the overflow apron and splitter box to mitigate settlements. Ground improvement, if required, should extend laterally a minimum of 2 m horizontally beyond the perimeter of the rigid structures. The level of ground improvement would be less than proposed at the buildings (i.e. smaller area replacement ratio / wider spacing).

Seepage into the lagoon is expected to be tidally influenced and construction of the deeper portions of the berm should be co-ordinated with low tide events. Notwithstanding this, it is expected that there will be limitations on practical dewatering that can be achieved in the existing lagoon and that specialized dewatering methods would be required to lower the water level to the base of the berm. Accordingly, the following general wet construction methodology is proposed for consideration potentially in conjunction with basic dewatering efforts if practical:

- Dredge to non-organic subgrade (inferred at 4 to 5 m below the top of the existing berm);
- Place well graded, 0.3 m diameter minus, durable, angular rock fill with an excavator or clam-shell bucket in lifts to waterline elevation. The proposed use of “Class 10 Rip Rap” (i.e. 0.3 m minus diameter) as a specification for material placed in wet conditions is geotechnically suitable;
- Install a heavy weight, non-woven geotextile separator such as Nilex 4510, or approved equivalent;
- Place and compact a well graded, 150 mm minus crushed rock fill capped with a minimum 200 mm thick layer of 25 mm minus crushed rock. Subject to further discussion, consideration could also be given to use of a well graded, 75 mm minus sand and gravel fill placed and compacted in lifts to a minimum 95% Modified Proctor Maximum Dry Density (MPMDD) above the waterline. The preferred berm material may be affected by erosion due to seismically induced sloshing forces (and to a lesser degree, regular lagoon flow).

A geotextile separator at the interface between the natural soil and the 300 mm minus rock fill would reduce the volume of rock fill that is required (i.e. less material “lost” into the soft subgrade) and reduce the potential for settlement as fines would not tend to migrate into the voids of the rock fill. However, there will be some practical limitations to being able to install geotextile below the water table in a controlled manner. Accordingly, consideration could be given to specifying a geotextile at that interface, subject to geotechnical review in relation to depth of water and actual subgrade conditions. We recommend Nilex 4510, or approved equivalent, for this application (i.e. same product as for above the 300 mm rock fill).

Some settlement additional to that of a well compacted granular fill that is placed in dry conditions could occur with placement of crushed rock below water as full compaction cannot be achieved and finer grained sediments could work their way into the rock fill voids.

We recommend that flexible connections be considered for pipes installed in this area, particularly near the transition zones between existing and new berms.

Erosion protection is recommended at the face of the slopes, particularly if a smaller diameter fill such as 75 mm minus material is used, or if flow between berms is expected to be consistently in one direction. Conceptually this protection would include a layer of non-woven geotextile (i.e. Nilex 4551, or approved equivalent), suitably secured at the top and toe and overlain with a 150 mm thick surface layer of rock fill.

Temporary culvert installations are proposed prior to overflow apron construction (i.e. during the preload) to provide a conduit for fluids to pass through to the other side of the berm. Consideration should be given to a low permeability head wall at each end of the culverts to reduce the potential for preferential flows along the outside of the culvert pipes and related erosion. Temporary culvert installations should be sealed with grout once the overflow apron is in place to minimize potential for problems in the future.

5.9 PIPES

In general, new pipes not within the new berm or buried in the vicinity of a new structure are to be installed on the inside edge of the existing lagoon berms at or near to the slope surface. It is anticipated that some localized excavation and replacement of poor soils at the ground surface will be required to provide suitable support.

The berms have been constructed of variable soils including an organic silt core in the SW/SE portions of the lagoon and organic silt on the exterior berm in the NW/NE portions of the lagoon. The new pipe should not be installed directly above the compressible organic silt core. This may require giving consideration to burial of the segment of pipe in the southwest part of the site that connects the new facilities to the outfall pipe. Cut-off walls should be installed where pipes enter and exit the berm and at each end of the pipe to reduce the potential of soil erosion adjacent to the pipes.

5.10 EXCAVATIONS/DEWATERING

In general, excavations for the buildings and pipes are anticipated to be advanced through variable fill ranging from organic silt core material to sand and gravel with variable fines. Accordingly, stability of temporary excavations is anticipated to be variable. For preliminary planning purposes, temporary excavation angles of 1H:1V and 2H:1V may be used for areas of granular and variable fill, respectively. Gentler slopes may be required in areas of very poor soil such as organic silts, loose silt and sand, or wet ground conditions. The lateral extent of excavations may affect equipment access and careful planning/sequencing of construction activities will be necessary.

We recommend that the interior lagoons be maintained in a drained condition as much as practical during construction to facilitate monitoring of berm response to construction activities and to reduce the potential for berm instability. As noted above, it may not be possible to fully drain the area of the new division berm, but this is anticipated to be a unique condition.

5.11 ENGINEERED FILL

Engineered fill required to raise subgrade for the buildings or to raise berms should consist of 75 mm minus well graded sand and gravel with less than 5% by weight smaller than 0.075 mm. Sand and gravel portions of the existing berms are anticipated to be suitable for this purpose, subject to confirmation by WSP. Engineered fill should be placed in evenly placed lifts and compacted to a minimum 95% MPMDD. In place lift thickness should not be more than 300 mm to achieve this compaction requirement. In-place density testing should be carried out to verify compacted densities.

5.12 FUTURE GEOTECHNICAL

Further geotechnical review is anticipated to be required in support of final design, tendering and construction. Scope is anticipated to include:

- Completion of supplementary assessment at the new Screening Building location;
- Geotechnical input for preparation of special provisions components of the specifications and drawings (as needed) (i.e. ground improvement, preload, etc.);
- Review of tender documents for general compliance with the intent of geotechnical recommendations;
- Assistance with design of construction erosion and sediment control (if requested);
- Geotechnical support during tendering (as needed); and
- Field reviews and testing during construction.

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TABLE 5.3.1 – GROUND IMPROVEMENT ALTERNATIVES SUMMARY TABLE

ALTERNATIVE	PRO	CON
Deep Soil Mixing (DSM)	• Effective at improving fine grained soils • Smaller footprint • Robust, uniform performance, least differential movements • Low potential for being affected by local berm instabilities/flow failures • Relatively low vibrations/noise level • Reasonably high production if cobbles/boulders/obstacles not present	• Higher mobilization and per unit costs compared to other ground improvement options (offset by smaller footprint) • Specialized contractor – reduced number of contractors • Large working space • On-site cement/grout mixing • Comprehensive QA/QC program required • Chemicals in lagoon potentially affect hydration

Compaction Piles	• Conventional installation technique
	  ◦ Broader range of contractors
	  ◦ Reduced mobilization costs
	• No cement mixing
	• Moderately effective at improving fine grained soils
	• Straight forward QA/QC program
	• Reasonably high production if cobbles/boulders/obstacles not present
		• Less effective than DSM in fine grained soils soils (comparable to Geopier GIS)
		• Equivalent shear strength of improved ground less than DSM (comparable to Geopier GIS)
		  ◦ Less resistance to local berm instabilities/flow failures
		  ◦ Larger footprint
		  ◦ More differential movements
		• Relatively high noise and vibration levels
		• Timber piles need to be treated above water table
		• Potential buoyancy challenges

Geopier Grouted Impact® System (Geopier GIS)	• Reduced mobilization costs (comparable to Compaction Piles)
	• Moderately effective at improving fine grained soils
	• Reasonably high production if cobbles/boulders/obstacles not present
	• Moderate noise and vibration levels
		• Less effective than DSM in fine grained soils (comparable to Compaction Piles)
		• Equivalent shear strength of improved ground less than DSM (comparable to Compaction Piles)
		  ◦ Less resistance to local berm instabilities/flow failures
		  ◦ Larger footprint
		  ◦ More differential movements
		• Moderate working space
		• On-site cement/grout mixing
		• Moderate QA/QC program required
		• Chemicals in lagoon potentially affect hydration
		• Moderate noise and vibration levels

	PROJECT: PORT ALBERNI WWTP GEOTECHNICAL DESIGN REPORT				
	TITLE: SITE LOCATION PLAN				
	CLIENT: ASSOCIATED ENGINEERING LTD.				
FIGURE NO.: 1	DATE: JAN 2018	FILE NO.: 171-04753-00	SCALE: NTS	DRAWN BY: LM	REV NO.: 1

WSP Canada Inc., 1935 Bollinger Road, Nanaimo, B.C., V9S 5W9 Phone: 250-753-1077 Fax: 250-753-1203 Email: nanaimo@wspgroup.com

	PROJECT: PORT ALBERNI WWTP GEOTECHNICAL DESIGN REPORT				
	TITLE: TEST HOLE LOCATION PLAN				
	CLIENT: ASSOCIATED ENGINEERING LTD.				
FIGURE NO.: 2	DATE: JAN 2018	FILE NO.: 171-04753-00	SCALE: NTS	DRAWN BY: LM	REV NO.: 1

WSP Canada Inc., 1935 Bollinger Road, Nanaimo, B.C., V9S 5W9 Phone: 250-753-1077 Fax: 250-753-1203 Email: nanaimo@wspgroup.com

2010 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: Lalinda Weerasekara, WSP Group Inc — May 15, 2017

Site Coordinates: 49.2479 North 124.8214 West

User File Reference: Port Alberni

National Building Code ground motions:
2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.758	0.564	0.303	0.161	0.354

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. ***These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.*** Warning: You are in a region which considers the hazard from a deterministic Cascadia subduction event for the National Building Code. Values determined for high probabilities (0.01 per annum) in this region do not consider the hazard from this type of earthquake.

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.184	0.395	0.535
Sa(0.5)	0.126	0.294	0.381
Sa(1.0)	0.066	0.153	0.208
Sa(2.0)	0.035	0.079	0.110
PGA	0.093	0.192	0.257

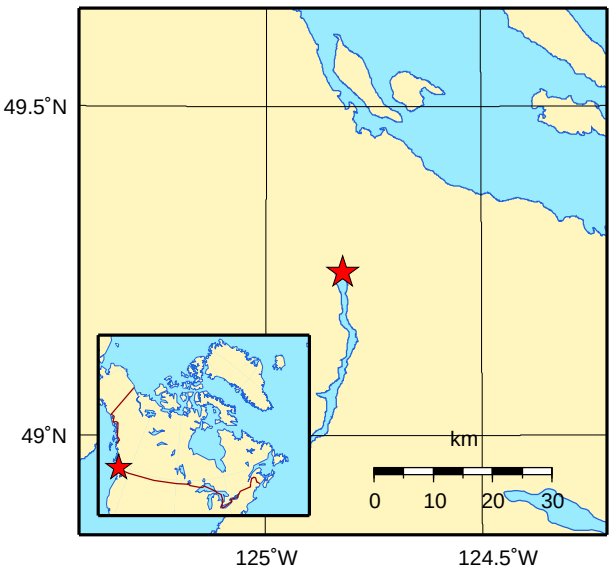
References

National Building Code of Canada 2010 NRCC no. 53301; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2010, Structural Commentaries NRCC no. 53543 (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2010 National Building Code of Canada (in preparation)

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information



Aussi disponible en français

FIGURE 4 SOIL STRESS DISTRIBUTION - STATIC

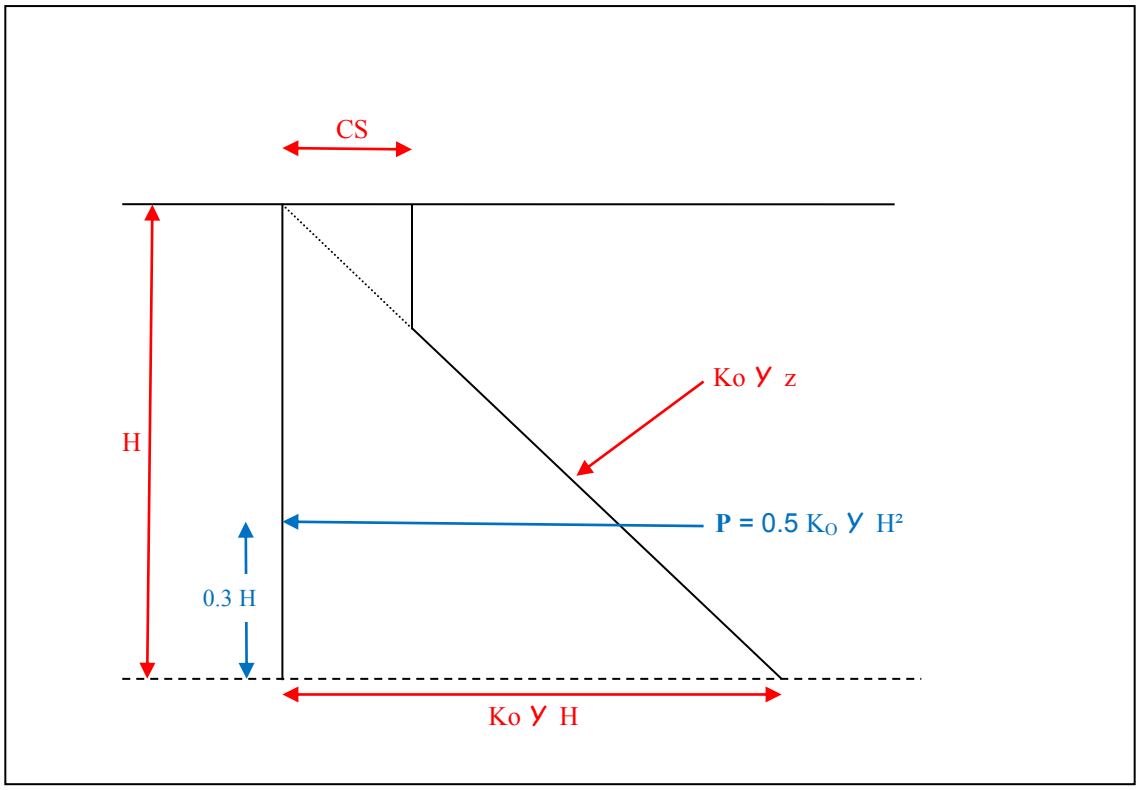
CS = Compaction stress, uniform locked in lateral stress associated with backfill compaction (15 to 20 kPa).

K_o = Coefficient of earth stress at rest.

γ = Unit bulk density of the wall backfill (kN/m^3).

H = Total embedded height of wall (m).

z = Depth of embedded wall from surface (m).



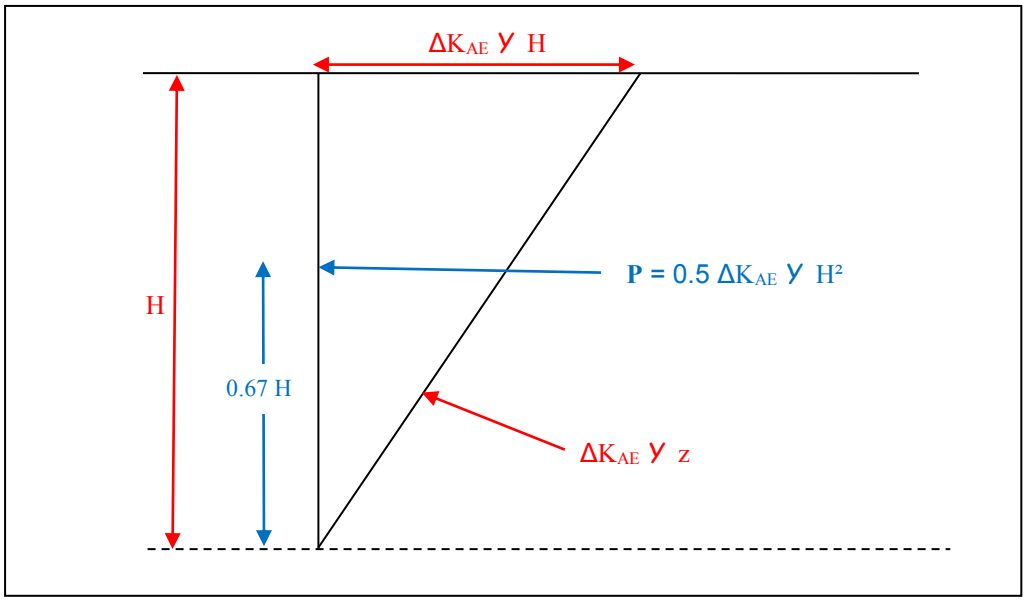
NOTE : The above lateral stress design recommendations are based on the assumption that the back of the wall is fully drained (no hydrostatic pressures acting on the wall). As outlined in the text of the report, if sufficient drainage is not provided behind the walls, hydrostatic and hydrodynamic loads need to be included in the design.

FIGURE 5 SOIL STRESS DISTRIBUTIONS – DYNAMIC

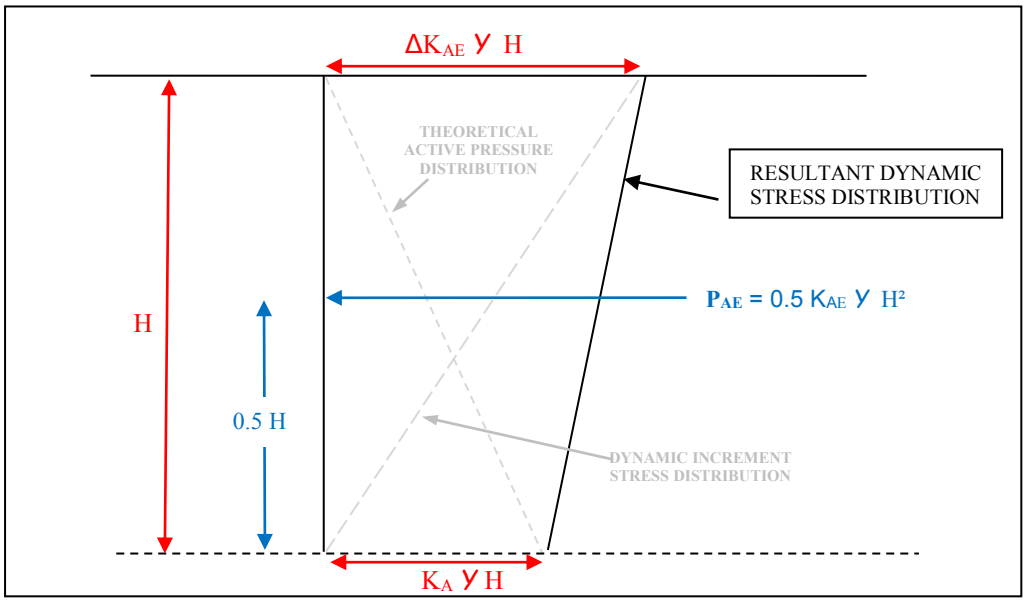
K_{AE} = Seismic active earth coefficient (Mononobe-Okabe). K_A = Coefficient of active earth pressure.

ΔK_{AE} = Differential seismic active earth coefficient ($K_{AE} - K_A$). H = Total embedded height of wall (m).

γ = Unit bulk density of the wall backfill (kN/m^3). z = Height of embedded wall from base (m).



DYNAMIC INCREMENT



DYNAMIC TOTAL

NOTE : The above lateral stress design recommendations are based on the assumption that the back of the wall is fully drained (no hydrostatic pressures acting on the wall). As outlined in the text of the report, if sufficient drainage is not provided behind the walls, hydrostatic and hydrodynamic loads need to be included in the design.

NOTE : The dynamic earth stress is additive to the static triangular (self weight) earth stress distribution (active state), and any hydrostatic pressures. It is believed that the "locked in" compaction stresses are relieved in the first few cycles of seismic motion, and thus are not included in the total dynamic loading. The total dynamic loading under dry conditions acts at approximately the mid-height of the embedded height of the wall.

PHOTOGRAPHS

Photo	Description
	**Photo 1:** General view of sand at 5 m depth in BH17-02 (lower half of photo). Note the organic silt/peat at about 3 m depth in upper half of photo.
	**Photo 2:** Sandy gravel at 8.5 m depth in BH17-02 (lower half of photo)

PHOTOGRAPHS

Photo	Description
	**Photo 3:** Typical sand with some fines from BH17-02 at about 14.5 m depth
	**Photo 4:** Typical CLAY/SILT from BH17-02 at about 26 m depth.

PHOTOGRAPHS

Photo	Description
	**Photo 5:** General view of conditions in TP17-01 with the existing berm. Note significant sloughing below water level.
	**Photo 6:** Inferred natural silty sand below 3 m depth at TP17-01

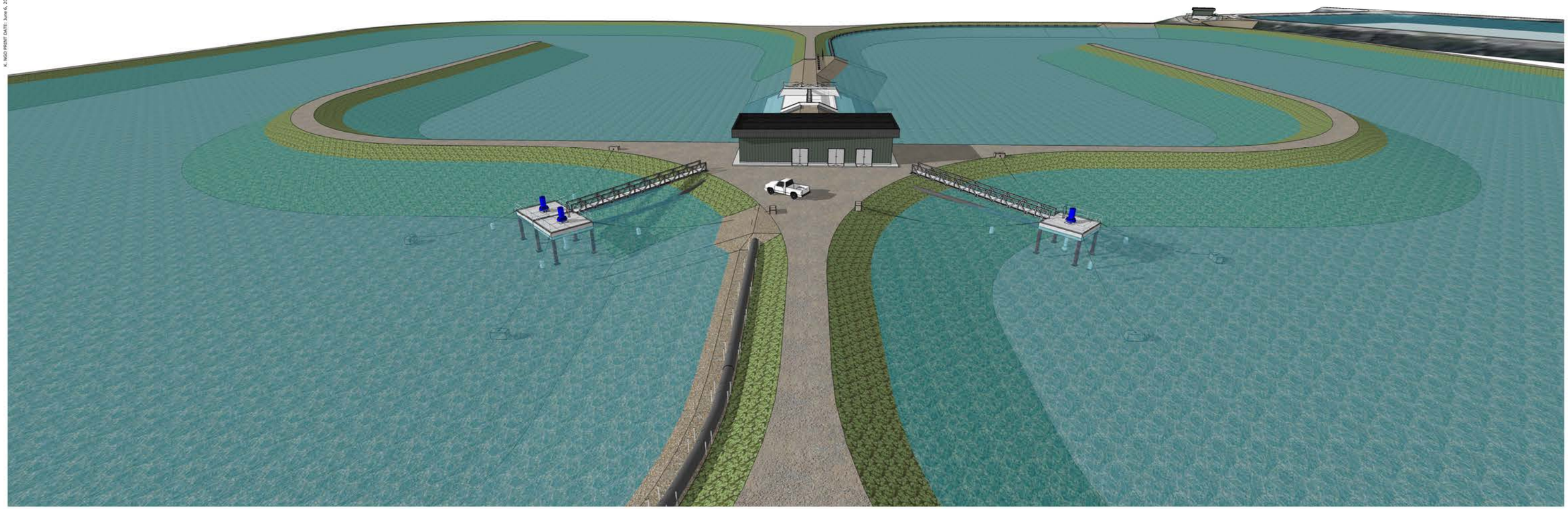
PHOTOGRAPHS

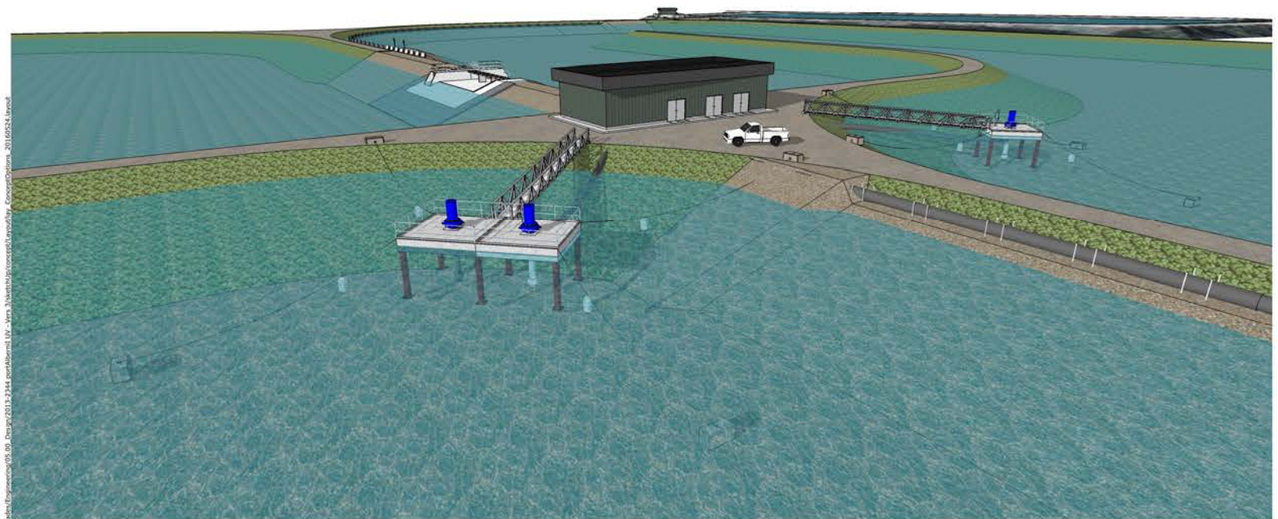
Photo	Description
	**Photo 7:** View of granular fill over interior silty sand core at TP17-02. The core material is at the base of the excavation in the photo.
	**Photo 8:** View to northwest from proposed UV/Aerator Building along the approximate alignment of the proposed in-fill division berm.

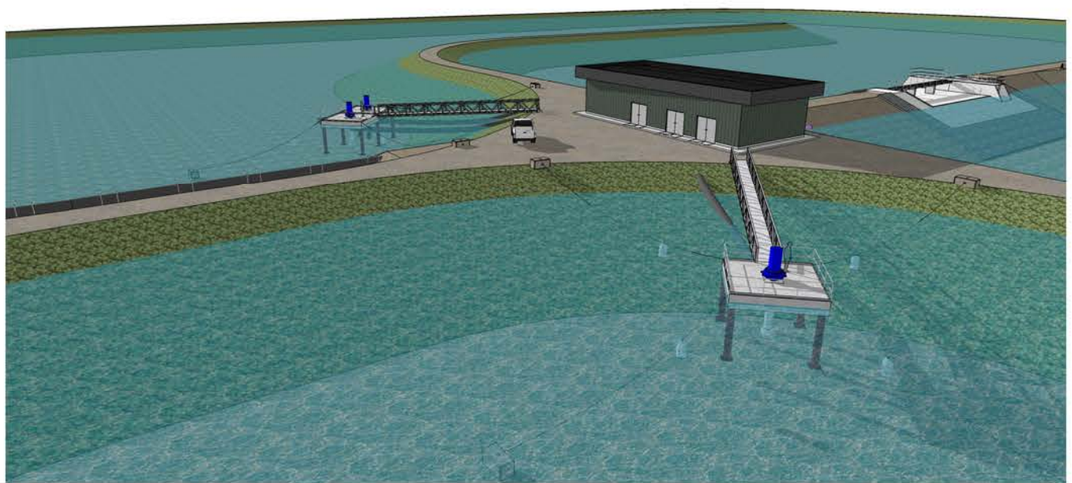
APPENDIX

1. CONCEPT DESIGN DRAWINGS – NOV 2017

K. NGO PRINT DATE: June 6, 2016







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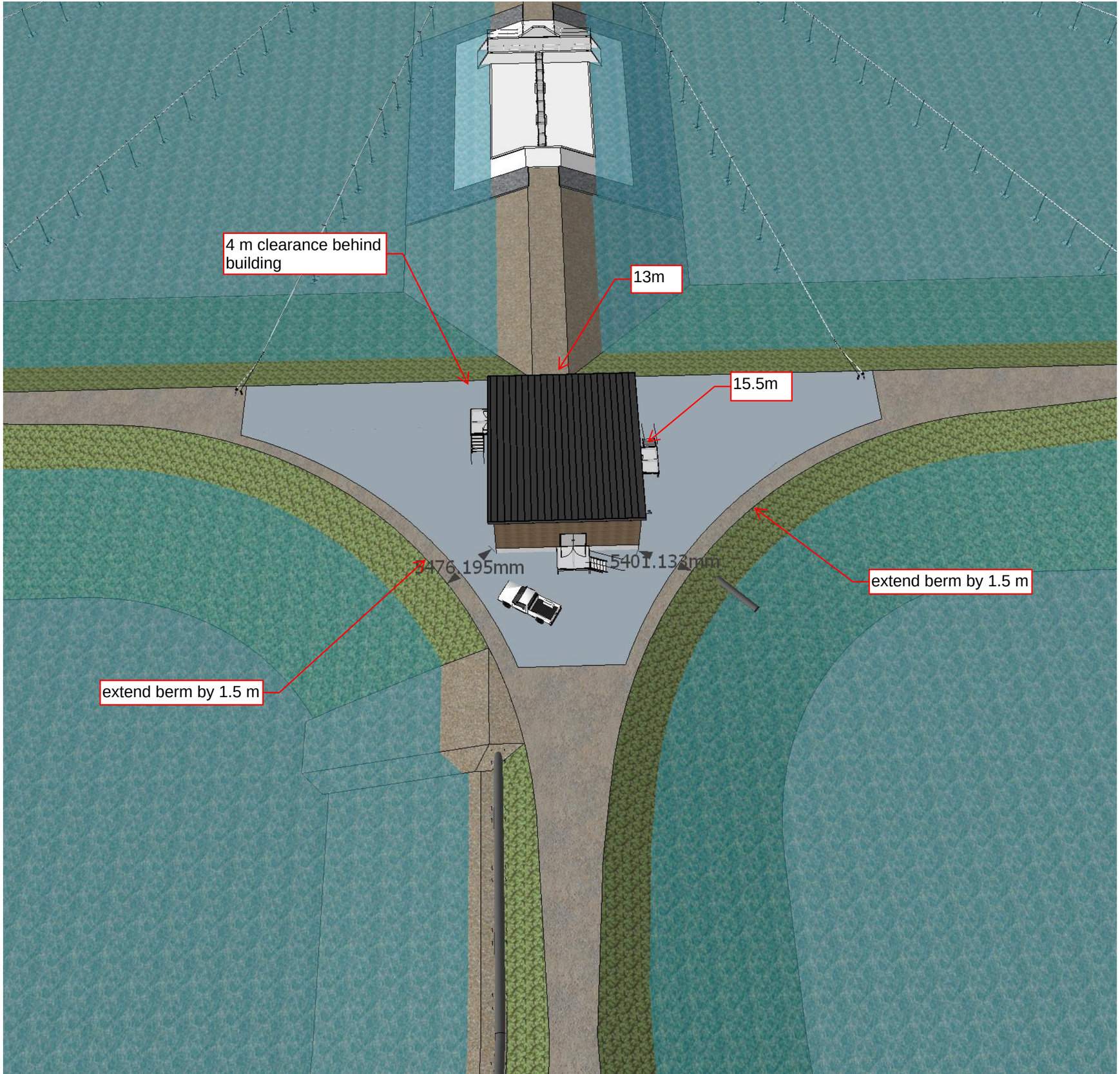
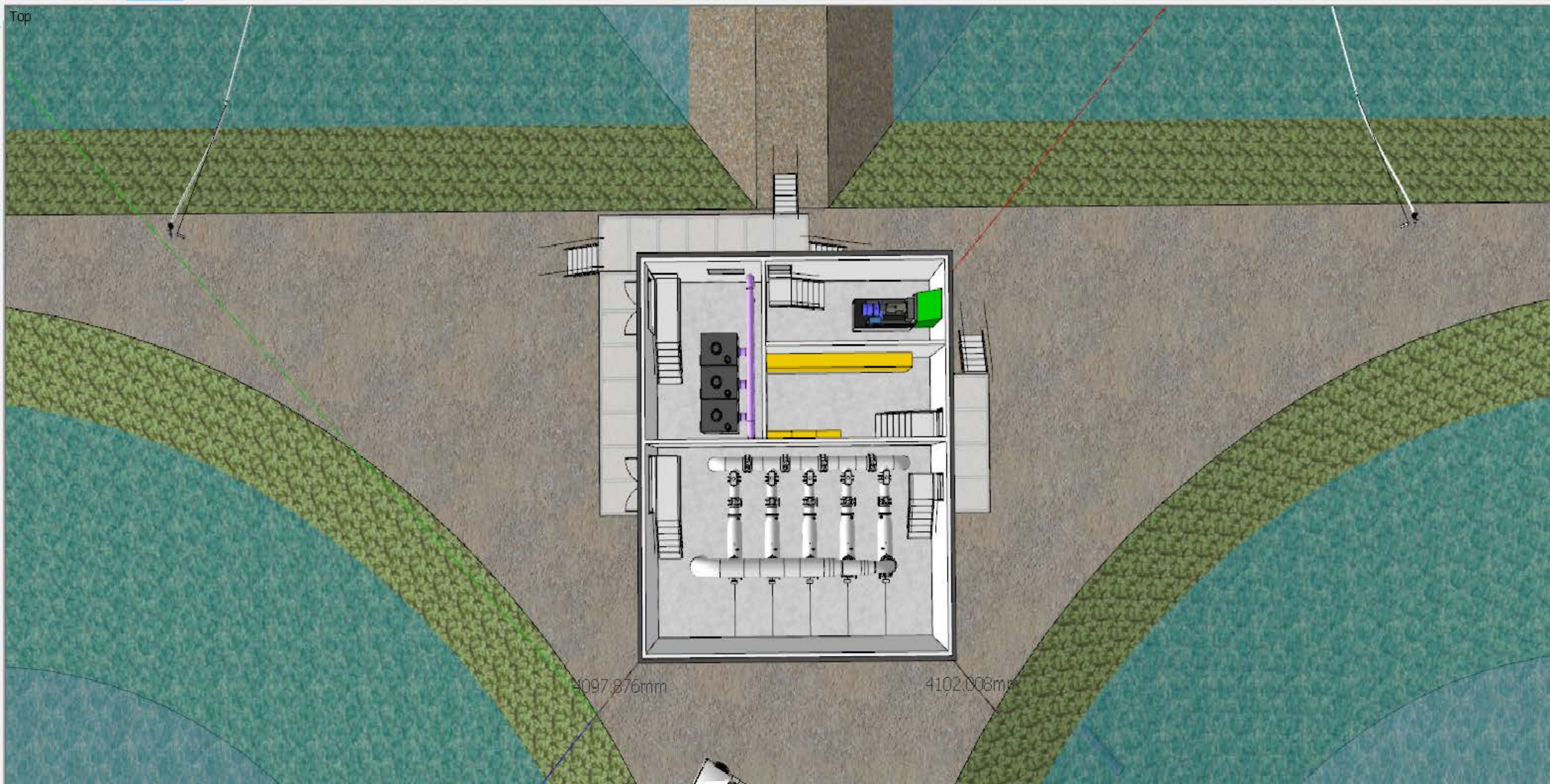
Associated Engineering
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

CONCEPT DESIGN

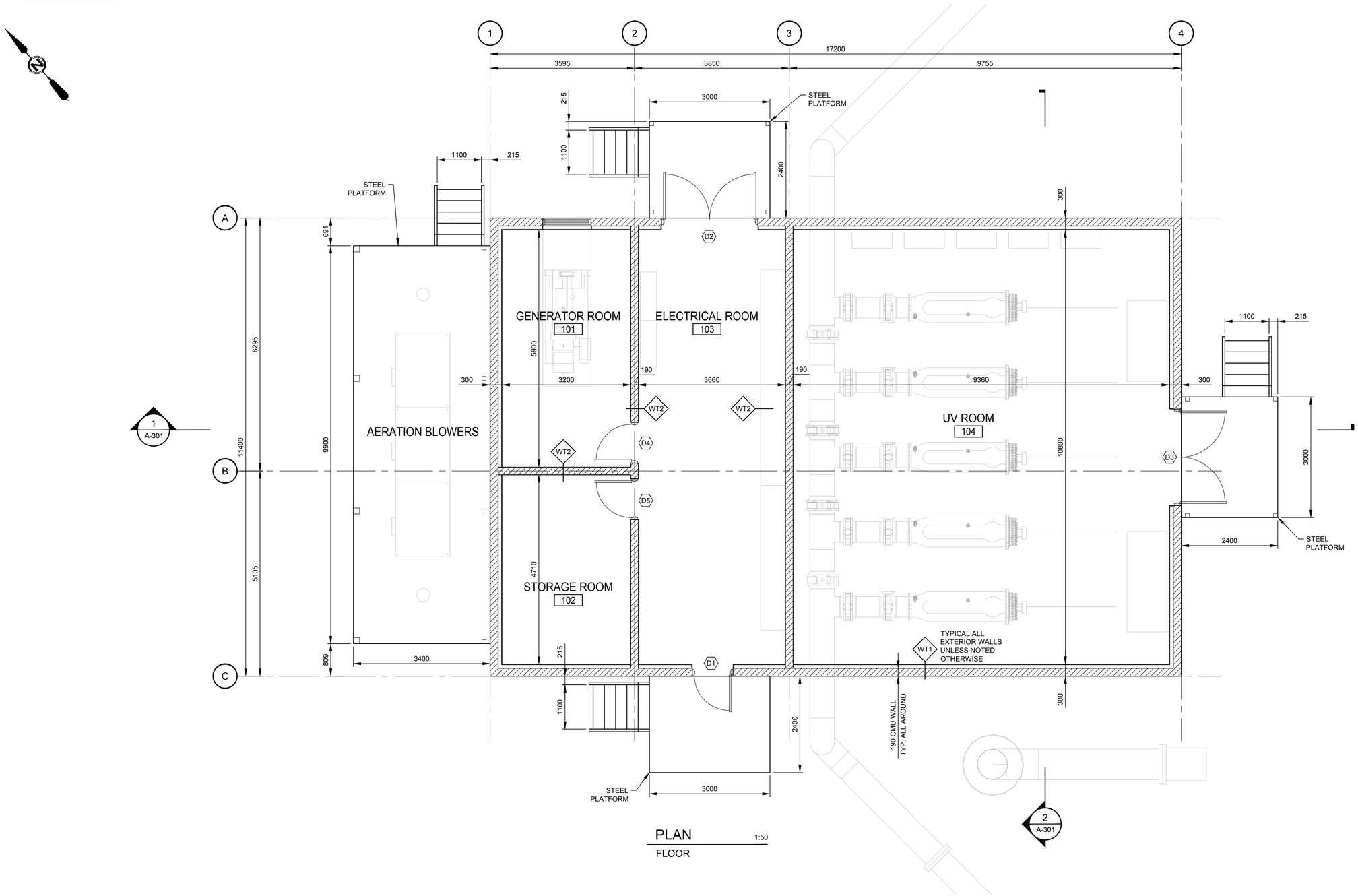
DESIGN	T. ROBINSON M. SIMHON K. NGO	City of Port Alberni LAGOON UPGRADES	2013-2344
DRAWN	K. NGO		SPACE PLANNING UV & AERATION BUILDING ISOMETRIC
DATE	2016JUN06	SCALE: AS SHOWN	DRAWING No.: 2344-00-A-008 / REVISION A / SHEET 6 /10


4 m clearance behind building
13m
15.5m
extend berm by 1.5 m
extend berm by 1.5 m
3476.195mm
5401.133mm


Top
4097.876mm
4102.008mm

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:50
FLOOR

WALL TYPES LEGEND

WT1 — EXTERIOR WALL
-190 CONCRETE MASONRY UNIT
-METAL Z-GIRTS (20 Ga.)
-50 RIGID INSULATION (R12)
-VAPOR BARRIER (BLUESKIN PEEL & STICK)
-19 PLY SHEATHING & 12 GYPSUM

WT2 — INTERIOR WALL
-190 CONCRETE MASONRY UNIT, SMOOTH FACE

FLOOR TYPES LEGEND

FT1 -CONCRETE FLOOR STRUCTURE

ROOF TYPES LEGEND

RT1
-SBS CAP SHEET AND BASE SHEET BY SOPREMA OR APPROVED EQUAL
-12mm OVERLAY BOARD
-100 RIGID INSULATION (R20)
-VAPOR BARRIER
-300 CONCRETE ROOF SLAB

PARAPET TYPES LEGEND

PT1
-PRE-FINISHED METAL CLADDING FASCIA
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-190 MASONRY BLOCK (SMOOTH FACE)
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-16 PRESSURE TREATED PLYWOOD
-SBS ROOFING SYSTEM

PT2
-SBS ROOFING SYSTEM
-16 PRESSURE TREATED PLYWOOD
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-190 MASONRY BLOCK (SMOOTH FACE)
-100 RIGID INSULATION (PLUG)
-190 MASONRY BLOCK (SMOOTH FACE)
-VAPOR BARRIER
-51 RIGID INSULATION (R12)
-16 PRESSURE TREATED PLYWOOD
-SBS ROOFING SYSTEM

NOTE:
ALL SBS ROOFING TO BE INSTALLED TO RCABC SPECIFICATION FOR A 5 YEAR WARRANTY.

P:\2017\2972\00_WstWtr_Trtmnt_Upg\Working_Dwgs\200_Architectural\2972-00-a-101.dwg
DATE: 2017-11-27, Jhunn Dualan

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PRELIMINARY/
FOR DISCUSSION
NOT FOR CONSTRUCTION
DRAFT

REV	DATE	DESIGN	DRAWN	DESCRIPTION
A	2017NOVXX	J. COPE	H. DUALAN JR	ISSUED FOR XXXXXX

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

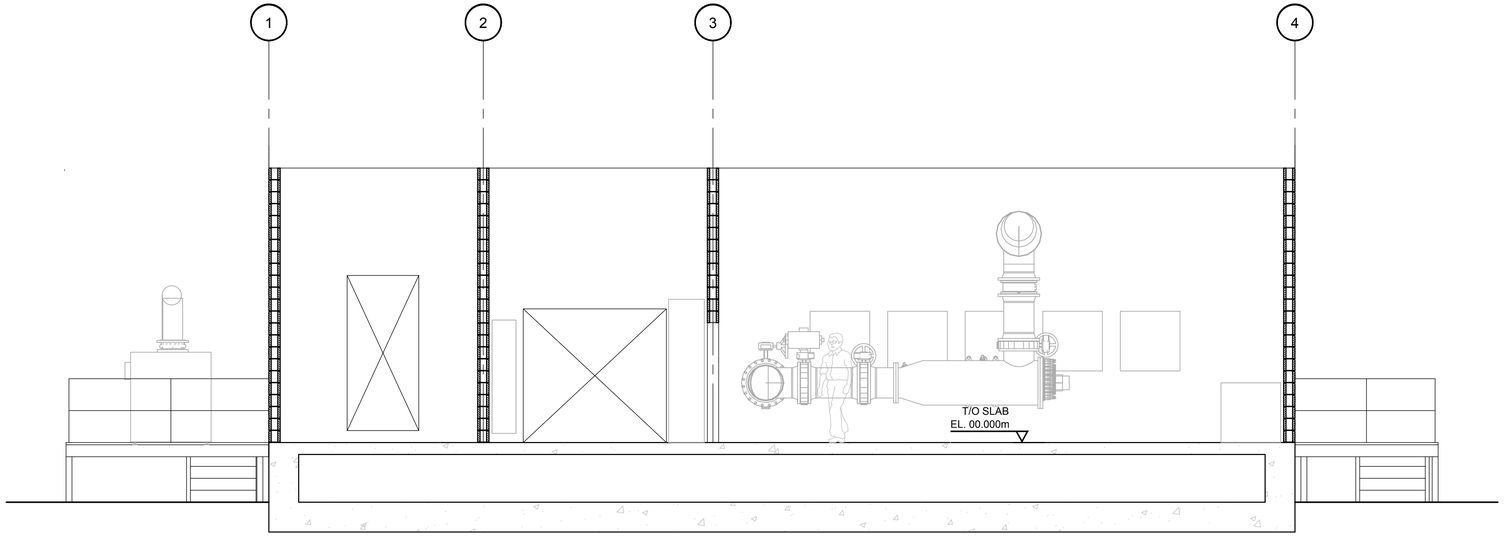
SCALE: AS SHOWN

THE CITY OF Port Alberni

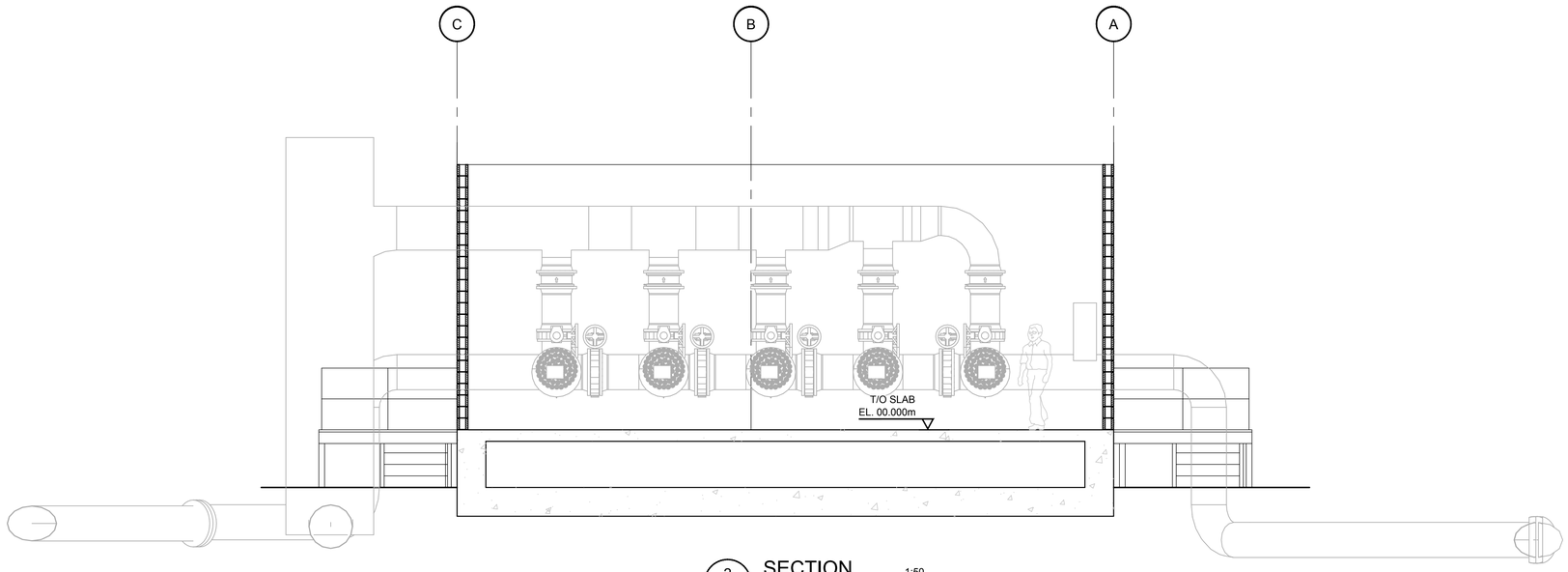
ARCHITECTURAL

FLOOR PLAN

DRAWING	REVISION	SHEET
2972-00-A-101	A	----



1 A-101 SECTION 1:50



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DATE: 2017-11-30, Jhum Dualan

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FOR DISCUSSION
NOT FOR CONSTRUCTION
DRAFT

REV	DATE	DESIGN	DRAWN	DESCRIPTION
A	2017NOVXX	J. COPE	H. DUALAN JR	ISSUED FOR XXXXXX

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

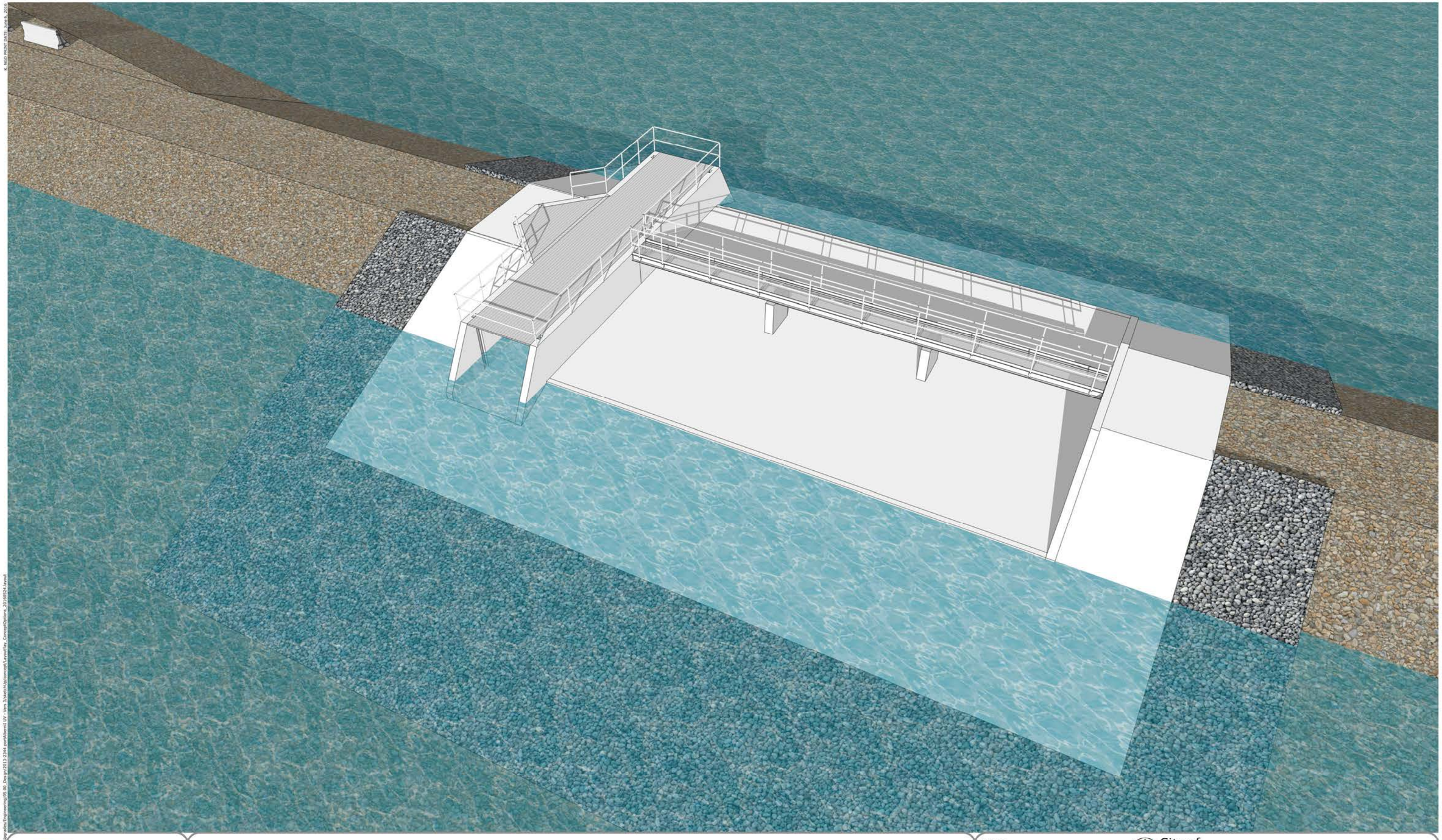
SCALE: AS SHOWN

THE CITY OF Port Alberni

ARCHITECTURAL

SECTIONS SHEET 1

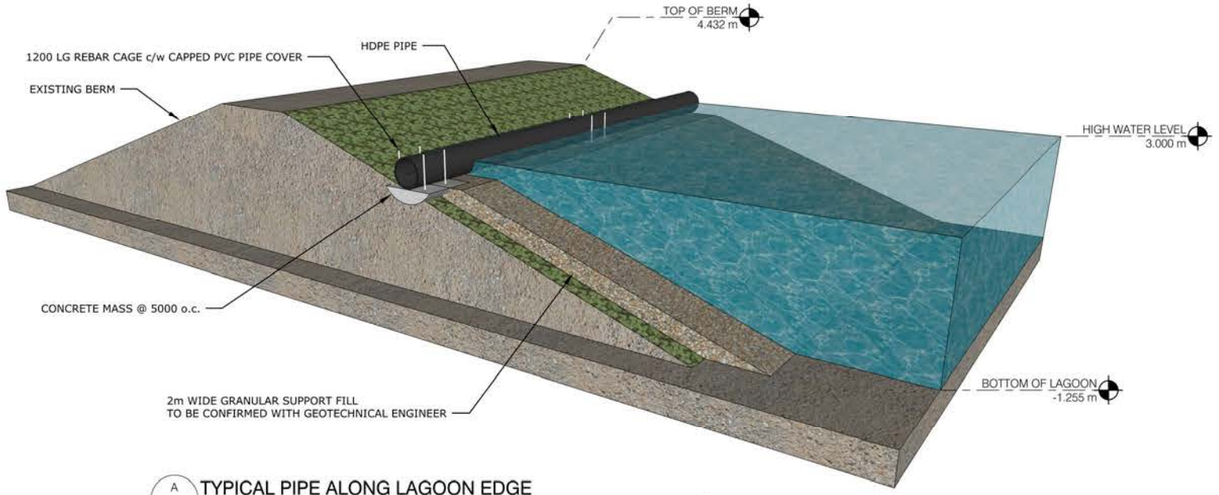
DRAWING	REVISION	SHEET
2972-00-A-301	A	----



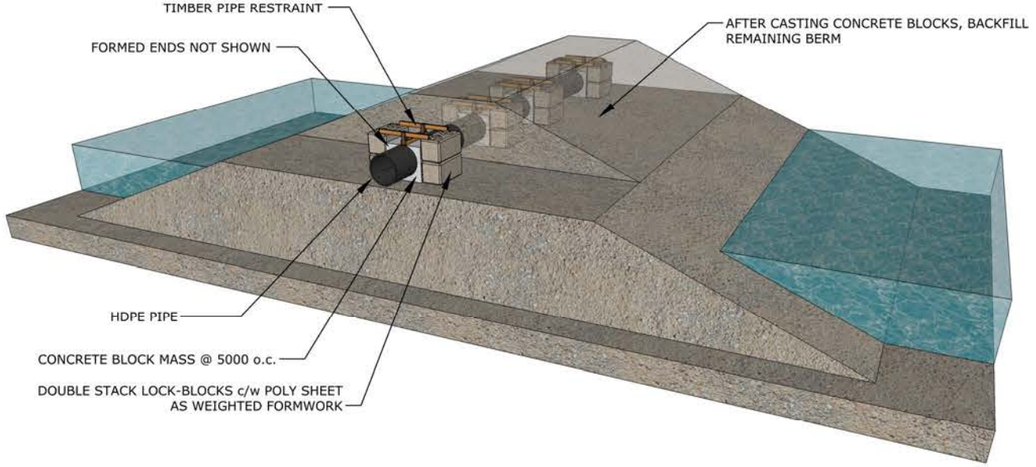
Associated Engineering
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

CONCEPT DESIGN

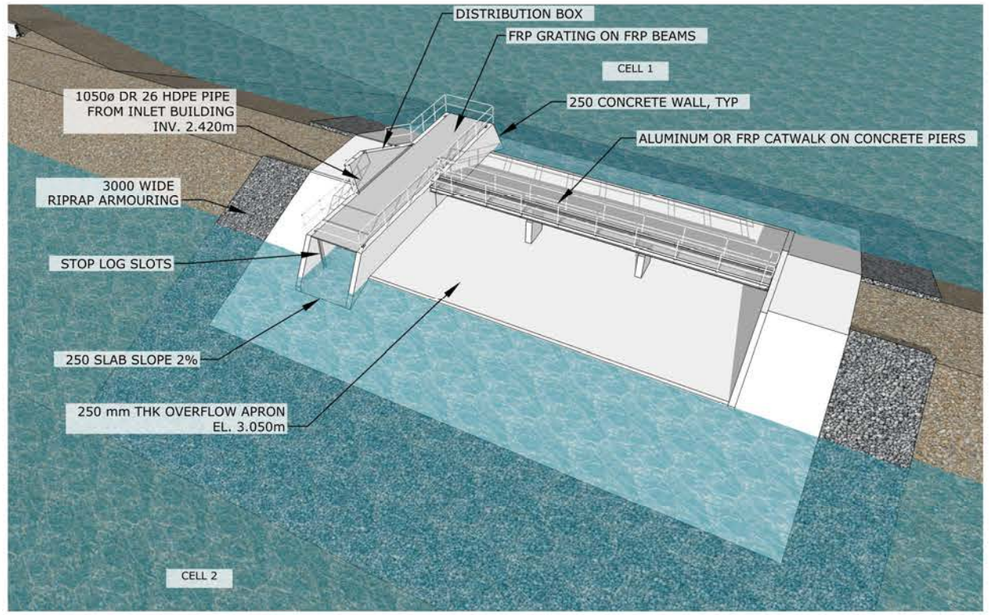
DESIGN	T. ROBINSON M. SIMHON K. NGO	City of Port Alberni LAGOON UPGRADES	2013-2344
DRAWN	K. NGO		SPACE PLANNING OVERFLOW
DATE	2016JUN06	SCALE: AS SHOWN	DRAWING No.: 2344-00-A-007 / REVISION A / SHEET 5 /10



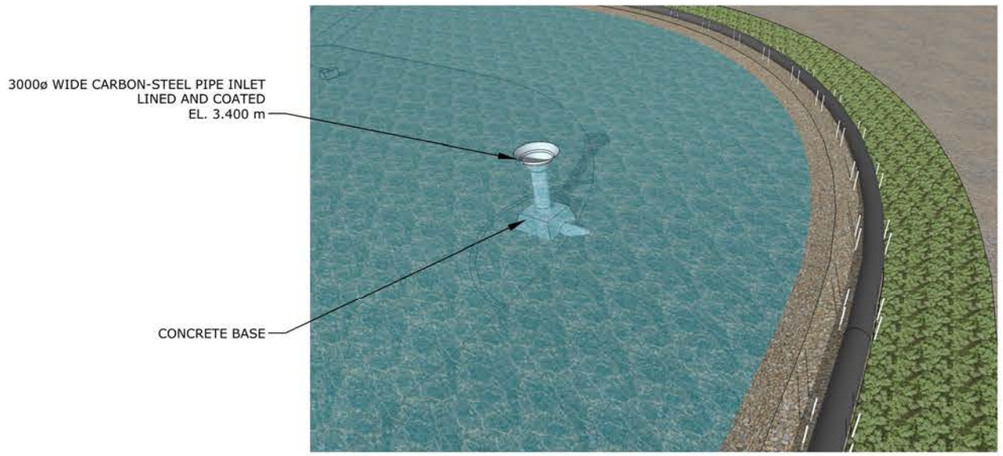
A - TYPICAL PIPE ALONG LAGOON EDGE



B - CONSTRUCTION SECTION FOR PIPE IN NEW BERM



C - LAGOON INLET STRUCTURE



D - LAGOON OVERFLOW

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CONCEPT DESIGN

DESIGN	T. ROBINSON, M. SIMHON, K. NGO	City of Port Alberni	2013-2344
		LAGOON UPGRADES	SPACE PLANNING
			DETAILS
DRAWN	K. NGO		
DATE	2016JUN06	SCALE: AS SHOWN	DRAWING No.: 2344-00-A-109 / REVISION: A / SHEET: 9 /10

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

PNT#	NORTHING	EASTING	ELEV
1	5135.328	2850.191	4.200
9	5121.223	2858.398	4.650
2	5133.317	2848.424	4.200
3	5131.971	2847.240	4.273
4	5128.593	2857.585	4.650
5	5126.716	2855.935	4.700
6	5124.838	2854.284	4.650
7	5124.978	2861.698	4.650
8	5123.100	2860.048	4.700
10	5118.376	2869.209	4.650

PNT#	NORTHING	EASTING	ELEV
11	5116.499	2867.559	4.700
12	5114.621	2865.909	4.650
13	5105.173	2884.231	4.650
14	5103.295	2882.581	4.700
15	5101.417	2880.931	4.650
16	5091.969	2899.253	4.650
17	5090.091	2897.603	4.700
18	5088.213	2895.953	4.650
19	5078.765	2914.275	4.650
20	5076.887	2912.625	4.700

PNT#	NORTHING	EASTING	ELEV
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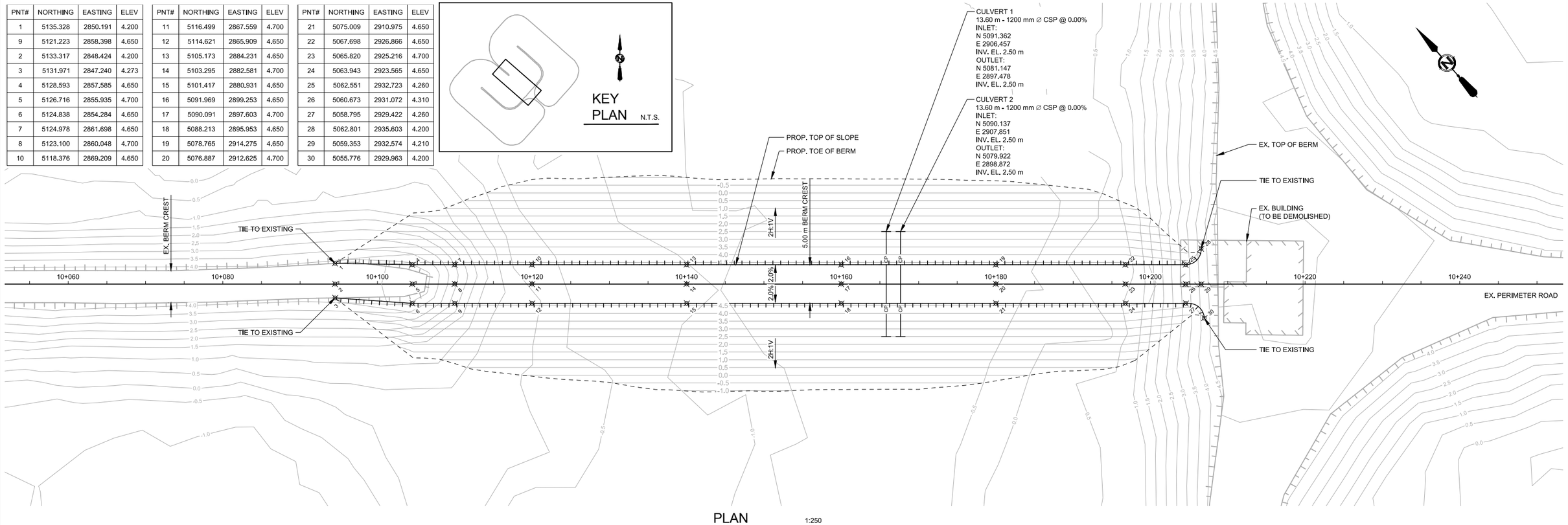
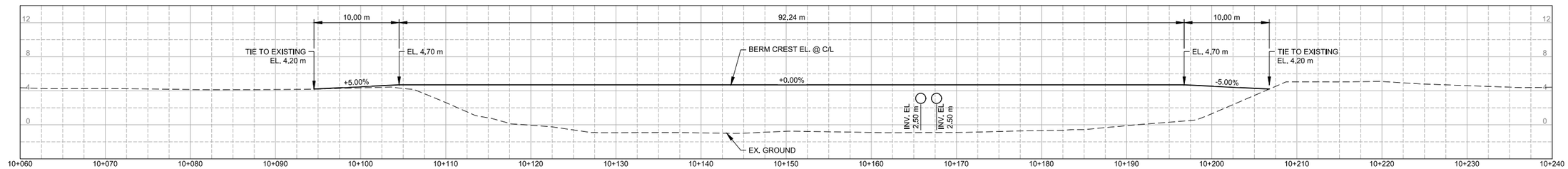
22	5067.698	2926.866	4.650
23	5065.820	2925.216	4.700
24	5063.943	2923.565	4.650
25	5062.551	2932.723	4.260
26	5060.673	2931.072	4.310
27	5058.795	2929.422	4.260
28	5062.801	2935.603	4.200
29	5059.353	2932.574	4.210
30	5055.776	2929.963	4.200



PLAN 1:250



PROFILE 1:250

SURVEY NOTES:

1. ORIGINAL GROUND AND EXISTING SITE FEATURES BASED ON BATHYMETRIC SURVEY COMPLETED BY GRANT LAND SURVEY, DATED SEPTEMBER 23, 2016.
2. COORDINATES SHOWN IN LOCAL, GROUND COORDINATE SYSTEM. TO CONVERT TO UTM ZONE 10 NAD83: SHIFT N 5452594.841, E 364495.260, SCALE FROM 0,0,0 BY 0.99981766.
3. ELEVATIONS ARE GEODETIC DATUM DERIVED FROM ICM 87H341.

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DATE: 2017-08-16, Jason White

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REV	DATE	DESIGN	DRAWN	DESCRIPTION
X	YYYYMMMDD	E. ENGINEER	D. DRAFTER	ISSUED FOR XXXXXX

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

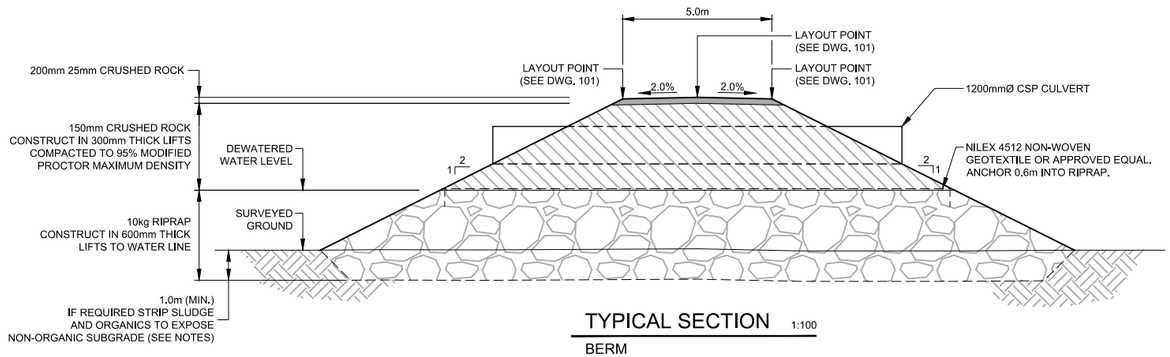
20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
LAGOON BERM
GENERAL ARRANGEMENT

DRAWING	REVISION	SHEET
2792-00-C-101	X	---- /



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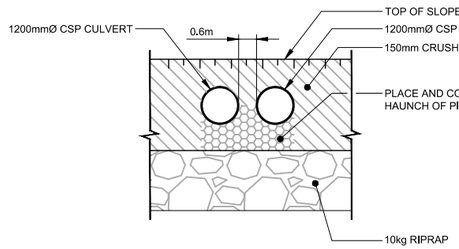
BERM



DETAIL 1:100

CULVERTS

NOTES:

1. SUBGRADE TO BE INSPECTED BY GEOTECHNICAL ENGINEERING PRIOR TO COMMENCEMENT OF FILL PLACEMENT. PROVIDE 72 HOURS NOTICE TO ENGINEER PRIOR TO INSPECTION.

Associated Engineering

PRELIMINARY/
FOR DISCUSSION
NOT FOR CONSTRUCTION

DRAFT

REV	DATE	DESIGN	DRAWN	DESCRIPTION
X	YYYYMMMDD	E. ENGINEER	D. DRAFTER	ISSUED FOR XXXXXX

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

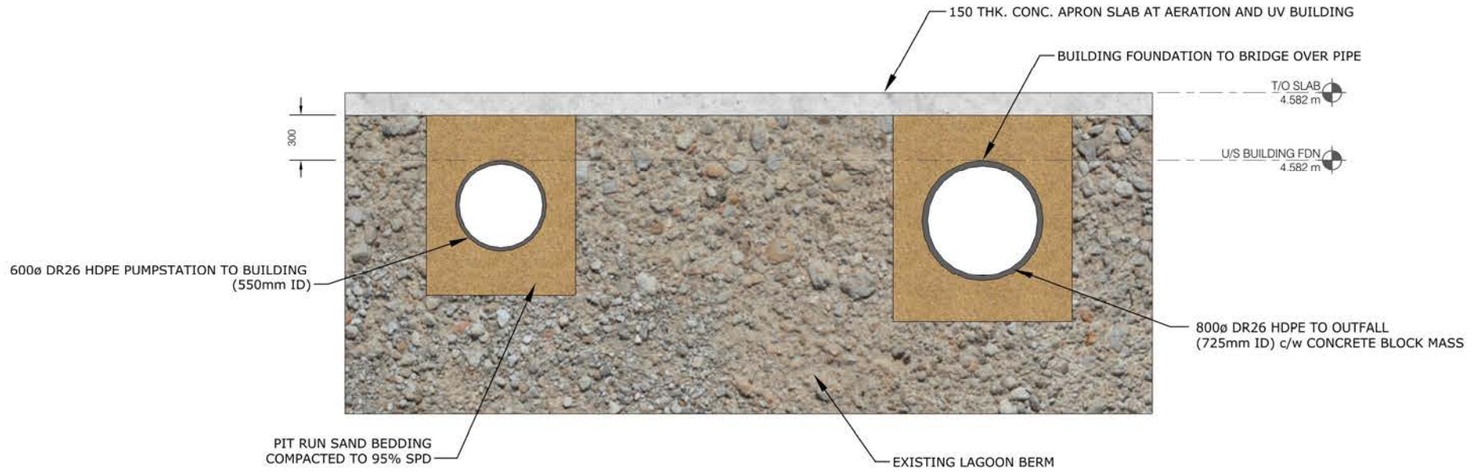
SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
LAGOON BERM
DETAILS

DRAWING	REVISION	SHEET
2792-00-C-201	X	----

K. NGO PRINT DATE: June 6, 2016



A
-
TYPICAL PIPE TRENCH DETAIL
1:20

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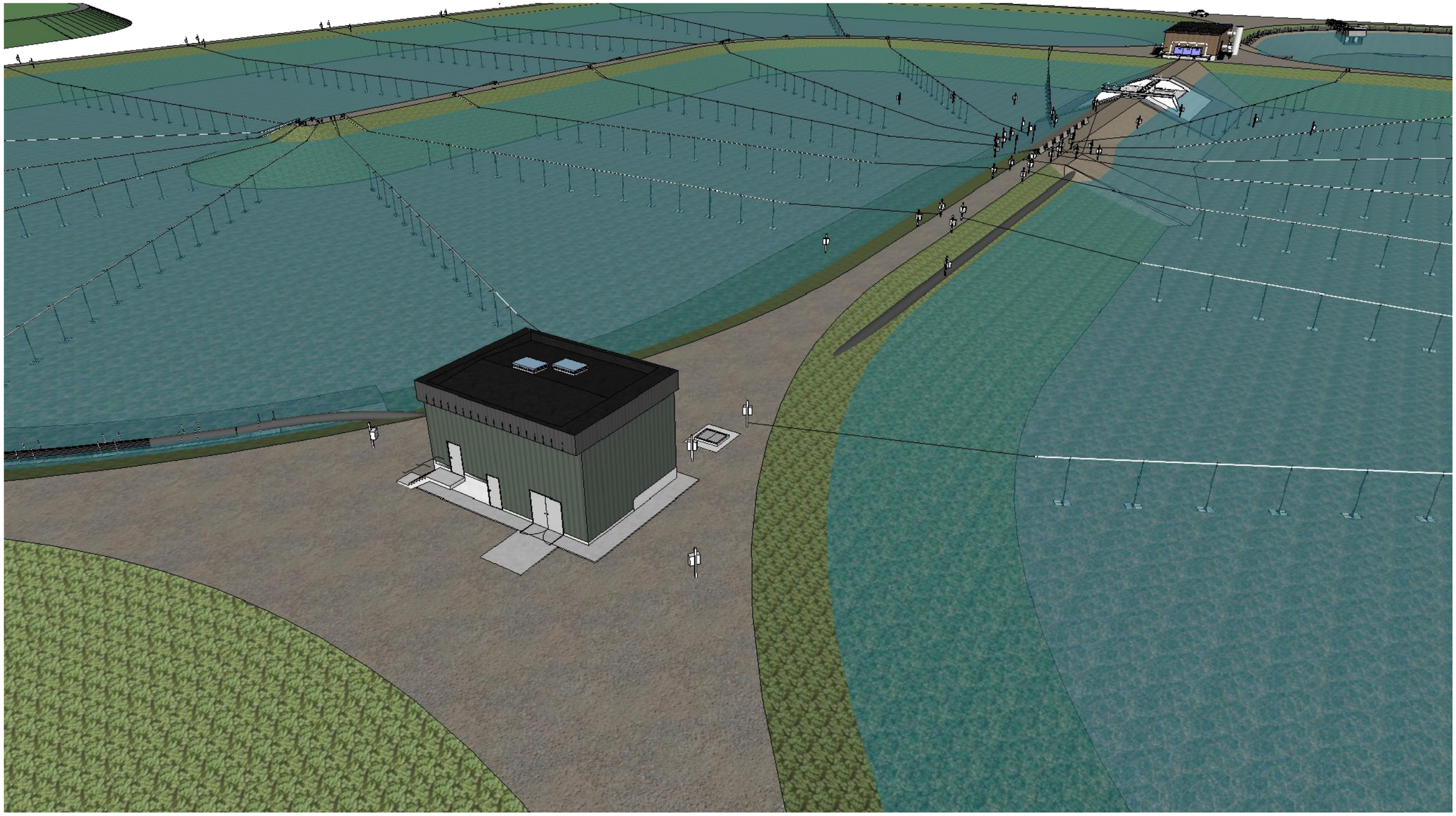
Associated Engineering
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

CONCEPT DESIGN

DESIGN	T. ROBINSON M. SIMHON K. NGO	City of Port Alberni LAGOON UPGRADES	2013-2344 SPACE PLANNING DETAILS 2
DRAWN	K. NGO		
DATE	2016JUN06	SCALE: AS SHOWN	DRAWING No.: 2344-00-A-110 / REVISION: A / SHEET: 10/10



Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

DESIGN	<Design>
REVIEW	<Review>
DRAWN	<Drawn>
DATE	November 27, 2017

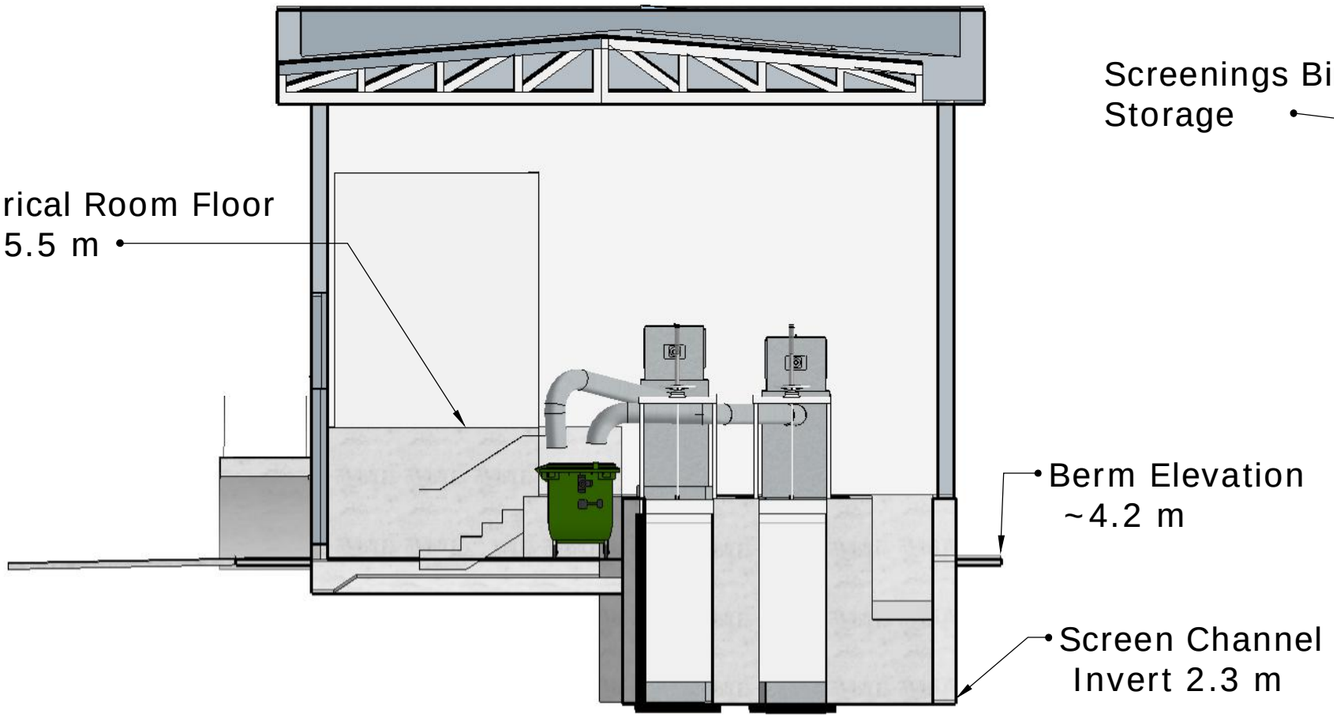
City of Port Alberni

Wastewater Upgrades
Screen Building

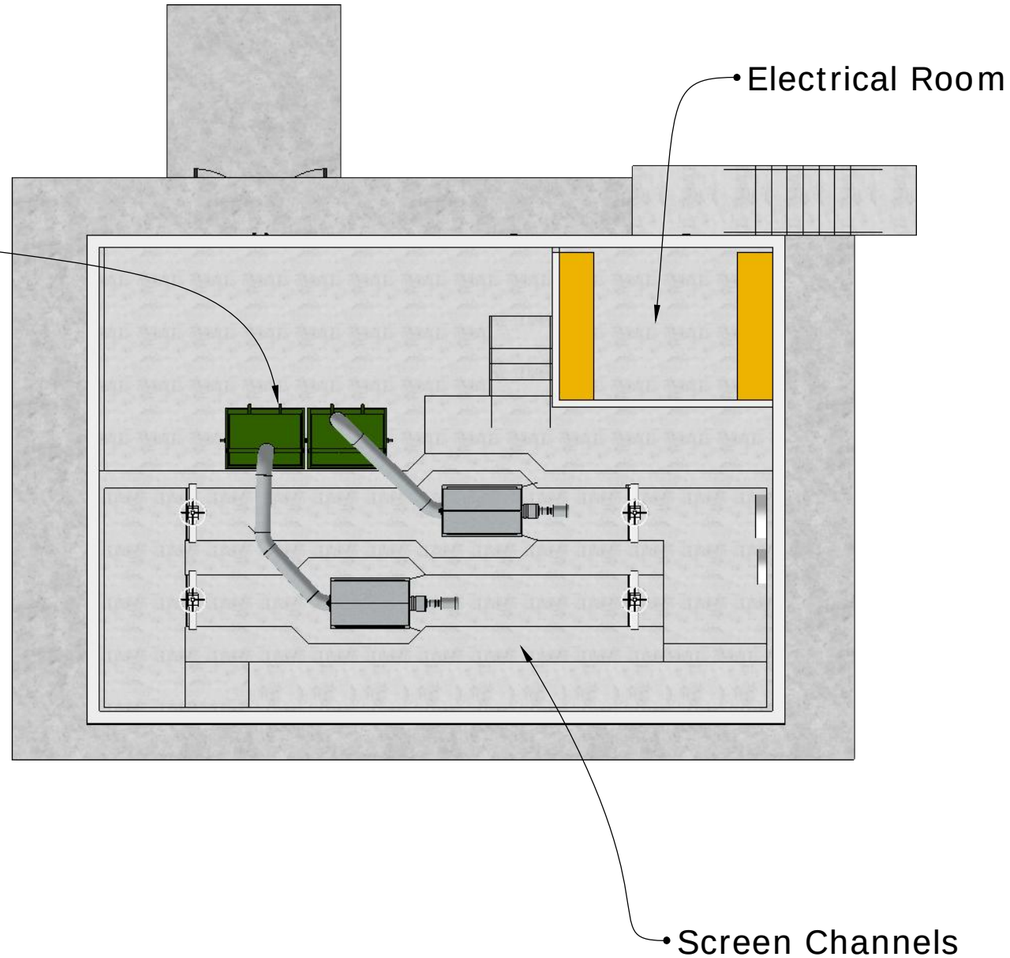
SCALE 1:100

2017-2972

DRAWING No.:	REVISION	SHEET
2972-00-SK-001	1	1 / 2



Elevation



Plan

Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

DESIGN	<Design>
REVIEW	<Review>
DRAWN	<Drawn>
DATE	November 27, 2017

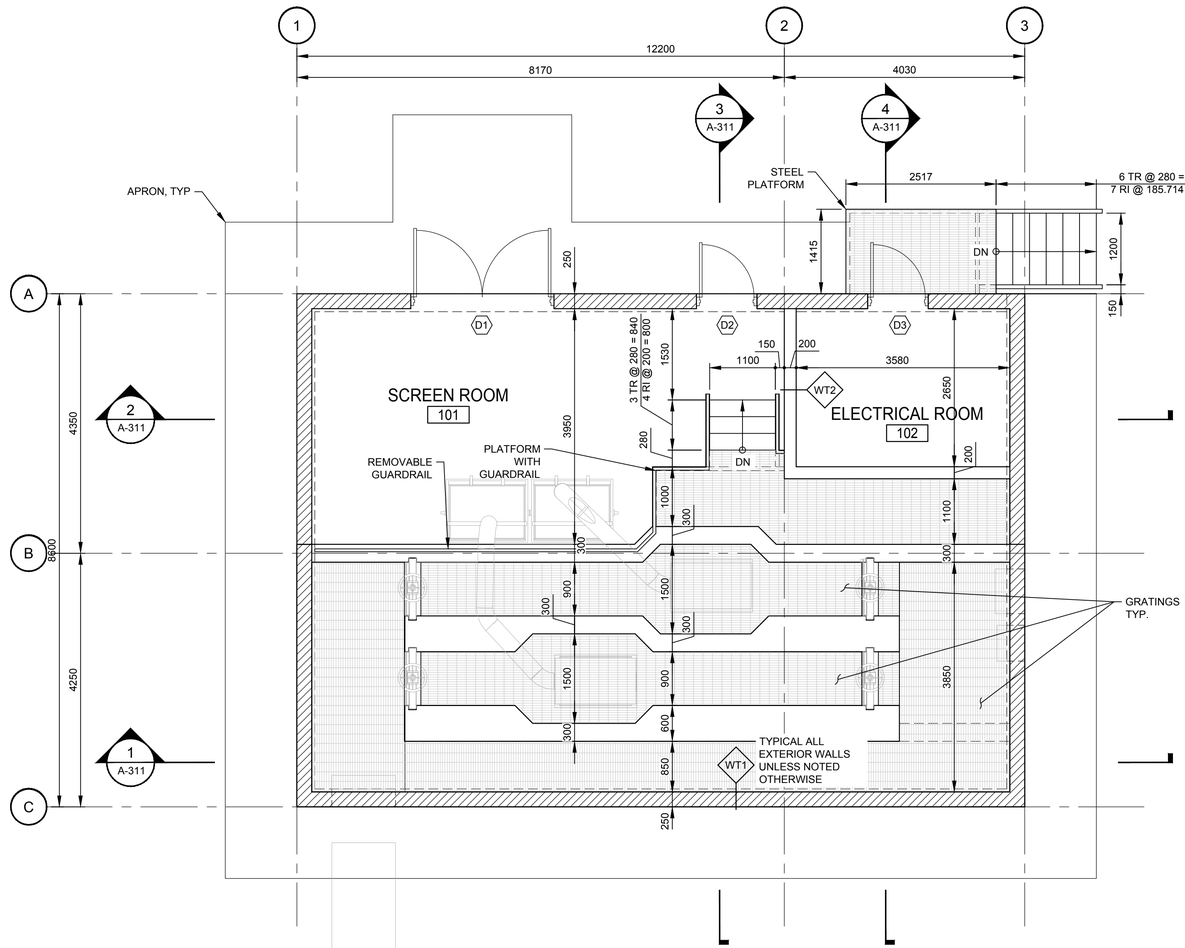
City of Port Alberni
Wastewater Upgrades
Screen Building
SCALE 1:100

<ProjectNumber>
Page 2

DRAWING No.:	REVISION	SHEET
2972-00-SK-002	1	2 / 2

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:50

FLOOR

WALL TYPES LEGEND

WT1 — EXTERIOR WALL
-240 CONCRETE MASONRY UNIT
-METAL Z-GIRTS (20 Ga.)
-50 RIGID INSULATION (R12)
-VAPOR BARRIER (BLUESKIN PEEL & STICK)
-19 PLY SHEATHING & 12 GYPSUM

WT2 — INTERIOR WALL
-190 CONCRETE MASONRY UNIT, SMOOTH FACE

FLOOR TYPES LEGEND

FT1 -CONCRETE FLOOR STRUCTURE

ROOF TYPES LEGEND

RT1
-SBS CAP SHEET AND BASE SHEET BY SOPREMA OR APPROVED EQUAL
-12mm OVERLAY BOARD
-100 RIGID INSULATION (R20)
-VAPOR BARRIER
-300 CONCRETE ROOF SLAB

PARAPET TYPES LEGEND

PT1
-PRE-FINISHED METAL CLADDING FASCIA
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-190 MASONRY BLOCK (SMOOTH FACE)
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-16 PRESSURE TREATED PLYWOOD
-SBS ROOFING SYSTEM

PT2
-SBS ROOFING SYSTEM
-16 PRESSURE TREATED PLYWOOD
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-190 MASONRY BLOCK (SMOOTH FACE)
-100 RIGID INSULATION (PLUG)
-190 MASONRY BLOCK (SMOOTH FACE)
-VAPOR BARRIER
-51 RIGID INSULATION (R12)
-16 PRESSURE TREATED PLYWOOD
-SBS ROOFING SYSTEM

NOTE:
ALL SBS ROOFING TO BE INSTALLED TO RCABC SPECIFICATION FOR A 5 YEAR WARRANTY.

P:\20172972000_WstWtr_Trtmnt_Upgd\Working_Dwgs\200_Architectural\2972-00-a-111.dwg
DATE: 2017-12-06, Jhunn Dualan

Associated Engineering
2012 BEST MANAGED COMPANIES Platinum member

PRELIMINARY/ FOR DISCUSSION
NOT FOR CONSTRUCTION
DRAFT

REV	DATE	DESIGN	DRAWN	DESCRIPTION
A	2017DECXX	J. COPE	H. DUALAN JR	ISSUED FOR XXXXXX

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

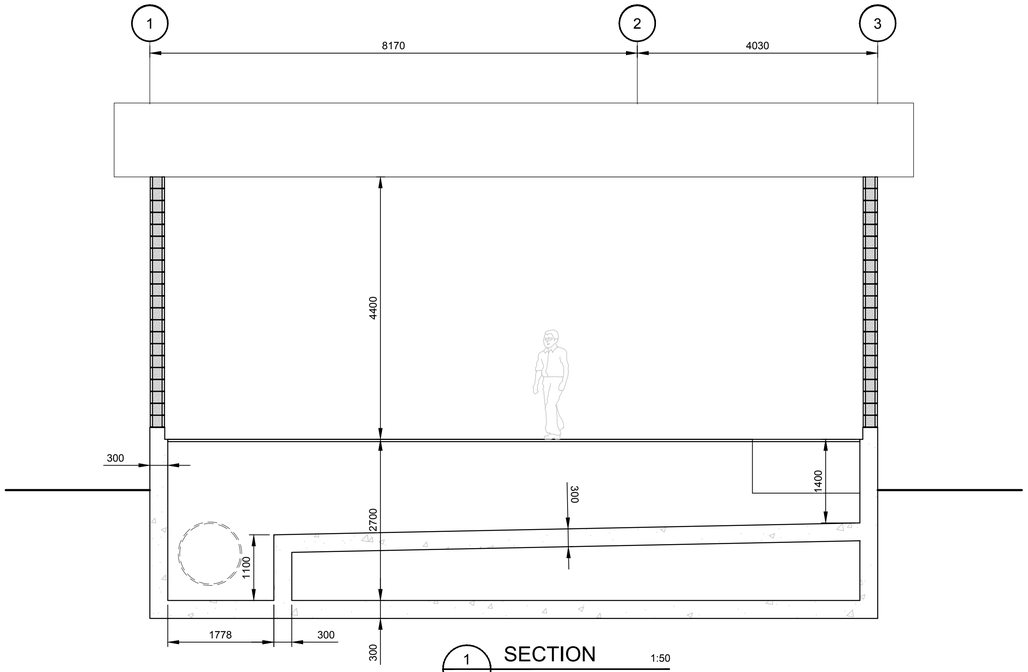
ARCHITECTURAL

SCREEN BUILDING - FLOOR PLAN

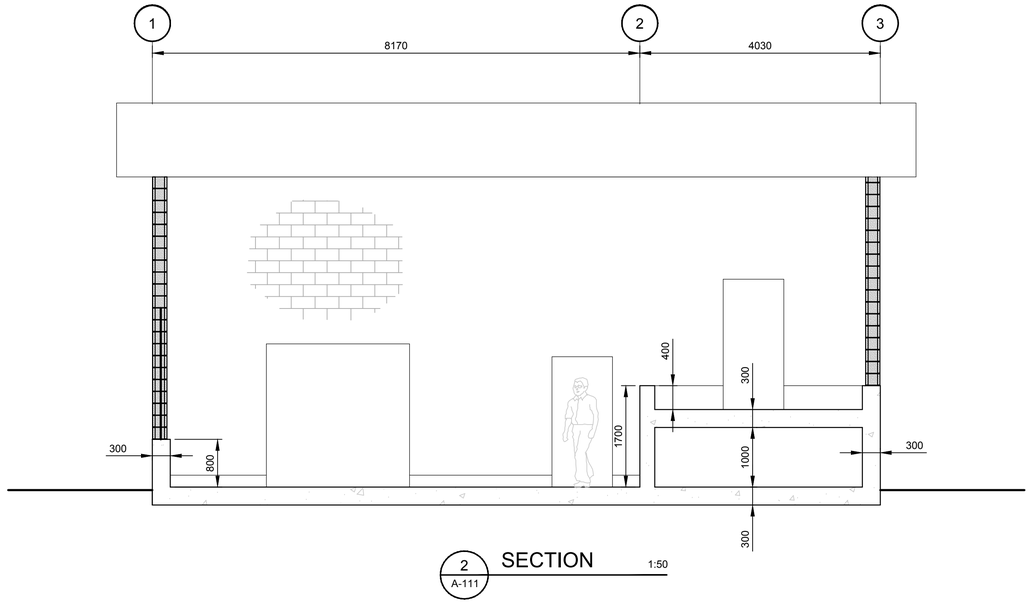
DRAWING	REVISION	SHEET
2972-00-A-111	A	---- /

IF NOT 50 mm ADJUST SCALES
50 mm

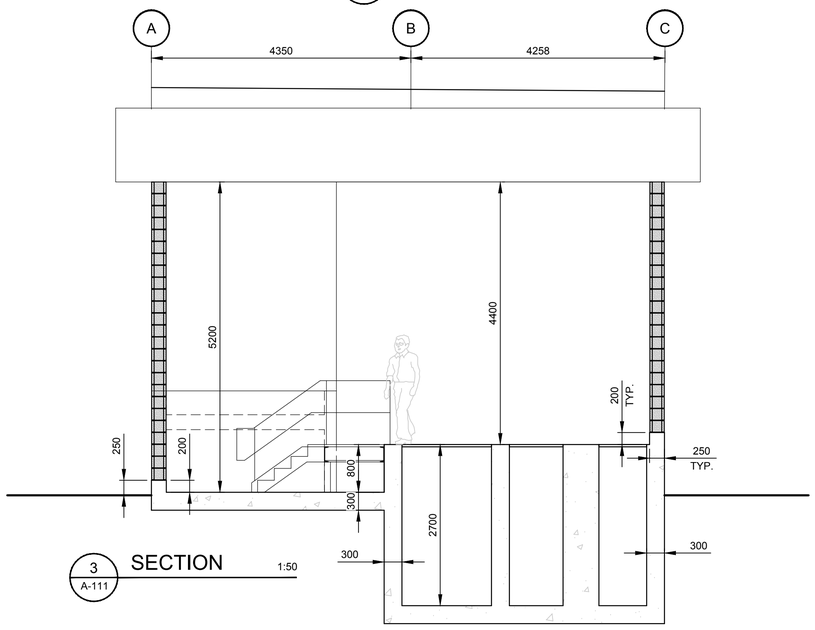
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



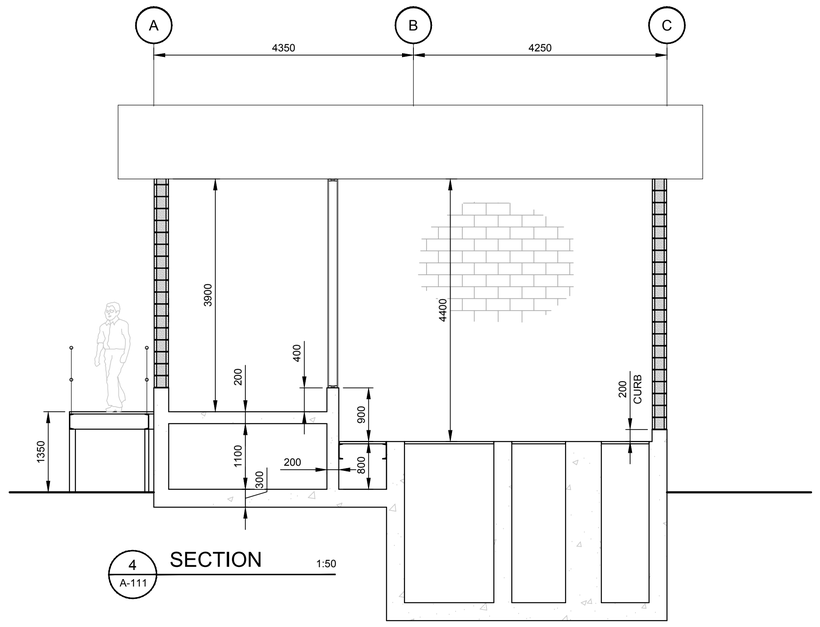
1 A-111 SECTION 1:50



2 A-111 SECTION 1:50



3 A-111 SECTION 1:50



4 A-111 SECTION 1:50

P:\20172972\00_WstWtr_Trtmnt_Upg\Working_Dwgs\200_Architectural\2972-00-a-311.dwg
DATE: 2017-12-06, Jhunn Dualan

Associated Engineering
CANADA'S BEST MANAGED COMPANIES Platinum member

PRELIMINARY/
FOR DISCUSSION
NOT FOR CONSTRUCTION

DRAFT

REV	DATE	DESIGN	DRAWN	DESCRIPTION
X	YYYYMMMDD	E. ENGINEER	D. DRAFTER	ISSUED FOR XXXXXX

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

ARCHITECTURAL

SCREEN BUILDING - SECTIONS

DRAWING	REVISION	SHEET
2972-00-A-311	X	----

APPENDIX

2. AS-BUILT SECTIONS OF EXISTING BERM

CONTRACT A-89810 STARTS AT EXISTING CITY SEWAGE LAGOON DYKE.

CITY SEWAGE LAGOON

SLOPE DYKE FROM EL. 122.0' AT GATE EVENLY TO THAT OF THE TOP OF THE CITY SEWAGE LAGOON DYKE.

℄ FENCE

GATE

TOP OF DYKE EL. 122.0'

NEW DITCH 850 FT. APPROX. LENGTH

MILL GRID NORTH IS TRUE NORTH

N 42 +38
W 31 +03

370'-0" REF. 1

TOP OF DYKE TO EL. 122.0'

SLOPE 100'-0"

TOP OF DYKE TO EL. 121.0'

APPROX. TREE LINE

℄ RESERVOIR

FUTURE

300'-0"

175'-0" R.

45°

TOP OF DYKE EL. 122.0'

NW-NE Berm Constructed Using Section A-A Dwg 13.030 (No Core)

200' R.

300' R.

FLOW

FUTURE

150' R.

90°-0"

120'-0"

175'-0"

BENCH MARK 44-W (N.E. CORNER JOHNSTONE ISLAND) NAIL WITH TAG IN 5½ FT. SPRUCE. EL. 114.7 FT.

500'-0"

TOP OF DYKE EL. 121.0'

20' R.

RIP-RAP SEE REF. 1 NOTE 5

SLOPE 100'-0"

ELECTRICAL BUILDING SEE REF. 4

20'-0"

150' R.

REF. 1

RESERVOIR OUTLET SEE REF. 5

TOP OF DYKE TO EL. 122.0'

350'-0"

1400'-0"

130'-0"

FUTURE

RIP-RAP SEE REF. 1 NOTE 5

RESERVOIR DRAIN

SW-SE Berm Constructed Using Section A-A Dwg 13.007 (Core)

Interior Berm Constructed Using Section B-B Dwg 13.030 No Core)

POINT 'A'

FOR ELEVATION OF RESERVOIR BOTTOM SEE NOTE 6, REF. 1

RIP-RAP CONTINUOUS AROUND DYKE FROM POINT 'A' TO POINT 'B' AS SHOWN ON REF. 1

1200'-0"

NOTE: WATER'S EDGE SHOWN AT EL. 105.6'

POINT 'B'

350'-0"

7048 LIGHTNIN AERATOR RELOCATED FROM LUPSI CUPSI POINT BY CONTRACT A-89822 FOR RIP-RAP BY CONTRACT A-89816 SEE NOTE 1, REF. 1

FOR RIP-RAP SEE NOTE 1, REF. 1

14 AERATORS - 1 LIGHTNIN, RELOCATED FROM LUPSI CUPSI POINT AND 13 WELLES AQUA-LA, OR MODEL 475 AERATORS, PLUS 4 FUTURE AERATORS. EACH AERATOR TO BE SECURED BY 3 POINT MOORING TO DYKES. FOR DETAILS SEE REF. 7

FOR PIPE LINES SEE REF. 2

SUBMARINE ELECTRICAL CABLE SEE REF. 2

N 45° 00' W FROM MILL GRID NORTH

N 22 +87
W 18 +60

NEW 200' ℄ CLARIFIER SEE REF. 3

N 22 +79.43
W 19 +98.48

SOMASS RIVER

FLOW

REF. NO	REFERENCES NO.	DESCRIPTION
1	E-13,007	AERATION RESERVOIR SECTIONS AND DETAILS
2	E-13,025	EFFLUENT RIVER CROSSING PIPELINE PROFILE & DETAILS
3	E-13,021	200' ℄ CLARIFIER LAYOUT AND DETAILS
F 4	E-13,032	AERATOR ELECT BLDG. ARRANGEMENT & DETAILS
B 5	E-13,031	AERATION RESERVOIR OUTFALL ARRGT & DETAILS
C 6	E-13,030	AERATION RESERVOIR ALTERNATE SECTIONS
D 7	E-13,033	AERATION RESERVOIR AERATOR ANCHORS & RUBB. DUCTS

NO.	BY	DATE	REVISION	APP'D
F	GWW	17 FEB 70	CORRECTED REF. 4 ISSUED FOR CONTRACT A-89822	
E	GWW	4 DEC 69	AERATOR MOORINGS ADDED.	
D	GWW	6 NOV 69	LOCATED AERATORS ADDED SECTION K-K AND REF. 7	RC
C	W.E.J	6 OCT 69	ISSUED FOR REF. ONLY FOR CONTRACT A-89817. CLARIFIER CO-ORDINATES REVISED. REF. 6 ADDED.	
B	W.E.J	18 SEP 69	ISSUED AS REFERENCE FOR TENDER A-89817. REF 5 CORRECTED.	RC
A	GWW	4 JULY 69	ISSUED FOR CONTRACT A-89816 AND FOR REFERENCE ONLY CONTRACT A-89810	RC
–		4 JUNE 69	ISSUED FOR TENDER A-89810	

BY	DATE	PRELIMINARY ISSUE
RC	30 APR 69	FOR INFORMATION
RC	14 MAY 69	FOR INFORMATION - WAS D2346-131-SK.10
RC	20 MAY 69	FOR INFORMATION
RC	24 MAY 69	FOR INFORMATION
—		APPROVED

D2346-131-206

MacMillan Bloedel Limited

ALBERNI PULP AND PAPER DIVISION

DEPT. SEWERS AND EFFLUENT TREATMENT

DATE:

AERATION RESERVOIR
GENERAL ARRANGEMENT

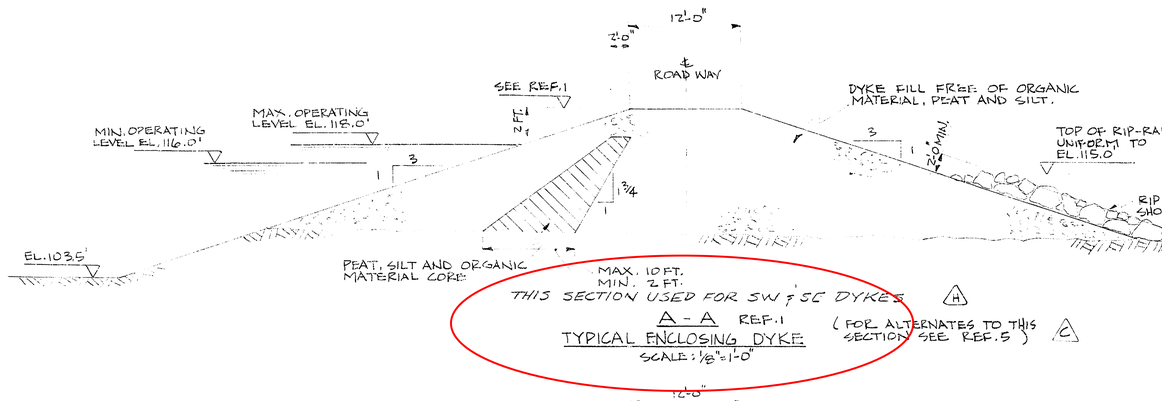
FILE: 7003 7082 7085

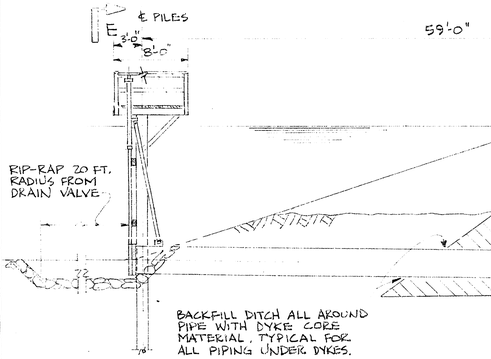
SCALE: 1" = 100 FT. CHECKED: EMB RCW

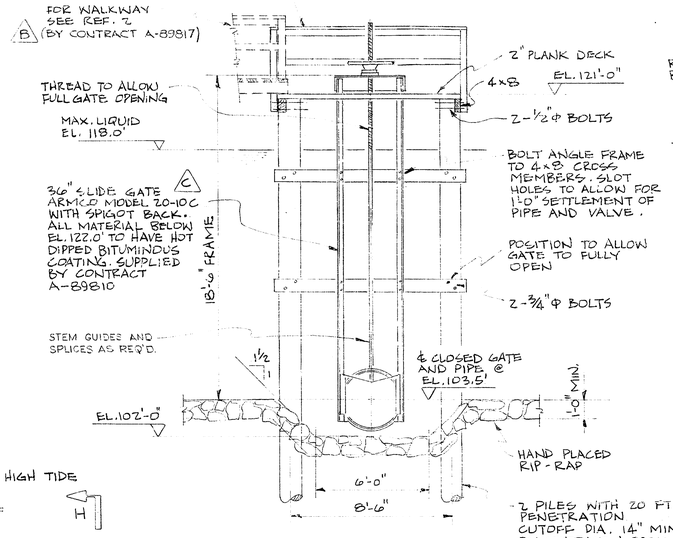
DRAWN: GWW APPROVED:

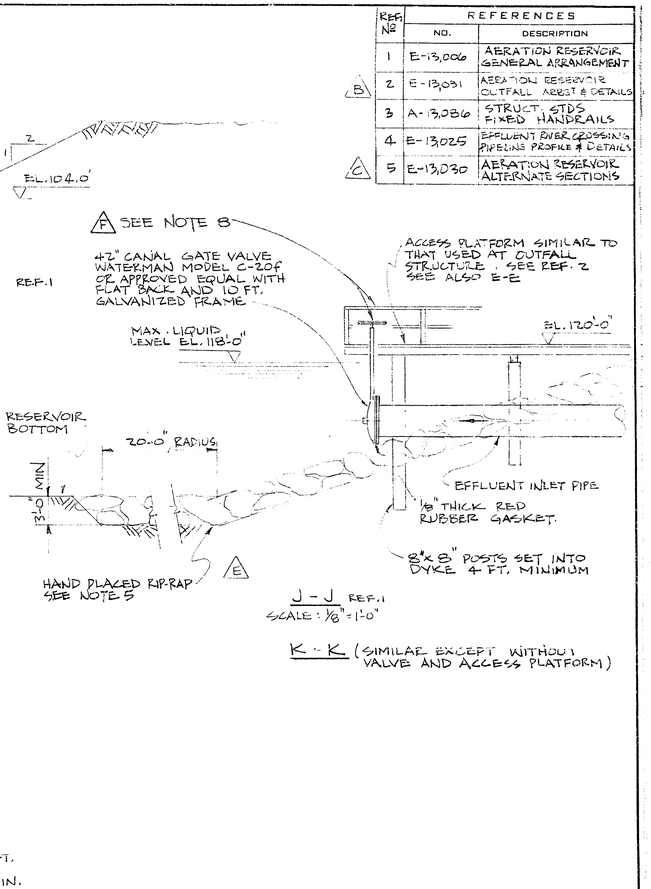
DWG.: E-13,006

REV. F









REF. №	REFERENCES NO.	DESCRIPTION
1	E-13,006	AERATION RESERVOIR GENERAL ARRANGEMENT
2	E-13,031	AERATION RESERVOIR OUTFALL ARRGT & DETAILS
3	A-13,086	STRUCT. STDS FIXED HANDRAILS
4	E-13,025	EFFLUENT RIVER CROSSING PIPELINE PROFILE & DETAILS
5	E-13,030	AERATION RESERVOIR ALTERNATE SECTIONS

B

C

NOTES

F

1. PLACE A 60 FT. DIA. CIRCLE OF RIP-RAP WITH 1 FT. MIN. THICKNESS, UNDER THE LIGHTNIN AERATOR 704B WITH A SURFACE TO WITHIN PLUS OR MINUS SIX INCHES OF THE RESERVOIR BOTTOM.
2. PILES TO BE CREOSOTED FIR, 16 LB/CU.FT. FULL CELL TREATMENT. ALL OTHER TIMBER BELOW EL. 120' TO BE GIVEN 2 BRUSH COATS CREOSOTE OIL.
3. ALL FASTENINGS TO BE GALVANIZED STEEL.
4. ASBESTOS BONDED AND COATED ARMCO CORRUGATED STEEL PIPE WITH WATER TIGHT COUPLERS, BY CONTRACT A-89816.
5. FOR RESERVOIR INLETS AND OUTLETS RIP-RAP SHALL BE HAND PLACED WITH FLAT SURFACES FORMING THE SIDES AND BOTTOM TO WITHIN PLUS OR MINUS TWO INCHES OF THE SURFACES SPECIFIED ON THE DRAWING AND WITH ALL JOINTS KEYED WITH SMALL STONES.
6. ENTIRE RESERVOIR BOTTOM TO BE EXCAVATED TO EL. 103.5'
7. PLATFORM AND HANDRAILS TO BE FROM CONSTRUCTION GRADE FIR.
8. CONTRACT A-89822 TO INSTALL OWNER'S 42" VALVE SHOWN IN SECTION J-J. PLATFORM BY OTHERS.

F

NO.	BY	DATE	REVISION	APPD.
H	MID	14 JAN.71	GENERAL REVISION AS BUILT	
G	GWW	17 FEB 70	ISSUED FOR CONTRACT A-89822	WR WRD
F	GWW	4 DEC 69	NOTE 8 ADDED NOTE 1 REVISED WAS 18 AERATORS	WR
E	GWW	7 NOV 69	VALVE & PLATFORM ADDED TO SECTION J-J	RC
D	WEJ	6 OCT 69	ISSUED FOR REF. ONLY FOR CONTRACT A-89817	WR
C	GWW	19-9-69	DRAIN VALVE WAS MODEL 101C. REF. 5 ADDED	RC
B	U.S.BO	18.8.69	ISSUED AS REFERENCE FOR TENDER A-89817 REF 2 ADDED	RC WR
A	GWW	4 JULY 69	ISSUED FOR CONTRACT A-89810	WR WRD
		4 JUNE 69	ISSUED FOR TENDER A-89810	

BY	DATE	PRELIMINARY ISSUE
RC	20 MAY 69	FOR INFORMATION
RC	24 MAY 69	FOR INFORMATION
—		APPROVED

.2346-131-207

K. Ker Lawson
6 June 1969

MacMillan Bloedel Limited

ALBERNI PULP AND PAPER DIVISION

DEPT. SEWERS AND EFFLUENT TREATMENT

DATE:

AERATION RESERVOIR SECTIONS AND DETAILS

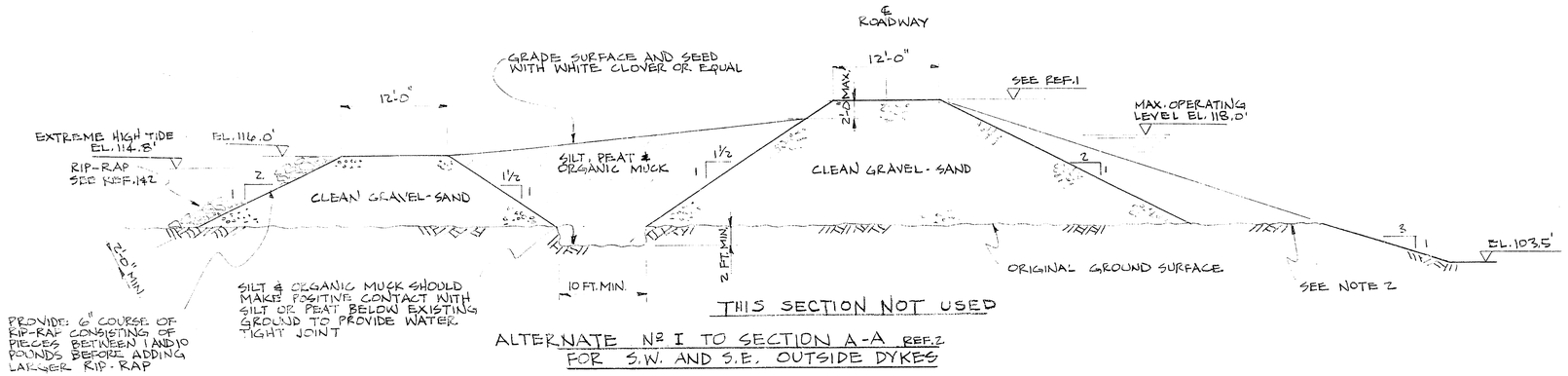
FILE: 7003 7082 7085

SCALE: AS NOTED | CHECKED: SMB, RC | I.D. or M.:

DRAWN: GWW | APPROVED: | R.E.S.:

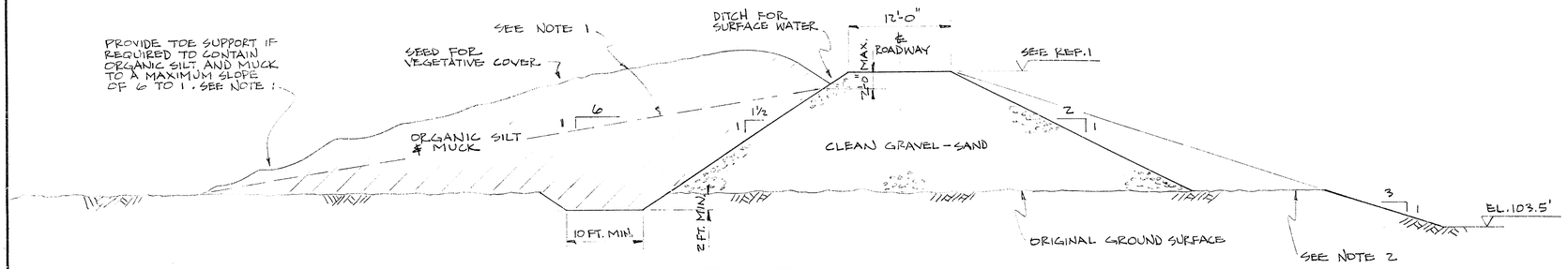
DWG.: E-13,007 | REV. PH

REFERENCES		
REF NO.	DWG. NO.	DESCRIPTION
1	E-13,006	AERATION RESERVOIR GEN. ARRANGEMENT
2	E-13,007	AERATION RESERVOIR SECTIONS & DETAILS

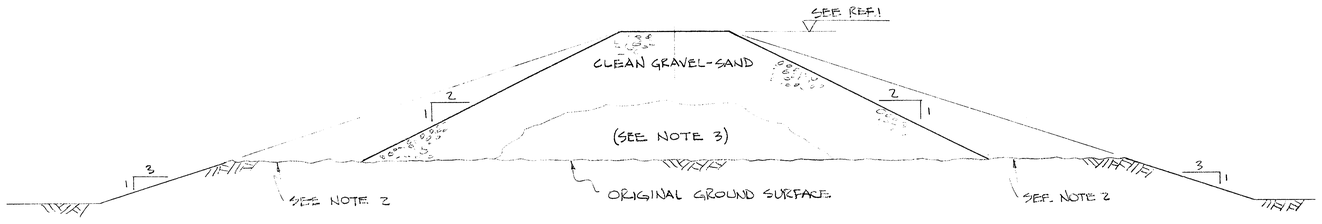


THIS SECTION NOT USED

ALTERNATE Nº I TO SECTION A-A REF. 2
FOR S.W. AND S.E. OUTSIDE DYKES



ALTERNATE Nº II TO SECTION A-A REF. 2
FOR N.W. AND N.E. OUTSIDE DYKES



ALTERNATE TO SECTION B-B REFS. 1 & 2
TYPICAL INNER DYKE

NOTES:

1. FOR THE N.W. AND N.E. OUTSIDE DYKES THE GRAVEL TOE SUPPORT IS NOT REQUIRED IF SUFFICIENT ORGANIC MUCK IS PLACED SUCH THAT THE VOLUME OF MUCK IS GREATER THAN THAT UNDER A LINE PROJECTED DOWN FROM A POINT TWO FEET BELOW THE TOP OF THE DYKE AT 1 VERTICAL ON 6 HORIZONTAL. IF THE VOLUME IS LESS THAN THE ABOVE MINIMUM LIMIT THEN A TOE SUPPORT WILL BE REQUIRED TO CONTAIN THE ORGANIC MUCK AT A SLOPE NO STEEPER THAN 1:6.
2. THE UNDISTURBED ORIGINAL GROUND SURFACE SHALL BE LEFT AS SHOWN IN SECTIONS AT EACH INSIDE DYKE TOE. ALL VEGETATION SHALL BE REMOVED BUT SOD SHALL BE UNDISTURBED.
3. SOME SILTY GRAVEL-SAND MAY BE USED IN CONSTRUCTION OF THE INNER DYKES PROVIDED THAT THESE DYKES WILL WITHSTAND THE TRAFFIC OF CONSTRUCTION EQUIPMENT WITHOUT DAMAGE.
4. WHERE DYKE SECTION CHANGES FROM "SECTION A-A" ON REF. 1 TO "ALTERNATE SECTION A-A" SHOWN ON THIS DRAWING, THE IMPERVIOUS CORES MUST CONTACT EACH OTHER AND FORM A CONTINUOUS WATER STOP AROUND THE PERIMETER OF THE RESERVOIR. WHERE THIS IMPERVIOUS CORE PASSES UNDER THE ROADWAY, IT SHALL BE MADE OF SELECTED SILTY SAND AND GRAVEL WITH CROSS SECTION AS SHOWN BY "SECTION A-A" REF. 1.

NO.	DATE	REVISION	BY
–	GWN 1968	ISSUED FOR CONTRACT A-83816	RC

BY	DATE	PRELIMINARY ISSUE
RC	12-9-69	FOR COMMENTS AND APPROVAL
–		APPROVED FOR CONSTRUCTION

P.E. W. SEAL
P.2346-131-230
R. Buchanan
19 [illegible] 1969
SANDWELL

MacMillan Bloedel Limited

ALBERNI PULP AND PAPER DIVISION

DEPT. SEWERS AND EFFLUENT TREATMENT

DATE:

AERATION RESERVOIR ALTERNATE SECTIONS

FILE: 7003 7013 7082

SCALE: 1/8" = 1'-0" | CHECKED: RKC | B. of M.:
DRAWN: GWN | APPROVED: | R.E.B.:

DWG.: E-13,030 | REV.

APPENDIX

3. BOREHOLE LOGS & GRADATION ANALYSES REPORTS

WSP Canada Inc.
1935 Bollinger Road
Nanaimo, B.C. V9S 5W9
Tel: +1 250-753-1077
Fax: +1 250-753-1203
www.wsp.com

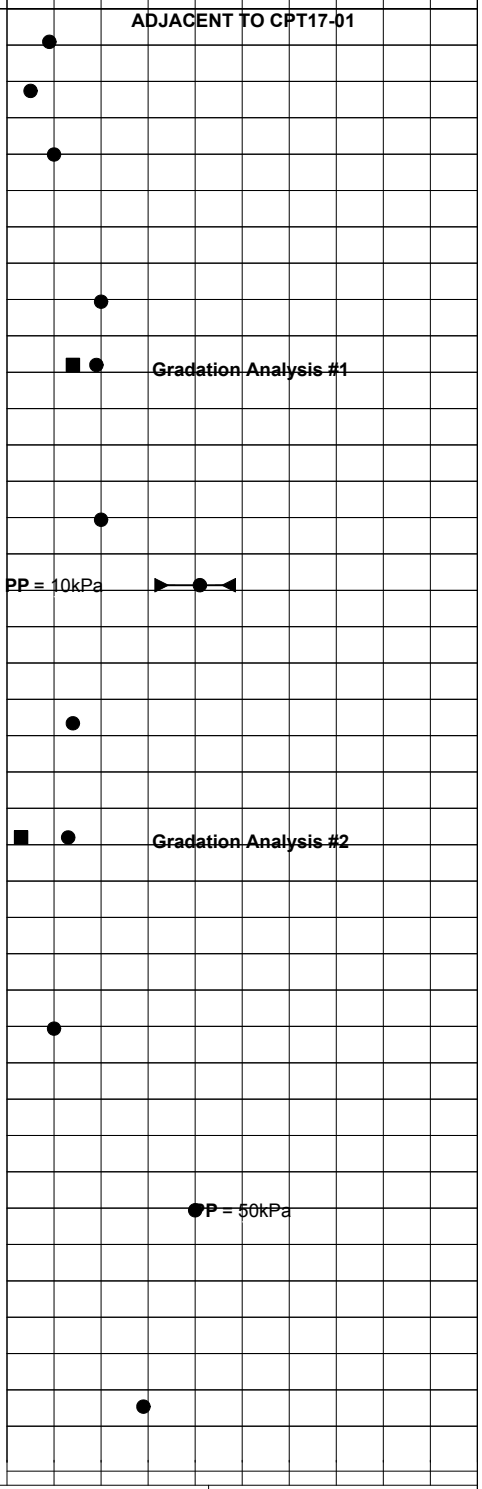
Port Alberni WWTP Upgrade
Geotechnical Assessment

BH17-01

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	Well 1	C	N	Type/ Sample #	Water Level
		compact, brown SAND AND GRAVEL (FILL), some fines, poorly graded, max particle size observed = 80 mm, moist, cobbles.			25	SPT1	
						G1	
2	5				10	SPT2	P1 Apr 20 2017
						RS1	
	10	loose to compact, grey SAND, some gravel, some fines, poorly graded, max particle = 20 mm, moist.					
4						G2	
	15	- interbedded with silt layers lenses to 5.8 m depth					
						RS2	
6	20	- below 5.8 m trace to some fines					
						G3	
	25						
8		very soft to soft, grey SILT, some sand, low plasticity, moist, shells.				G4	
						RS3	
	30	loose to compact, grey, gravelly SAND, trace fines, coarse grained sand, poorly graded, max particle size observed = 10 mm, wet, heaving.					
10						G5	
	35						
						RS4	
12	40						
	45						
14						G6	
	50						
16		loose/soft, silty SAND/sandy SILT, trace gravel, low plasticity, moist to wet, shells, wood debris, organics, poorly graded, fine grained sand.				G7	
	55						
18		loose to compact, grey SAND, trace fines, trace gravel, poorly graded, coarse grained sand, wet.					
	60	loose, grey, SAND AND SILT, trace gravel, poorly graded, trace organics, shells.					
						G8	
	65						

Continued on Pg 2 of 2



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
☒ Remolded strength in kPa
■ Percent Passing # 200 sieve

Bentonite/Grout Plug
Solid Pipe
Cuttings
Slotted Pipe
Sand/Pea-Gravel

Drill Method: Sonic
Date Drilled: 18/04/2017
Logged by: LM
Checked by: DF

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 2/6/17

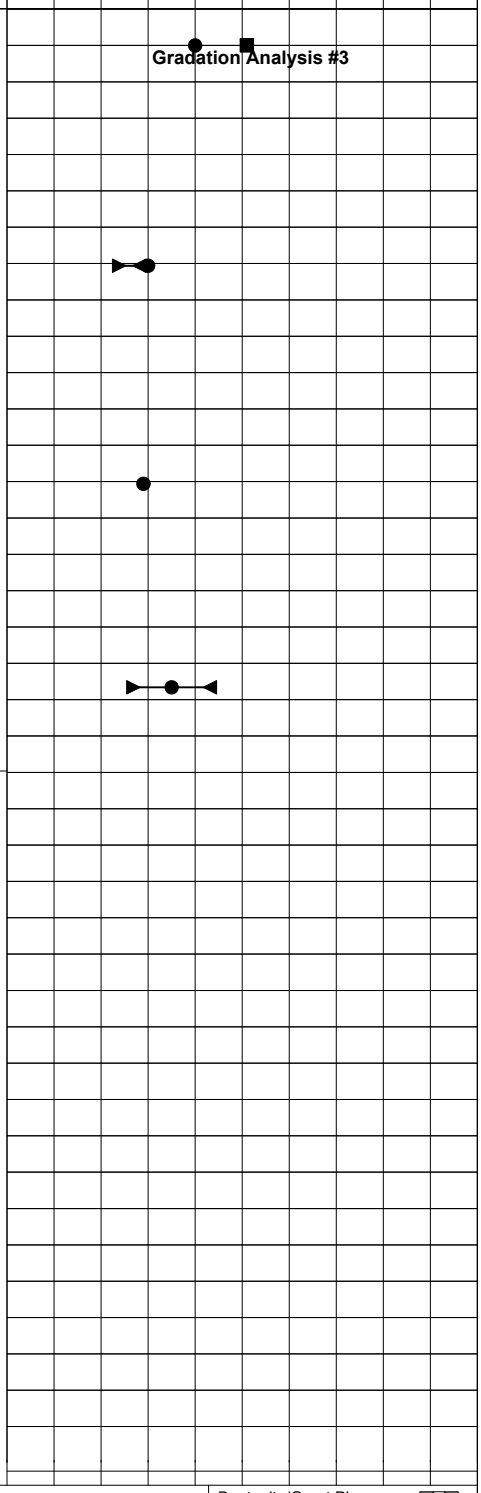
WSP Canada Inc.
1935 Bollinger Road
Nanaimo, B.C. V9S 5W9
Tel: +1 250-753-1077
Fax: +1 250-753-1203
www.wsp.com

Port Alberni WWTP Upgrade
Geotechnical Assessment

BH17-01

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	Well 1	C	N	Type/ Sample #	Water Level
	70	loose, grey, SAND AND SILT, trace gravel, poorly graded, trace organics, shells. *(continued)*					
22							
	75	sandy SILT, intermediate plasticity below 22 m.					
24						G9	
	80						
26						G10	
	85						
	90						
28							
	95	CLAY and SILT, some sand below 29 m				G11	
30							
	100	Free water in hole at 1.8 m depth at end of drilling. Hole sloughing upon completion. Bottom of hole at 30.5 meters					
32	105						
	110						
34							
	115						
36							
	120						
38							
	125						
	130						



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Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
☒ Remolded strength in kPa
■ Percent Passing # 200 sieve

Bentonite/Grout Plug
Solid Pipe
Cuttings
Slotted Pipe
Sand/Pea-Gravel

Drill Method: Sonic
Date Drilled: 18/04/2017
Logged by: LM
Checked by: DF

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 2/6/17

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www.wsp.com

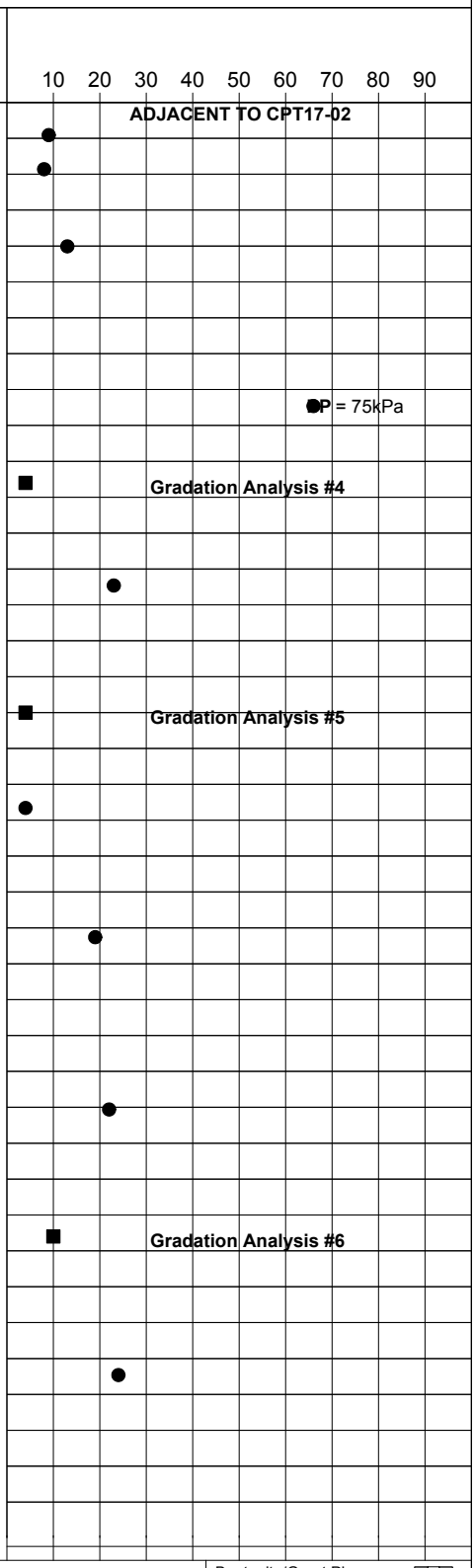
Port Alberni WWTP Upgrade
Geotechnical Assessment

BH17-02

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	Closure 1	C	N	Type/ Sample #	Water Level
		compact, brown SAND AND GRAVEL (FILL), some fines, poorly graded, max particle size observed = 80 mm, moist, cobbles.			19	SPT1	
						G1	
2	5	- below 1.8 m wet -below 2.1 m, grey			11	SPT2	
						RS1	
4	10	firm, brown SILT, some sand, trace gravel, low plasticity, moist, organics.					
						G2	
6	15 20 25	loose, grey, gravelly SAND, trace fines, poorly graded, coarse grained sand, max particle size observed = 30 mm, trace wood debris, wet, heaving.				RS2	
						G3	
8 10	30 35	loose to compact, grey, sandy GRAVEL, trace fines, poorly graded, rounded, max particle size observed = 60 mm, wet, heaving.				RS3	
						G4	
12	40	loose to compact, grey SAND, some fines, trace gravel, poorly graded, max particle size observed = 60 mm, wet, trace shells/wood debris.				G5	
14	45 50					G6	
16	55						
18	60	- below 17.4 m some silt - fine grained gravel layer 18.3 to 18.9 m				G7	
	65						

Continued on Pg 2 of 2



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
☒ Remolded strength in kPa
■ Percent Passing # 200 sieve

Bentonite/Grout Plug
Solid Pipe
Cuttings
Slotted Pipe
Sand/Pea-Gravel

Drill Method: Sonic
Date Drilled: 19/04/2017
Logged by: LM
Checked by: DF

1 LOG PER PAGE 2/6/17

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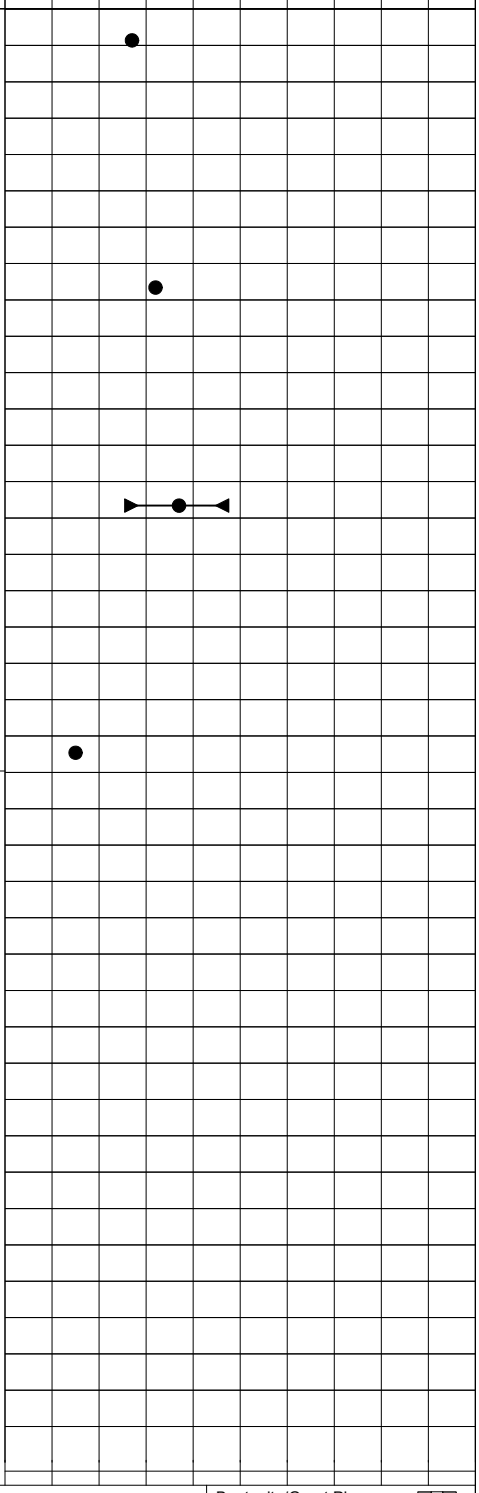
Fax: +1 250-753-1203
www.wsp.com

Port Alberni WWTP Upgrade
Geotechnical Assessment

BH17-02

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	Closure 1	C	N	Type/ Sample #	Water Level
	70	loose to compact, grey SAND, some fines, trace gravel, poorly graded, max particle size observed = 60 mm, wet, trace shells/wood debris. *(continued)*				G8	
22	75	- below 22.9 m silty					
24	80					G9	
		soft, grey CLAY and SILT, some sand to sandy, intermediate plasticity, moist to wet, shells, wood debris.					
26	85						
						G10	
28	90						
	95						
30	100					G11	
		Backfilled with grout upon completion. Free water at 1.8 m depth after drilling. Bottom of hole at 30.5 meters					
32	105						
	110						
34							
	115						
36	120						
38	125						
	130						



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
⊠ Remolded strength in kPa
■ Percent Passing # 200 sieve

Bentonite/Grout Plug
Solid Pipe
Cuttings
Slotted Pipe
Sand/Pea-Gravel

Drill Method: Sonic
Date Drilled: 19/04/2017
Logged by: LM
Checked by: DF

1 LOG PER PAGE 2/6/17

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1935 Bollinger Road
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www.wsp.com

Port Alberni WWTP Upgrade
Geotechnical Assessment

BH17-03

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		compact, brown SAND AND GRAVEL (FILL), trace to some fines, poorly graded, max particle = 40 mm, moist.		16	SPT1	
1.5	5	- loose/soft from 1.5 to 2.1 m		4	SPT2	
2.1	7			23	SPT3	
4.1	13.5	- softer/less drilling resistance below 4.1 m depth Backfilled to surface with sand. Bottom of hole at 4.3 meters				

10 20 30 40 50 60 70 80 90

PREDRILL FOR CPT17-03

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
⊠ Remolded strength in kPa
■ Percent Passing # 200 sieve

Bentonite/Grout Plug
Solid Pipe
Cuttings
Slotted Pipe
Sand/Pea-Gravel

Drill Method: Sonic
Date Drilled: 19/04/2017
Logged by: LM
Checked by: DF

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Port Alberni WWTP Upgrade
Geotechnical Assessment

BH17-04

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		compact, brown SAND AND GRAVEL (FILL), some fines, poorly graded, max particles size observed = 80 mm, moist, cobbles.		12	SPT1	
	5	- compact to dense, grey, 0.9 to 0.1 m depth				
2				46	SPT2	
		- silty below 2.1 m			G1	
	10					
		- some fines below 3.0 m				
4				38	SPT3	
	15	Backfilled to surface with sand. Bottom of hole at 4.6 meters				
6	20					
	25					
8						
	30					
10						
	35					
12						
	40					
	45					
14						
	50					
16						
	55					
18						
	60					
	65					

10 20 30 40 50 60 70 80 90

PREDRILL FOR CPT17-04

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
⊠ Remolded strength in kPa
■ Percent Passing # 200 sieve

Bentonite/Grout Plug
Solid Pipe
Cuttings
Slotted Pipe
Sand/Pea-Gravel

Drill Method: Sonic
Date Drilled: 19/04/2017
Logged by: LM
Checked by: DF

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Port Alberni WWTP Upgrade
Geotechnical Assessment

BH17-05

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	Closure 1	C	N	Type/ Sample #	Water Level
		compact, brown, SAND AND GRAVEL (FILL), some fines, poorly graded, max particle size observed = 50 mm, moist.			17	SPT1	
						G1	
2	5	firm to stiff, brown, sandy SILT, trace gravel, low plastic, moist, wood debris			1	SPT2	
		interbedded, gravelly SAND and sandy SILT, very loose/very soft, organics/wood debris, max particle size observed = 40 mm, poorly graded.				G2	
	10					G3	
		loose, grey GRAVEL, some sand, trace fines, poorly graded, rounded, max particle size observed = 60 mm, wet			4	SPT3	
4						G4	
						G5	
	15	soft, dark brown, ORGANIC SILT, non plastic, wood debris, moist.				G6	
					3	SPT4	
		very loose, grey/brown SAND, some fines, trace gravel, poorly graded, max particle size observed = 20 mm, wet					
6	20	Free water at 3.4 m below ground surface at end of drilling.					
		Hole sloughing.					
		Bottom of hole at 5.2 meters					
8	25						
	30						
10							
	35						
12							
	40						
	45						
14							
	50						
16							
	55						
18							
	60						
	65						

10 20 30 40 50 60 70 80 90

MC = 131%

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
☒ Remolded strength in kPa
■ Percent Passing # 200 sieve

Bentonite/Grout Plug
Solid Pipe
Cuttings
Slotted Pipe
Sand/Pea-Gravel

Drill Method: Sonic
Date Drilled: 20/04/2017
Logged by: LM
Checked by: DF

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 2/6/17

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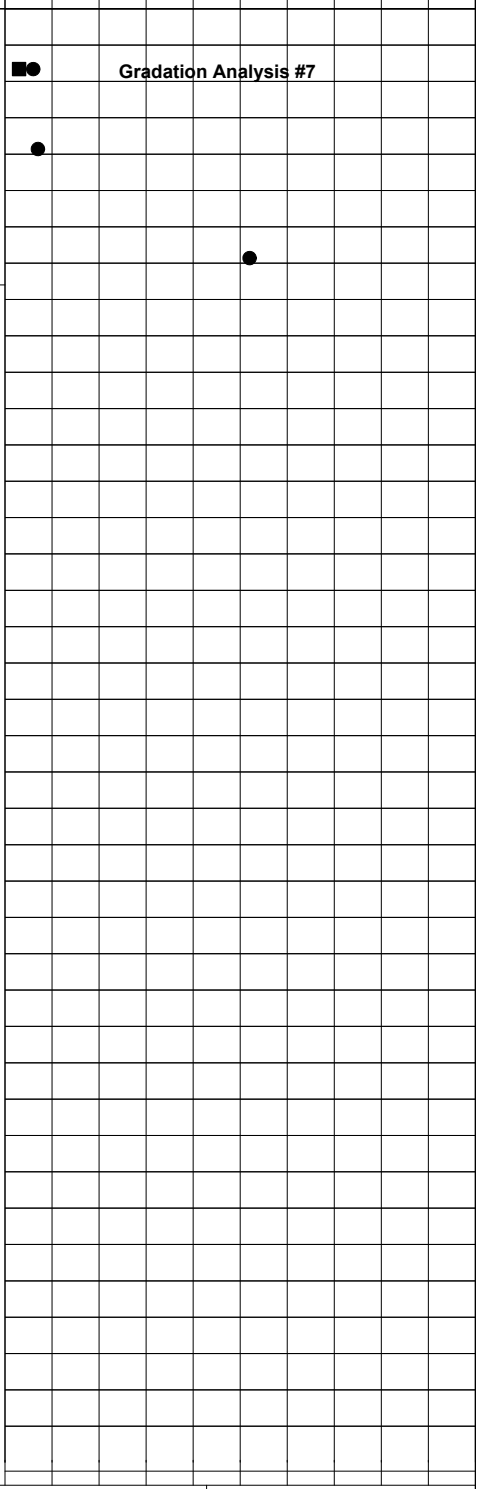
Port Alberni WWTP Upgrade
Geotechnical Assessment

TP17-01

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		compact, brown SAND AND GRAVEL (FILL), trace fines, poorly graded, moist to wet, max particle size observed = 100 mm, cobbles. - backfill			B1	
					G1	
		loose, grey/brown silty SAND, some gravel, poorly graded, max particle size observed = 60 mm, moist to wet, organics/shells, wood debris, sloughing - wet below 3.5 m			G2	
		Free water at 3.5 m. Backfilled with bucket packed excavated material. Bottom of test pit at 3.8 meters				



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
☒ Remolded strength in kPa
■ Percent Passing # 200 sieve

Drill Method: Test Pit
Date Drilled: 21/04/2017
Logged by: LM
Checked by: DF

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

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Port Alberni WWTP Upgrade
Geotechnical Assessment

TP17-02

Project No: 171-04753-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		compact, brown SAND AND GRAVEL (FILL), trace fines, poorly graded, max particle size observed = 60 mm, moist.			B1	
		loose, brown silty SAND, (FILL - INFERRED BERM CORE ZONE) some gravel, poorly graded, max particle size observed = 30 mm, moist, organics.			G1	
		Backfilled with bucket packed excavated material. - no seepage or sloughing observed				
1.2	4	Bottom of test pit at 1.2 meters				

10 20 30 40 50 60 70 80 90

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) Liquid Limit (%)
Moisture Content (%)
Ground Water Level
(X) Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
X Shear strength in kPa (Unconfined)
⊗ Shear strength in kPa (Field vane)
☒ Remolded strength in kPa
■ Percent Passing # 200 sieve

Drill Method: Test Pit
Date Drilled: 21/04/2017
Logged by: LM
Checked by: DF

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 2/6/17

WSP Canada Inc.

760 Enterprise Crescent
Victoria, BC
Canada V8Z 6R4
Tel.: 250-475-1000
Fax.: 250-475-2211
E-mail: victoria@wsp.com

AGGREGATE GRADATION CHART

IDENTIFICATION:

Client: Associated Engineering Ltd
Project: Industrial WWTP Upgrade - Port Alberni
File No.: 171-04753-00
Report No.: 1

Sample Location: In-situ
BH17-01, Box 2, 4.7m-5.0m
Date: 08-May-17

SAMPLING INFORMATION:

Material: Sand, some gravel, some fines
Specification: n/a

Date Sampled	18-Apr-17
Date Tested	08-May-17
Sample No:	1
Fracture by mass	n/a
Supplier:	In Situ
Sampled by:	LM
Tested by:	GG

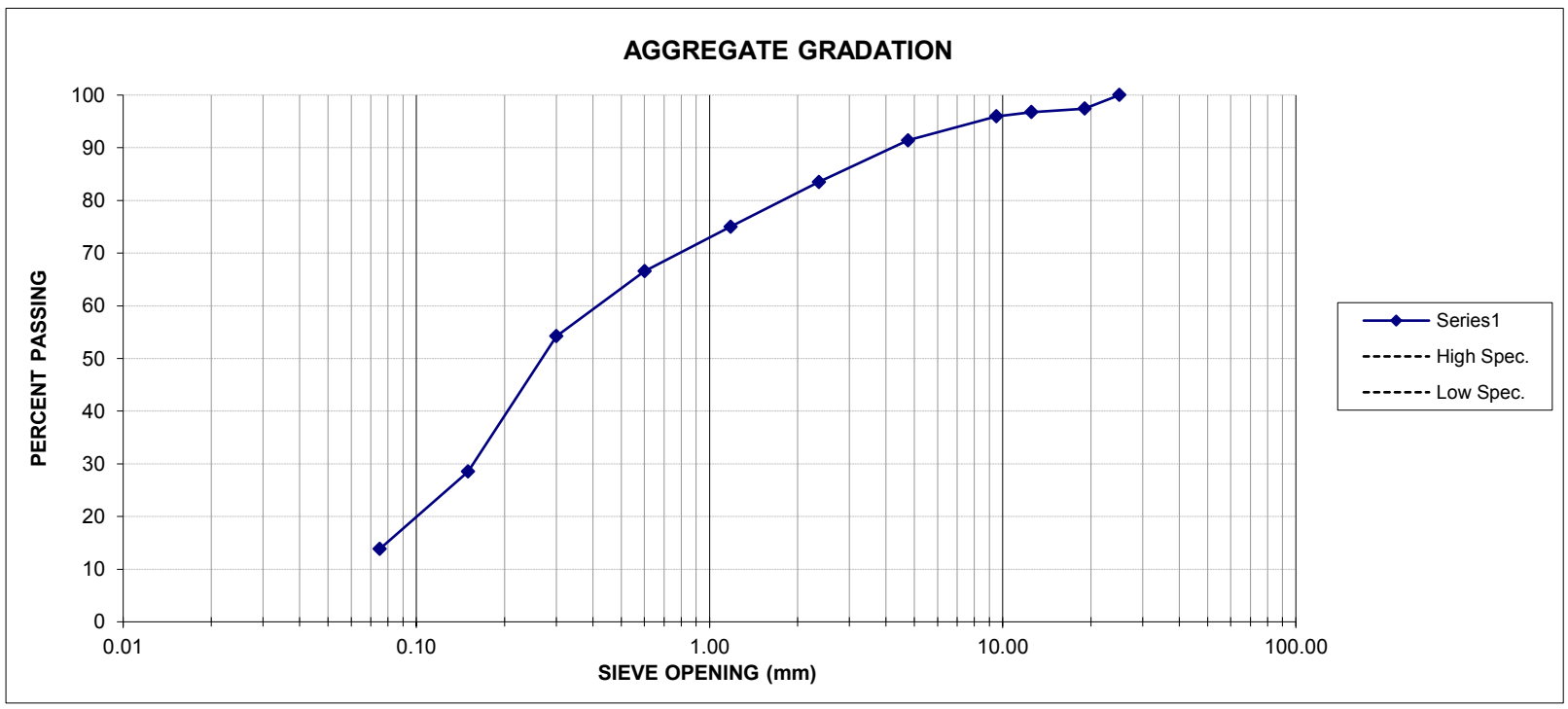
Material Specification

Sieve	High Spec.	Low Spec.

Sieve Analysis

Sieve	% Passing
75.0	
63.0	
50.0	
37.5	
25.0	100.0
19.0	97.4
12.5	96.8
9.5	95.9
4.75	91.4
2.36	83.5
1.18	75.0
0.600	66.6
0.300	54.2
0.150	28.5
0.075	13.8

AGGREGATE GRADATION:



REMARKS: Tested according to ASTM C-: 136 and C-117

REPORTS TO:

WSP CANADA INC.

per:

WSP Canada Inc.

760 Enterprise Crescent
Victoria, BC
Canada V8Z 6R4
Tel.: 250-475-1000
Fax.: 250-475-2211
E-mail: victoria@wsp.com

AGGREGATE GRADATION CHART

IDENTIFICATION:

Client: Associated Engineering Ltd
Project: Industrial WWTP Upgrade - Port Alberni
File No.: 171-04753-00
Report No.: 2

Sample Location: In-situ
BH17-01, Box 4, 10.7m-12.2m
Date: 08-May-17

SAMPLING INFORMATION:

Material: Sand, gravelly, trace fines
Specification: n/a

Date Sampled	18-Apr-17
Date Tested	08-May-17
Sample No:	2
Fracture by mass	n/a
Supplier:	In Situ
Sampled by:	LM
Tested by:	GG

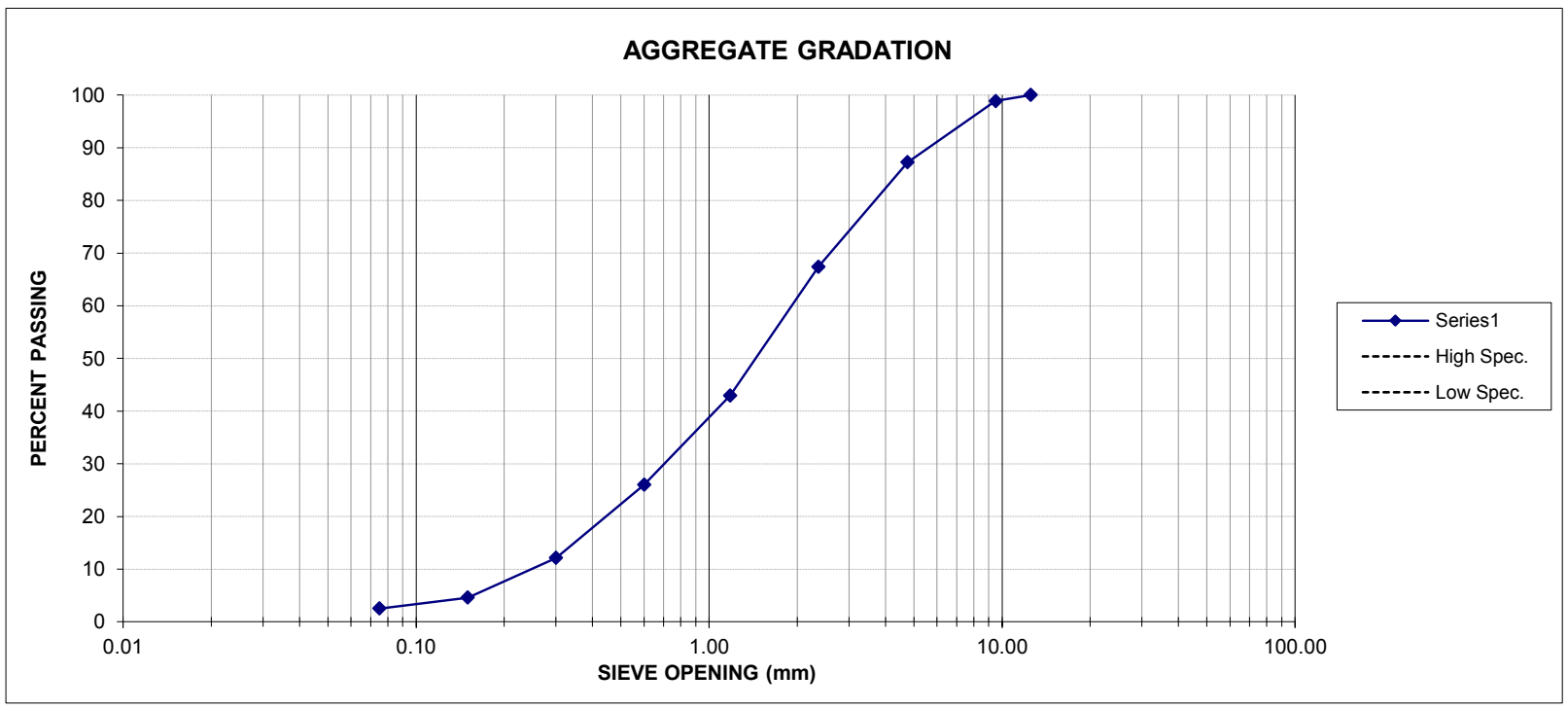
Material Specification

Sieve	High Spec.	Low Spec.

Sieve Analysis

Sieve	% Passing
75.0	
63.0	
50.0	
37.5	
25.0	
19.0	
12.5	100.0
9.5	98.9
4.75	87.2
2.36	67.4
1.18	43.0
0.600	26.0
0.300	12.1
0.150	4.6
0.075	2.5

AGGREGATE GRADATION:



REMARKS: Tested according to ASTM C-: 136 and C-117

REPORTS TO:

WSP CANADA INC.

per:

WSP Canada Inc.

760 Enterprise Crescent
Victoria, BC
Canada V8Z 6R4
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Fax.: 250-475-2211
E-mail: victoria@wsp.com

AGGREGATE GRADATION ANALYSIS

IDENTIFICATION:

Client: Associated Engineering Ltd
Project: Industrial WWTP Upgrade - Port Alberni

File No.: 171-04753-00
Report No.: 3

Sample Location: In-situ
BH17-01, Box 7, 20.4m-20.7m

Date: 11-May-17

SAMPLING INFORMATION:

Material: Sand and SILT, trace gravel, trace organics, shells
Specification: n/a

Date Sampled	18-Apr-17
Date Tested	08-May-17
Sample No:	3
Fracture by mass	N/A
Supplier:	In Situ
Sampled by:	LM
Tested by:	GG

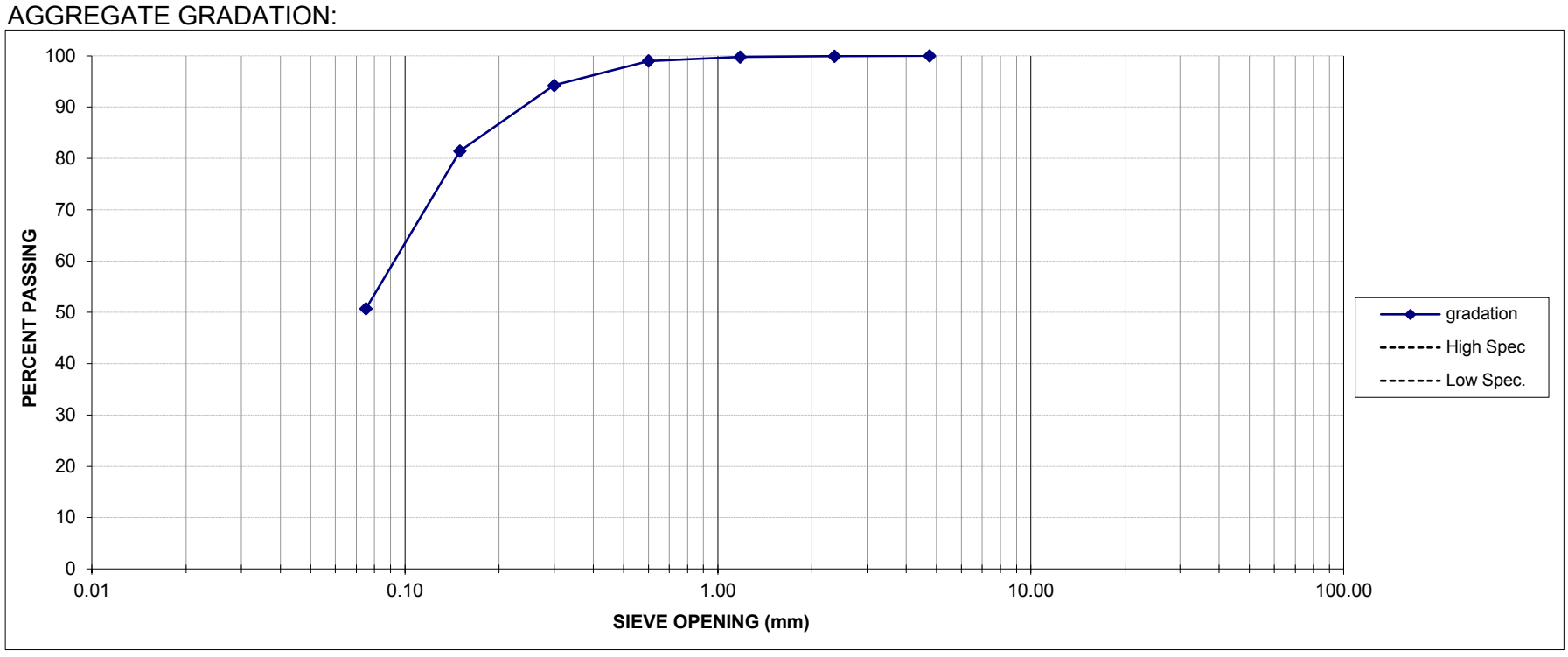
Material Specification

Sieve	High Spec.	Low Spec.

Sieve Analysis

Sieve	% Passing
75	
63	
50	
37.5	
25	
19.0	
12.5	
9.5	
4.75	100.0
2.36	99.9
1.18	99.8
0.600	99.0
0.300	94.2
0.150	81.4
0.075	50.7

AGGREGATE GRADATION:



REMARKS: Tested according to ASTM C- 136 and C-117

REPORTS TO:

WSP CANADA INC.

per: _____

WSP Canada Inc.

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Victoria, BC
Canada V8Z 6R4
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E-mail: victoria@wsp.com

AGGREGATE GRADATION CHART

IDENTIFICATION:

Client: Associated Engineering Ltd
Project: Industrial WWTP Upgrade - Port Alberni
File No.: 171-04753-00
Report No.: 4

Sample Location: In-situ
BH17-02, Box 2, 4.6m-6.1m
Date: 08-May-17

SAMPLING INFORMATION:

Material: Gravelly sand, trace fines
Specification: n/a

Date Sampled	19-Apr-17
Date Tested	08-May-17
Sample No:	4
Fracture by mass	n/a
Supplier:	In Situ
Sampled by:	LM
Tested by:	GG

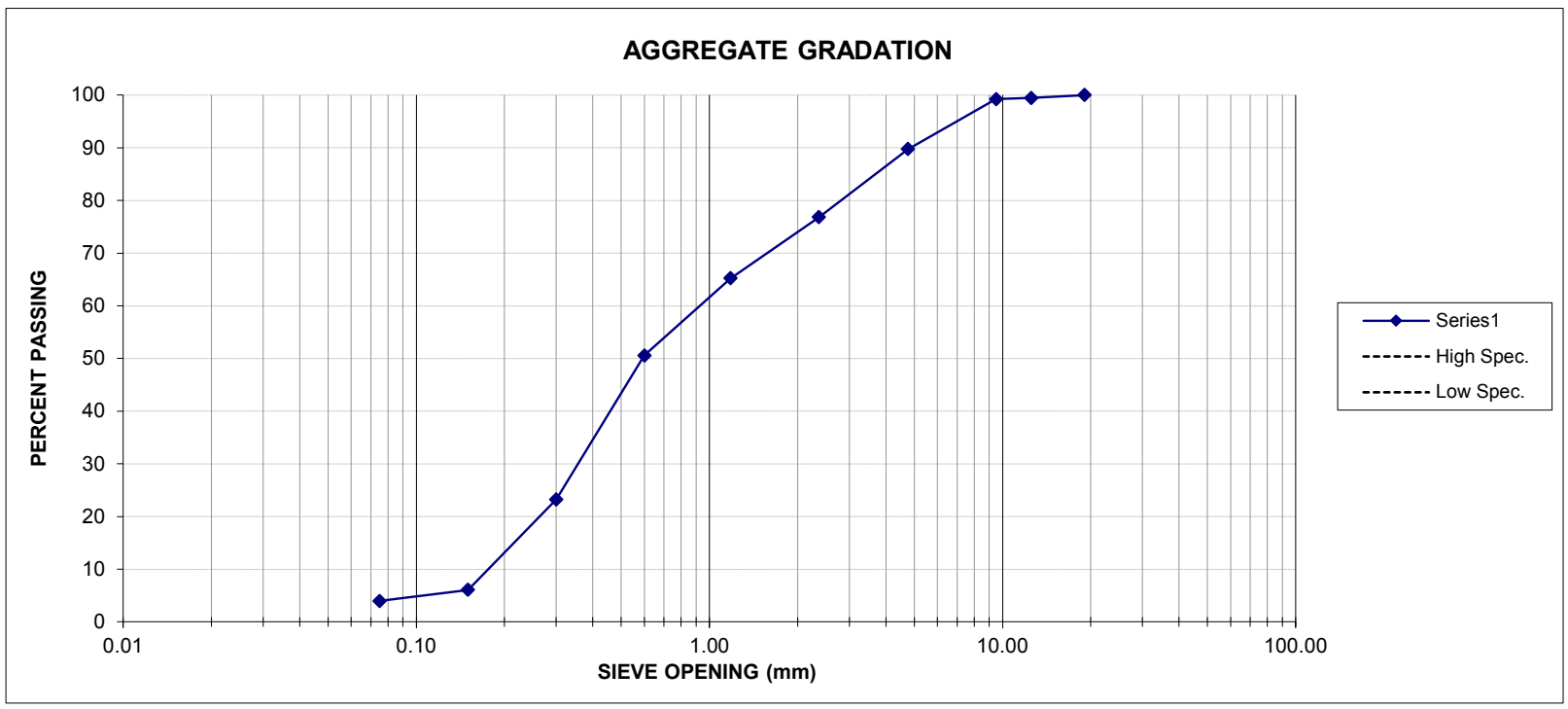
Material Specification

Sieve	High Spec.	Low Spec.

Sieve Analysis

Sieve	% Passing
75.0	
63.0	
50.0	
37.5	
25.0	
19.0	100.0
12.5	99.5
9.5	99.2
4.75	89.8
2.36	76.8
1.18	65.2
0.600	50.6
0.300	23.2
0.150	6.1
0.075	4.0

AGGREGATE GRADATION:



REMARKS: Tested according to ASTM C-: 136 and C-117

REPORTS TO:

WSP CANADA INC.

per:

WSP Canada Inc.

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E-mail: victoria@wsp.com

AGGREGATE GRADATION CHART

IDENTIFICATION:

Client: Associated Engineering Ltd
Project: Industrial WWTP Upgrade - Port Alberni
File No.: 171-04753-00
Report No.: 5

Sample Location: In-situ
BH17-02, Box 3, 7.9m-9.1m
Date: 08-May-17

SAMPLING INFORMATION:

Material: Sandy gravel, trace fines
Specification: n/a

Date Sampled	19-Apr-17
Date Tested	08-May-17
Sample No:	5
Fracture by mass	n/a
Supplier:	In Situ
Sampled by:	LM
Tested by:	GG

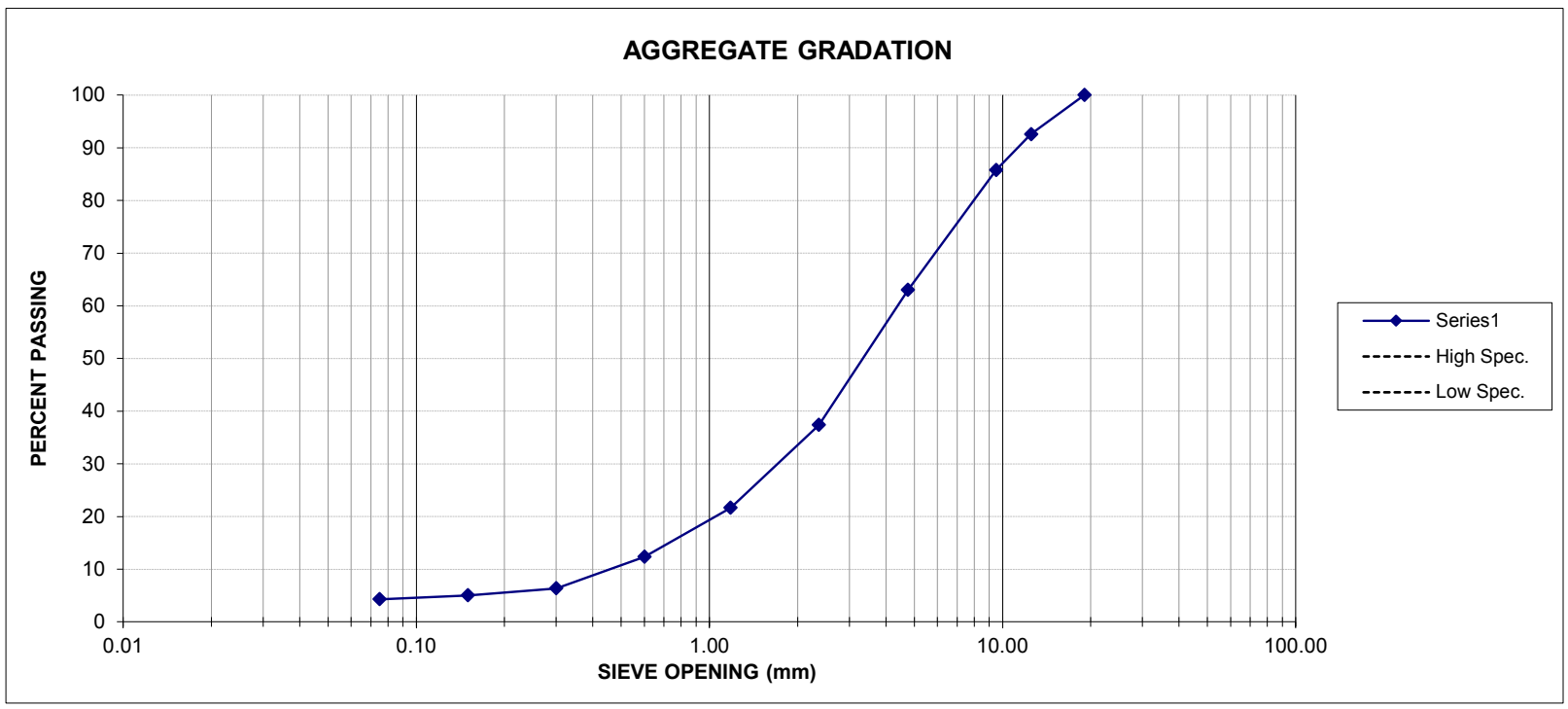
Material Specification

Sieve	High Spec.	Low Spec.

Sieve Analysis

Sieve	% Passing
75.0	
63.0	
50.0	
37.5	
25.0	
19.0	100.0
12.5	92.6
9.5	85.8
4.75	63.0
2.36	37.4
1.18	21.7
0.600	12.3
0.300	6.4
0.150	5.0
0.075	4.3

AGGREGATE GRADATION:



REMARKS: Tested according to ASTM C-: 136 and C-117

REPORTS TO:

WSP CANADA INC.

per:

WSP Canada Inc.

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Victoria, BC
Canada V8Z 6R4
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Fax.: 250-475-2211
E-mail: victoria@wsp.com

AGGREGATE GRADATION CHART

IDENTIFICATION:

Client: Associated Engineering Ltd
Project: Industrial WWTP Upgrade - Port Alberni
File No.: 171-04753-00
Report No.: 6

Sample Location: In-situ
BH17-02, Box 3, 15.5m-16.2m
Date: 08-May-17

SAMPLING INFORMATION:

Material: Sand, some fines, trace gravel
Specification: n/a

Date Sampled	19-Apr-17
Date Tested	08-May-17
Sample No:	6
Fracture by mass	n/a
Supplier:	In Situ
Sampled by:	LM
Tested by:	GG

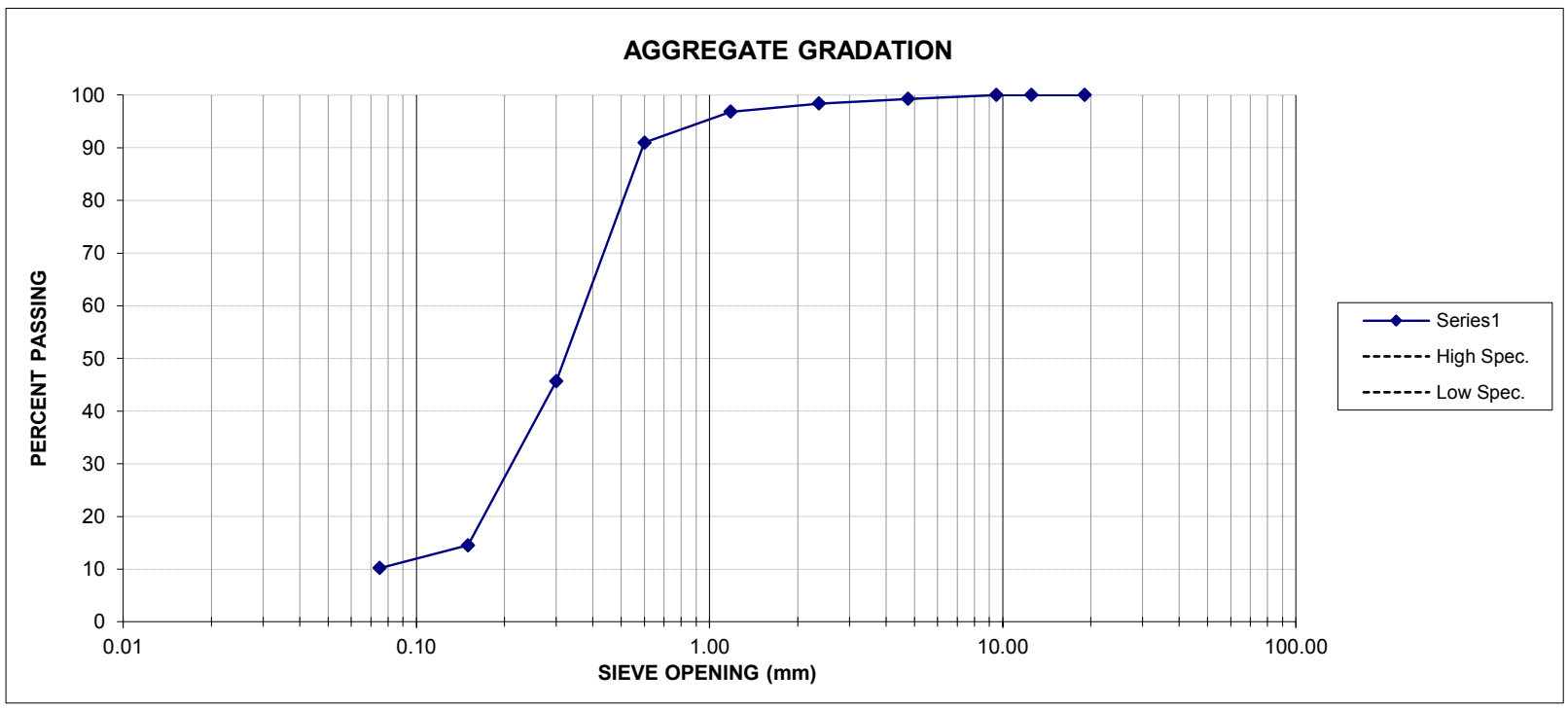
Material Specification

Sieve	High Spec.	Low Spec.

Sieve Analysis

Sieve	% Passing
75.0	
63.0	
50.0	
37.5	
25.0	
19.0	100.0
12.5	100.0
9.5	100.0
4.75	99.3
2.36	98.4
1.18	96.8
0.600	91.0
0.300	45.7
0.150	14.5
0.075	10.2

AGGREGATE GRADATION:



REMARKS: Tested according to ASTM C-: 136 and C-117

REPORTS TO:

WSP CANADA INC.

per:

WSP Canada Inc.

1935 Bollinger Road
Nanaimo, BC
Canada V9S 5W9
Tel.: 250-753-1077
Fax.: 250-753-1203
E-mail: nanaimo@wsp.com

AGGREGATE GRADATION ANALYSIS

IDENTIFICATION:

Client: Associated Engineering (BC) Ltd.
Project: Port Alberni WWTP
Sample Location: In-situ; TP17-01 Bulk 1, 0.8 m

File No.: 171-04753-00
Report No.: 7
Date: 8-May-17

SAMPLING INFORMATION:

Material: Sand and Gravel, trace fines
Specification: N/A

Date Sampled	21-Apr-17
Date Tested	06-May-17
Sample No:	4583
Fracture by mass	N/A
Supplier:	N/A
Sampled by:	LM
Tested by:	TR

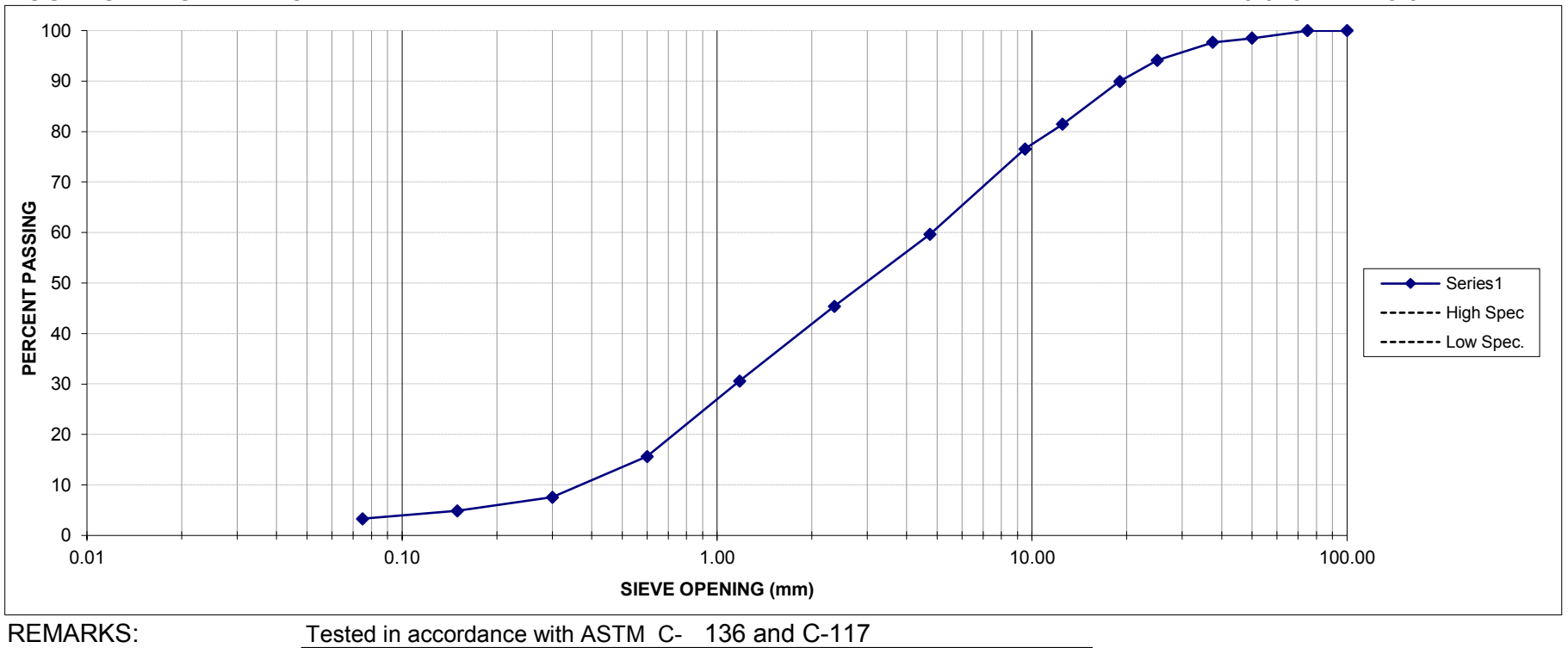
Material Specification

Sieve	High Spec.	Low Spec.

Sieve Analysis

Sieve	% Passing
150	100.0
100	100.0
75	100.0
50	98.5
37.5	97.7
25	94.1
19	89.9
12.5	81.5
9.5	76.6
4.75	59.7
2.36	45.4
1.18	30.6
0.600	15.6
0.300	7.5
0.150	4.9
0.075	3.3

AGGREGATE GRADATION:



REMARKS: Tested in accordance with ASTM C- 136 and C-117

REPORTS TO:

WSP CANADA INC.

per: _____

APPENDIX

4. CONE PENETRATION TESTING RESULTS

Site Investigation Summary

Cone Penetration Testing Report

GREGG DRILLING CANADA LTD.

2017

Authored by: Kelly Cabal & Dr. Peter K. Robertson

Prepared for: WSP

Site: Port Alberni Waste Water Treatment, Port Alberni, B.C.

Table of Contents

April 24, 2017

WSP
Attn: Darryl Furey

Subject:CPT Site Investigation
Port Alberni Waste Water Treatment
Port Alberni, British Columbia
GREGG Project Number: 17-025CA

Dear Mr. Furey:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☒
3	Seismic Cone Penetration Tests	(SCPTU)	☒
4	UVOST Laser Induced Fluorescence	(UVOST)	☐
5	Groundwater Sampling	(GWS)	☐
6	Soil Sampling	(SS)	☐
7	Vapor Sampling	(VS)	☐
8	Pressuremeter Testing	(PMT)	☐
9	Vane Shear Testing	(VST)	☐
10	Dilatometer Testing	(DMT)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.

Peter Robertson
Technical Director, Gregg Drilling & Testing, Inc.

GREGG
GEOTECH DRILLING - GROUP OF COMPANIES

Cone Penetration Testing Description

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance (q_c), sleeve resistance (f_s), and penetration pore water pressure (u_2). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the u_2 location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

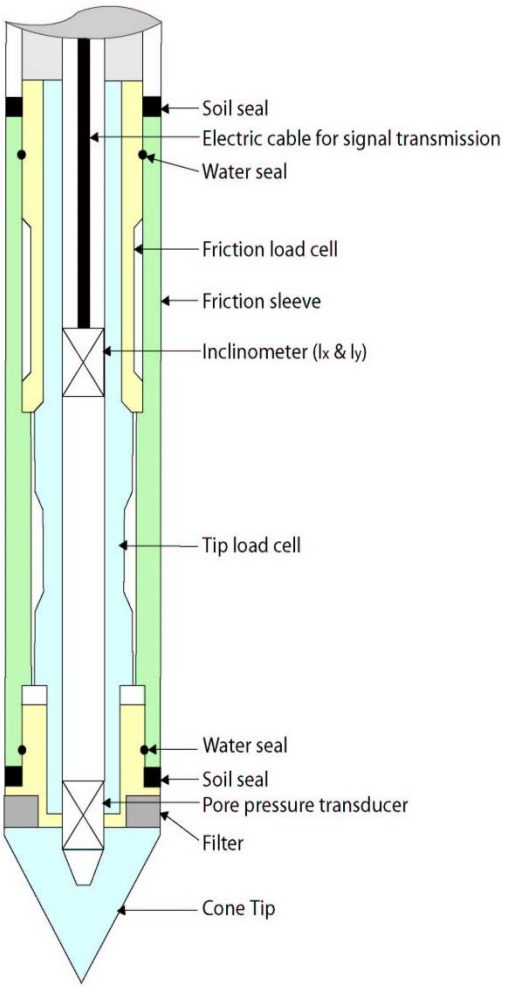


Figure CPT

Gregg 15cm^2 Standard Cone Specifications

Dimensions	
Cone base area	15 cm^2
Sleeve surface area	225 cm^2
Cone net area ratio	0.80
Specifications	
Cone load cell	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
Sleeve load cell	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
Pore pressure transducer	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

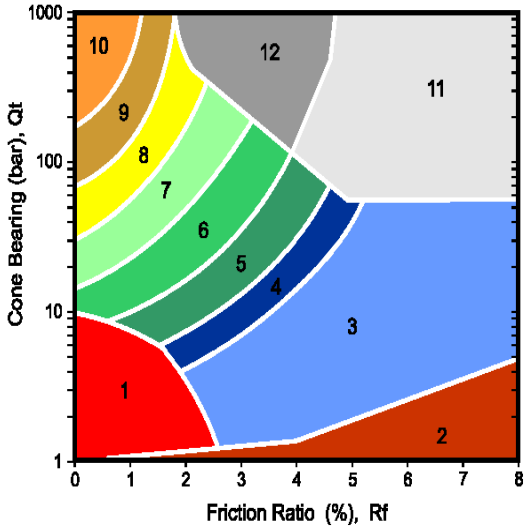
Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.

CPT Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



ZONE	SBT
1	Sensitive, fine grained
2	Organic materials
3	Clay
4	Silty clay to clay
5	Clayey silt to silty clay
6	Sandy silt to clayey silt
7	Silty sand to sandy silt
8	Sand to silty sand
9	Sand
10	Gravely sand to sand
11	Very stiff fine grained*
12	Sand to clayey sand*

*over consolidated or cemented

Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

Pore Pressure Dissipation Tests

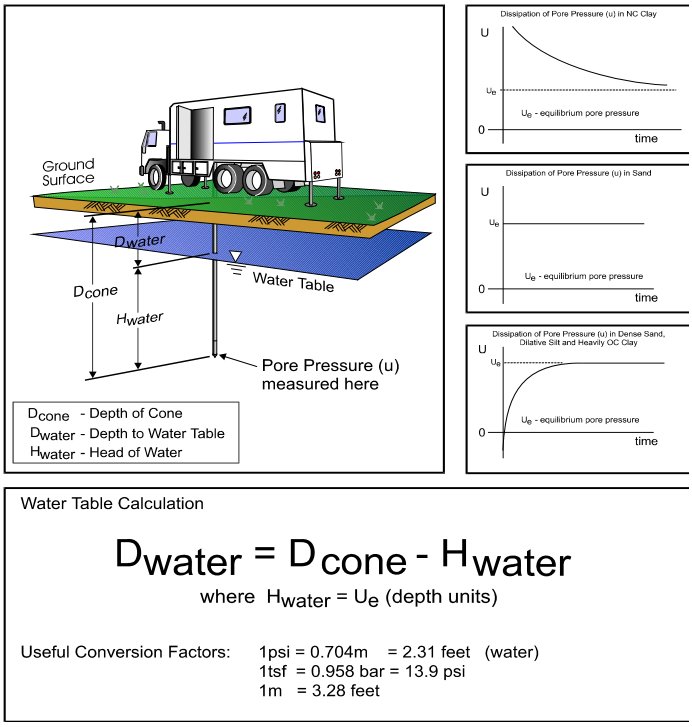
Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u)* with time is measured behind the tip of the cone and recorded.

Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

A summary of the pore pressure dissipation tests are summarized in Table 1.

Groundwater Sampling

Gregg Drilling & Testing, Inc. conducts groundwater sampling using a sampler as shown in *Figure GWS*. The groundwater sampler has a retrievable stainless steel or disposable PVC screen with steel drop off tip. This allows for samples to be taken at multiple depth intervals within the same sounding location. In areas of slower water recharge, provisions may be made to set temporary PVC well screens during sampling to allow the pushing equipment to advance to the next sample location while the groundwater is allowed to infiltrate.

The groundwater sampler operates by advancing 44.5mm (1¾ inch) hollow push rods with the filter tip in a closed configuration to the base of the desired sampling interval. Once at the desired sample depth, the push rods are retracted; exposing the encased filter screen and allowing groundwater to infiltrate hydrostatically from the formation into the inlet screen. A small diameter bailer (approximately ½ or ¾ inch) is lowered through the push rods into the screen section for sample collection. The number of downhole trips with the bailer and time necessary to complete the sample collection at each depth interval is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation. Upon completion of sample collection, the push rods and sampler, with the exception of the PVC screen and steel drop off tip are retrieved to the ground surface, decontaminated and prepared for the next sampling event.

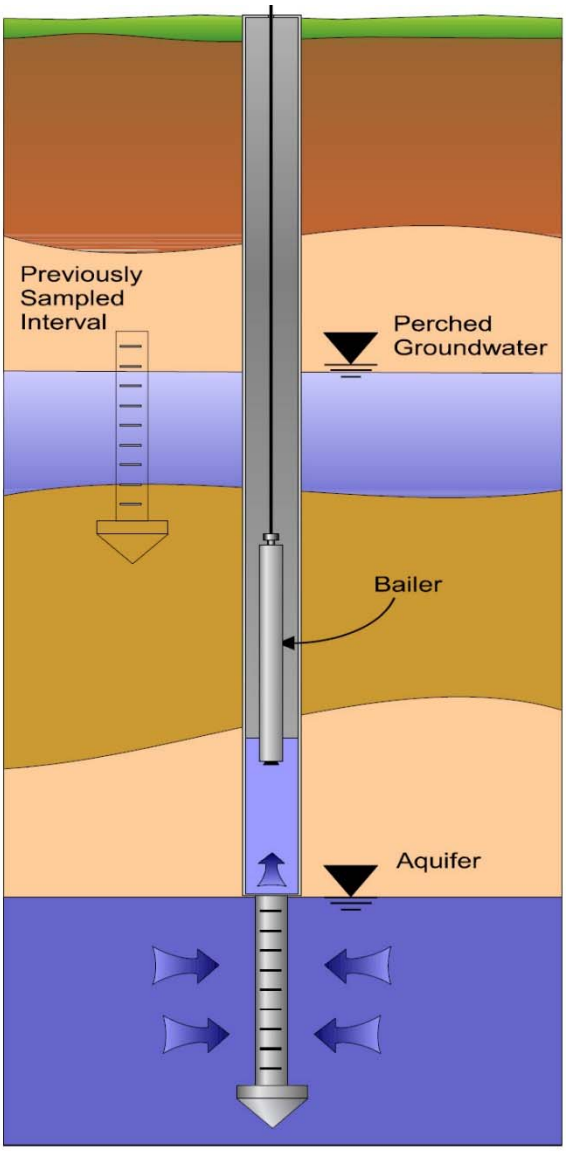


Figure GWS

For a detailed reference on direct push groundwater sampling, refer to Zemo et. al., 1992.

Soil Sampling

Gregg Drilling & Testing, Inc. uses a piston-type push-in sampler to obtain small soil samples without generating any soil cuttings, *Figure SS*. Two different types of samplers (12 and 18 inch) are used depending on the soil type and density. The soil sampler is initially pushed in a "closed" position to the desired sampling interval using the CPT pushing equipment. Keeping the sampler closed minimizes the potential of cross contamination. The inner tip of the sampler is then retracted leaving a hollow soil sampler with inner 1¼" diameter sample tubes. The hollow sampler is then pushed in a locked "open" position to collect a soil sample. The filled sampler and push rods are then retrieved to the ground surface. Because the soil enters the sampler at a constant rate, the opportunity for 100% recovery is increased. For environmental analysis, the soil sample tube ends are sealed with Teflon and plastic caps. Often, a longer "split tube" can be used for geotechnical sampling.

For a detailed reference on direct push soil sampling, refer to Robertson et al, 1998.

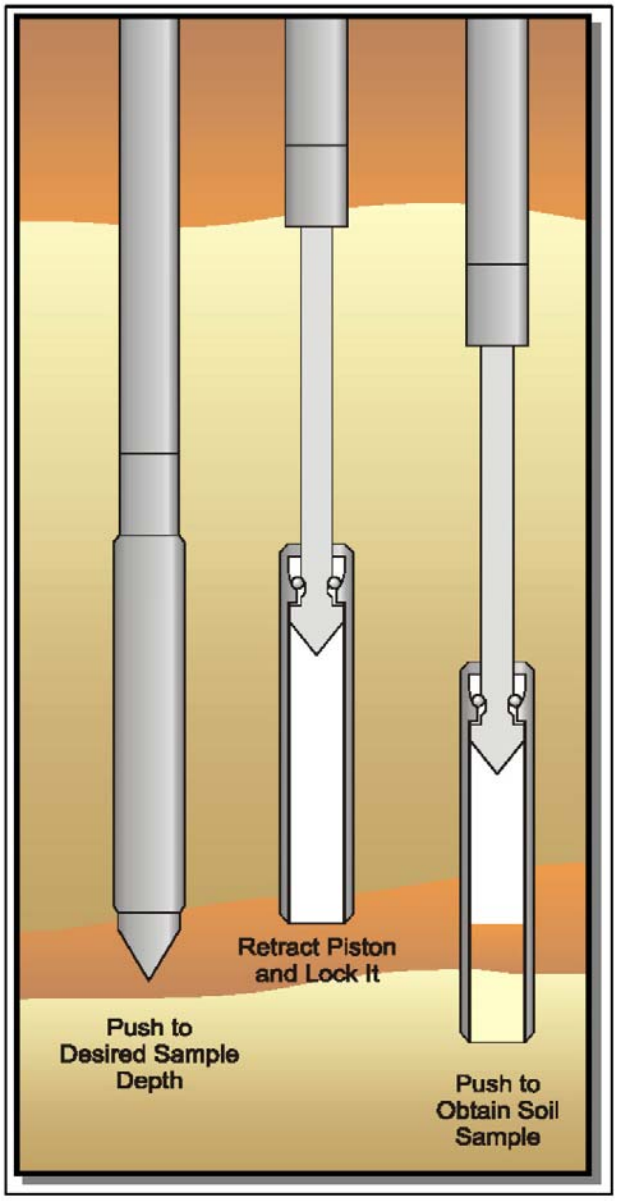


Figure SS

Seismic Cone Penetration Testing (SCPT)

Seismic Cone Penetration Testing (SCPT) can be conducted at various intervals during the Cone Penetration Test. Shear wave velocity (Vs) can then be calculated over a specified interval with depth. A small interval for seismic testing, such as 1-1.5m (3-5ft) allows for a detailed look at the shear wave profile with depth. Conversely, a larger interval such as 3-6m (10-20ft) allows for a more average shear wave velocity to be calculated. Gregg's cones have a horizontally active geophone located 0.2m (0.66ft) behind the tip.

To conduct the seismic shear wave test, the penetration of the cone is stopped and the rods are decoupled from the rig. An automatic hammer is triggered to send a shear wave into the soil. The distance from the source to the cone is calculated knowing the total depth of the cone and the horizontal offset distance between the source and the cone. To calculate an interval velocity, a minimum of two tests must be performed at two different depths. The arrival times between the two wave traces are compared to obtain the difference in time (Δt). The difference in depth is calculated (Δd) and velocity can be determined using the simple equation: v = Δd/Δt

Multiple wave traces can be recorded at the same depth to improve quality of the data.

A complete reference on seismic cone penetration tests is presented by Robertson et al. 1986 and Lunne et al. 1997.

A summary the shear wave velocities, arrival times and wave traces are provided with the report.

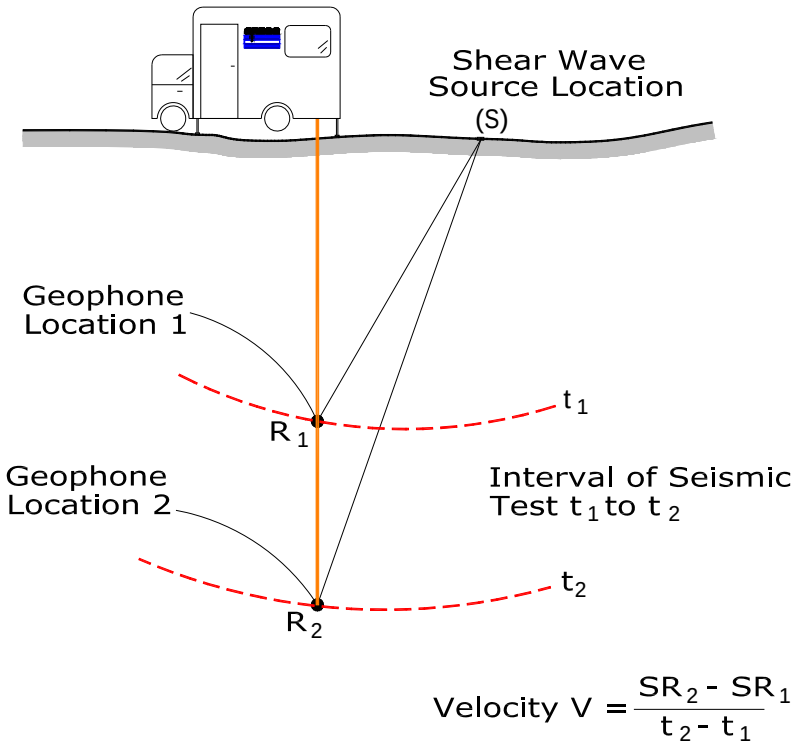


Figure SCPT

References

Lunne, T., Robertson, P.K. and Powell, J.J.M., “Cone Penetration Testing in Geotechnical Practice” E & FN Spon. ISBN 0 419 23750, 1997

Mayne, P.W., “NHI (2002) Manual on Subsurface Investigations: Geotechnical Site Characterization”, available through www.ce.gatech.edu/~geosys/Faculty/Mayne/papers/index.html, Section 5.3, pp. 107-112.

Roberston, P.K., “Soil Classification using the Cone Penetration Test”, Canadian Geotechnical Journal, Vol. 27, 1990 pp. 151-158.

Robertson, P.K., and K.L. Cabal, “Guide to Cone Penetration Testing, 6th Edition” 2015. http://www.greggdrilling.com/technical-guides

Robertson, P.K., R.G. Campanella, D. Gillespie and A. Rice, “Seismic CPT to Measure In-Situ Shear Wave Velocity”, Journal of Geotechnical Engineering ASCE, Vol. 112, No. 8, 1986 pp. 791-803.

Robertson, P.K., Sully, J., Woeller, D.J., Lunne, T., Powell, J.J.M., and Gillespie, D.J., "Guidelines for Estimating Consolidation Parameters in Soils from Piezocone Tests", Canadian Geotechnical Journal, Vol. 29, No. 4, August 1992, pp. 539-550.

Robertson, P.K., T. Lunne and J.J.M. Powell, “Geo-Environmental Application of Penetration Testing”, Geotechnical Site Characterization, Robertson & Mayne (editors), 1998 Balkema, Rotterdam, ISBN 90 5410 939 4 pp 35-47.

Copies of ASTM Standards are available through www.astm.org

TABLE 1: Summary of CPTs

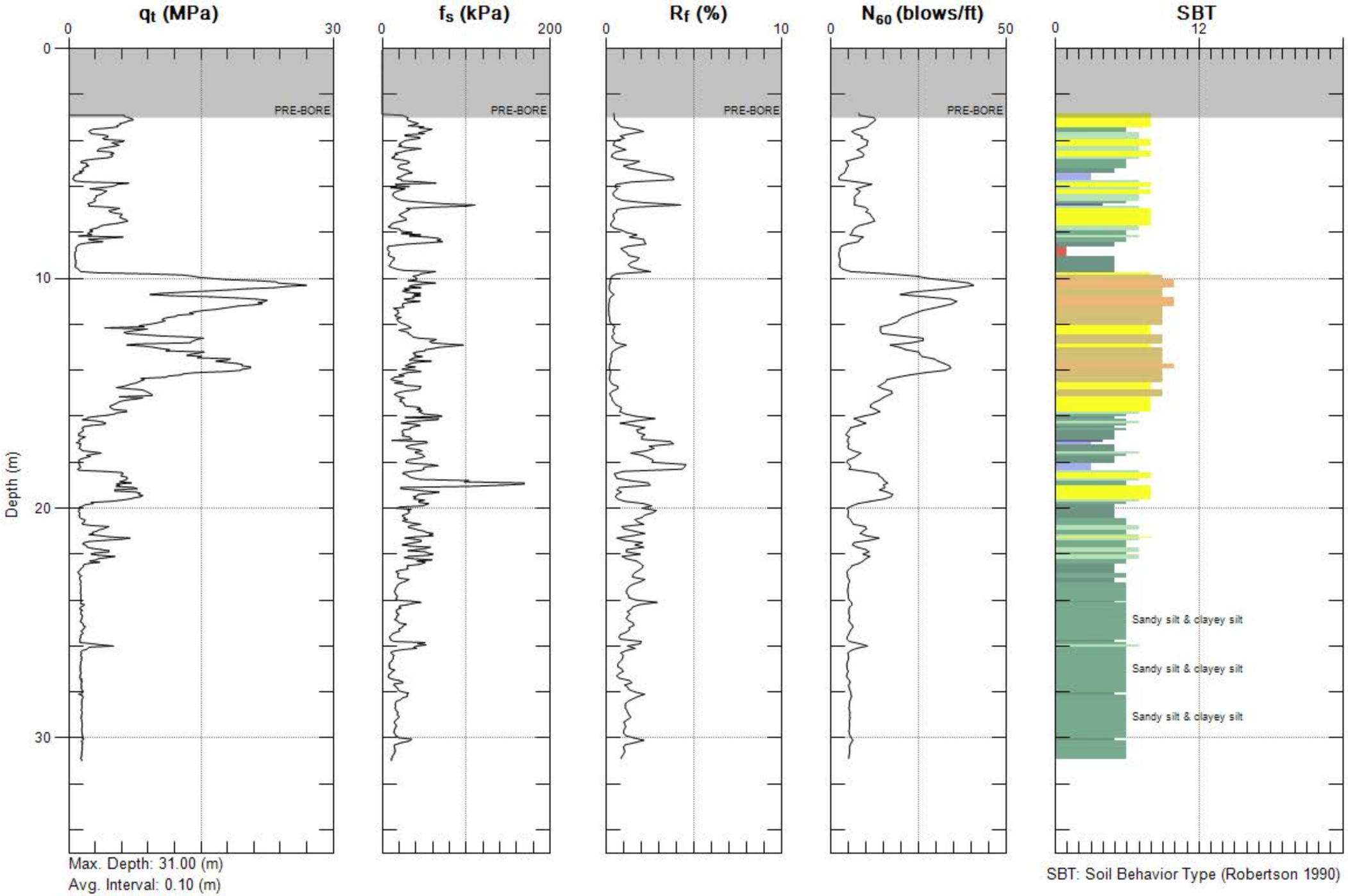
CPT Sounding Identification	Date	Termination Depth (m)	Depth of Groundwater Samples (m)	Depth of Soil Samples (m)	Depth of Pore Pressure Dissipation Tests (m)
CPT17-01	4/19/17	31.00	-	-	6.1, 8.1, 13.7, 15.1, 19.8, 25.9
CPT17-02	4/20/17	5.80	-	-	-
CPT17-02b	4/20/17	32.75	-	-	-
CPT17-03	4/20/17	20.05	-	-	7.85, 8.85, 12.25, 17.85, 20.0
CPT17-04	4/19/17	20.00	-	-	7.7, 16.0, 20.0

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-01

Engineer: LUKE
Date: 4/19/17 09:31



Max. Depth: 31.00 (m)
Avg. Interval: 0.10 (m)

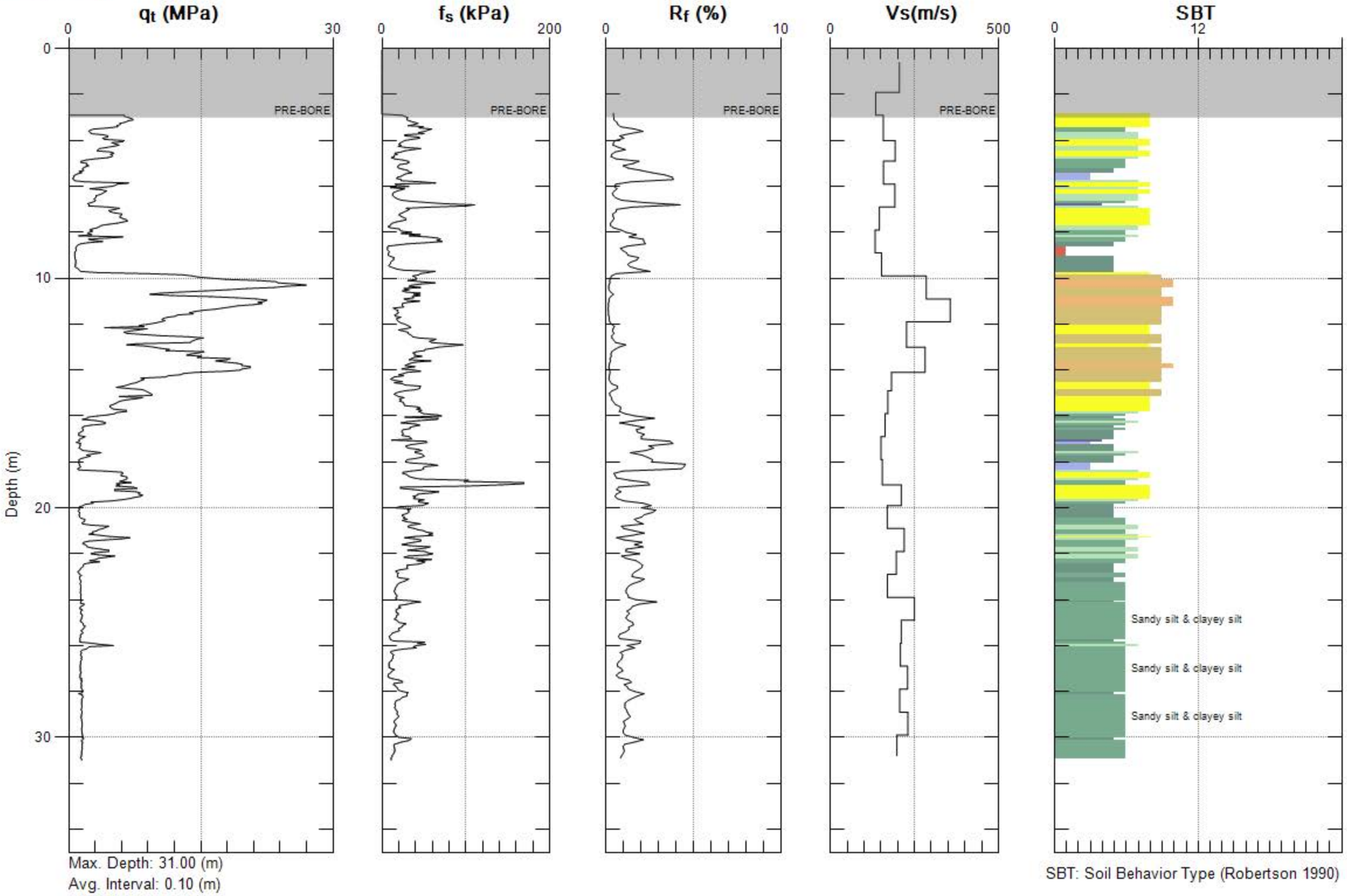
SBT: Soil Behavior Type (Robertson 1990)

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-01

Engineer: LUKE
Date: 4/19/17 09:31



Max. Depth: 31.00 (m)
Avg. Interval: 0.10 (m)

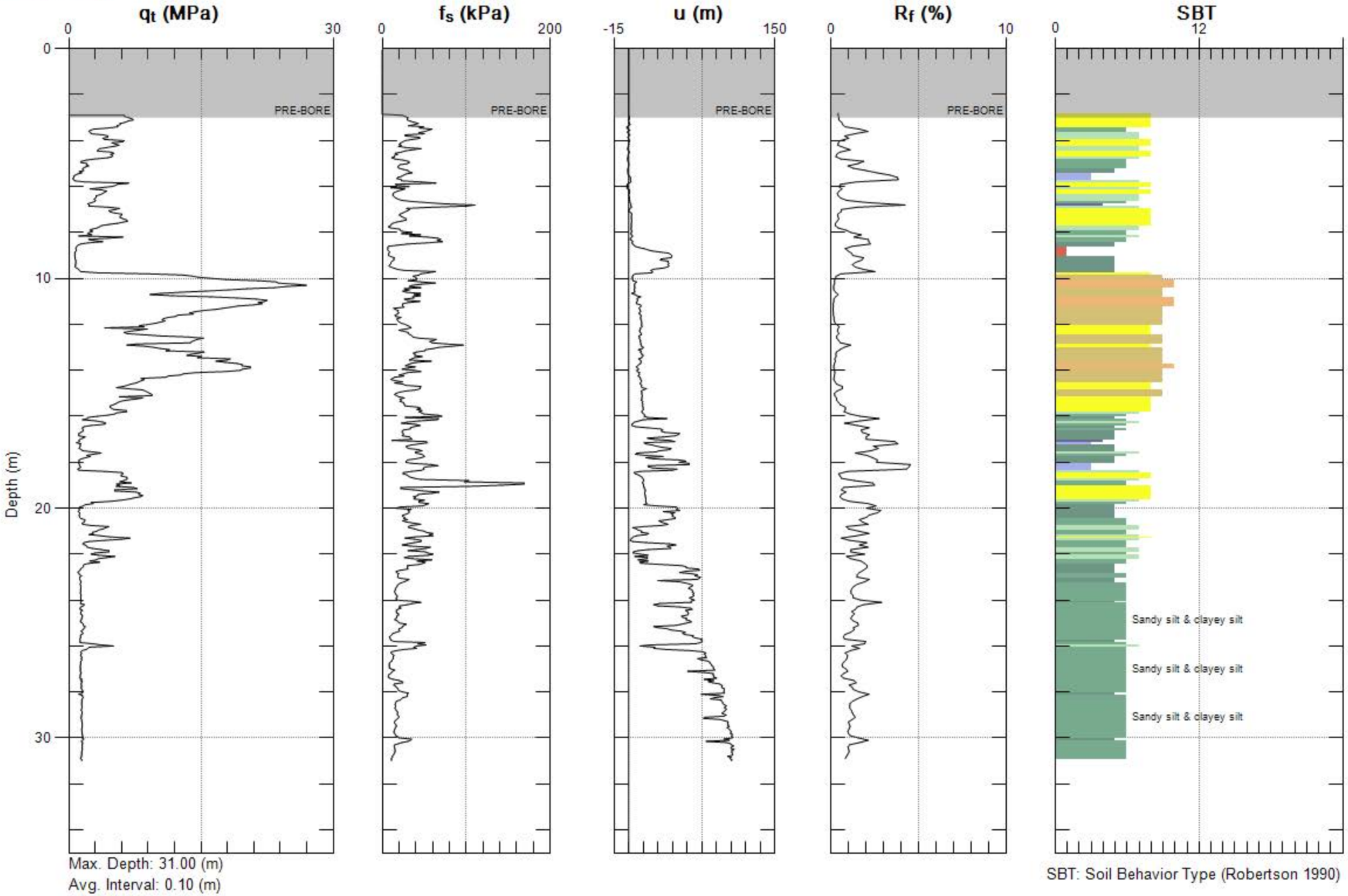
SBT: Soil Behavior Type (Robertson 1990)

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-01

Engineer: LUKE
Date: 4/19/17 09:31



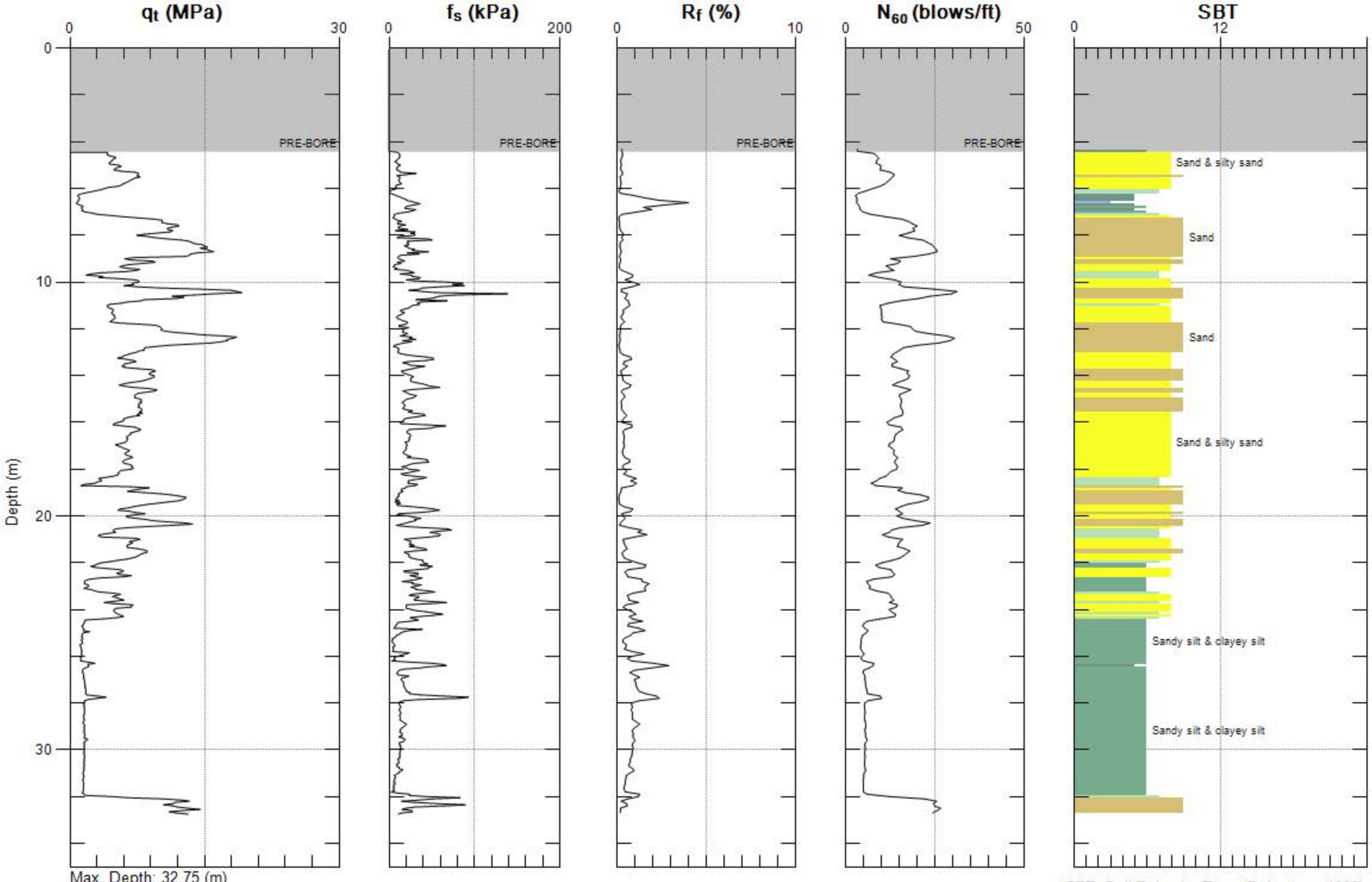
Max. Depth: 31.00 (m)
Avg. Interval: 0.10 (m)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-02b
Engineer: LUKE
Date: 4/20/17 02:58



Max. Depth: 32.75 (m)
Avg. Interval: 0.10 (m)

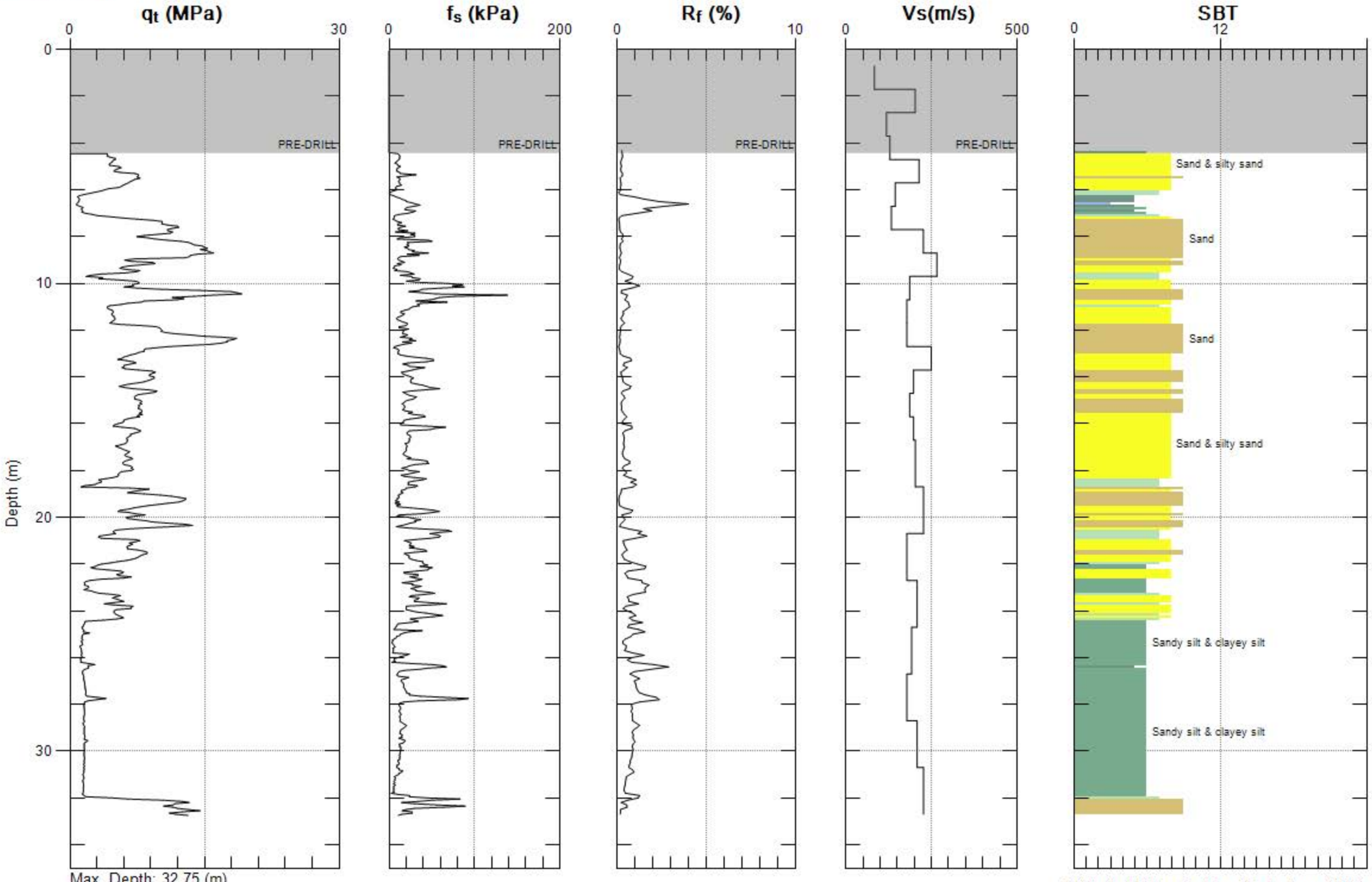
SBT: Soil Behavior Type (Robertson 1990)

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-02b

Engineer: LUKE
Date: 4/20/17 02:58



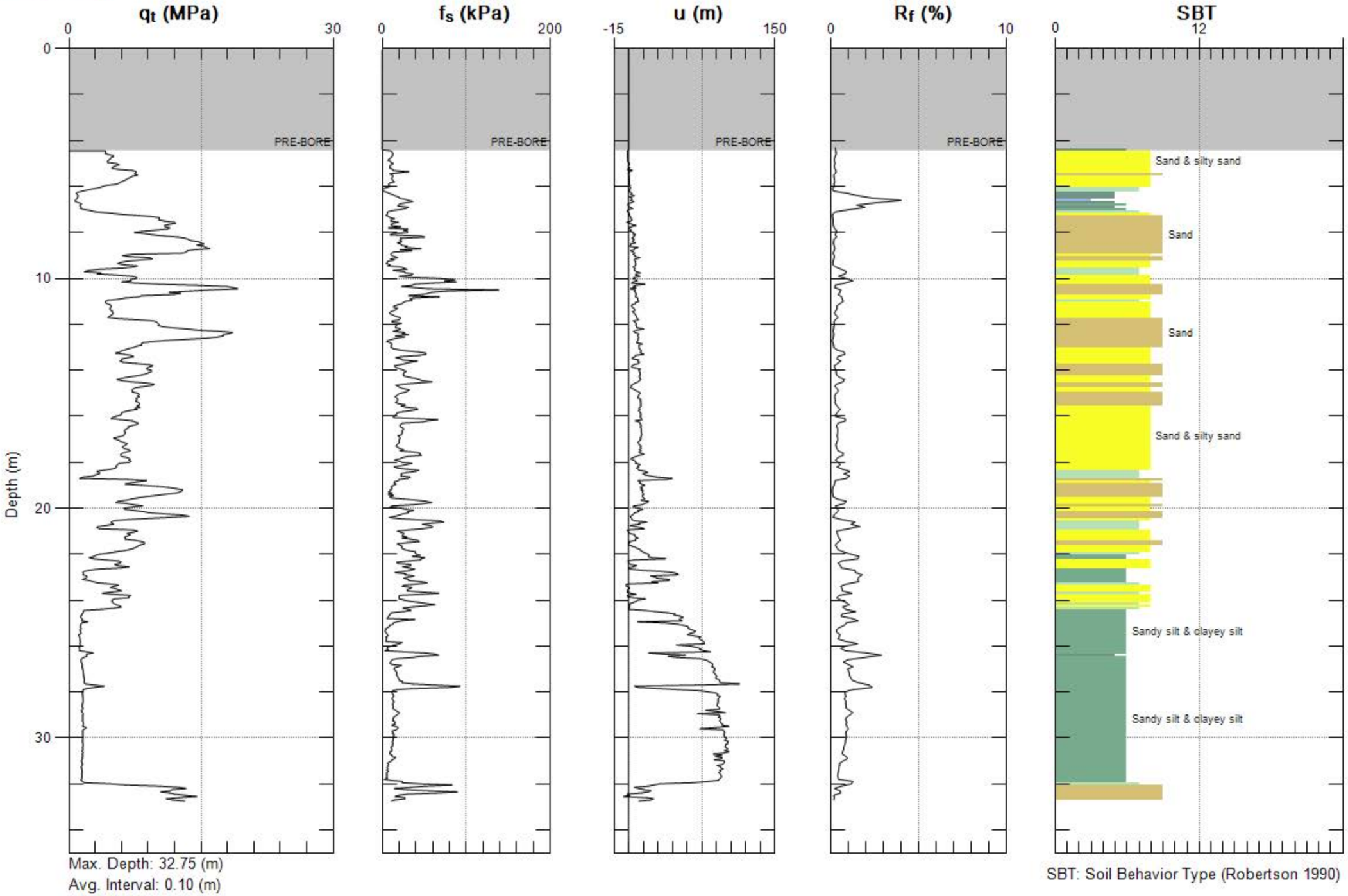
Max. Depth: 32.75 (m)
Avg. Interval: 0.10 (m)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-02b
Engineer: LUKE
Date: 4/20/17 02:58



Max. Depth: 32.75 (m)
Avg. Interval: 0.10 (m)

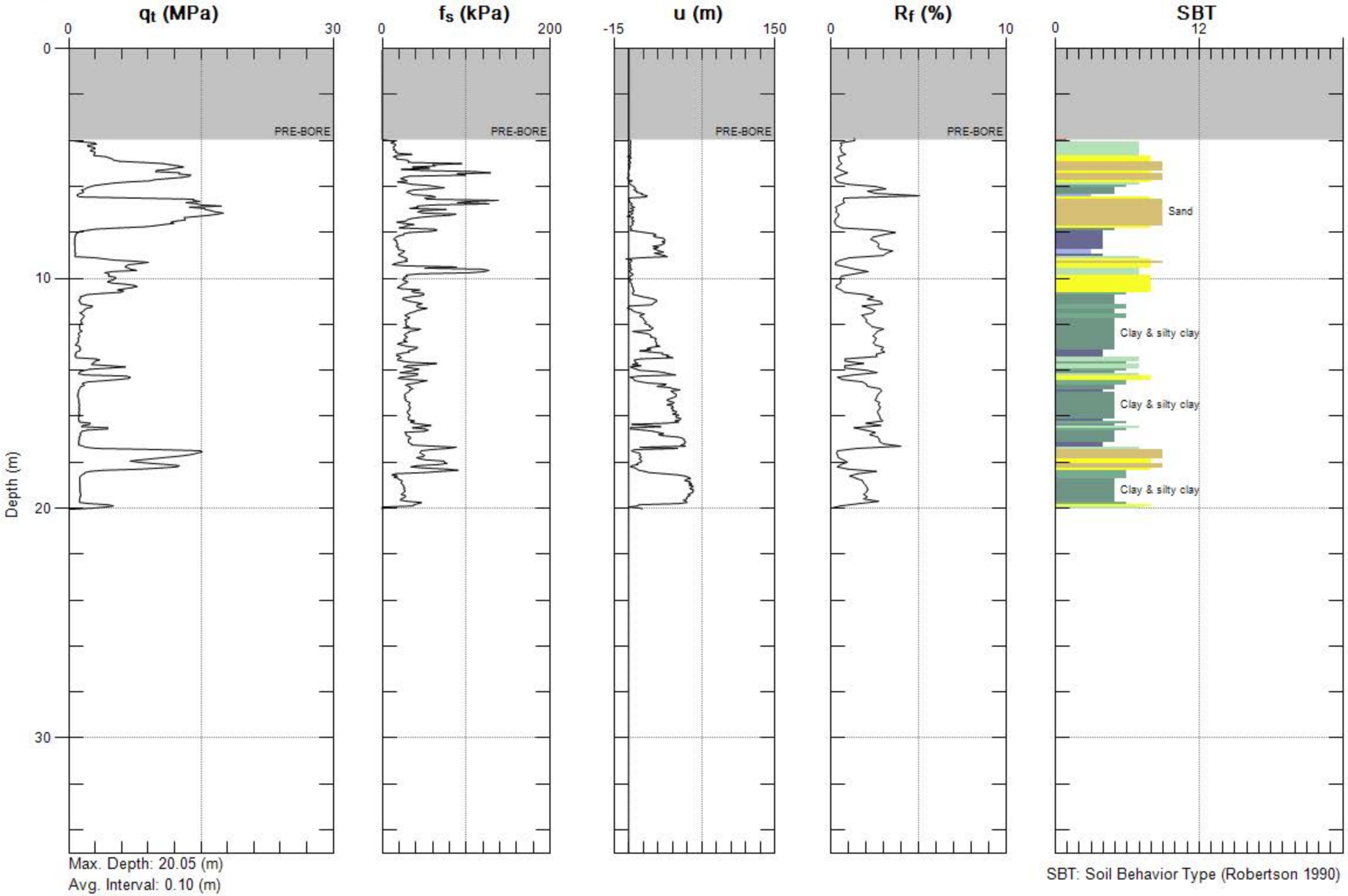
SBT: Soil Behavior Type (Robertson 1990)

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-03

Engineer: L.MARQUIS
Date: 4/20/17 08:20



Max. Depth: 20.05 (m)
Avg. Interval: 0.10 (m)

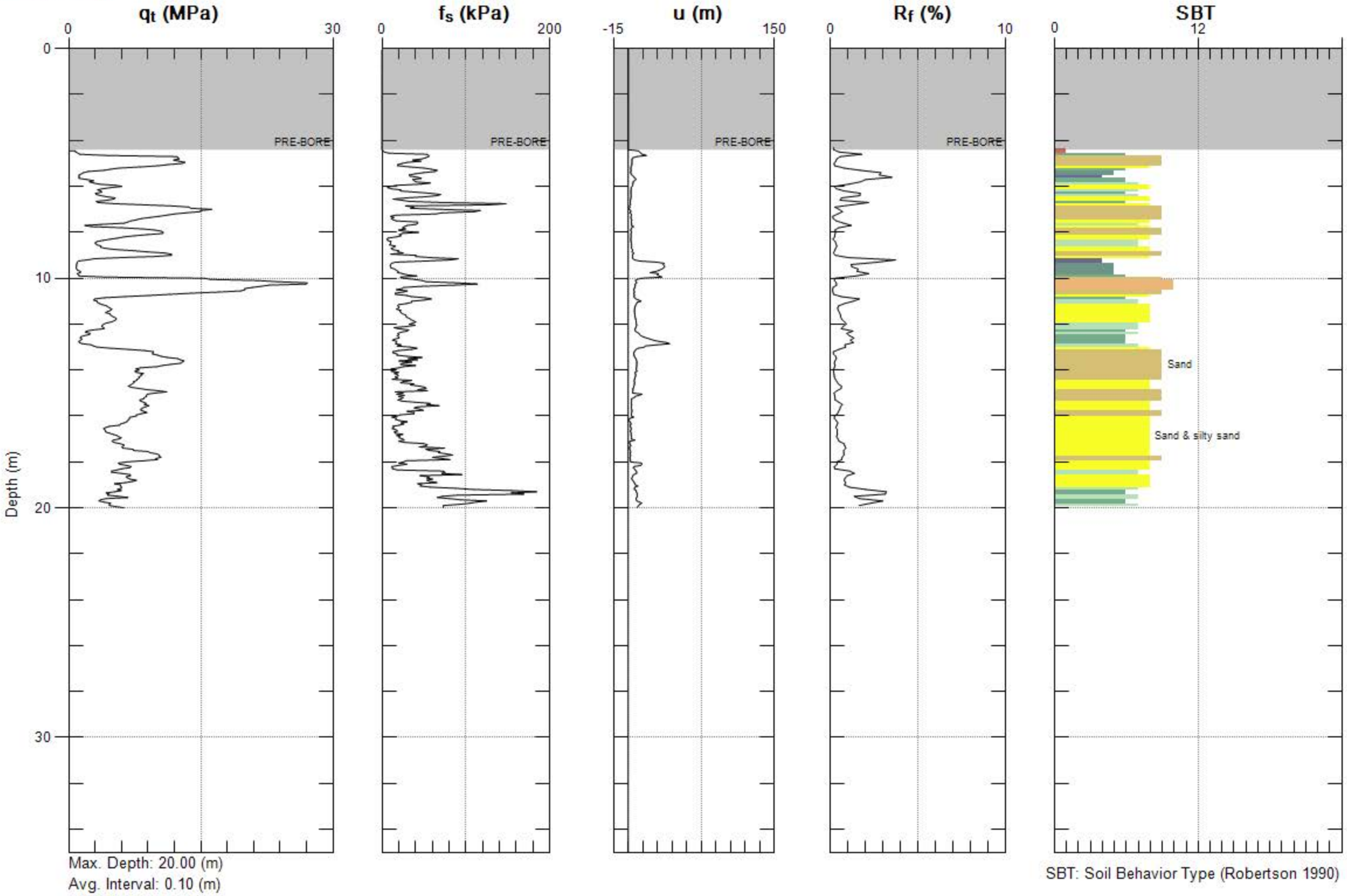
SBT: Soil Behavior Type (Robertson 1990)

GREGG

WSP

Site: PORT ALBERNI
Sounding: CPT17-04

Engineer: LUKE
Date: 4/19/17 03:55



Max. Depth: 20.00 (m)
Avg. Interval: 0.10 (m)

SBT: Soil Behavior Type (Robertson 1990)

Shear Wave Velocity Calculations

PORT ALBERNI WASTE WATER FACILITY

CPT 17-01

Geophone Offset: 0.20 Meters

Source Offset: 0.51 Meters

04/19/17

Test Depth (Meter)	Geophone Depth (Meter)	Waveform Ray Path (Meter)	Incremental Distance (Meter)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (M/Sec)	Interval Depth (Meter)
0.80	0.60	0.79	0.79	5.8000			
2.10	1.90	1.97	1.18	11.5500	5.7500	205.2	1.25
3.10	2.90	2.94	0.98	18.8000	7.2500	134.8	2.40
4.15	3.95	3.98	1.04	25.4000	6.6000	157.3	3.43
5.10	4.90	4.93	0.94	30.3000	4.9000	192.6	4.43
6.10	5.90	5.92	1.00	36.6000	6.3000	158.0	5.40
7.10	6.90	6.92	1.00	41.8000	5.2000	191.7	6.40
8.10	7.90	7.92	1.00	48.6500	6.8500	145.6	7.40
9.10	8.90	8.91	1.00	56.1500	7.5000	133.1	8.40
10.10	9.90	9.91	1.00	62.7000	6.5500	152.4	9.40
11.10	10.90	10.91	1.00	66.2000	3.5000	285.4	10.40
12.10	11.90	11.91	1.00	69.0000	2.8000	356.8	11.40
13.20	13.00	13.01	1.10	73.8500	4.8500	226.6	12.45
14.30	14.10	14.11	1.10	77.7500	3.9000	281.9	13.55
15.10	14.90	14.91	0.80	82.1500	4.4000	181.7	14.50
16.10	15.90	15.91	1.00	88.0000	5.8500	170.8	15.40
17.10	16.90	16.91	1.00	94.1500	6.1500	162.5	16.40
18.10	17.90	17.91	1.00	100.8000	6.6500	150.3	17.40
19.15	18.95	18.96	1.05	107.6000	6.8000	154.4	18.43
20.10	19.90	19.91	0.95	112.1000	4.5000	211.0	19.43
21.10	20.90	20.91	1.00	118.0000	5.9000	169.4	20.40
22.10	21.90	21.91	1.00	122.5500	4.5500	219.7	21.40
23.10	22.90	22.91	1.00	127.6500	5.1000	196.0	22.40
24.10	23.90	23.91	1.00	133.5500	5.9000	169.5	23.40
25.10	24.90	24.91	1.00	137.5500	4.0000	249.9	24.40
26.05	25.85	25.86	0.95	142.0500	4.5000	211.1	25.38
27.05	26.85	26.85	1.00	146.8500	4.8000	208.3	26.35
28.05	27.85	27.85	1.00	151.2000	4.3500	229.8	27.35
29.05	28.85	28.85	1.00	156.0500	4.8500	206.2	28.35
30.10	29.90	29.90	1.05	160.6000	4.5500	230.7	29.38
31.00	30.80	30.80	0.90	165.1500	4.5500	197.8	30.35

Shear Wave Velocity Calculations

PORT ALBERNI WASTE WATER FACILITY
PORT ALBERNI

Geophone Offset: 0.20 Meters
Source Offset: 0.51 Meters

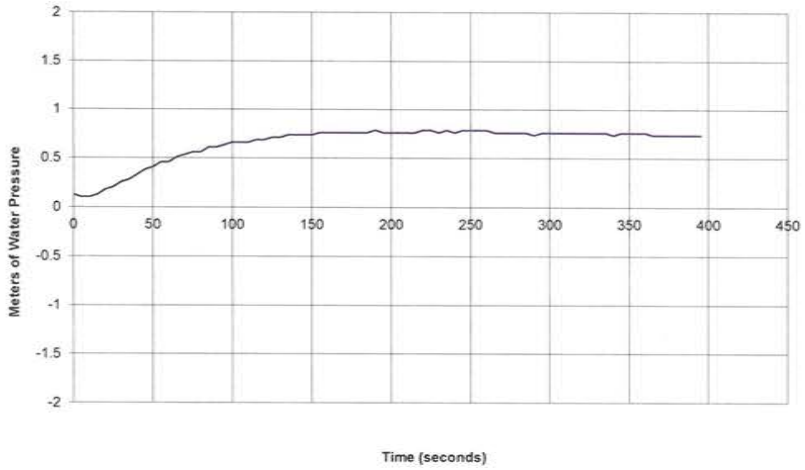
04/20/17

Test Depth (Meter)	Geophone Depth (Meter)	Waveform Ray Path (Meter)	Incremental Distance (Meter)	Characteristic Arrival Time (ms)	Incremental Time Interval (ms)	Interval Velocity (M/Sec)	Interval Depth (Meter)
0.90	0.70	0.87	0.87	17.5000			
1.90	1.70	1.77	0.91	28.4000	10.9000	83.4	1.20
2.90	2.70	2.75	0.97	33.2000	4.8000	202.7	2.20
3.90	3.70	3.73	0.99	41.5000	8.3000	118.9	3.20
4.90	4.70	4.73	0.99	49.2000	7.7000	128.9	4.20
5.90	5.70	5.72	1.00	53.8500	4.6500	214.0	5.20
6.90	6.70	6.72	1.00	60.7500	6.9000	144.4	6.20
7.90	7.70	7.72	1.00	68.2500	7.5000	133.0	7.20
8.90	8.70	8.71	1.00	72.6500	4.4000	226.8	8.20
9.90	9.70	9.71	1.00	76.4000	3.7500	266.3	9.20
10.90	10.70	10.71	1.00	81.7500	5.3500	186.7	10.20
11.90	11.70	11.71	1.00	87.3500	5.6000	178.4	11.20
12.90	12.70	12.71	1.00	92.9500	5.6000	178.4	12.20
13.90	13.70	13.71	1.00	96.9500	4.0000	249.8	13.20
14.90	14.70	14.71	1.00	102.0000	5.0500	197.9	14.20
15.90	15.70	15.71	1.00	107.3500	5.3500	186.8	15.20
16.90	16.70	16.71	1.00	112.4000	5.0500	197.9	16.20
18.90	18.70	18.71	2.00	122.2500	9.8500	203.0	17.70
20.90	20.70	20.71	2.00	131.0500	8.8000	227.2	19.70
22.90	22.70	22.71	2.00	142.2500	11.2000	178.5	21.70
24.90	24.70	24.71	2.00	151.8500	9.6000	208.3	23.70
26.90	26.70	26.70	2.00	162.2500	10.4000	192.3	25.70
28.90	28.70	28.70	2.00	173.4500	11.2000	178.5	27.70
30.90	30.70	30.70	2.00	183.0500	9.6000	208.3	29.70
32.90	32.70	32.70	2.00	191.8500	8.8000	227.2	31.70

GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

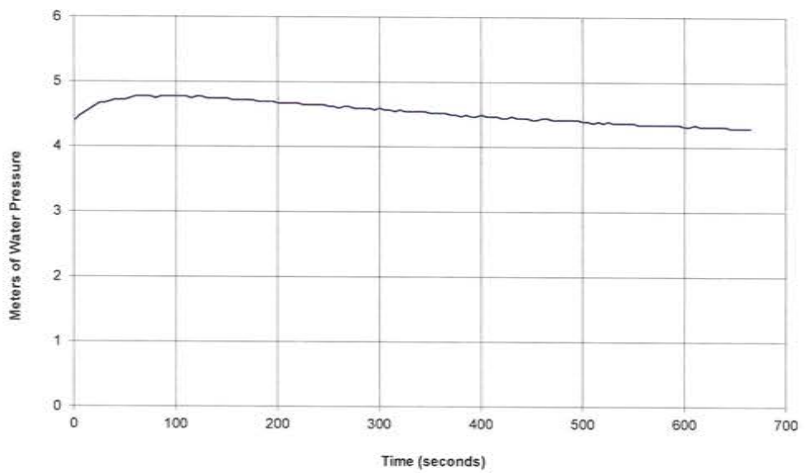
Sounding: CPT17-01
Depth: 6.1
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

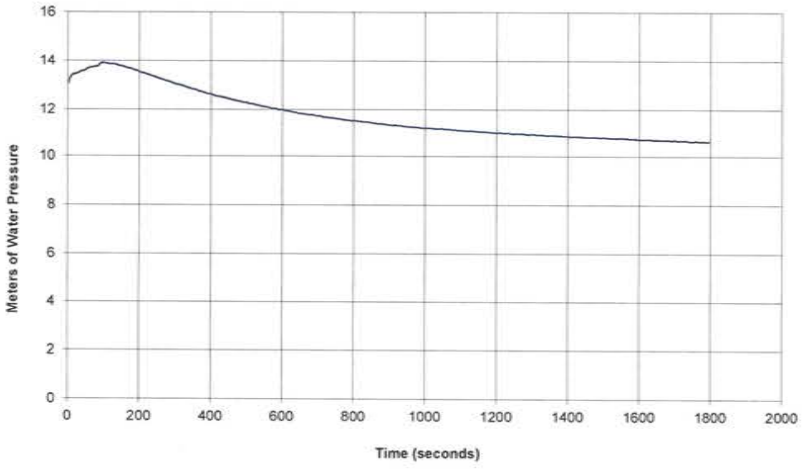
Sounding: CPT17-01
Depth: 8.1
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

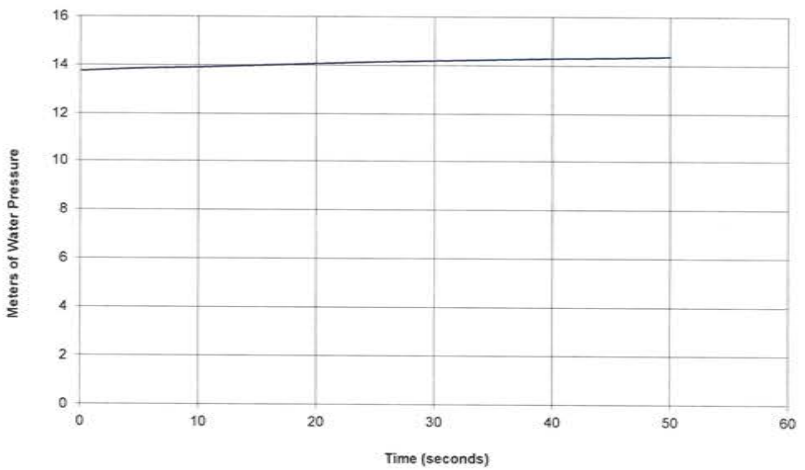
Sounding: CPT17-01
Depth: 13.7
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

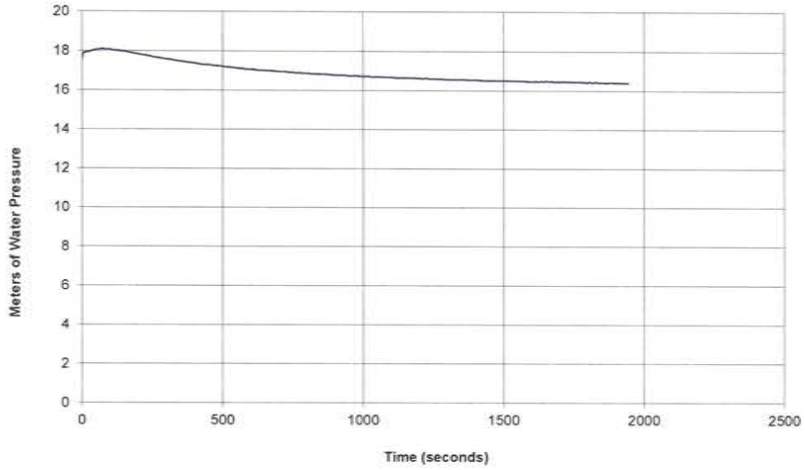
Sounding: CPT17-01
Depth: 15.1
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

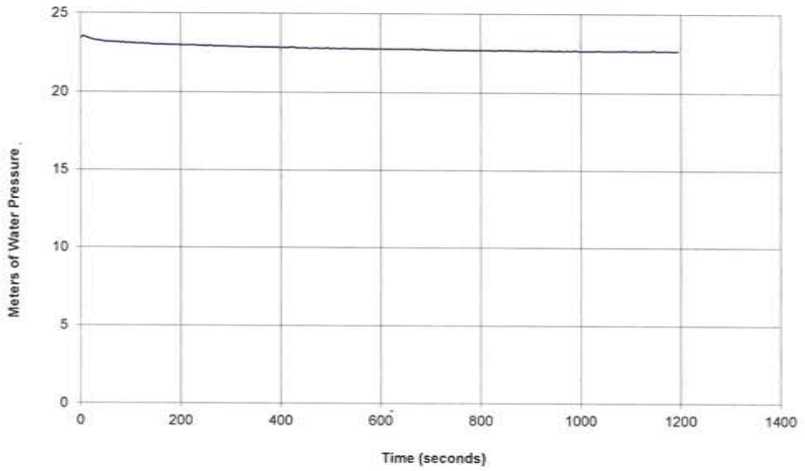
Sounding: CPT17-01
Depth: 19.8
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

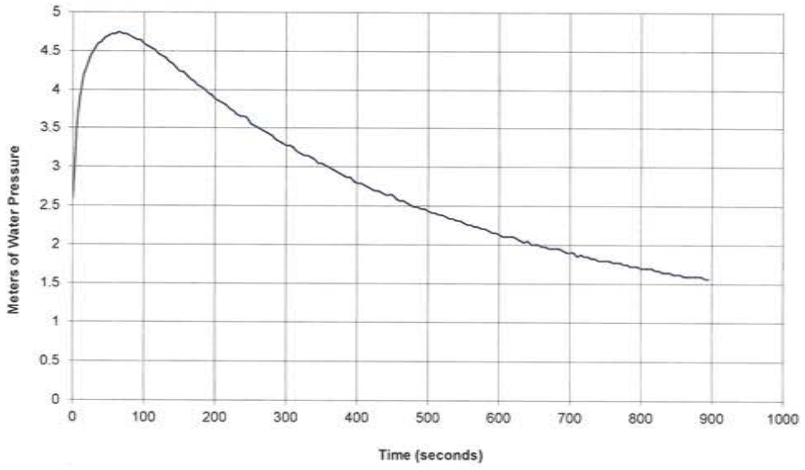
Sounding: CPT17-01
Depth: 25.9
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

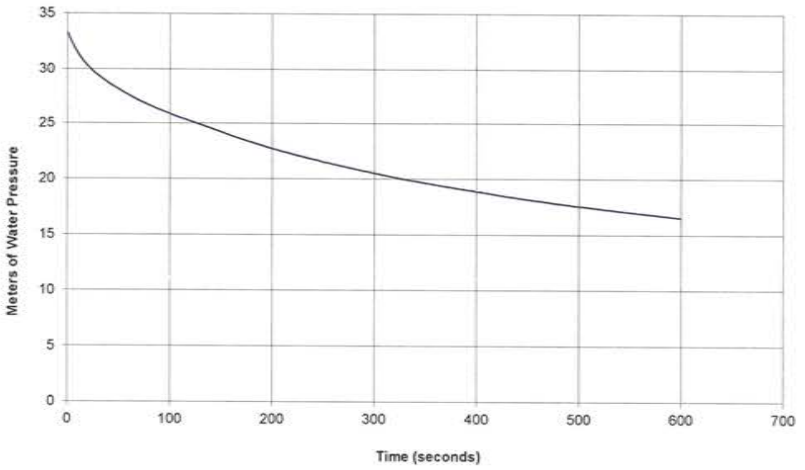
Sounding: CPT 17-03
Depth: 7.85
Site: PORT ALBERNI
Engineer: L.MARQUIS



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

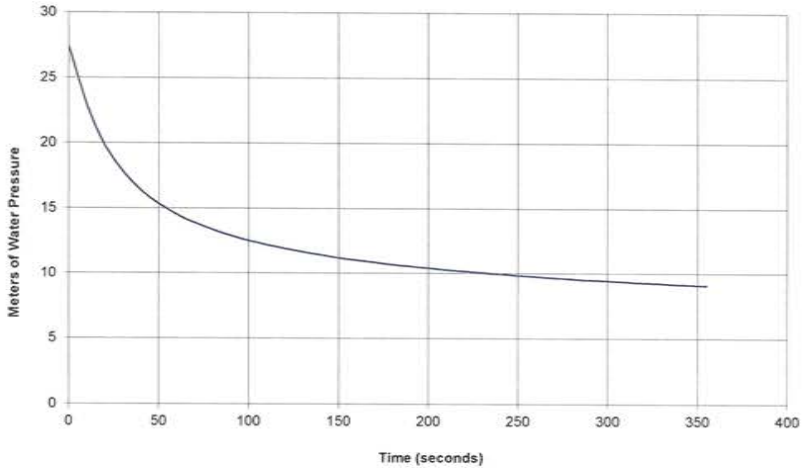
Sounding: CPT 17-03
Depth: 8.85
Site: PORT ALBERNI
Engineer: L.MARQUIS



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

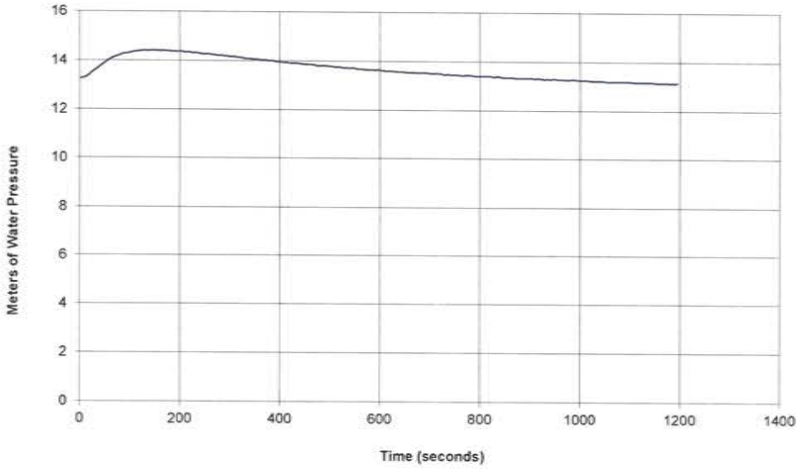
Sounding: CPT 17-03
Depth: 12.25
Site: PORT ALBERNI
Engineer: L.MARQUIS



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

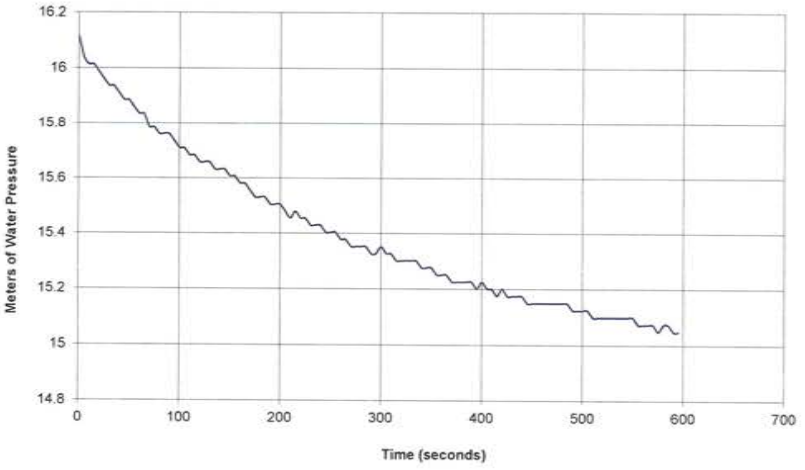
Sounding: CPT 17-03
Depth: 17.85
Site: PORT ALBERNI
Engineer: L.MARQUIS



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

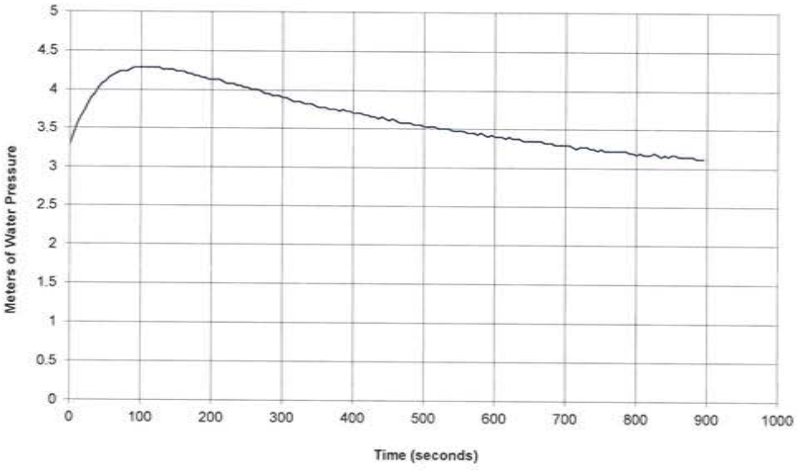
Sounding: CPT 17-03
Depth: 20
Site: PORT ALBERNI
Engineer: L.MARQUIS



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

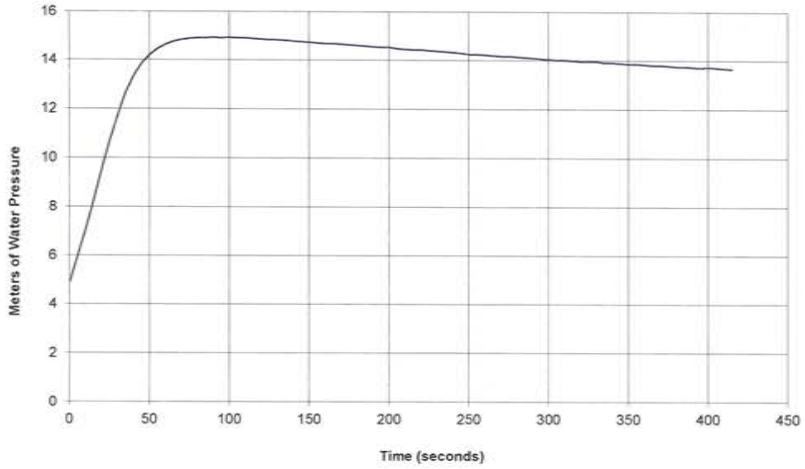
Sounding: CPT17-04
Depth: 7.7
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

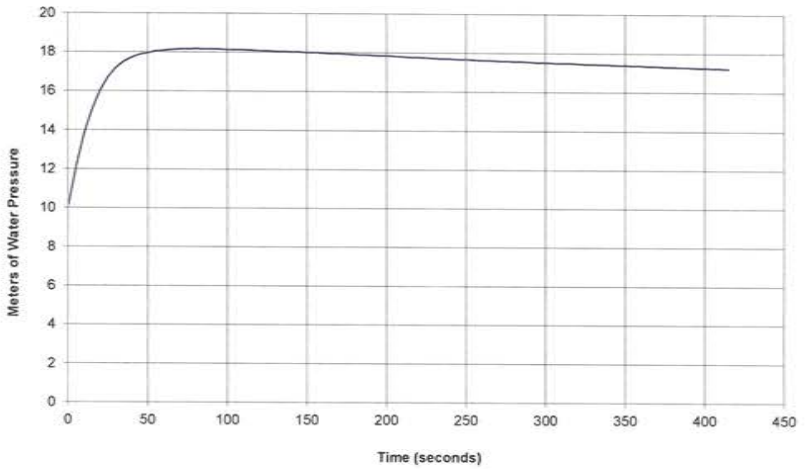
Sounding: CPT17-04
Depth: 16
Site: PORT ALBERNI
Engineer: LUKE



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT17-04
Depth: 20
Site: PORT ALBERNI
Engineer: LUKE



APPENDIX

5. SUMMARY OF SEISMIC ANALYSES

APPENDIX 5 – SUMMARY OF SEISMIC ANALYSES

A5.1 INTRODUCTION

This technical memorandum outlines the details of the seismic analyses performed for the Port Alberni Wastewater Treatment Plant. This memorandum is intended to be read in conjunction with WSP's Geotechnical Assessment Report dated January 2018, which contains the details of subsurface conditions, foundation options and other relevant geotechnical recommendations.

This memorandum provides the details of the model development and calibration, analysis methodology, and results of the seismic ground deformation analysis performed using the FLAC (Fast Lagrangian Analysis of Continua, version 8.0) computer program. Details of input ground motions and supplementary comparative analyses performed using simplified approaches are also included.

A5.2 GEOTECHNICAL DESIGN PARAMETERS

This section provides the details of site characterization that were used to determine input geotechnical design parameters. Soil characterization is based on CPT data, observations of soil samples, and laboratory test results.

A5.2.1 SOIL BEHAVIOUR CLASSIFICATION

MICROSTRUCTURE

Most of the existing empirical correlations developed for the interpretation of CPT data are predominately based on calibrations conducted on young and uncemented soils with little or no microstructure (Robertson 2009; Mayne 2014). Robertson (2016) highlighted the limitations in using such CPT-based correlations for soils with microstructure.

To confirm the applicability of conventional CPT-based correlations for this site, Robertson (2016) suggested using a K_G^*, parameter estimated using cone penetration resistances and shear wave velocities. According to Robertson (2016), most young and uncemented soils will exhibit K_G^* values between 100 and 300. The estimated K_G^* values are shown in Figure A5-1 for the two deep CPTs and also for coarse and fine-grained soils separately. This method of classification identifies the soils as young and uncemented, which is consistent with the geological interpretation. Therefore, the conventional CPT-based correlations are applicable to this site to determine geotechnical design parameters from penetration resistances.

SOIL BEHAVIOR TYPE

To characterize in situ soils with respect to their seismic response, soils were differentiated between sand-like and clay-like responses. Sand-like soils are susceptible to cyclic liquefaction while clay-like soils are not susceptible to cyclic liquefaction although cyclic softening could occur. Clay-like soils can also develop pore pressures during undrained cyclic loading but generally do not reach zero effective stress; hence retain some level of stiffness and strength during cyclic loading and generally deform less than sand-like soils. The transition from sand-like to clay-like occurs in a fairly narrow range of Plasticity Index (PI), as such sand-like soils tend to have PI < 10% and clay-like soils tend to have PI > 18% (Bray and Sancio 2006).

Using CPT resistances, a similar classification can be performed by using the Soil Behaviour Index (I_c) defined by Robertson (1990). Robertson and Wride (1998) suggested I_c of 2.6 as the approximate boundary between sand-like and clay-like soils, although intermediate soils can exhibit I_c values between 2.4 and 2.6. More recently, Robertson (2016) published an updated approach where a modified Soil Behaviour Index (I_B) was proposed to demarcate sand-like and clay-like soils. In this method, I_B of 32 represent the lower bound for most sand-like soils and I_B of 22 represent the upper boundary of most clay-like soils. The soil behaviours estimated using Robertson (1990) and Robertson (2016) methods are shown in Figure A5-2 and A5-3 for the two deep SCPT holes.

Robertson (2016) extended the modified classification system by incorporating the dilative and contractive potentials of the soil. A soil identified as “contractive” will develop positive porewater pressures during undrained shear loading therefore tends to be more susceptible to liquefaction and associated strength loss. In contrast, “dilative” soils will generate negative porewater pressure, thereby increases the shear strength and resistance to liquefaction. The soil profiles developed based on the modified method with dilative/contractive potentials are shown in Figure A5-4.

A5.2.2 SAND-LIKE SOILS

The equivalent SPT blow counts (N_{60}) in sand layers generally range from 10 to 20, therefore classified as “compact” (Figure A5-5). The equivalent blow counts estimated using the approach proposed by Jefferies and Davies (1993). Relatively thin dense sand layers with blow counts exceeding 20 were also noticed at some locations, although those appear to be discontinuous. Loose layers with SPT blow counts less than 10 are estimated for the transition layer encountered near the base of the sand layer.

For this site, fines content is an important factor in view of its impact on the liquefaction resistance and deciding the feasibility of certain ground improvement options. Traditionally, the CPT-based fines estimates are considered less reliable, therefore several methods were considered in estimating the fines content. The fines contents estimated using the methods proposed by Suzuki et al (1998) and Robinson et al. (2013) are shown in Figures A5-6 and A5-7, respectively. The variation in fines content was considered in the sensitivity analyses in relation to liquefaction susceptibility and feasibility review of ground improvement alternatives.

Post-seismic shear strengths were estimated using the approach proposed by Idriss and Boulanger (2008). Based on the soil profile, the void ratio distribution is judged to be negligible. The estimated post-seismic shear strengths for the two deep CPTs are shown in Figure A5-8. For the subsequent analyses, a post-seismic shear strength ratio of 0.06 was selected.

A5.2.3 CLAY-LIKE SOILS

The degree of cyclic softening of fine-grained soils is an important consideration given its potential to trigger deep-seated failures that could extend to the building footprint. In such situations, near-surface ground improvements may not entirely mitigate the movement towards Somass River, and will have a significant impact on the project cost if such movements are to be mitigation.

Figure A5-9 shows the peak undrained shear strength estimated using a N_{kt} of 14 as per the method proposed by Lunne et al (1997). According to this plot, the peak undrained shear strength of deep fine-grained soil layers ranges from about 50 kPa to 70 kPa. Figure A5-10 shows the peak undrained shear strength ratios estimated using CPTs for the two deep soil profiles. The shear strength ratio appear to be decreasing with depth and approaches about 0.2, which corresponds to a shear strength ratio of a typical normally consolidated soil. This observation is consistent with the geological history, compressibility and strength characteristics interpreted from CPTs and laboratory tests. As noted above and shown on Figure A5-4, the clay-like soils at this site are identified as contractive according to the modified soil classification presented by Robertson (2016).

Figure A5-11 shows soil sensitivity estimated from CPTs using the method proposed by Robertson (2009). Fine-grained soils are classified as medium to high-sensitive (Canadian Foundation Engineering Manual 2006), with sensitivities mostly ranging from 3 to 6. Generally, the soil sensitivity at this site appears to increase with depth. Figure A5-12 shows soil sensitivities estimated using index tests according to the method proposed by Mitchell and Soga (2005). Four Atterberg Limit Determination tests were available to estimate sensitivity using this method. Except for the test performed at a depth of 23.5 m in BH17-01, the estimated soil sensitivity of the remaining three samples ranged from 4 to 7, which is consistent with the CPT-based interpretations for those samples.

A5.2.4 SOIL BEHAVIOR CLASSIFICATION SUMMARY

In summary, the coarse-grained soils encountered at this site are classified as contractive under undrained shear loading, and are therefore highly susceptible to cyclic liquefaction.

The fine-grained soils at this site are compressible with a light over-consolidation. With estimated moderate to high sensitivities, these soils are susceptible to significant strength loss from disturbances caused by cyclic loading.

The estimated soil behaviours are consistent with the geological interpretations. Design implications of these soil behaviours are discussed in the following sections.

A5.3 GROUND MOTIONS

A5.3.1 SEISMIC HAZARD

The site is located in a high seismic zone due to its close proximity to the Cascadia Subduction Zone located off the west coast of Canada. As a result, the seismic hazard at this site is influenced by the following three types of earthquake sources (Adams and Halchuk, 2003):

- **Shallow Crustal Earthquakes (Crustal):** These earthquakes occur in the overriding North American plate at depths of about 10 to 20 km. The earthquake magnitude generally ranges from about M6.5 to M7.5 with strong shaking lasting for about 10 to 15 seconds. An example of this earthquake is the 1943 M7.3 Central Vancouver Island earthquake. Hodgson (1946) reported the details of an undersea power line that was destroyed in the Alberni Inlet, amongst various other damages occurred in the Port Alberni area.
- **Deep In-Slab Earthquakes (In-Slab):** These earthquakes occur at a depth of about 40 to 60 km, at or below the subducting slab between southern Puget Sound and southern Gulf Islands. The earthquake magnitude generally varying from M6.5 to M7.5 with 15 to 30 seconds of strong shaking. Examples of this type of earthquakes include the 1949 and 1965 Puget Sound Earthquakes and 2001 Nisqually Earthquake.

- **Cascadia Megathrust Earthquakes (Interface):** These earthquakes occur at the interface of Juan de Fuca and North American plates. The earthquake magnitude is expected to be range M8.0 to M9.0 with 1 to 2 minutes of strong shaking. The Cascadia interface has been seismically quiescent in the recent history, preventing the use of recent seismicity data to estimate the recurrence rate for these events. As a result, recurrence rates have been estimated using paleoseismic evidence, such as coastal subsidence and tsunami deposition.

Seismic hazard values corresponding to the 2475-year return period design event were obtained from the interactive website http://www.earthquakescanada.nrcan.gc.ca/index-eng.php maintained by the Geological Survey of Canada (GSC). At the time of preparing this report, the 2015 National Building Code of Canada (NBCC) seismic hazard values were available. However, as the British Columbia Building Code (BCBC) has not been updated to adopt the 2015 NBCC seismic hazard values, WSP was informed to undertake the seismic analysis using the 2010 NBCC values as per the 2012 BCBC requirements.

Table A5-1 Spectral Response Accelerations for Site Class C for 5% Damping (as per 2010 NBCC)

PGA	SA(0.2)	SA(0.5)	SA(1.0)	SA(2.0)
0.354	0.758	0.564	0.303	0.161

Source : Geological Survey of Canada

For the liquefaction triggering analyses discussed in the following section, an earthquake magnitude (M_w) of 7.0 was selected for the Crustal and In-Slab events and an M_w of 8.5 was selected for the Interface event.

A5.3.2 GROUND MOTION DEVELOPMENT

The following factors were considered in the selection of ground motion suite:

- Both Crustal and In-Slab ground motions were matched to periods less than 1 seconds and Interface motions were matched to periods between 1 second and 10 seconds.
- Scaling was undertaken such that the average response spectrum of each suite of time histories was not more than 10% below the target spectrum over the period range of interest.
- For each seismic source, a suite of five earthquake time histories were developed. Seismic design parameters (e.g., cyclic shear stresses) were selected by computing the average response of the five motions for each seismic source, followed by selecting the maximum response of the three average responses.

CRUSTAL MOTIONS

The seed motions for Crustal earthquake sources were obtained using the Pacific Earthquake Engineering Research Center (PEER) web-tool that can be accessed through http://ngawest2.berkeley.edu. This interactive database is a repository of shallow crustal ground motions records obtained from various parts of the world. The web-tool also allows users to select and download seed motions that have the best spectral match to a target spectrum. The goodness of fit is measured by computing the Mean Squared Error (MSE) between the target spectrum and response spectrum of the scaled ground motion.

The candidate motions were selected subject to the following conditions:

- Scaling factors – between 0.25 and 4.0
- Earthquake magnitude, Mw – between M6.0 and M7.5
- Closest distance/horizontal distances to rupture plane (i.e., R_jb and R_rup) – between 10 km and 30 km
- For the purpose of matching the target spectrum, the period range of interest was selected between 0.1 and 1 seconds.

From this database, five candidate motions were selected by ranking them with respect to MSE, scaling factors and fault mechanisms. No more than two seed motions were selected from a given historical event.

IN-SLAB MOTIONS

For the In-Slab seismic source, the seed motions were obtained from the COSMOS Strong-motion Virtual Data Centre (http://strongmotioncenter.org/vdc/scripts/earthquakes.plx). The candidate motions were scaled and spectrally matched to the target response spectrum for periods less than 1 second. If necessary, the motions were baseline corrected using the SeismoSignal (SeismoSoft 2016) program.

SUBDUCTION (INTERFACE) MOTIONS

The uniform hazard response spectrum given in the 2010 NBCC does not include contributions from the Cascadia subduction event, as such, the seismic hazard from such events were estimated using a deterministic approach. However, in the 2015 NBCC, the Cascadia subduction earthquake zone was considered as a separate zone model and combined probabilistically with other models. The 2015 NBCC provides spectral accelerations compatible with the 2,475-year hazard, which was selected for developing ground motions for the Interface event.

The seed motions for the Interface seismic sources were obtained from the recent Japanese earthquakes which have recorded earthquake magnitudes that ranged from M8.0 to M9.0. This range of earthquake magnitudes are expected from a partial to full-length rupture of the Cascadia fault line (e.g., Hyndman and Rogers, 2010; Goldfinger et al., 2012). The records were scaled to match the spectral shapes of periods greater than 1 second.

A5.3.3 SUMMARY OF DESIGN SEISMIC MOTIONS

The details of 15 seed motions are given in Table A5-2. The acceleration time histories of these ground motions are shown in Figures A5-13(a) through (c). The response spectra of the scaled motions with respect to the target spectrum are shown in Figure A5-14.

Table A5-2: Details of Seed Motions Selected for Each Seismic Source

	ID	Earthquake	Year	Recording Station	M_w	R_{rup} (km)
Crustal	CR1	Loma Prieta	1989	Capitola Fire Station	7.0	20
	CR2	San Fernando	1971	DOT highway department sta.	6.6	36
	CR3	San Fernando	1971	LA - Hollywood Stor FF	6.6	25
	CR4	Imperial Valley	1979	Calipatria Fire Station	6.53	25
	CR5	Imperial Valley	1979	Cerro Prieto	6.53	15
In-Slab	IS1	Nisqually, WA	2001	USGS 7032	6.8	75
	IS2	Nisqually, WA	2001	USGS 7032	6.8	75
	IS3	El Salvador	2001	R110_DB-7175 (180)	7.6	60
	IS4	El Salvador	2001	R110_DB-7175 (270)	7.6	60
	IS5	Tarapaca, Chile	2005	R0_IQUIQUE IDIEM-Ln	7.8	115
Subduction (Interface)	IF1	Tohoku, Japan	2011	R209_YMT008	9.0	~210
	IF2	Tohoku, Japan	2011	R209_YMT008	9.0	~210
	IF3	Tokachi-oki Japan	2003	Noya, R152 HKD107-EW	8.0	~130
	IF4	Tokachi-oki Japan	2003	Noya, R152 HKD107-NS	8.0	~130
	IF5	Tokachi-oki Japan	2003	Ebetsu, R245 HKD181-EW	8.0	~230
	IF5	Tokachi-oki, Japan	2003	Ebetsu, R245 HKD181-NS	8.0	~230

Notes: Mw – Moment magnitude, Rrup – the shortest distance to the rupture plane and ID – assigned identification number for the earthquake.

Besides spectral accelerations, other characteristics of the input ground motion are recognized to have a significant impact on the seismic displacements (Bray and Travasarou 2007, Yegian et al. 1991; Kim and Sitar 2004; Athanasopoulos-Zekkos 2008). According to previous studies, these parameters include, but not limited to, Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV), mean period (T_m), Arias Intensity (I_a), significant duration ($D_{5\text{-}95}$), elastic spectral acceleration at the degraded fundamental period ($Sa(1.5*T_s)$), Root Mean Square Acceleration (a_{rms}), Characteristic Intensity (I_c). A summary of these ground motion parameters are given in Table A5-3 for each input motion and also some select parameters are plotted in Figure A5-15.

A5.4 SITE-SPECIFIC SIMPLIFIED LIQUEFACTION ASSESSMENT

A5.4.1 GROUND RESPONSE ANALYSES

To estimate the near-surface seismic ground response and seismic demands for liquefaction triggering, one-dimensional (1D) site-specific ground response analyses were undertaken at the two initially proposed building locations. This analysis was performed using SHAKE2000 (Ordonez, 2013), which employs an equivalent-linear total-stress approach.

SOIL INPUT PARAMETERS

The modulus degradation and damping curves selected for each soil type are summarized in Table A5-4 and also shown in Figure A5-16 and A5-17 for the two generalized soil profiles.

Table A5-4: Modulus degradation and damping curves selected for each soil type

SOIL TYPE	MODULUS DEGRADATION AND DAMPING CURVES
Clay and Silt	Vucetic and Dobry (1991) curves
Sand, Sand and Gravel Mixtures	Seed et al. (1986) upper bound curve for modulus degradation and lower bound curve for damping.
Till-like	EPRI (1993)

The shear wave velocity profiles were primarily developed from SCPTs and are shown in these plots. As stated previously, the available information is not sufficient to confirm the depth to firm ground (i.e., till or bedrock). SCPT17-01 was terminated at a depth of 31 m, which was the maximum targeted depth of investigation, while SCPT17-02b was terminated at a depth of 32 m due to effective refusal related to instrument inclination and the potential for instrument damage. For the ground response analyses, the elastic-half space was considered at a depth 40 m.

A5.4.2 LIQUEFACTION SUSCEPTIBILITY

A simplified liquefaction triggering assessment was conducted in accordance with the procedure outlined by Idriss and Boulanger (2008). The intent of this simplified analysis was to supplement and confirm the results obtained from advance numerical modeling performed using FLAC. The seismic demand in the form of Cyclic Stress Ratio (CSR) was estimated from the SHAKE analysis. As stated previously, the design CSR was selected as the maximum of three averages computed for the three seismic sources.

LIQUEFACTION SUSCEPTIBILITY OF SAND-LIKE SOILS

A soil exhibiting sand-like behaviour is considered susceptible to liquefaction if the Factor of Safety computed from the above approach is less than 1.1. Under such conditions, the excess porewater pressure ratio (R_u) in soil is expected to be greater than 0.75. R_u is expected to be small for soils with Factor of Safety greater than 1.4, as such strength and stiffness degradation under seismic loading can be disregarded. In soil layers with a Factor of Safety between 1.1 and 1.4, the generation of excess porewater pressure may still result in considerable degradation of strength and stiffness, although it is less severe than that for fully liquefied soils.

For the liquefaction triggering assessment, the resistance to liquefaction (i.e., Cyclic Resistance Ratio, CRR) of sand-like soil was primarily determined using CPTs. CRR of sand-like soils was calculated according to the method outlined by Idriss and Boulanger (2008). In this assessment, the fines content was estimated using the correlation proposed by Suzuki et al., (1998), as this method provide a lower-bound estimate for fines content (i.e., conservative in terms of liquefaction resistance).

CYCLIC FAILURE POTENTIAL OF CLAY-LIKE SOIL

Clay-like soils can also develop porewater pressures during undrained cyclic loading, but generally do not reach zero effective stress. As a result, the degree of strength and stiffness degradation is not significant as in sand-like soil. Nevertheless, soft normally or lightly overconsolidated clay-like soils can develop large positive porewater pressures that can trigger potentially large ground deformations depending on the ground geometry, sensitivity and external building loads.

For clay-like soils, the potential for cyclic softening was estimated based on CPTs using the approach proposed by Idriss and Boulanger (2008). In this approach, $\mathrm{CRR}_{\mathrm{M=7.5}}$ of clay-like soils was estimated using the following:

$$CRR_{M=7.5} = 0.8 \times S \times (OCR)^{m}$$

Where, *S* is the peak undrained shear strength ratio at normally consolidated state and *m* is an exponent determined from the SHANSEP method (Ladd and Foott 1974). The shear strength ratio (S) and OCR were estimate from CPTs, while the exponent, *m* was taken as 0.8.

The susceptibility of these soils to liquefaction or cyclic softening was also assessed using the empirical methods proposed by Bray and Sancio (2006) and Seed et al. (2003), and the results are plotted in Figure A5-18. With the exception of an index test completed at a depth 23.7 m, the remaining four index tests indicate that fine-grained materials as moderate to low susceptible to liquefaction and cyclic softening. The soil sample collected at a depth of 23.7 m is classified as potentially liquefiable (or cyclic softening), and may have been sourced from a relatively low plastic silt layer. These index-based approaches do not directly consider the intensity, duration of seismic loading and shear strength of the soil, therefore prominence was given to the CPT-based assessment.

A5.4.3 SUMMARY OF LIQUEFACTION ASSESSMENT

The CSR, CRR and Factor of Safety plots for the two building sites are shown in Figures A5-19(a) and (b). The key observations of the liquefaction triggering assessment are as follows:

- Loose to compact sand-like soils encountered in the upper 20 to 24 m are identified as potentially liquefiable. The total thickness of soil layers identified as liquefiable is 9 m at SCPT17-01 and 12.5 m at SCPT17-02b. The liquefiable layers are highlighted in yellow in Figures A5-19(a) and (b).
- The clay-like soils encountered at depths greater than 20 to 24 m are at low risk of cyclic softening with a Factor of Safety exceeding 1.1.

A5.5 TWO-DIMENSIONAL NUMERICAL (FLAC) MODELING

A5.5.1 GENERAL

Considering the limitations in the simplified liquefaction assessment in sites that are prone to liquefaction and large ground displacements, two-dimensional (2D) ground deformation analysis was completed using FLAC. This finite-difference program utilizes an explicit solution scheme which is suited for conducting liquefaction-induced ground deformation analyses for sites likely to undergo significant geometry changes. For this project, the main intent of performing FLAC analysis was to identify the ground deformation mechanism and risks of deep-seated failures.

This 2D modeling approach overcomes many limitations in the 1D simplified analysis and generally perceived to provide a more realistic indication of the displacement pattern and magnitude. It is important to note that strong shaking would generate significant excess porewater pressures and lead to highly nonlinear soil response and liquefaction, which are not explicitly captured using an equivalent-linear approach. Based on our review of the data, it is our opinion that the SHAKE analysis is sufficient to estimate liquefaction triggering while the FLAC analysis identifies the displacement mechanism and order of magnitude displacement.

A5.5.2 MODEL DETAILS

The 2D model established using a ground profile provided by Associated aligned in the northwest/southeast direction was selected for FLAC modeling. Soil profile in the model was based on the conditions encountered at the boreholes and assumptions that these conditions extended laterally beyond the test hole locations.

The layering and mesh used in the FLAC model are shown in Figure A5-20. The model is about 40 m deep and 450 m wide, and includes about 17000 elements of approximately 1 m x 1 m soil elements. The primary focus of this analyses was the Aeration/UV building which is closest to the river and has the highest risk of failure caused by ground movements. With sharp topographical changes towards the river near ground surface, this ground profile in general is considered to represent the most critical condition for a seismic ground deformation assessment.

Average ground displacements associated with In-Slab and Interface ground motions suites were found to be similar to the following individual ground motions: 2001 Nisqually (IS2) and 2003 Tokachi-oki (IF3) respectively. Accordingly, results for analyses conducted with these ground motions are presented on the attached Figures.

For modeling the seismic wave propagation, Kuhlemeyer and Lysmer (1973) recommended an element size smaller than 1/10th to 1/8th of the wave length associated with the highest frequency component of the input wave. Based on this recommendation, for a 1 m thick soil element with a minimum near-surface shear wave velocity of about 100 m/s, the maximum frequency that is transmitted through the soil column is estimated to be about 20 Hz. This is considered acceptable as the power spectrum obtained by filtering the frequency contents greater than 20 Hz is not significantly different to that of the unfiltered motion.

Compliant (absorbing) boundary conditions were used at the base of the model, in which the seismic input motion was applied as a shear stress time history. The model was extended at least 5 m into the lower boundary zone in order to reduce base rotations and beam-like deflections that may occur when compliant boundary conditions are imposed to the model base.

Free-field boundary conditions were applied to the sides of the model and boundary zones were introduced between the lateral boundary and potentially liquefiable soils. These zones tend to eliminate numerical issues that sometimes arise by having free-field conditions near to liquefiable soils zones. The general slope failure mechanism is not impacted by these boundary layers as these layers are located sufficiently far away from the location of interest (i.e., two buildings).

Flow mode was on during shaking.

A5.5.3 CONSTITUTIVE MODELS AND SOIL INPUT PARAMETERS

The granular soil layers were modeled using the user-defined UBCSAND constitutive model developed by Professor Peter Byrne and his co-workers (e.g. Byrne et al., 2004, Beaty and Byrne, 2011). UBCSAND is an effective stress plasticity model developed primarily for sand-like soils likely to experience variations in effective stress due to porewater pressure build-up and degradation of stiffness due to seismic loading. As a result, the UBCSAND model is used extensively in advanced seismic assessment that involve modeling of dynamic response of soils with potential for liquefaction, cyclic mobility or softening. The model adopts a hyperbolic relationship between shear stress ratio and plastic shear strain, and estimates the plastic volumetric response using a flow rule that is a function of the stress ratio. The model is also capable of simulating the "banana-shaped" loops in the stress versus strain plots, resulting from shear-induced dilation as it repeatedly crosses the phase transformation line during undrained cyclic shearing.

The 904aR version of the UBCSAND model (Beaty and Byrne 2011) was used in this analysis. The model was calibrated by simulating the cyclic response of a single soil element under simple shear loading, and matching the empirical liquefaction triggering relationship recommended by Idriss and Boulanger (2008). The 904aR version was also calibrated to capture the static bias ($K_{\square}$) and overburden stress ($K_{\square}$) effects of sand-like soils (Beaty and Byrne 2011). Further details relating to the UBCSAND formulation can be found in Beaty and Byrne (2011). The cyclic resistance of each layer was determined based on the equivalent corrected, clean sand SPT blow count, $(N_1)_{60,cs}$ estimated from CPTs.

Material located above the groundwater table and other non-liquefiable materials were modeled using the Mohr-Coulomb constitutive model. The hysteresis damping of these materials was modeled using the built-in "sig-4" model. As the constitutive models and hysteresis damping are insufficient to produce sufficient damping at small strain levels, a small amount of full Rayleigh damping (both mass-proportional and stiffness-proportional), equal to 0.5% of critical damping at a frequency of 0.5 Hz, was applied.

A5.5.4 MODELLING APPROACH

The general steps involved in the FLAC analyses are summarized below:

- **Static equilibrium:** The model was brought to mechanical and groundwater flow equilibrium in several steps by switching off the dynamic mode. During this process, the initial static equilibrium was achieved by using the linear elastic model, followed by the Mohr-Coulomb model. The in-plane and out-of-plane horizontal stresses ($\square_{xx}$ and $\square_{zz}$) were adjusted by specifying a lateral earth pressure coefficient of 0.45. After achieving the static equilibrium using the Mohr-Coulomb model, the model was again brought to static equilibrium by assigning the UBCSAND constitutive model to the potentially liquefiable soils.
- **Dynamic analysis:** Prior to initiating the dynamic analyses, Rayleigh damping, compliant and free-field boundary conditions were activated. Groundwater flow was allowed during the dynamic analyses. Remeshing algorithms were utilized to allow the model to run without causing numerical instabilities caused by large mesh distortions. Several other subroutines were used to track the maximum stresses in ground improved zones, excess porewater pressures, displacements, etc.
- **Post-Seismic Static Equilibrium:** The post-seismic residual shear strengths were assigned for elements exceeding R_u of 0.75. Once modelling of shaking was complete, the model was allowed to run until excess porewater pressures dissipated and displacements became stable.

A5.5.5 LIQUEFACTION POTENTIAL

Figure A5-21 shows R_u estimated at the end of shaking for the two ground motions. As stated previously, the layers with R_u > 0.75 were considered liquefiable. These plots indicate that most soils in the upper 20 to 25 m are susceptible to liquefaction. In general, the results from FLAC analyses are consistent with the results obtained from the simplified liquefaction triggering assessment discussed previously.

Notwithstanding, soil layers that were identified as at low risk of liquefaction in the SHAKE analyses will also be subject to some degree of softening due to migration of excess porewater pressures from liquefiable layers. As a result, the extent of liquefaction is more severe in the FLAC analyses. Figure A5-22 shows the buildup of R_u for the IS2 (In-Slab) event at different time intervals. For this seismic event, most liquefaction susceptible soils are predicted to liquefy after 15 seconds of strong shaking.

According to the FLAC analyses, the estimated R_u in clay-like layers is less than 0.3 at the two building locations. In clay-like soils, the strength and stiffness loss become significant if R_u exceeds about 0.5 (Wijewickreme and Sanin 2010). At or near the Somass river, clay-like soils may develop R_u values greater than 0.5, which may contribute to the significantly large ground displacements (i.e., flow slide like) predicted at this location.

Seismically induced movements (vertical and lateral) are estimated for unimproved ground conditions in Sections A5.5.6, 7 and 8 below and are summarized in Table A5-5 in Section A5.5.9.

A5.5.6 POST-SEISMIC SETTLEMENT

- **2D FLAC Analyses:** At present, post-seismic volumetric strains due to reconsolidation of liquefied soils cannot be accurately modelled using constitutive models such as UBCSAND. This is mainly because majority of the post-seismic reconsolidation strains are associated with the sedimentation process, which cannot be easily incorporated into a constitutive model (Boulanger and Ziotopoulou 2015). As a result, the post-seismic volumetric strains for this project were estimated separately using the approach outlined by Ishihara and Yoshimine (1992), in which the maximum shear strains estimated using FLAC was used along with the initial relative density of the soil layers.
- **Simplified Methods:** The post-seismic settlements were also estimated using several simplified approaches. As such, the “free-field” post-seismic settlement was estimated using the approaches proposed by Wu (2001), Zhang et al. (2002), Ishihara and Yoshimine (1992) for sand-like soils. The methods are mainly based on the laboratory test results conducted on clean-sand or sands with small amounts of fines. The post-seismic volumetric strains of potentially liquefiable silt layers were estimated using the approach proposed by Wijewickreme and Sanin (2004).

  For shallow foundations, additional “shear-induced” settlements will contribute to the total settlement. The estimation of this shear-induced settlement is complex and depends on the foundation type and ground improvement option. Furthermore, additional vertical displacements will occur due to lateral movements. As per Seed et al (2003), the vertical displacement associated with this lateral movement is expected to range from about 10 to 20% of the lateral displacement.

A5.5.7 LATERAL SPREAD

- **2D FLAC Analyses:** Figure A5-23 shows the horizontal displacement contours estimated at the end of shaking, and Figure A5-24 shows the displacement time histories at the building locations for the average in-slab and interface seismic events. Without any ground improvement, the horizontal ground displacements for the In-Slab input motion is estimated to result in movements of 0.3 m at the Screening building and 0.6 m at the Aeration/UV building. The estimated movements for the Interface event is about 1.5 m at the Screening building and 2 m for the Aeration/UV building. These results are in general agreement with the displacements independently obtained from the simplified methods (discussed below).
- In general, considerably larger displacements were predicted for the Interface motions (i.e. IF3). It is interpreted that the long duration of the Interface motion contributes to the greater accumulation of displacements since liquefaction is predicted to occur within a few seconds of shaking. The larger ground displacements may also be explained using the indicators such as Arias and Characteristic Intensities, which generally correlate well with the ground displacement. As indicated in Figure A5-15, these indices are significantly higher for the Interface motions than those estimated for the In-Slab and Crustal motions.
- **Simplified Methods:** For comparison and validation purposes, lateral spread displacements were also estimated using simplified approaches that are commonly used in practice including empirical approaches such as Youd et al. (2002, 2009), and semi-empirical approaches such as Zhang et al (2004) and Faris (2004). Lateral spread was estimated using general ground slopes of 2% to 7% (i.e. ignoring the potential influence of the berms) and liquefiable layers identified from the simplified liquefaction triggering analyses. Without ground improvement, lateral displacements in the order of 1 m and 3 m were estimated using these simplified methods for the Screening and Aeration/UV building locations, respectively. The lateral displacement profiles estimated using the simplified approaches are shown in Figure A5-24.

A5.5.8 FLOW SLIDE POTENTIAL

FLAC analyses indicate very large displacements (flow slide like conditions) occurring proximity to the Somass River. It is important to note that Hodgson (1946) and Rogers (1980) reported a failure of a cable line in the Alberni inlet, likely caused by submarine slope failure occurred during the 1946 earthquake. This is indicative of the potential ground failure risks at this site. However, the FLAC analyses indicate that the risk of such movements extending to the building site is small if ground improvement is undertaken. The Aeration/UV building is at a higher risk compared to the Screening building given its proximity to the River and steeper topographical conditions.

Notwithstanding this, the containment berms are not designed to the same seismic performance levels as the buildings and seismically induced failure of the berms is possible (although explicit review of existing berm stability was beyond the scope of this assignment). This could lead to localized flow failures that could regress into the building footprint area. Considering the indirect impact of berm failure on the building, ground improvement may need to be extended further away from the building perimeter. This potential for flow failure should be considered in the selection of a preferred ground improvement technique.

A5.5.9 SUMMARY OF FLAC ANAYLSES - DEFORMATIONS

Post-seismic displacements obtained from FLAC and simplified methods for the building site without ground improvement are summarized in Table A5-5. In summary:

- Without ground improvement, the simplified methods and FLAC analyses estimate a total post-seismic settlement in the range of 400 mm to 800 mm.
- Without ground improvement, lateral displacements is estimated to be in the order of 1 m for the Screening Building and 3 m for the Aeration/UV building.

Considering the inherent limitations in estimating in post-seismic displacements, the actual displacements are generally considered to range from 50% to 200% of the estimated values.

Table A5-5 Post-Seismic Displacements (Without Ground Improvement)

	Method		Aeration and UV building	Screening building
Post-Seismic Settlement	Simplified methods		0.4 to 0.8 m	0.4 to 0.8 m
	FLAC		0.4 to 0.8 m	0.4 to 0.8 m
Lateral Spreading	Simplified method		1 to 3 mm	1 to 2 m
	FLAC	In-Slab	0.6 m	0.3 m
		Interface	3 m	2 m

5.5.10 GROUND IMPROVEMENT MODEL

The predicted ground displacements are relatively large for a site that is required to support post-disaster structures. Therefore, the following ground improvement options were considered in the FLAC analyses to meet the seismic performance objectives of these two structures.

- Deep Soil-Cement Mixing Method (DMM)
- Compaction Piles:
- Geopier Grouted Impact® Pier System:

The depth and lateral extent of ground improvement was varied and analyses indicated that ground improvement should extend a minimum of 15 m below the foundation. The lateral extent of improvement was dependent upon the ground improvement method. Translational displacement of the ground improved zone may occur through a slip surface that develops below the ground improved zone.

DEEP SOIL-CEMENT MIXING

For the Deep Soil Cement Mixing (DSM) option, an equivalent shear strength of 250 kPa was selected for the DSM zone which extends. The FLAC model with the proposed DSM zone at Aeration/UV building is shown in Figure A5-26. The model indicated that ground improvement should extend a minimum of 5 m laterally beyond the foundation perimeter.

The estimated displacement time histories and displacement contours are shown in Figures A5-27 (a) and (b) for in-slab and interface ground motions. The maximum shear strains and excess porewater pressure ratios at the end of shaking are shown in Figure A5-28 for the interface ground motion. The FLAC analyses indicated that stresses within the improved ground zone are within than the design equivalent shear strength of 250 kPa.

As shown in Figures 27 and 28, the failure surface is expected to extend up to the DSM zone. However, within the ground improved zone below the buildings, ground movements are predicted to be relatively uniform due to the rigidity and high shear strength of the DSM zone.

Similar to the analyses conducted for the existing ground conditions, the largest ground deformations were obtained for the Interface event. For this event, the estimated lateral displacement at the Aeration/UV building and Screening buildings is about 1.0 m, and 0.8 m, respectively. These displacements are about five times larger than the displacements estimated for the In-Slab event. The estimated post-seismic settlement is 200 mm for the two buildings.

COMPACTION PILES AND GEOPIERS

For the compaction pile and Geopier options, FLAC analyses were performed assuming an equivalent clean-sand penetration resistance, $(N_1)_{60,cs}$ of 22 for the densified zone. The FLAC analyses indicated that the improved zone should extend laterally a minimum of 6 m from the building foundation perimeter.

For the Aeration/UV building, FLAC analysis indicate lateral displacements in the order of 1 m for the IF3 (interface) motion, and about 0.2 m movement for IS2 (inslab) motion. Similar to the DMM option, the failure plane extends to the building footprint (e.g., Figure A5-29). The estimated post-seismic settlement is 250 mm for the two buildings.

It should be noted that ground movement within the ground improved zone is possible with the compaction pile/geopier alternative.

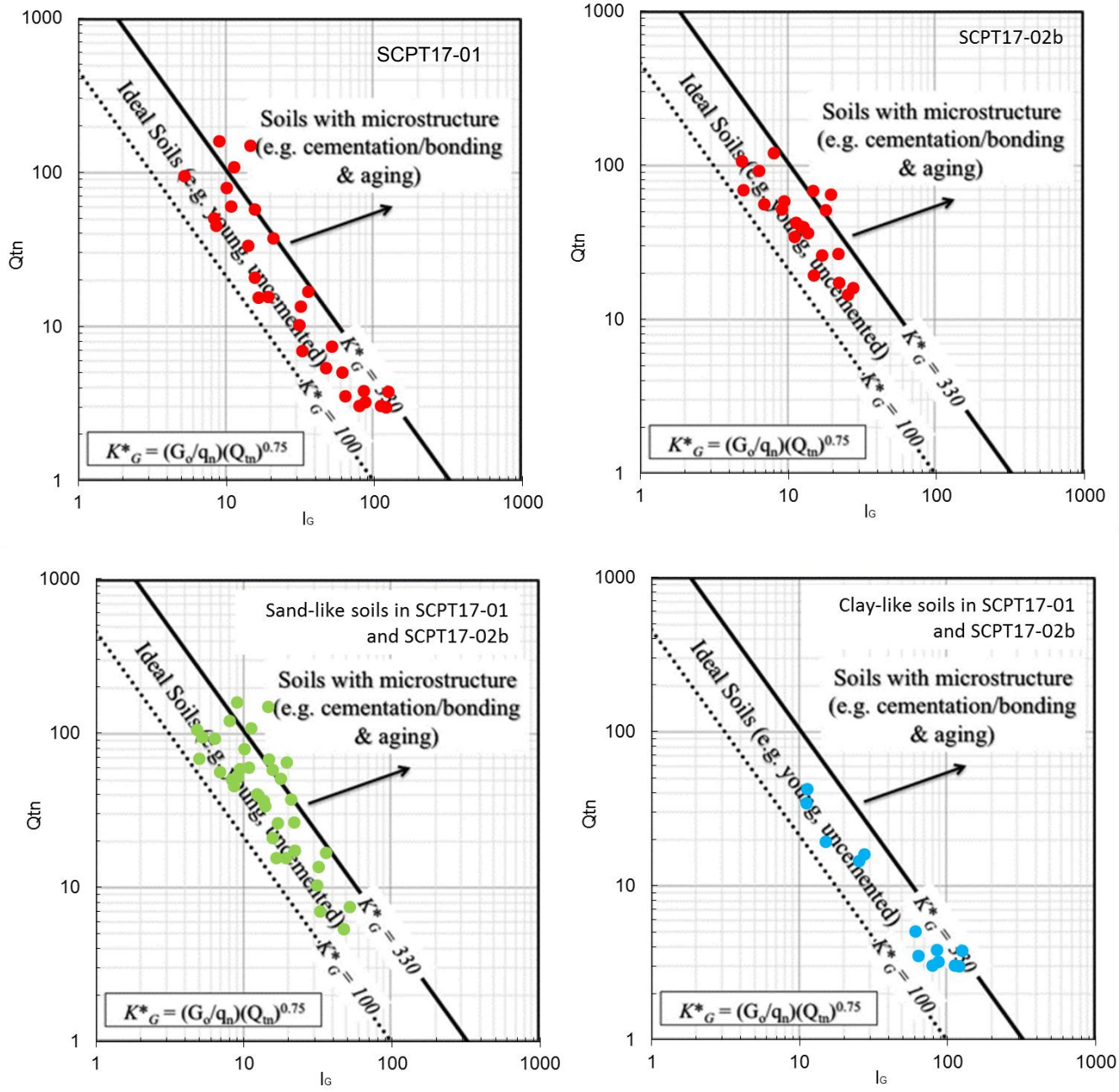


Figure A5-1 - Q_{tn} and I_G Plots for (a) SCPT17-01, (b) SCPT17-02b (c) Sand-Like and (d) Clay-Like Soils

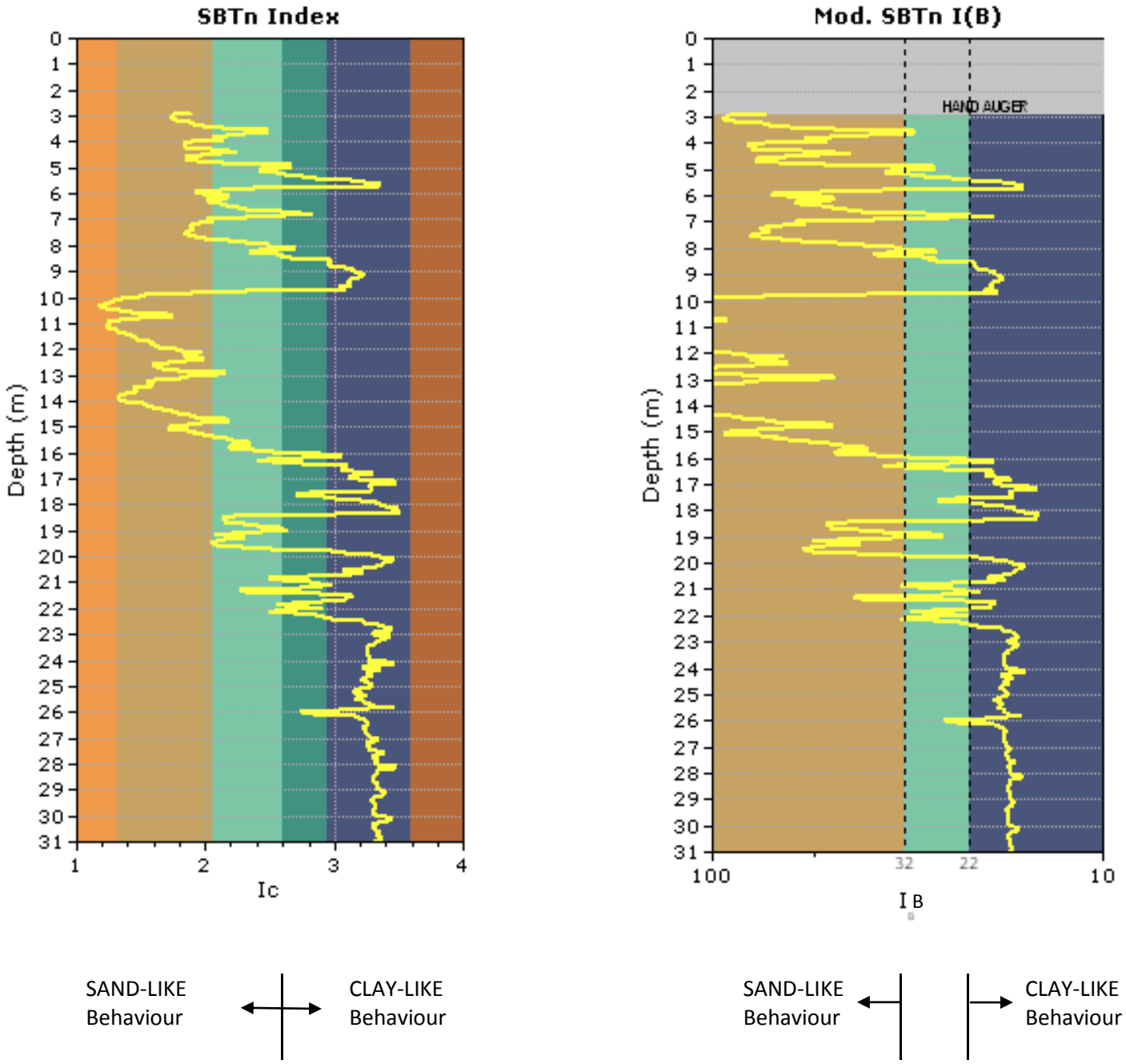
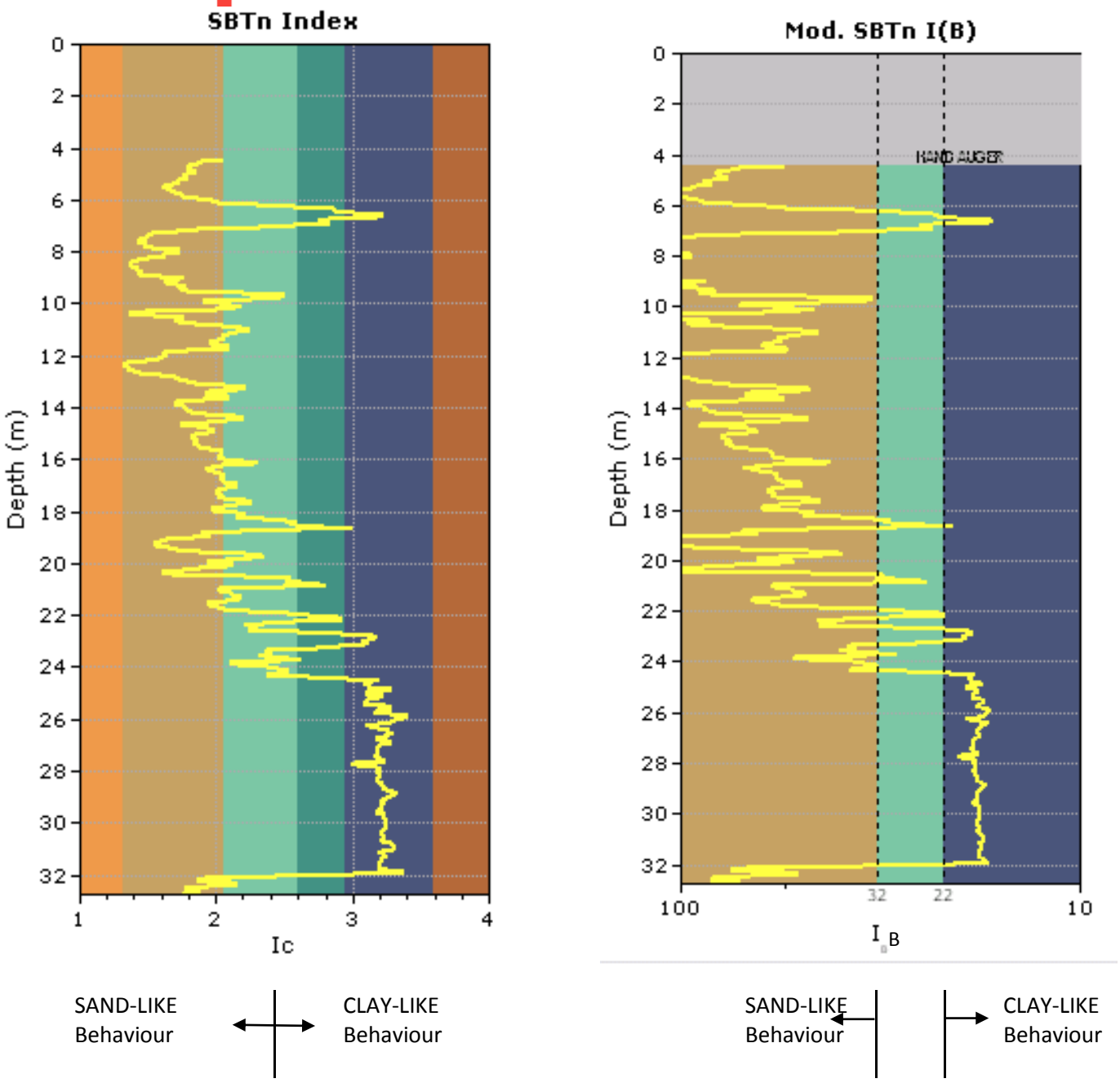
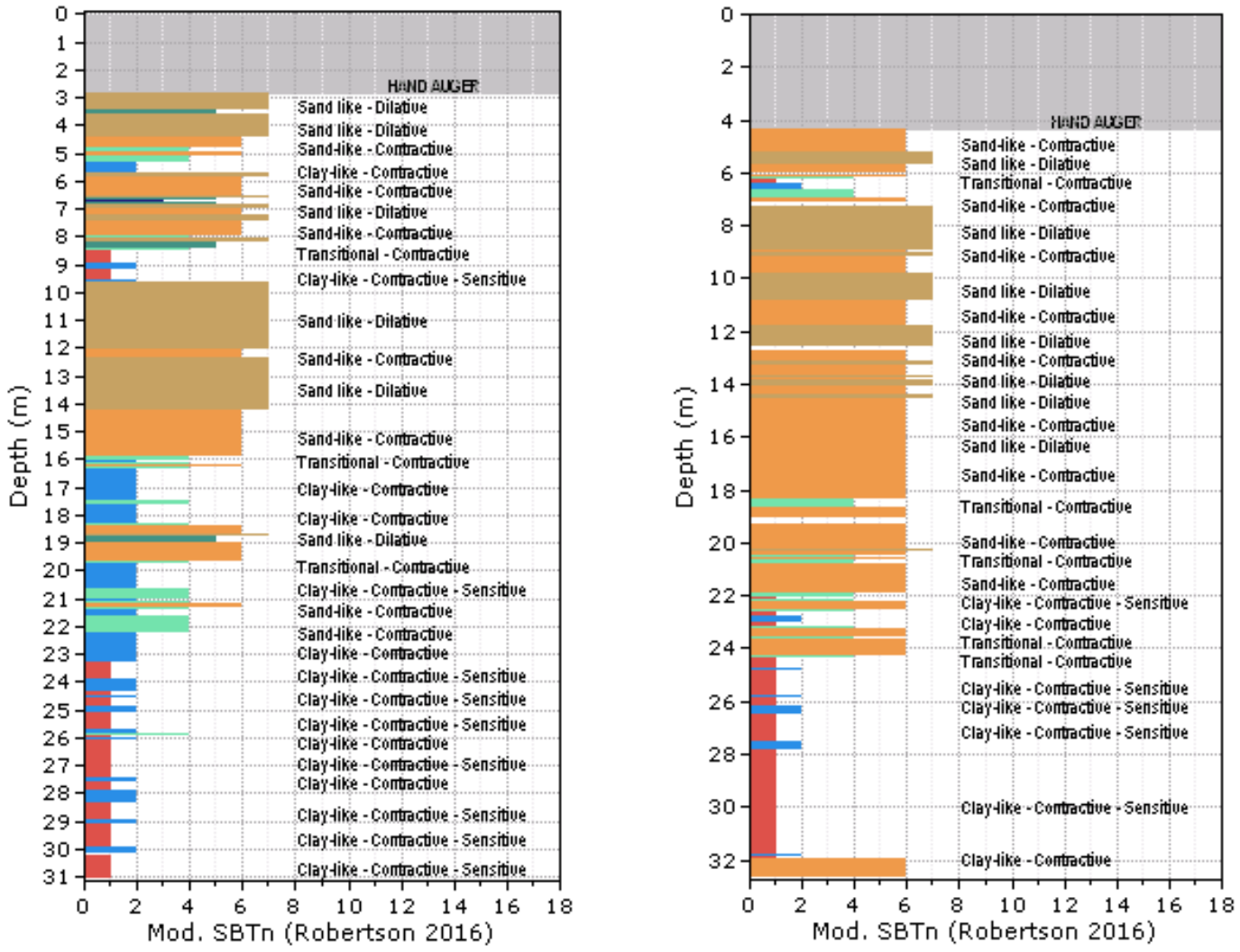


Figure A5-2 Soil Behavior Classifications as per the (a) Robertson (2009) and Robertson (2016) methods for SCPT17-01



(a) (b)

Figure A5-3. Soil Behavior Classifications as per the (a) Robertson (2009) and Robertson (2016) methods for SCPT17-2b



(a) (b)

Figure A5-4 Dilative and contractive potentials estimated based on the method proposed by Robertson (2016) methods for (a) SCPT17-01 and (b) SCPT17-02b. Contracine = soils are more likely to develop pore water pressure and therefore more susceptible to liquification and/or strength loss.

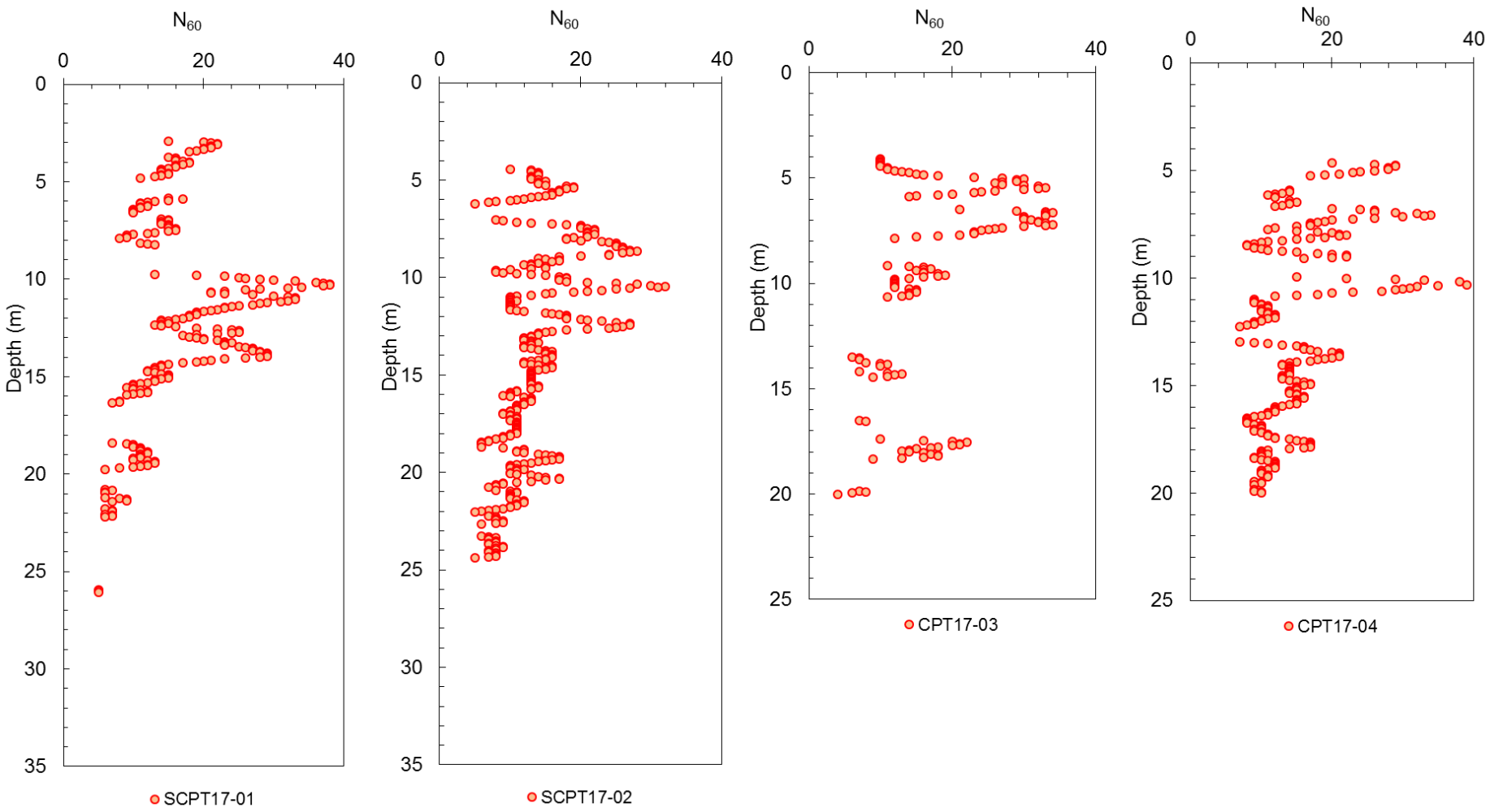


Figure A5-5. SPT N_{60} values estimated from CPTs using Jeffries and Davies (1993)

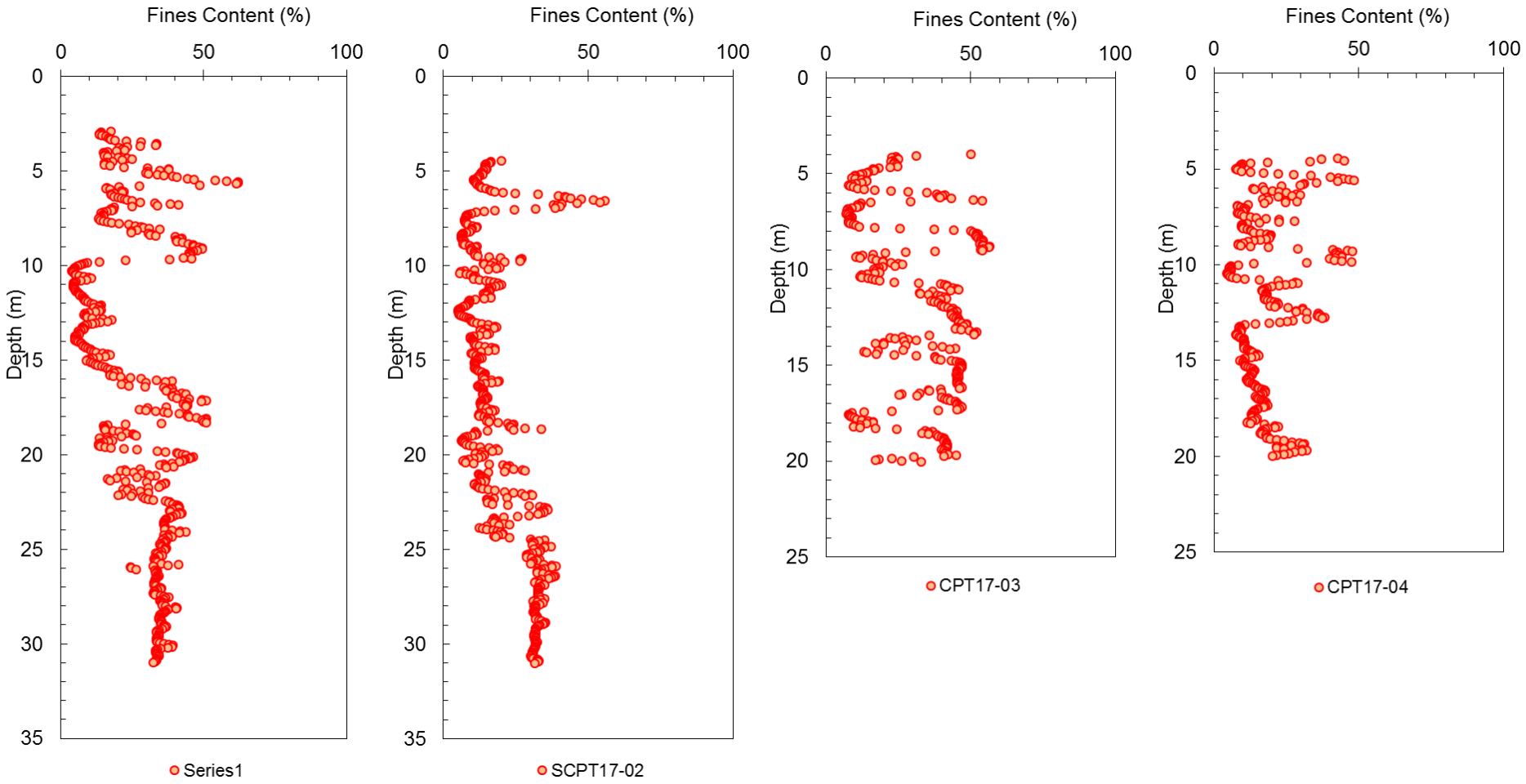


Figure A5-6 Fines contents estimated using the method proposed by Suzuki et al (1998)

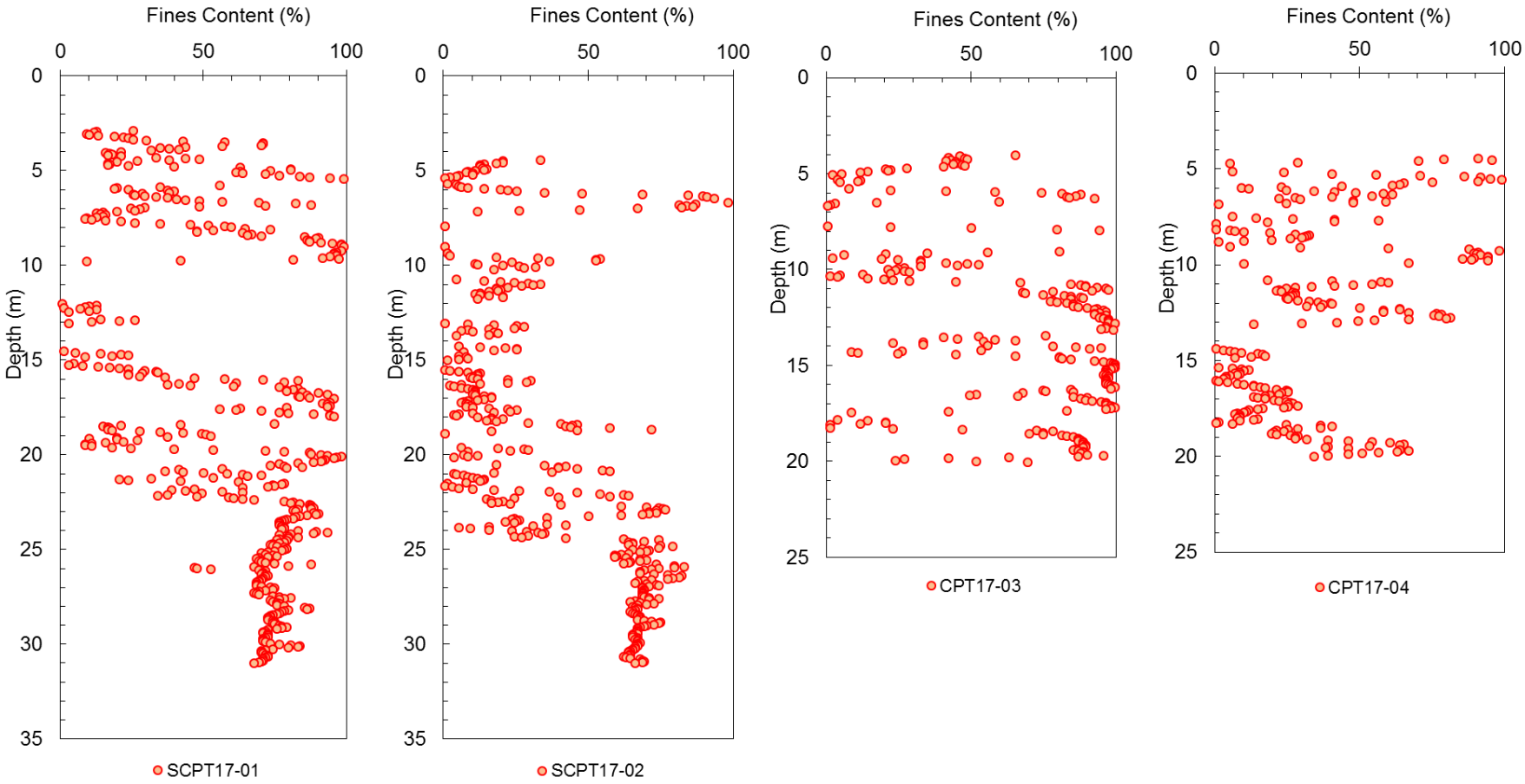


Figure A5-7 Fines contents estimated using the method proposed by Robinson et al (2013)

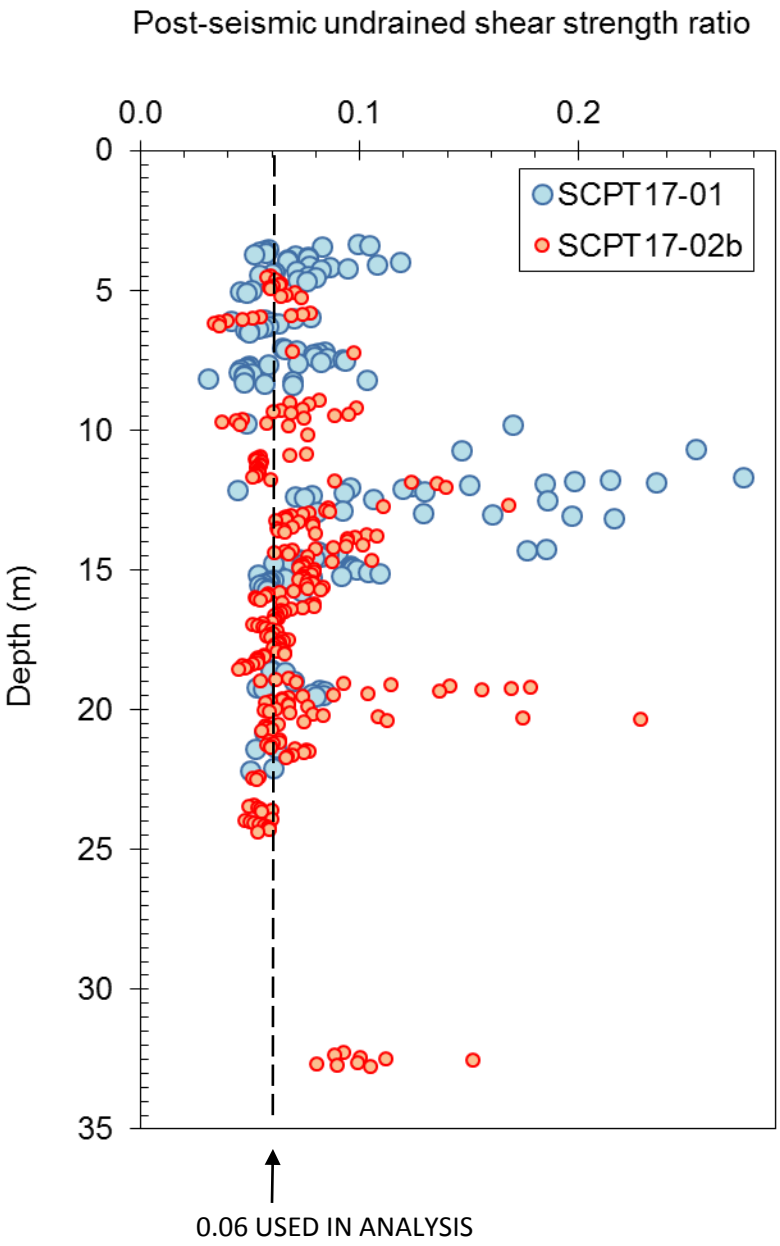


Figure A5-8 Post-seismic shear strengths estimated for sand-like soil layers using the Idriss and Boulanger (2008) method.

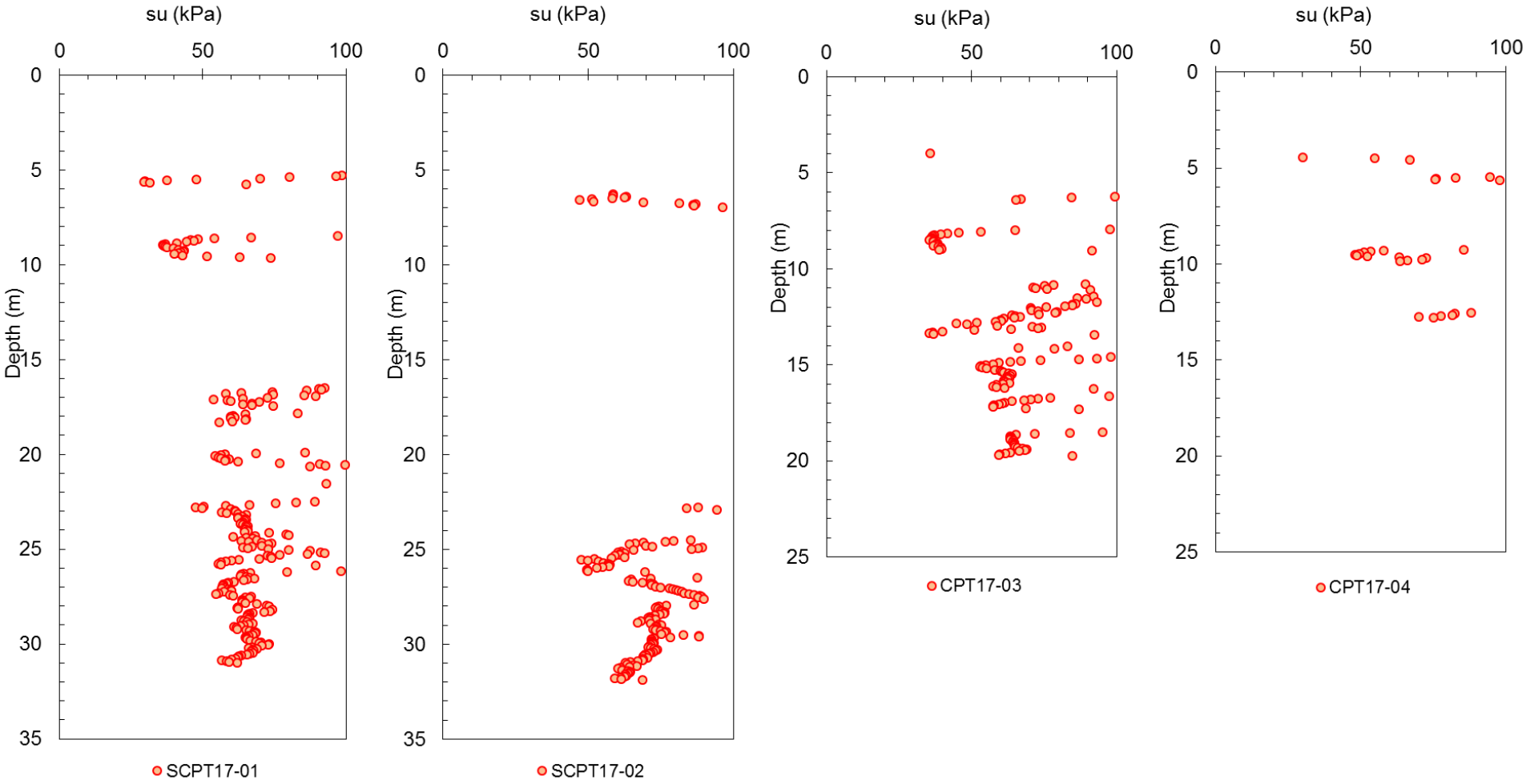


Figure A5-9 Peak undrained shear strength estimated using an N_{kt} of 14 as per Lunne et al (1997)

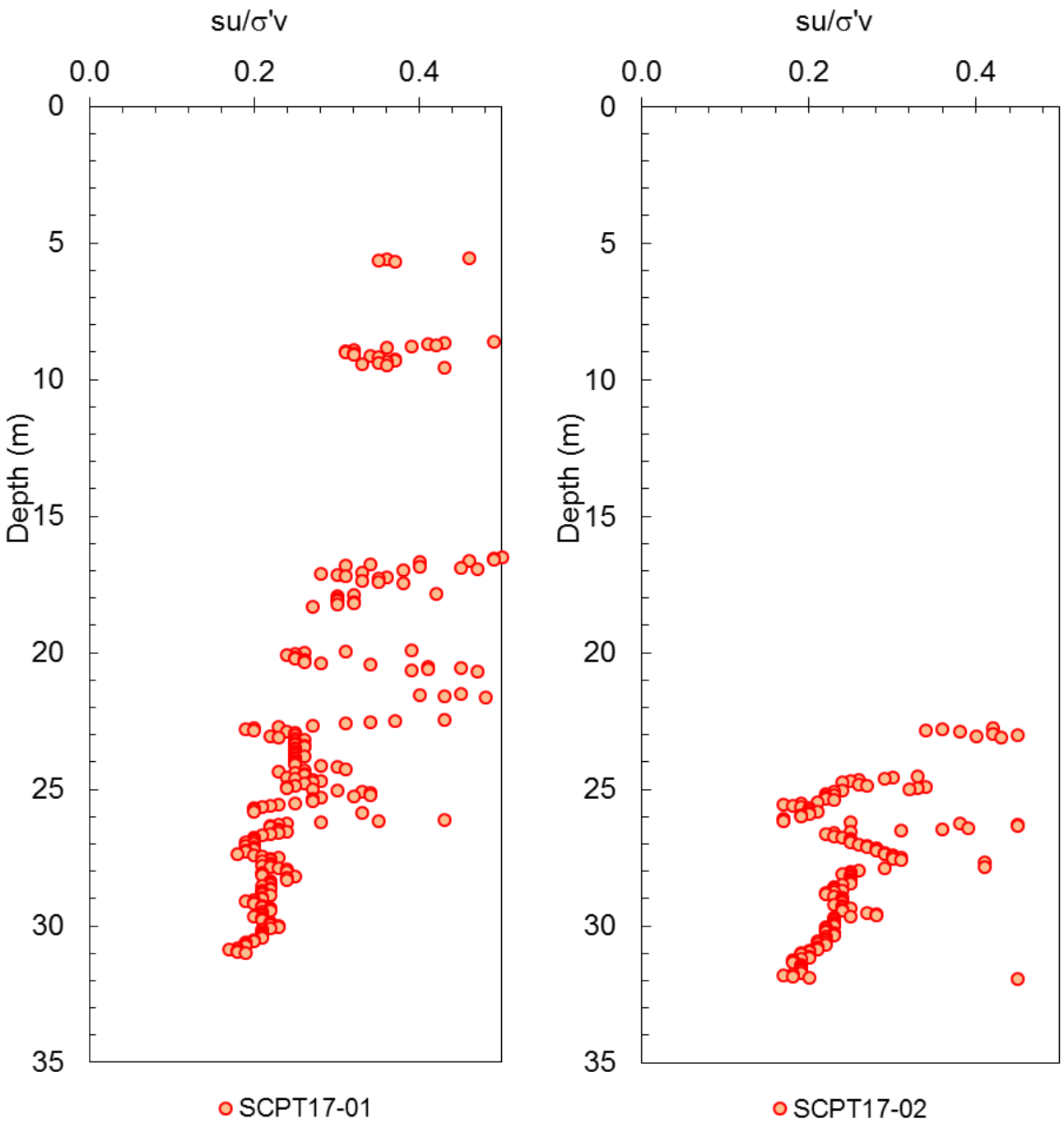


Figure A5-10 Peak undrained shear strength ratio estimated using an N_{kt} of 14 as per Lunne et al (1997)

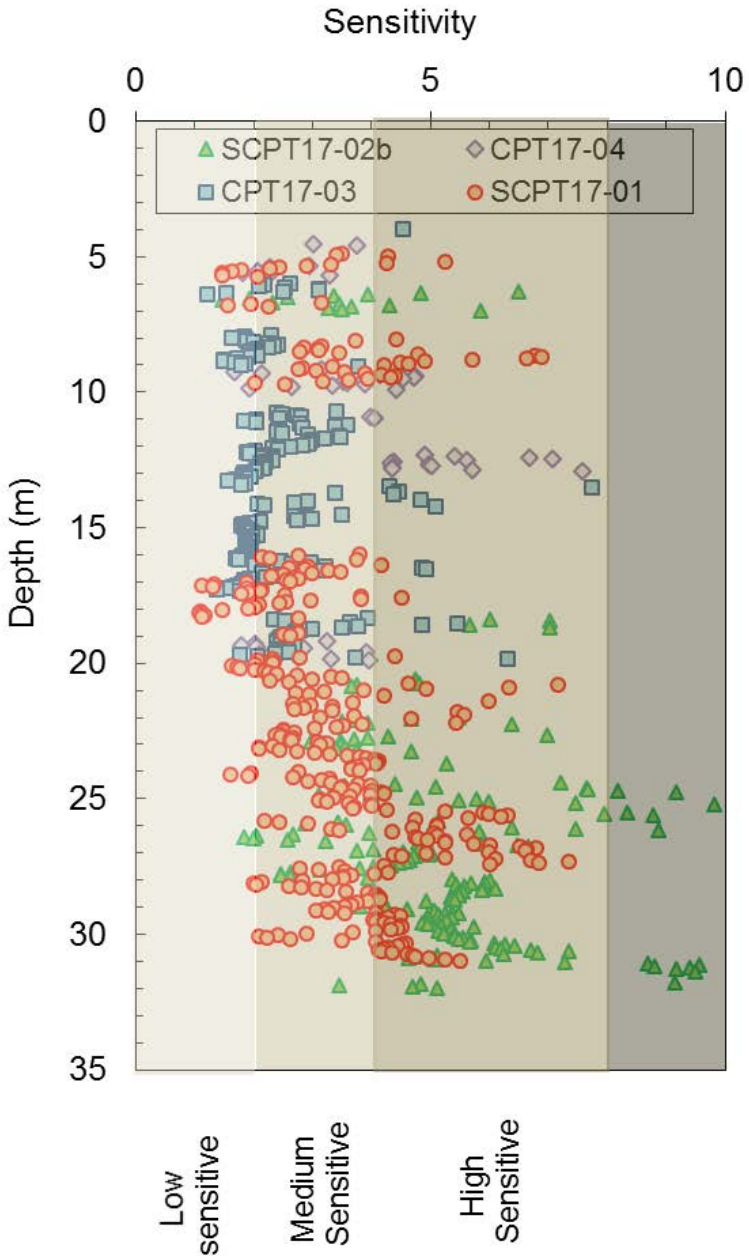


Figure A5-11 Sensitivity estimated from CPTs using the approach proposed by Robertson (2009)

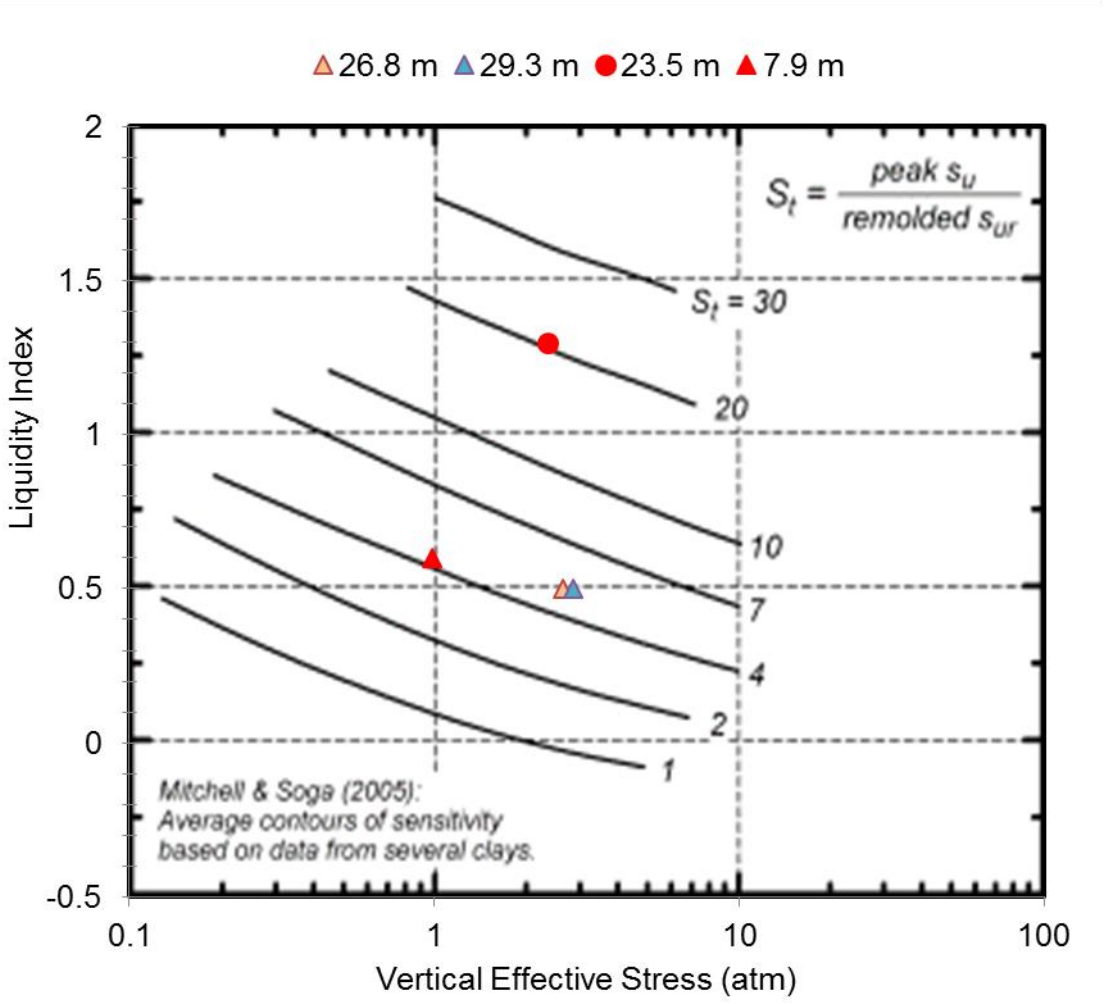


Figure A5-12 Soil sensitivities estimated using lab test results as per Mitchell and Soga (2005)

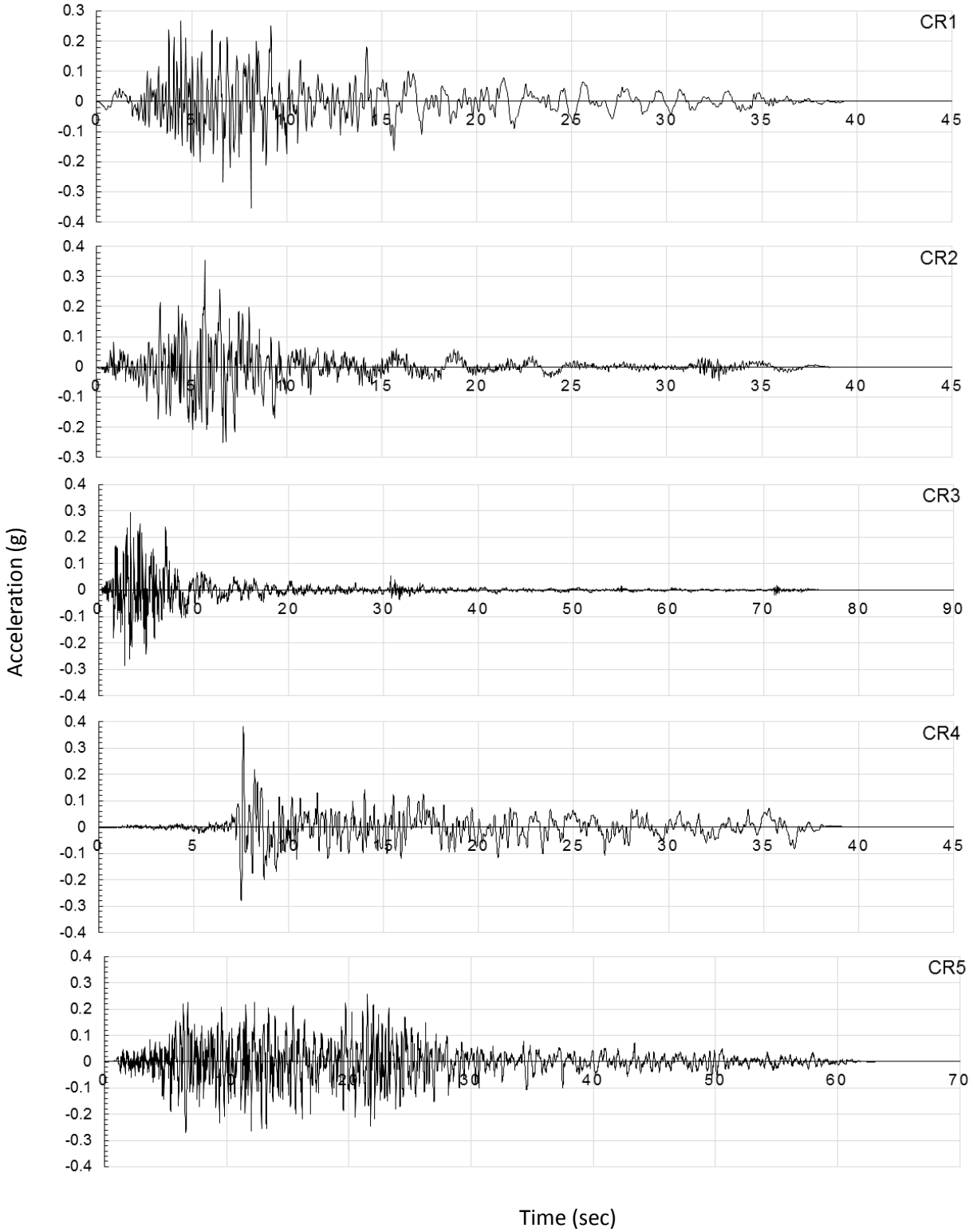


Figure A5-13(a) Scaled time histories for the Crustal seismic source.

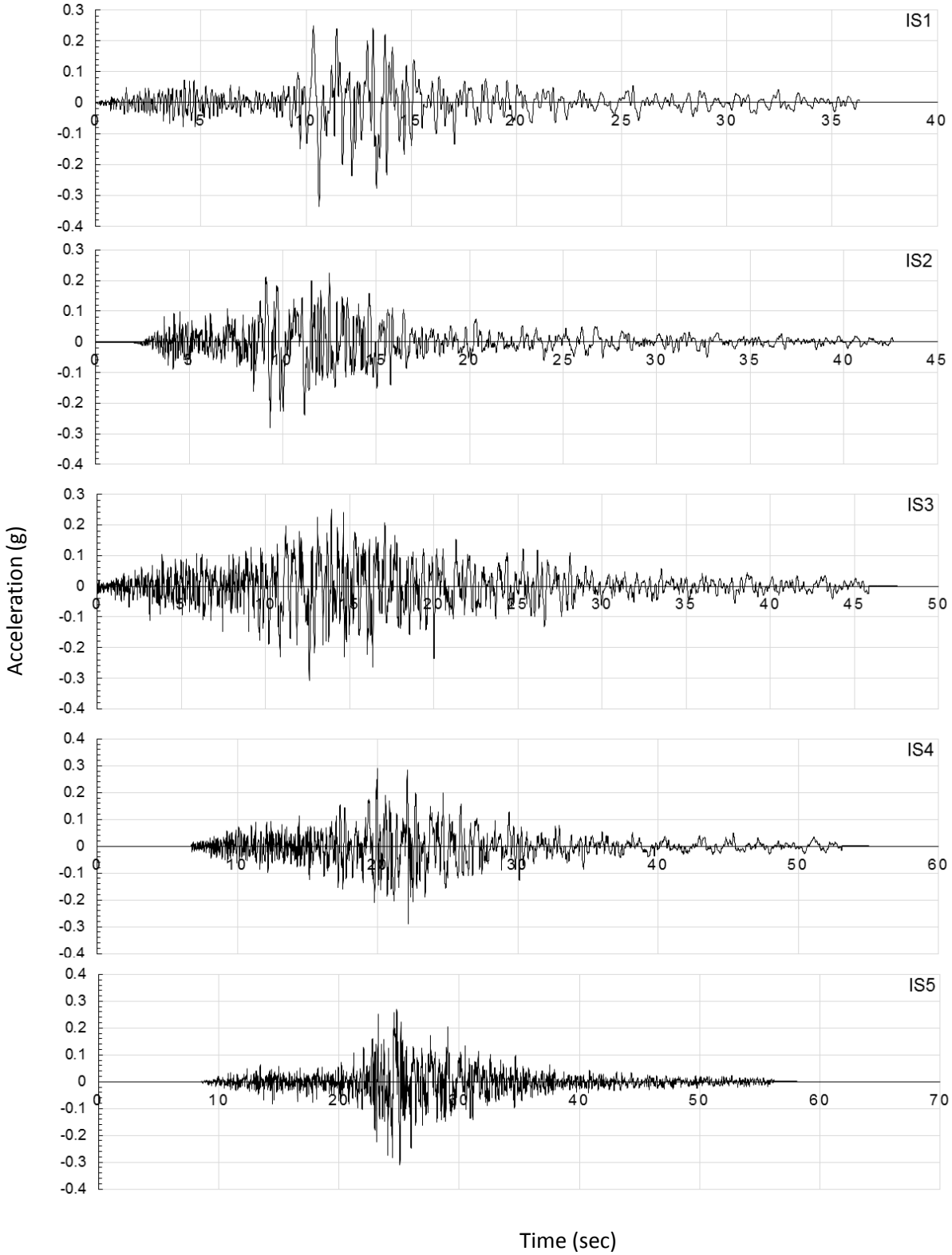


Figure A5-13(b) Scaled time histories for the Inslab seismic source.

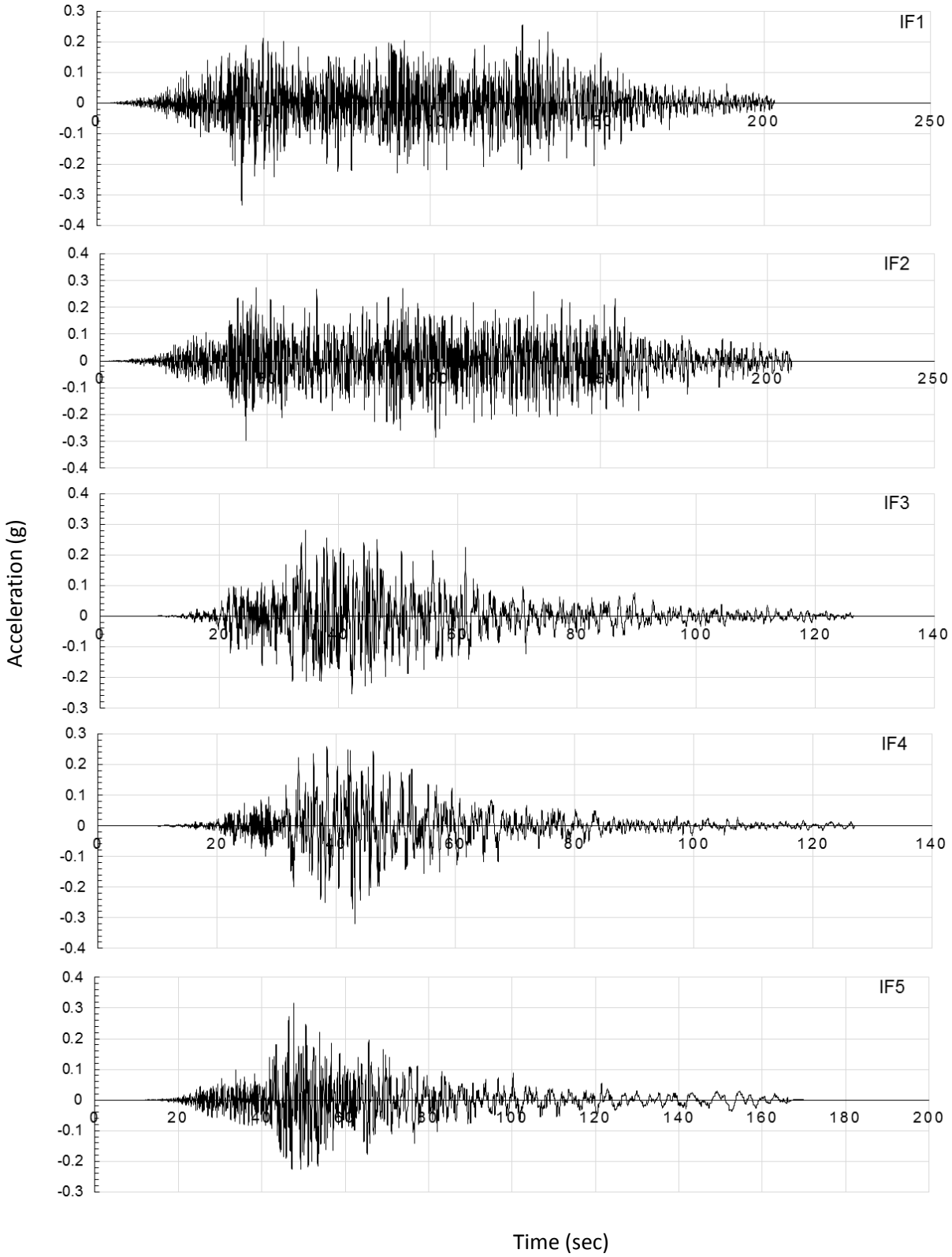
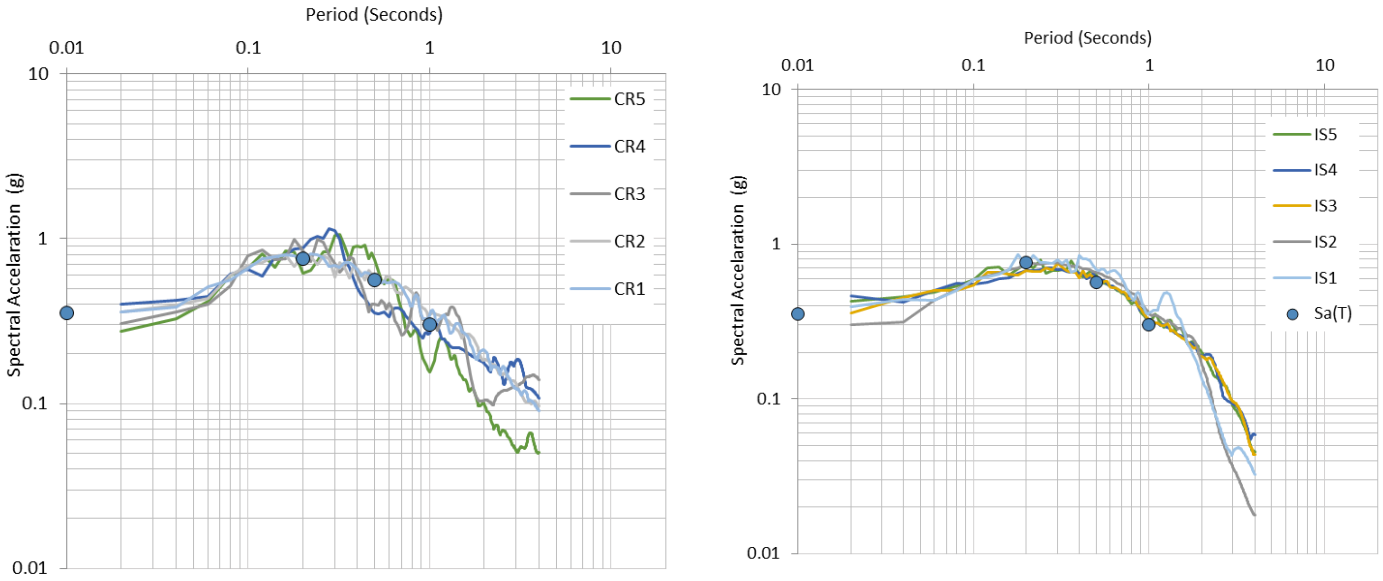
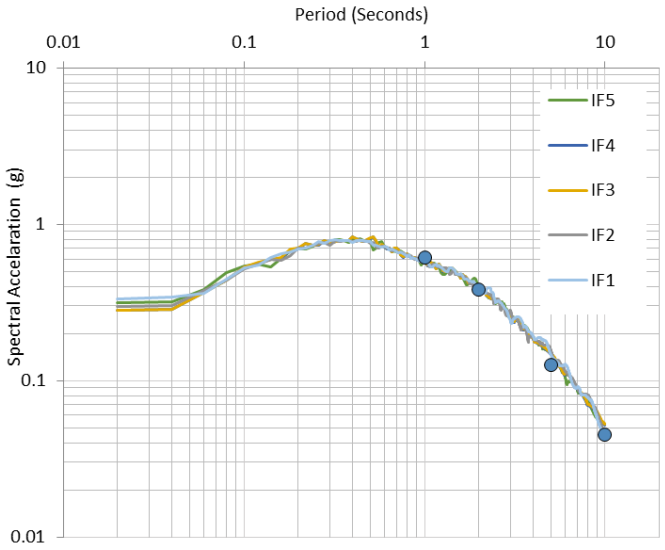


Figure A513(c) Scaled time histories for the Interface seismic source.



(a) (b)



(c)

Figure A5-14. Target and matched response spectrum of candidate motions for (a) Crustal, (b) Inslab and (c) Interface design earthquake events.

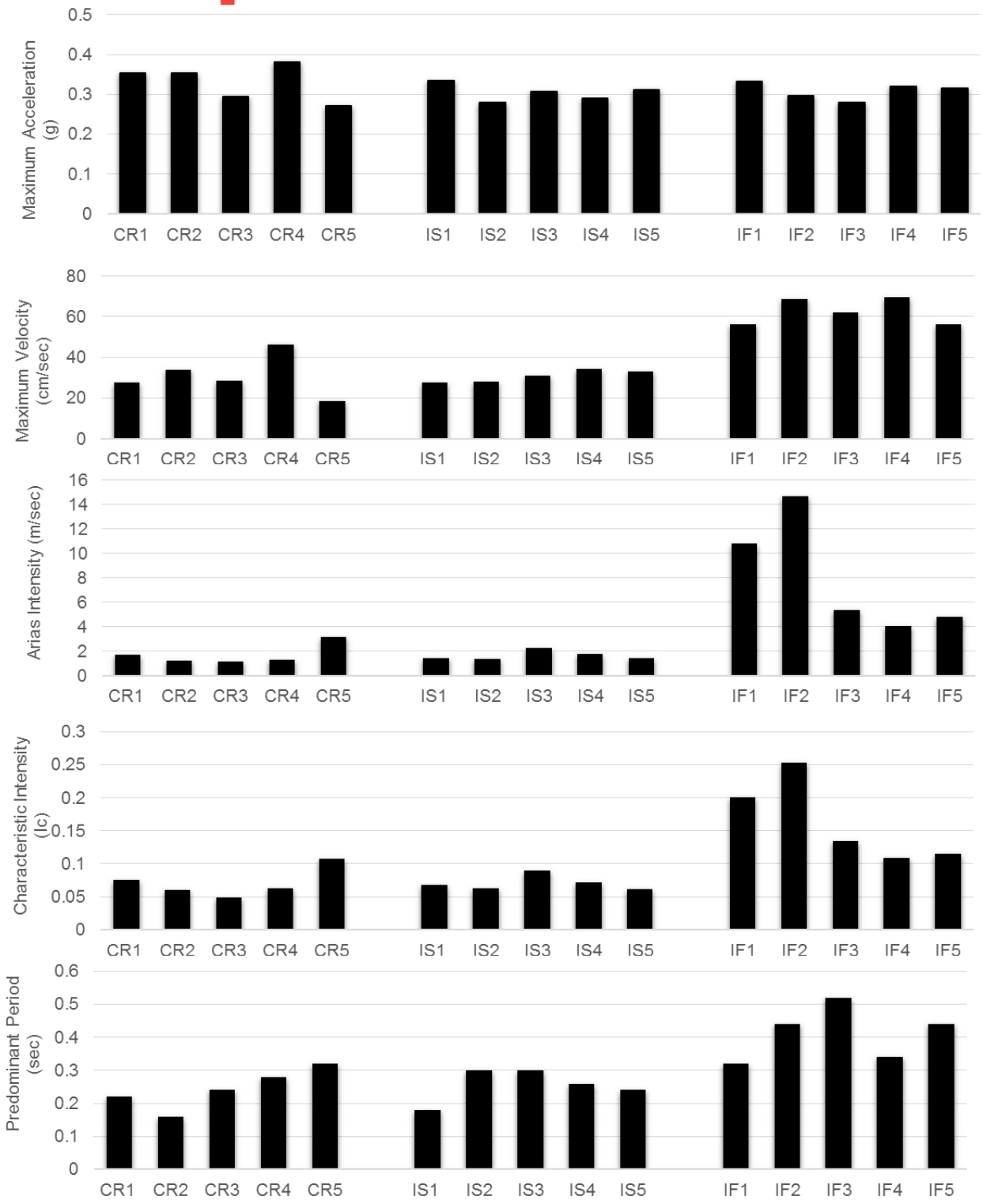


Figure A5-15. Select ground motion parameters of each input ground motion.

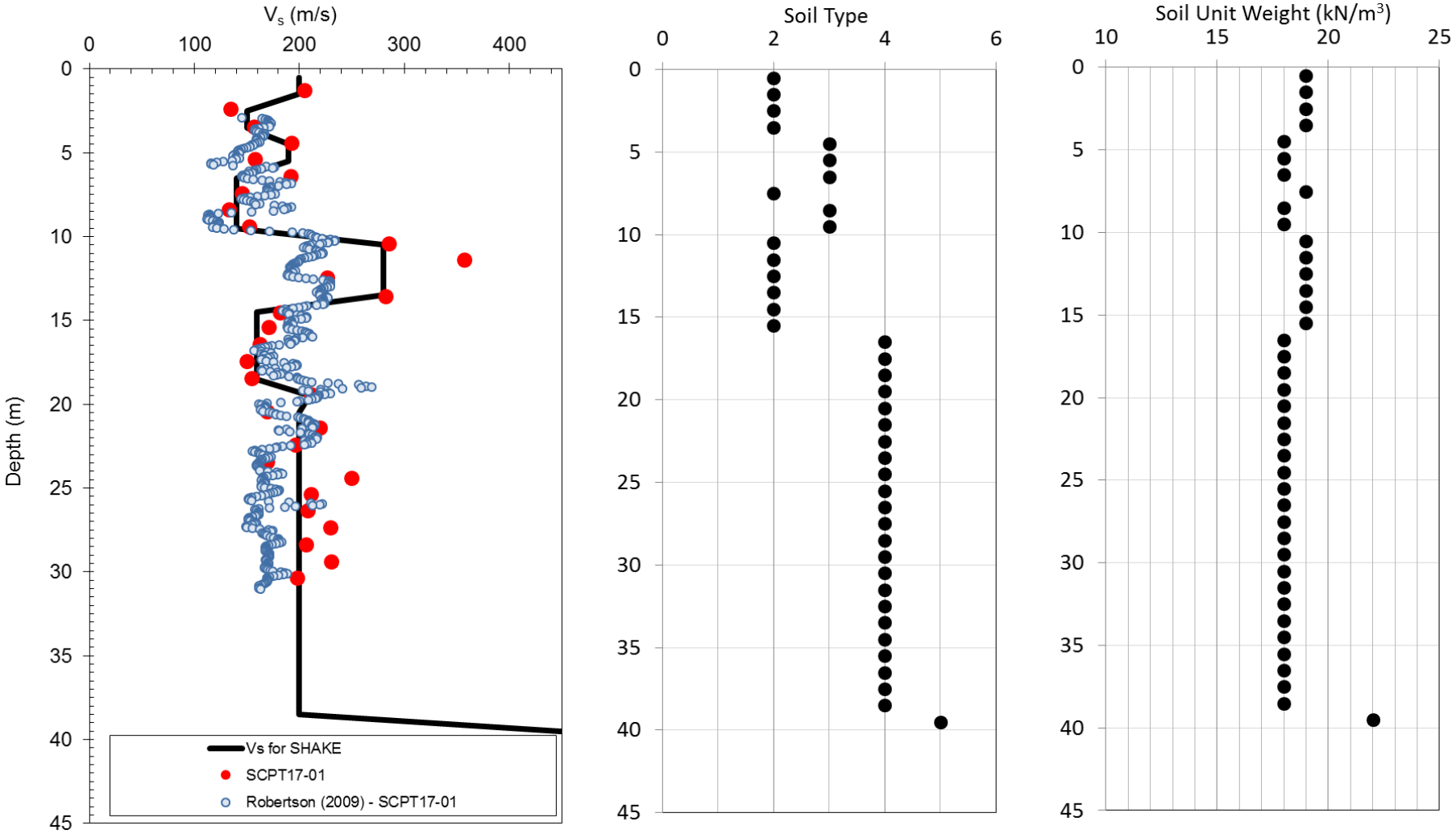


Figure A5-16: SHAKE input parameters for Soil Profile 1 (Aeration and UV Building)

- **Soil Type 2:** Seed et al. (1986)
- **Soil Type 3:** Vucetic and Dobry (1991) curves for PI of 5
- **Soil Type 4:** Vucetic and Dobry (1991) curves for PI of 15
- **Soil Type 5:** EPRI (1993) Soft rock

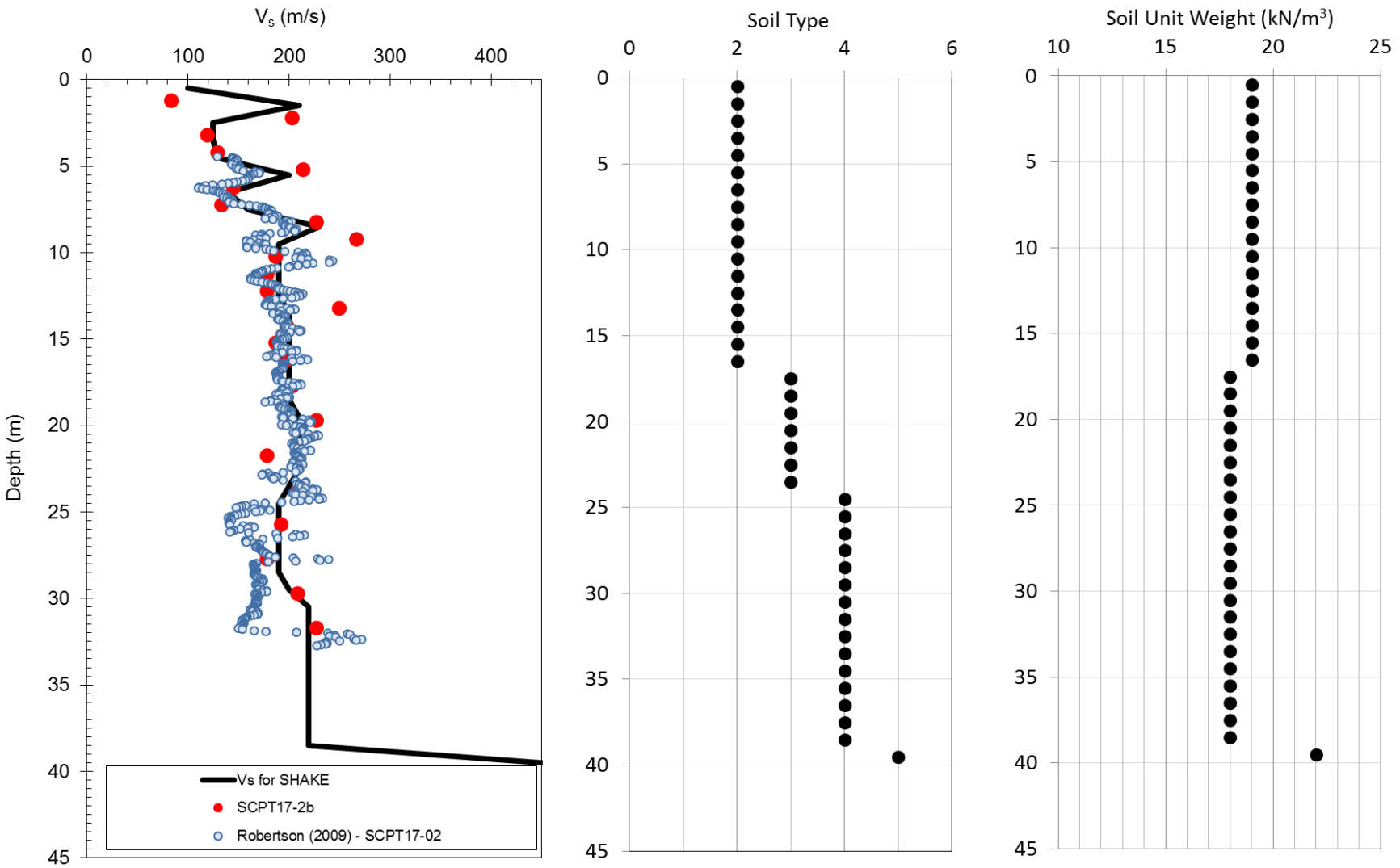


Figure A15-17: SHAKE input parameters for Soil Profile 2 (Screening Building)

- **Soil Type 2:** Seed et al. (1986)
- **Soil Type 3:** Vucetic and Dobry (1991) curves for PI of 5
- **Soil Type 4:** Vucetic and Dobry (1991) curves for PI of 15
- **Soil Type 5:** EPRI (1993) Soft rock

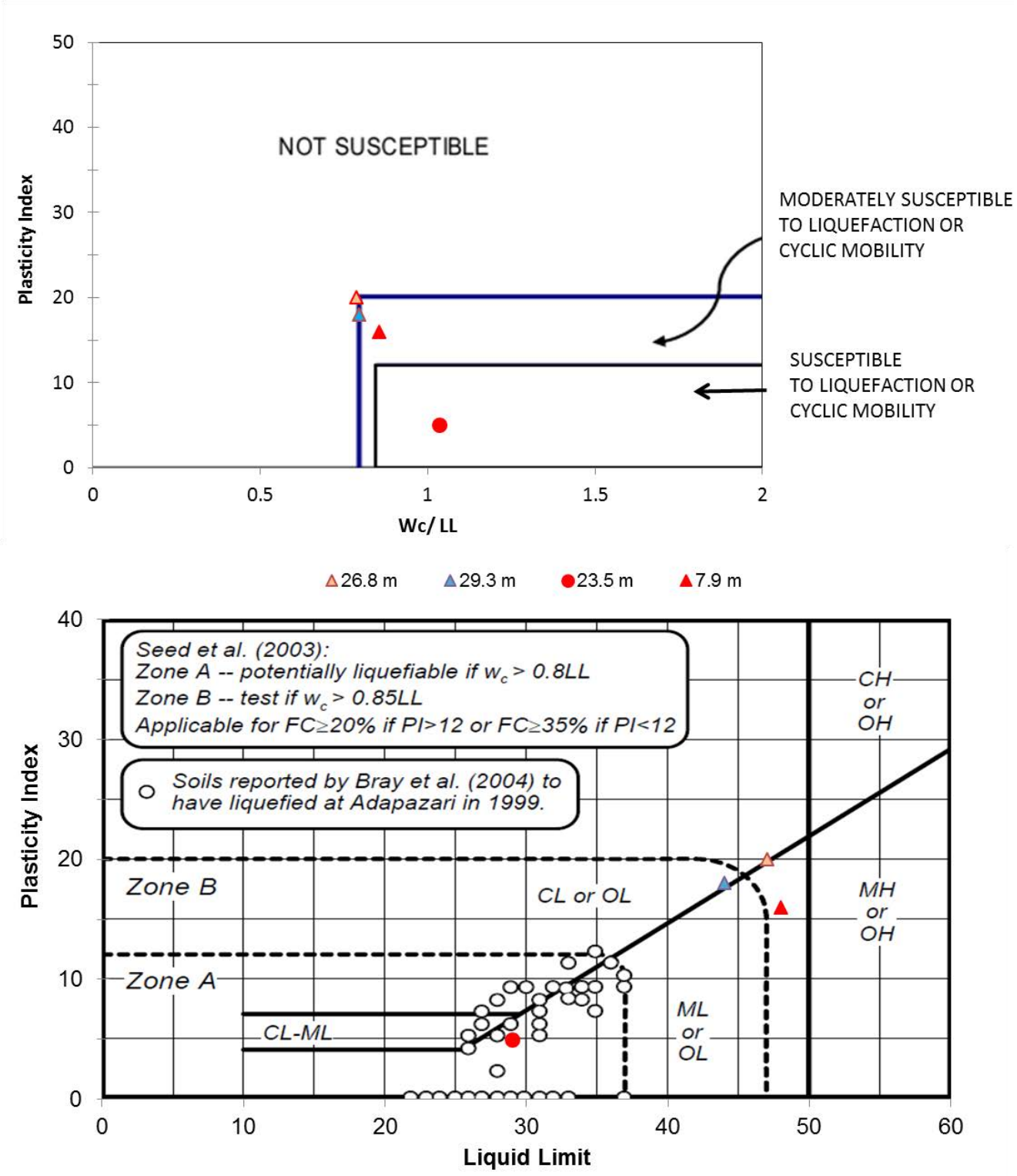


Figure A5-18 Liquefaction Susceptibility of fine-grained materials based on the approaches proposed by Bray and Sancio (2006) and Seed et al. (2003).

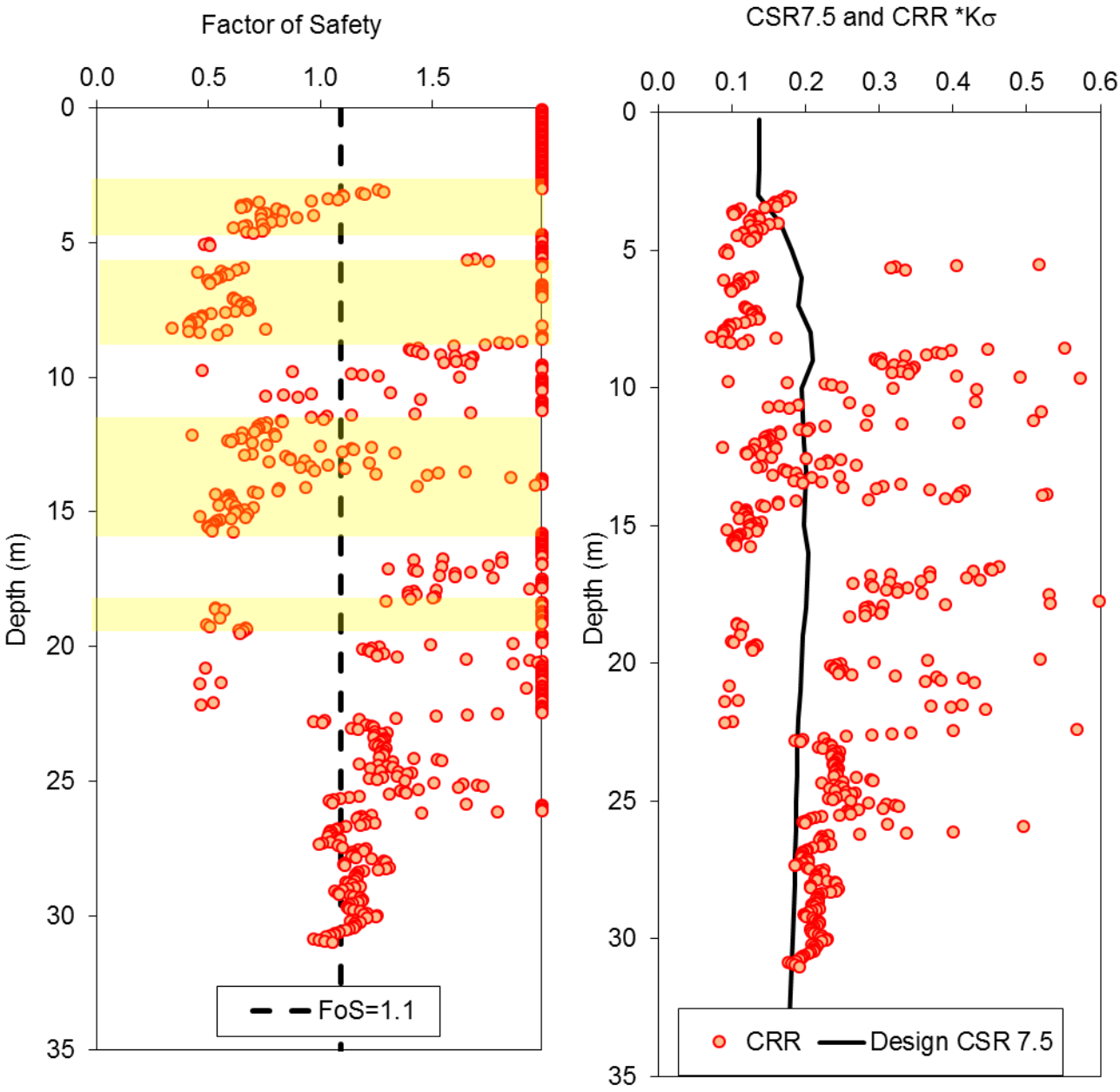


Figure A5-19(a) CSR, CRR and Factor of Safety against liquefaction (Soil Profile 1)

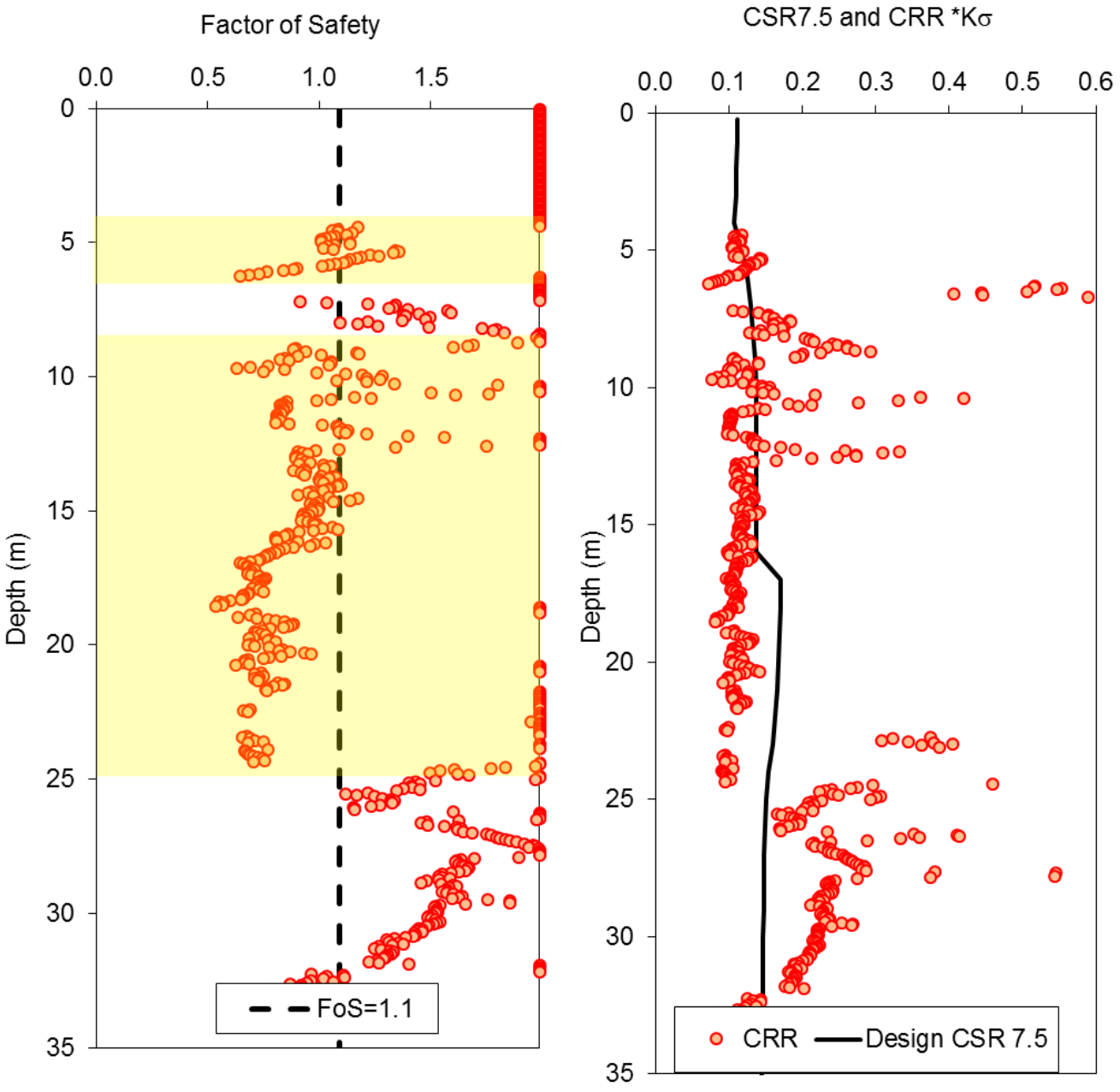


Figure A5-19 (b) CSR, CRR and Factor of Safety against liquefaction (Soil Profile 2)

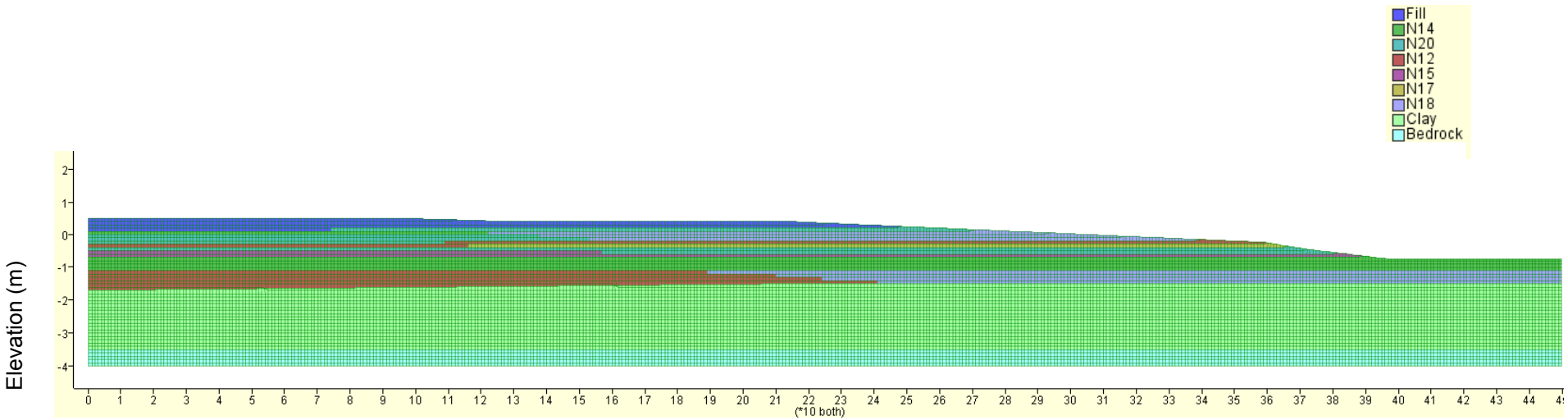


Figure A5-20: FLAC model for existing ground conditions

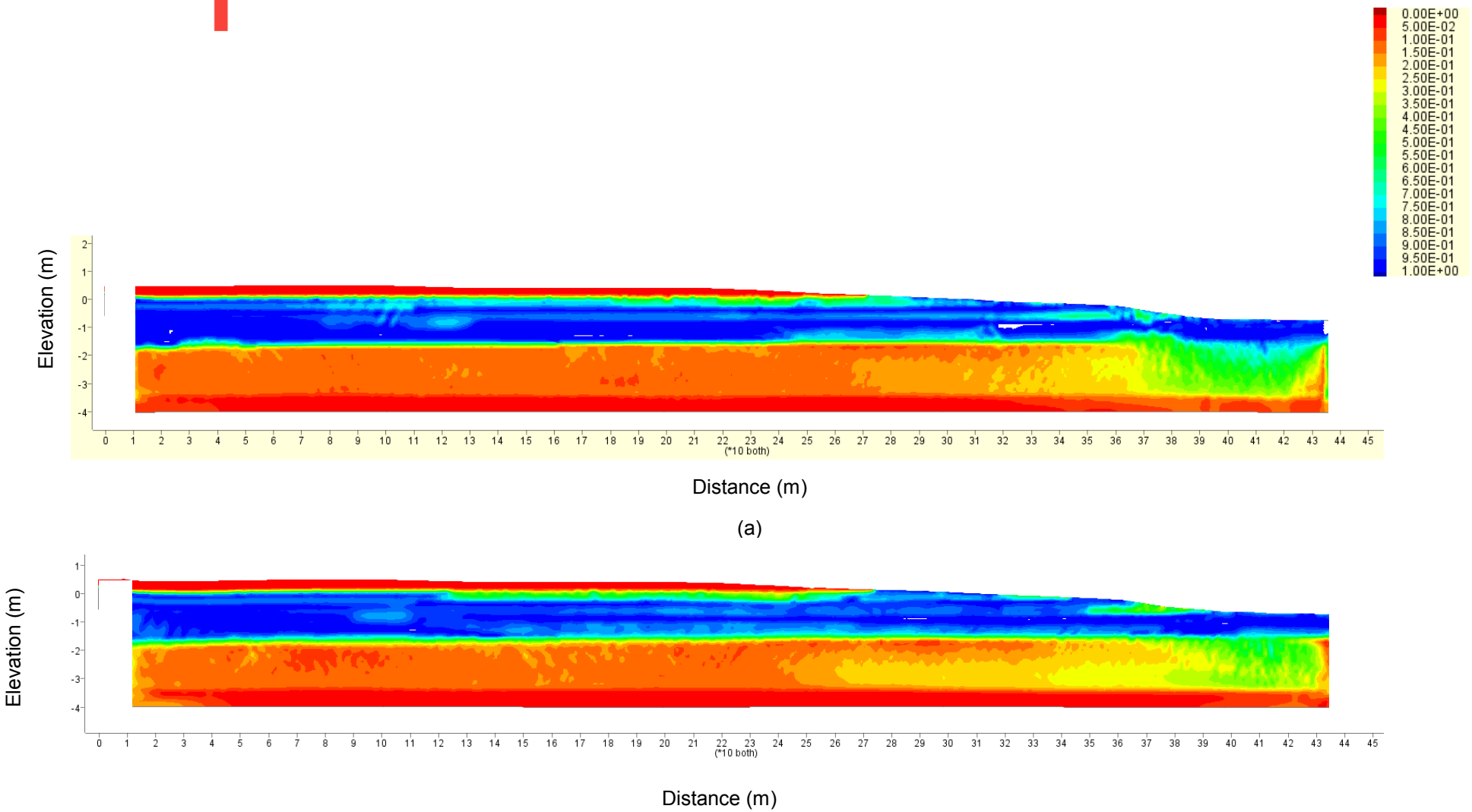


Figure A5-21: Maximum excess porewater pressure ratios estimated for (a) IS2 (in slab EQ) (at the end of shaking) and (b) IF3 (Interface EQ) (after 80 seconds)

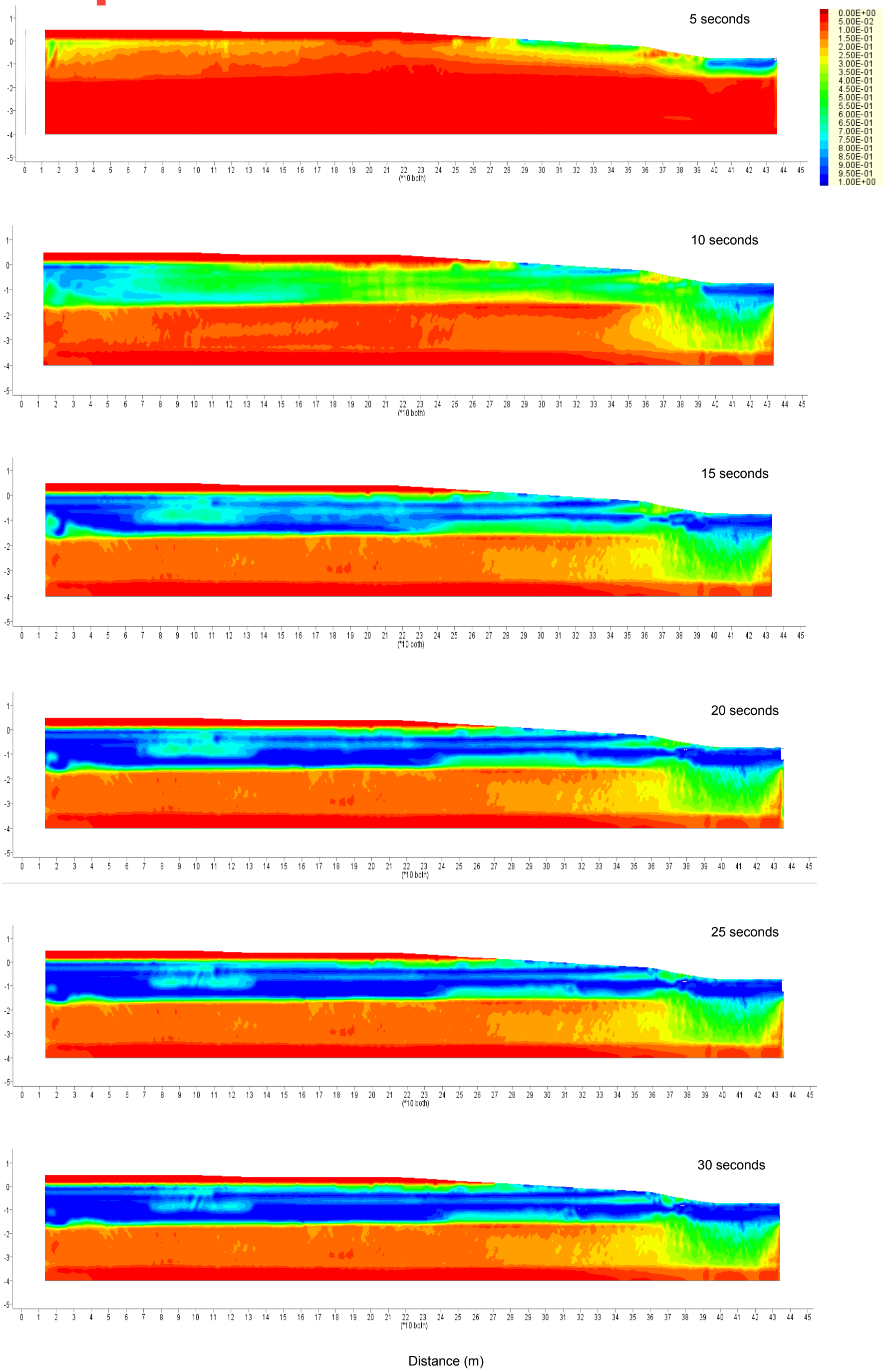


Figure A5-22: Maximum excess porewater pressure ratios estimated for the IS2 (In-slab EQ ground) motion

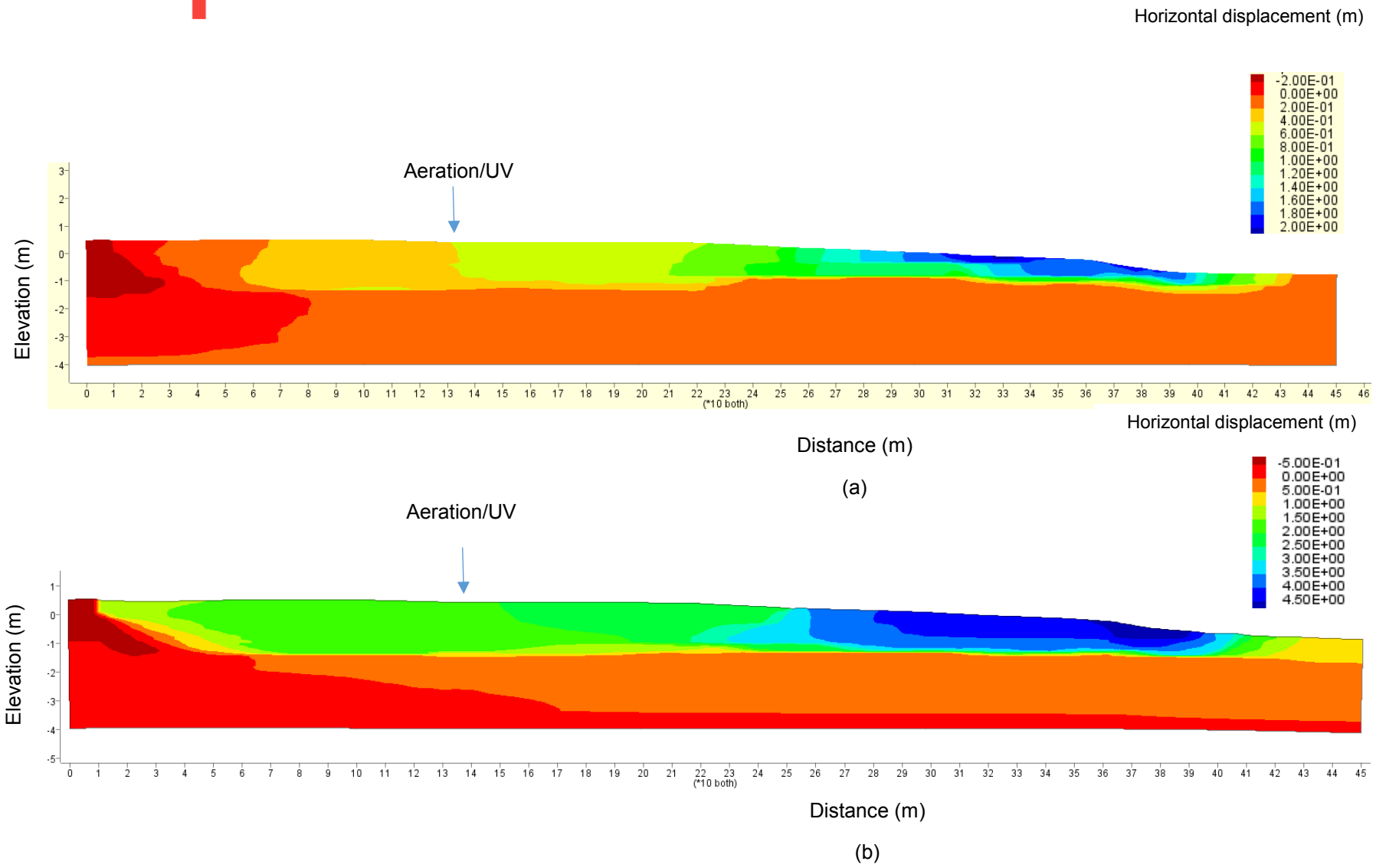


Figure A5-23. Horizontal displacements estimated at the end of shaking for (a) IS2 motion (In-slab EQ) and (b) IF3 motion (Interface EQ).

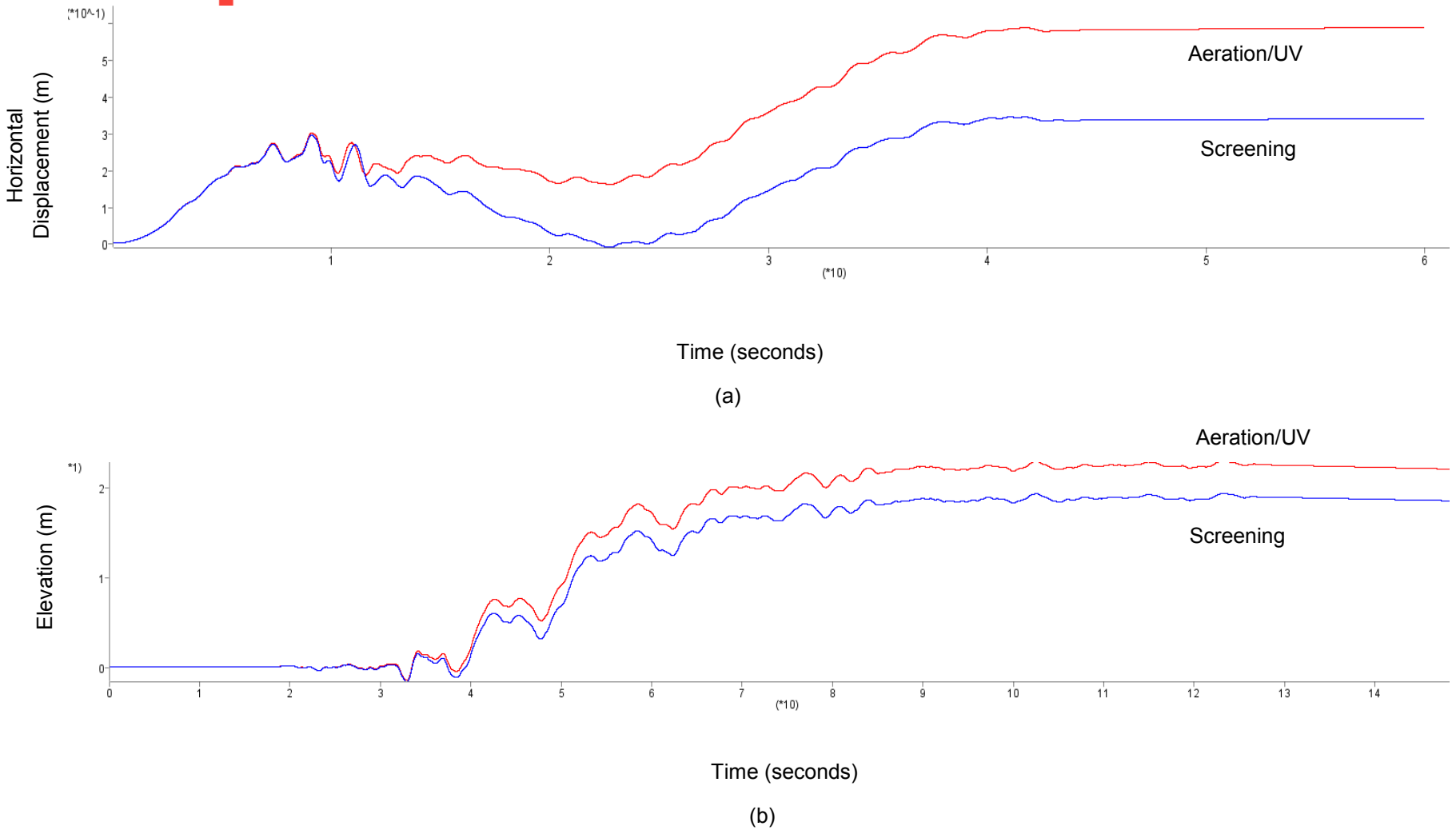


Figure A5-24: Displacement time histories recorded at two building locations (a) for IS2 (In-slab EQ) motion and (b) IF3 motion (Interface EQ)

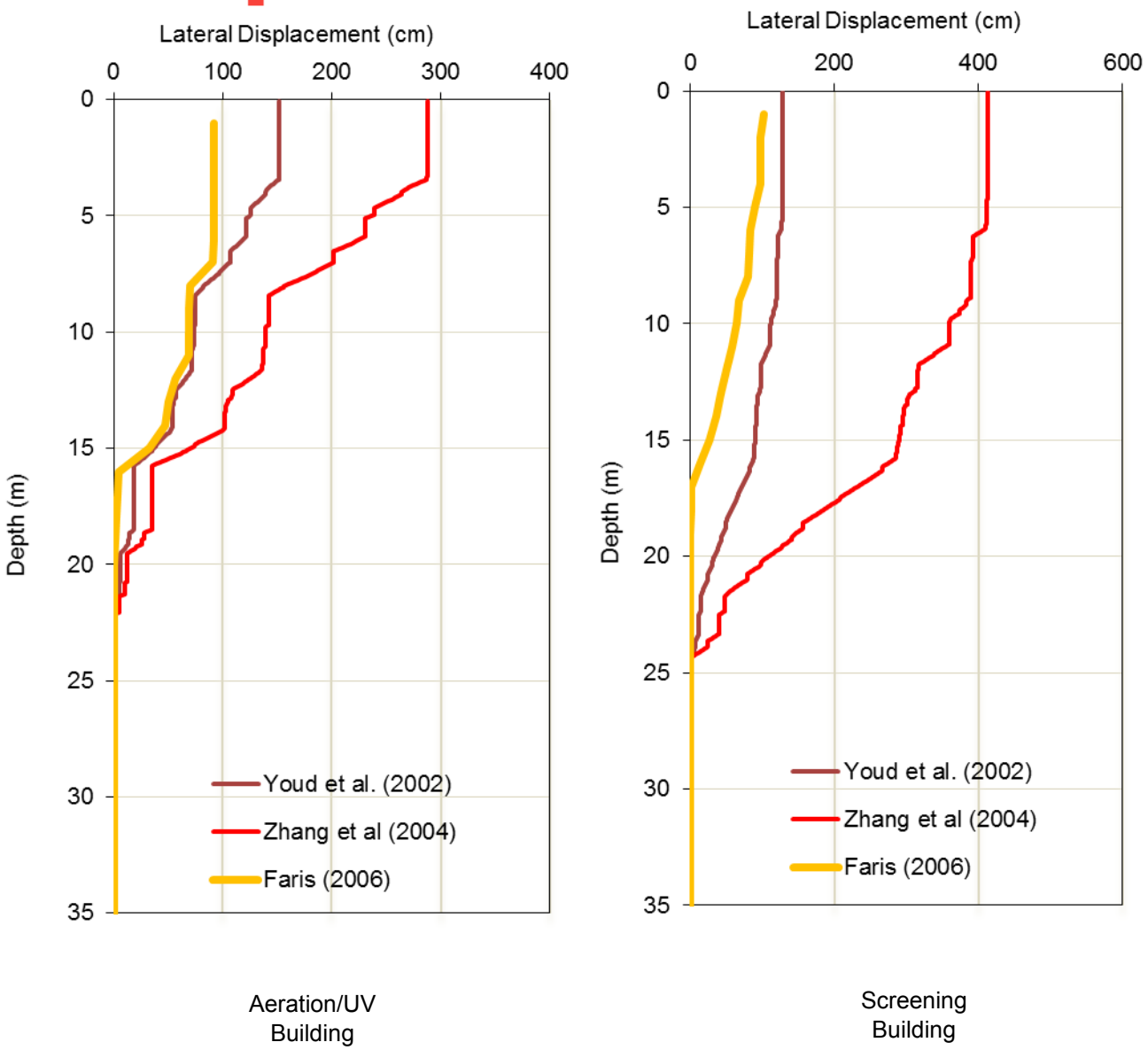


Figure A5-25- Post-seismic lateral spreading displacements estimated using Faris et al. (2006), Zhang et al (2002), Youd et al. (2002) methods.

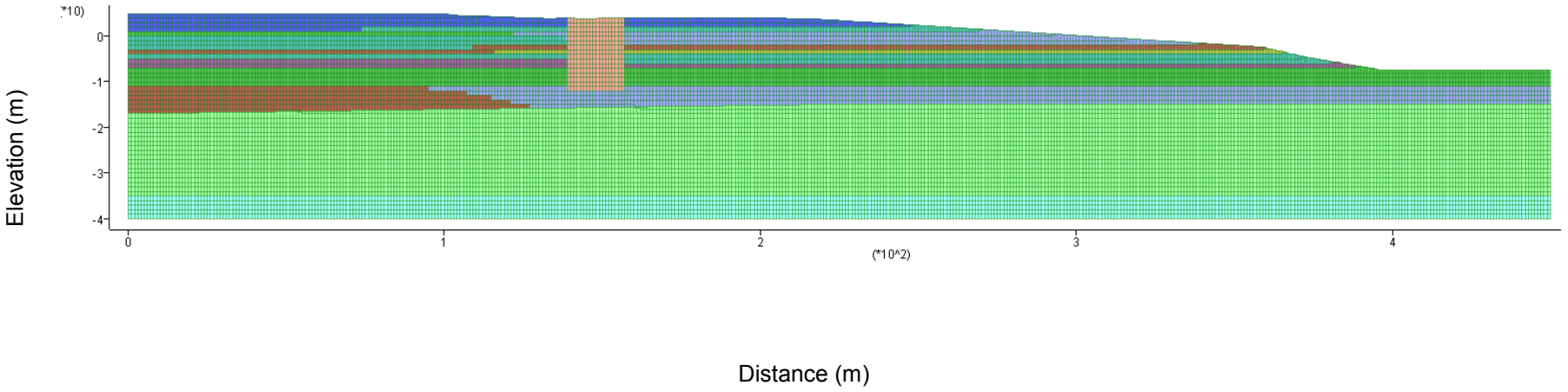


Figure A5-26: FLAC model with Deep Soil-Cement Mixing Method (DMM) of ground improvement (DMM) zone at the Aeration/UV building location.

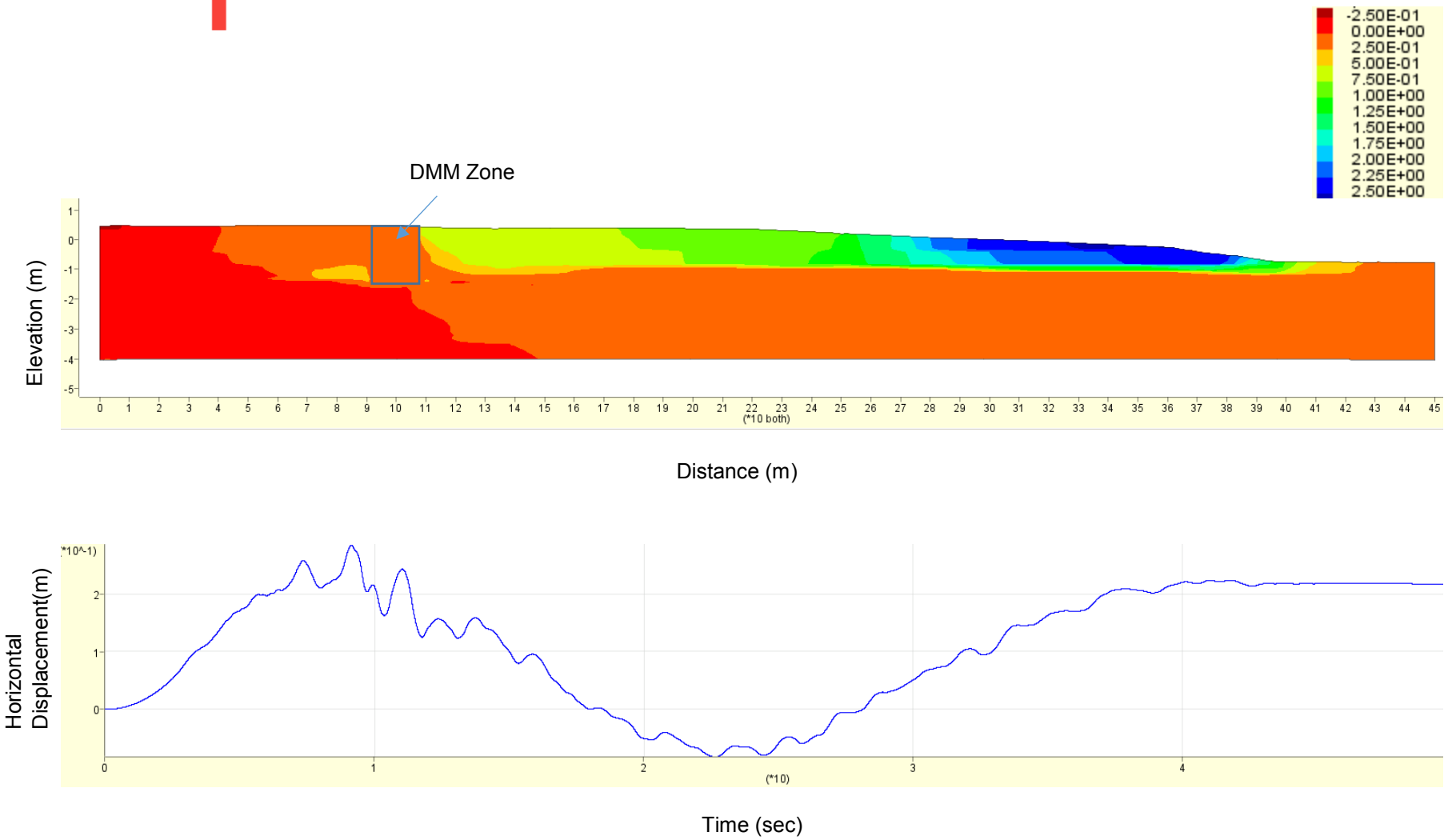


Figure A5-27 (a): After ground improvement: (a) Horizontal displacement profile at the end of shaking and (b) displacement time history at the Aeration/UV building (IS2 Motion) (In-slab EQ)

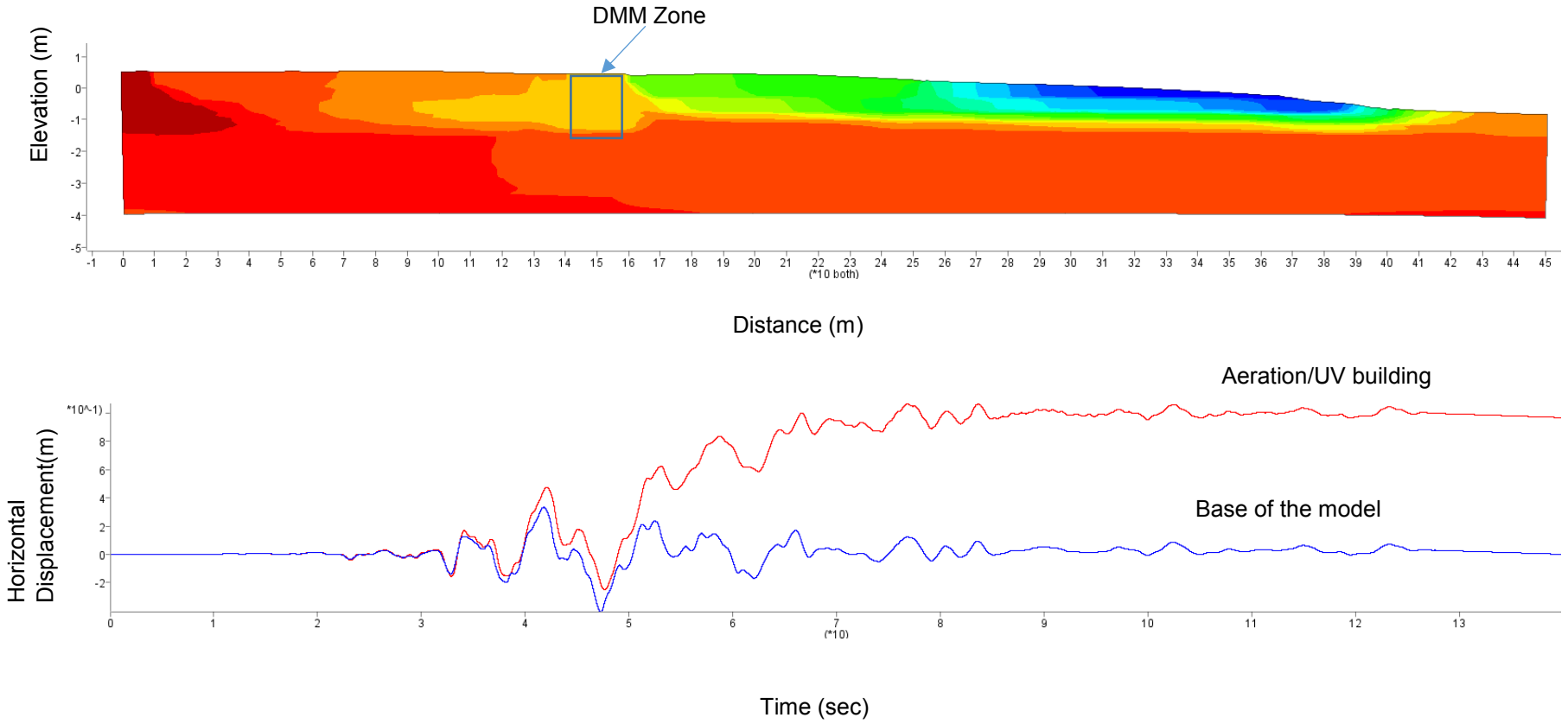


Figure A5-27 (b): After ground improvement: (a) Horizontal displacement profile at the end of shaking and (b) displacement time history at the Aeration/UV building location (IF3 Motion) (Interface EQ)

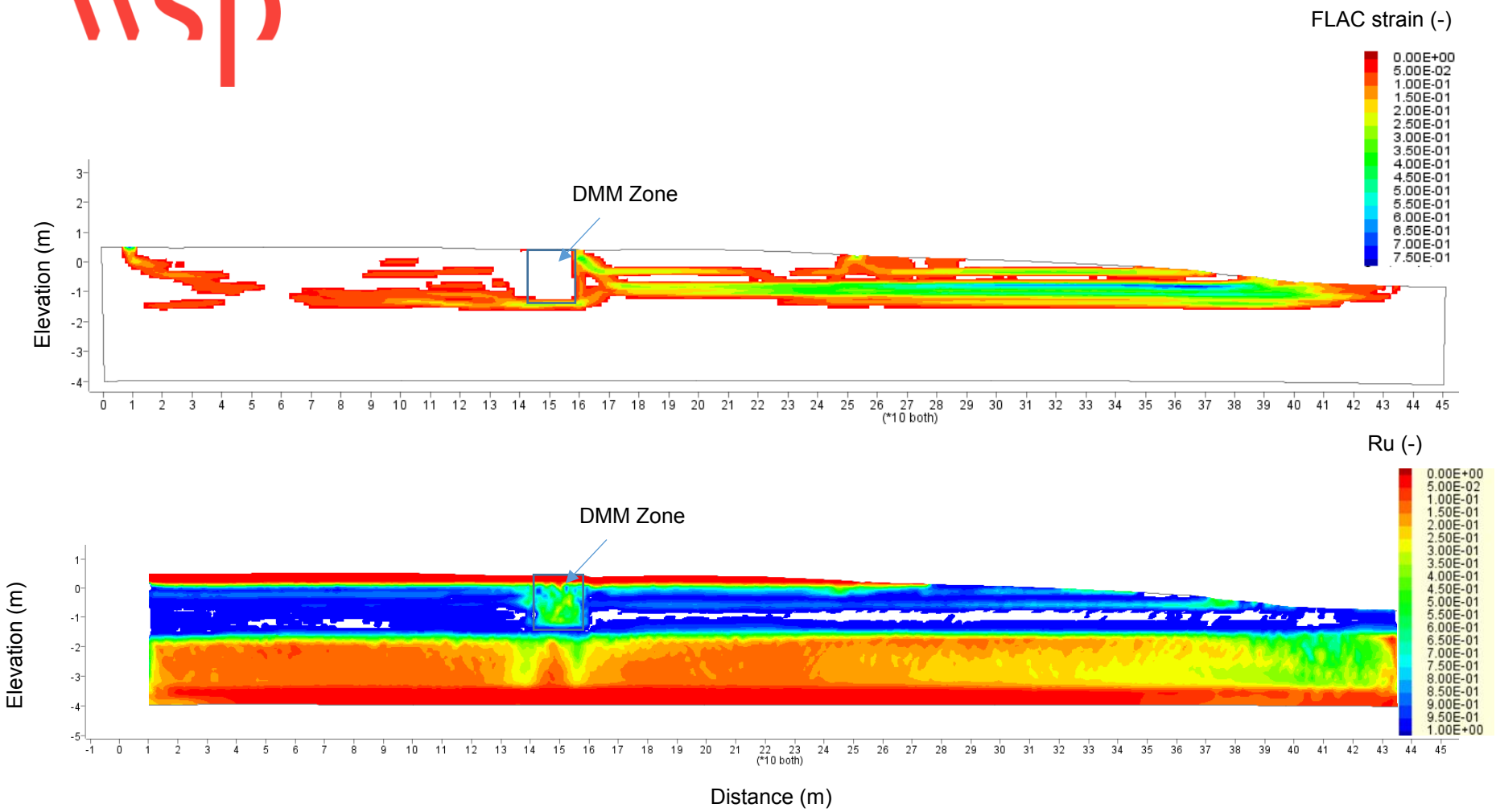


Figure A5-28: After ground improvement (a) Maximum shear strain and (b) excess pore water pressure contour at the end of shaking (for the Aeration/UV building – IF3 Motion) (Interface EQ)

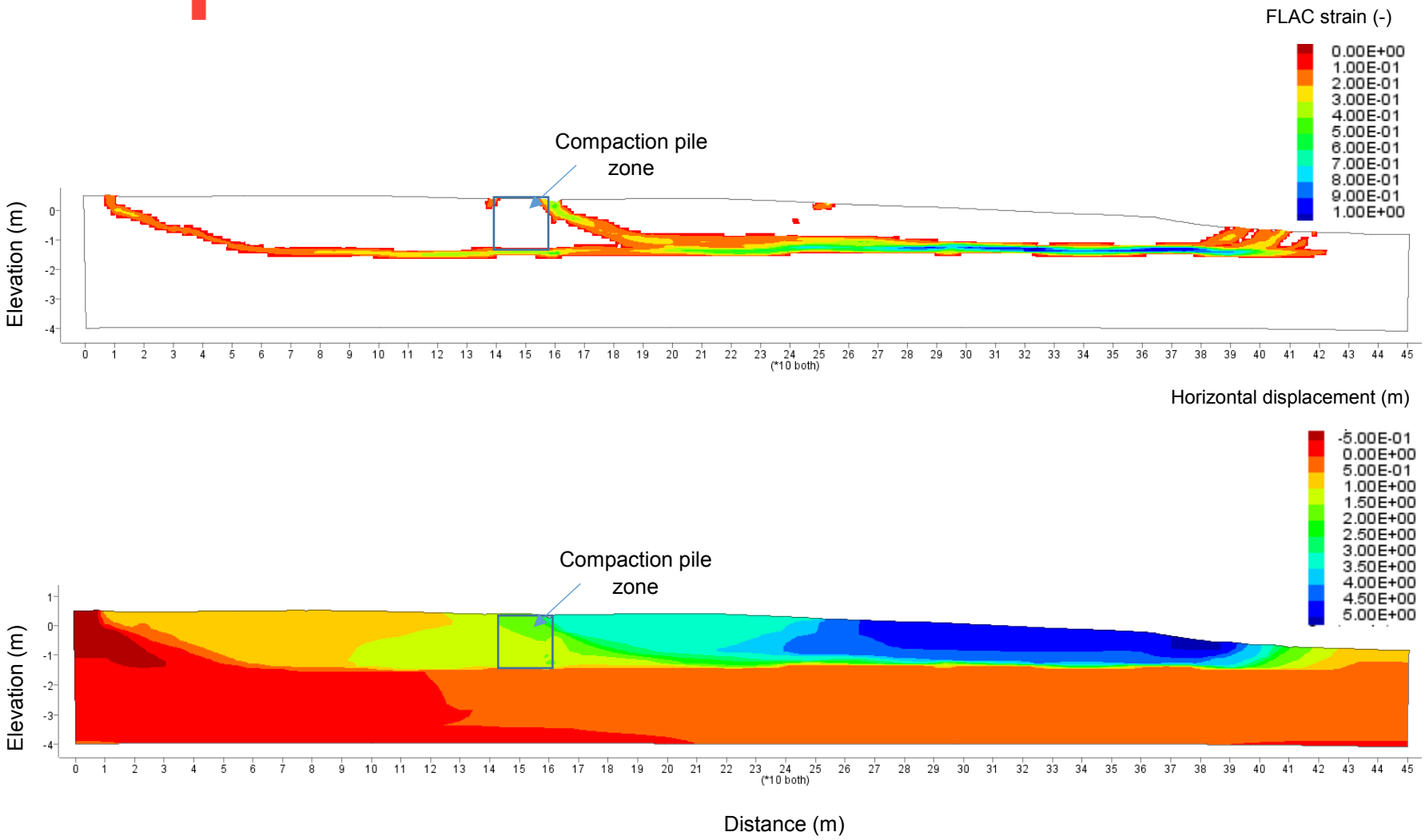


Figure A5-29: (a) Maximum shear strains and (b) horizontal displacements estimated at the end of shaking for the IF3 (Interface EQ) motion (Compaction pile option).

Table A5-3. Important Ground Motion Parameters

	Crustal					In-Slab					Interface				
	CR1	CR2	CR3	CR4	CR5	IS1	IS2	IS3	IS4	IS5	IF1	IF2	IF3	IF4	IF5
Max. Aceleration (g)	0.353	0.354	0.295	0.382	0.270	0.335	0.281	0.308	0.291	0.311	0.333	0.296	0.280	0.321	0.316
Time of Max. Aceleration (sec)	8.12	5.68	3.36	7.62	6.68	10.63	9.33	12.61	19.99	25.08	43.43	43.70	34.43	43.15	47.67
Max. Velocity (cm/sec)	27.7	34.0	28.5	46.2	18.6	27.8	28.2	31.0	34.3	33.1	56.2	68.6	62.0	69.4	56.1
Time of Max. Velocity (sec)	7.70	5.54	8.50	8.66	6.57	10.52	11.09	17.84	20.68	24.52	89.78	90.07	32.36	42.44	43.56
Max. Displacement (cm)	15.382	13.307	20.900	39.260	8.421	19.214	29.606	28.621	72.978	47.824	58.021	51.557	59.434	51.537	44.705
Time of Max. Displacement (sec)	8.40	9.36	7.08	16.87	10.15	11.47	9.07	8.84	13.04	22.77	88.40	88.04	36.81	47.14	53.44
Vmax / Amax: (sec)	0.080	0.098	0.099	0.123	0.070	0.085	0.102	0.103	0.120	0.109	0.172	0.236	0.226	0.221	0.181
Acceleration RMS: (g)	0.052	0.045	0.031	0.046	0.056	0.050	0.045	0.055	0.045	0.040	0.058	0.067	0.052	0.045	0.043
Velocity RMS: (cm/sec)	8.176	7.418	5.424	13.183	5.079	5.906	5.468	6.642	8.113	5.549	10.667	12.825	12.776	11.446	12.188
Displacement RMS: (cm)	4.541	4.382	3.873	13.851	2.361	9.663	14.967	16.103	45.575	21.598	8.183	8.292	13.804	9.759	10.439
Arias Intensity: (m/sec)	1.683	1.257	1.167	1.314	3.134	1.425	1.333	2.231	1.746	1.466	10.824	14.710	5.387	4.053	4.794
Characteristic Intensity (Ic)	0.076	0.061	0.048	0.063	0.107	0.068	0.062	0.089	0.072	0.062	0.201	0.254	0.135	0.109	0.115
Specific Energy Density (cm2/sec)	2674	2201	2337	6887	1646	1266	1275	2097	3622	1790	23923	34580	20963	16826	25476
Cumulative Absolute Velocity (cm/sec)	1344	982	1009	1178	2275	1117	1163	1757	1476	1260	8172	9944	3952	3151	4311
Acceleration Spectrum Intensity (g*sec)	0.282	0.275	0.284	0.298	0.329	0.298	0.283	0.263	0.259	0.273	0.292	0.289	0.295	0.296	0.292
Velocity Spectrum Intensity (cm)	129.0	137.1	106.0	103.7	96.3	143.0	136.8	135.8	138.8	142.5	235.5	233.8	229.6	224.3	232.1
Housner Intensity (cm)	128.8	130.3	104.1	110.4	83.3	128.8	124.0	126.4	127.3	127.4	227.5	223.5	224.4	220.3	223.4
Sustained Maximum Acceleration (g)	0.267	0.216	0.251	0.198	0.257	0.248	0.227	0.252	0.211	0.273	0.241	0.273	0.254	0.260	0.247
Sustained Maximum Velocity (cm/sec)	24.1	23.8	25.4	36.2	17.2	22.8	25.9	26.4	31.8	23.3	50.2	48.0	60.3	46.8	51.0
Effective Design Acceleration (g)	0.284	0.299	0.274	0.384	0.262	0.333	0.267	0.279	0.276	0.284	0.328	0.295	0.278	0.320	0.317
A95 parameter (g)	0.345	0.347	0.288	0.379	0.260	0.331	0.273	0.296	0.286	0.304	0.312	0.273	0.262	0.310	0.304
Predominant Period (sec)	0.220	0.160	0.240	0.280	0.320	0.180	0.300	0.300	0.260	0.240	0.320	0.440	0.520	0.340	0.440
Mean Period (sec)	0.601	0.564	0.576	0.657	0.392	0.550	0.509	0.477	0.527	0.477	0.779	0.847	0.904	0.989	0.910

APPENDIX

6. TERMS OF REFERENCE FOR GEOTECHNICAL REPORTS

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Appendix C – Hazardous Materials Survey

ASSOCIATED ENGINEERING LTD.

AERATION RESERVOIR ELECTRICAL BUILDINGS, PORT ALBERNI WASTE WATER TREATMENT PLANT

PRE-DEMOLITION HAZARDOUS MATERIALS SURVEY

NOVEMBER 13, 2017

AERATION RESERVOIR ELECTRICAL BUILDINGS, PORT ALBERNI WASTE WATER TREATMENT PLANT

PRE-DEMOLITION HAZARDOUS MATERIAL SURVEY

ASSOCIATED ENGINEERING LTD.

PROJECT NO.: 171-04753-00
DATE: NOVEMBER 13, 2017

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1 INTRODUCTION

WSP Consultants Inc. (WSP) was retained by Associated Engineering Ltd. (the Client) for the provision of a Pre-Demolition Hazardous Materials Survey (PHMS) for the three electrical buildings of the Port Alberni Waste Water Treatment Plant located in Port Alberni, BC. ("Subject Site" or "Site").

WSP understands that this PHMS is required for regulatory compliance and due diligence purposes prior to potential demolition or renovation repairs to the three electrical buildings on Site.

The three electrical buildings are known as the former Catalyst Aeration Reservoir Electrical Building, and the City of Port Alberni's two Aeration Electrical Buildings.

The former Catalyst Aeration Reservoir Electrical Building (AREB) is located in the southeast portion of the larger M-shaped reservoir at the T of the chamber separation diking. Available design plans for the AREB were dated 1969 and 1970. Available systems update plans for the AREB were dated 1989. The principal portion of the AREB has a concrete foundation slab footprint of approximately 24 ft. x 40 ft. (960 sq.ft. / 89 m^2) with partially reinforced concrete masonry unit (CMU) walls (none detected for vermiculite) approximately 13.5 ft. (4.1 m) in height, and a flat top multi-layered roof with an asbestos-containing panelling. On the northwest side of the AREB is an addition of similar construction with concrete foundation slab footprint of approximately 9 ft. x 22 ft. (200 sq.ft. / 18 m^2) with partially reinforced concrete masonry unit (CMU) walls approximately 8.5 ft. (2.6 m) in height and a flat top multi-layered roof. Approximately 1 m to the north of the addition is a modified Sea-Container (C-Can) with shelving, countertop, and sink. A wooden deck platform with structural steel framed hoist travel lift with corrugated metal roof is immediately adjacent to north of the above-noted.

The City of Port Alberni's two Aeration Electrical Buildings (AEB) are located on the east end of the north portion of perimeter dike of the smaller reservoir. The larger more recent westward 600 Volt AEB is thought to have been constructed in 1999. The 600 Volt AEB has a concrete foundation slab footprint of approximately 9 ft. x 16 ft. (145 sq. ft. / 13.5 m^2) with partially reinforced concrete masonry unit (CMU) walls (none detected for vermiculite) approximately 8 ft. (2.4 m) in height and a flat top concrete slab roof. The smaller older eastward 480 Volt AEB is thought to have been constructed in the 1960s. The 480 Volt AEB has a concrete foundation slab footprint of approximately 7.5 ft. x 9 ft. (70 sq. ft. / 6.4 m^2) with partially reinforced concrete masonry unit (CMU) walls in-filled with vermiculite approximately 9 ft. (2.6 m) in height, and a flat top concrete slab roof.

Various surface coatings (paints) were applied to the exterior and interior surfaces of the three buildings. Each of the buildings contained services associated electrical componentry which are connected to extended sub-surface utilities.

The above-noted three buildings are planned to be removed and/or substantially altered.

Based on the estimated construction and renovation dates, hazardous building materials may be present.

The objective of the PHMS is to establish the presence / absence, location, and type of hazardous building materials utilized in the construction of the three buildings on Site by means of sample collection and subsequent laboratory analysis. Section 20.112 of the BC Occupational Health and Safety Regulation requires that a hazardous materials survey to be conducted by a qualified person prior to any demolition or renovation activity which might disturb hazardous materials.

For the purposes of this survey, hazardous building materials will be defined as:

- Asbestos-containing materials (ACM);
- Lead materials and lead-based paints (LBP);
- Mercury;
- Polychlorinated biphenyls (PCB);
- Crystalline silica;
- Ozone depleting substances (ODS);
- Radioactive materials;
- Mould and/or microbial growth; and
- Flammable, Explosive, or Potentially Toxic/Hazardous Materials.

The survey and review was conducted in general accordance with WorkSafeBC Occupational Health and Safety Regulations Part 20, Construction, Excavation and Demolition, Section 20.112 Hazardous Materials.

The PHMS was conducted by identifying the above defined hazardous materials including suspect ACM and LBP through on-Site bulk sampling and subsequent laboratory analysis, review for visual / olfactory presence of suspected mould growth, and review of elements or components which may contain lead products, mercury, PCB, ODS, and RAM.

The samples were analyzed by International Asbestos Testing Laboratories (IATL), following methods that comply with the WorkSafeBC Occupational Health and Safety Regulations and Hazardous Waste Regulation as defined by the BC Ministry of Environment.

This report documents the on-Site field review of hazardous building materials completed by WSP on October 6, 2017.

2 LIMITATIONS

The PHMS included construction materials and components only. As it is neither practical nor feasible to sample materials on a foot by foot basis, visually similar materials' analysis results were extrapolated throughout the structure and / or based on estimated phases of construction, where that information was made available.

Energised electrical and mechanical equipment or systems were not opened for safety reasons. This survey excluded owner or occupant articles such as furniture or stored items. Concealed or inaccessible materials within the building structure, fire doors, reinforcing elements, and below ground materials including tanks and pipes were specifically excluded from our scope of work.

No below-grade water, drainage or plumbing systems or sub surface investigation of materials were included in the scope of this PHMS. No attic or crawl space areas were encountered as part of this PHMS.

WSP undertook on-Site bulk sampling for suspect asbestos materials, and suspect high lead content surface coatings (paints). In addition, WSP collected bulk samples of non-metallic base substrates with suspect high lead content surface coatings (paints) for potential toxicity characteristic leaching procedure (TCLP) analysis.

3 SCOPE OF WORK

The PHMS was performed by a qualified and experienced Environmental Technologist with AHERA Building Inspector Certification. The following tasks were performed as part of this survey:

- Review of provided AREB associated 1969-70 design drawings and 1989 renovation design drawings;
- On site review of building materials, and collection of bulk samples suspected to contain asbestos;
- On site review of building surface coatings, and collection of bulk samples (paints) suspected to contain elevated concentrations of lead;
- Visual review for identification of interior thermostats or fluorescent light tubes which may contain mercury;
- Visual review for identification of building construction materials which may contain silica such as concrete, cement, tile, brick, masonry, mortar;
- Visual review for identification of equipment which may have Ozone Depleting Substances (ODS i.e. halons or refrigerants);
- Visual review for identification of smoke detectors or exit signs with the potential to contain radioactive materials (RAM);
- Visual review of building interiors for signs of suspect mould growth;
- Visual review for stored materials which may be flammable or explosive;
- Photography of the above determined materials as encountered on Site; and
- Preparation of this report summarizing the specific hazardous building materials identified through review and analysis.

Building Plans showing bulk material sampling locations are attached in Appendix I. Photographs of suspect hazardous building materials are presented in Appendix II of this report.

4 METHODOLOGY

On October 6, 2017, Mr. Gordon Philippe, B. Tech. AHERA certified Environmental Technologist of WSP conducted the PHMS site work according to the following protocol. Visual review was conducted for suspect hazardous materials likely to be impacted by planned demolition or renovation activity which might disturb hazardous materials. The building areas and materials typically containing suspect hazardous materials were reviewed from the accessible areas.

Site visit photographs taken of the in-situ suspect materials are presented in Appendix II.

WSP undertook on-Site bulk sampling for suspect asbestos materials, and suspect high lead content surface coatings (paints). In addition, WSP collected bulk samples of non-metallic base substrates with suspect high lead content surface coatings (paints) for potential toxicity characteristic leaching procedure (TCLP) analysis.

The bulk sample collection frequency for suspect asbestos materials and elevated lead content surface coatings (paints) was consistent with recognized industry standards and principles of good occupational hygiene practice. The number of samples collected was based on experienced professional judgment in consideration of, but not necessarily limited to, the era of construction, and uniformity of materials, and size of area of homogeneous materials.

Collected samples were placed in plastic bags appropriate for the proposed analysis. The sample material descriptions, sample locations, and associated sample numbers were indicated on sample bags and the Chain-of-

Custody (COC) forms. Chain-of-custody protocol was observed during handling and transportation of the bulk samples.

The bagged samples and COC forms were sent to International Asbestos Testing Laboratories (IATL) in Mount Laurel, New Jersey, USA for analyses. IATL is an accredited laboratory that participates in the American Industrial Hygiene Association's (AIHA) Bulk Asbestos Proficiency Analytical Testing (BAPAT) Program.

The completed Chain-of-Custodies (COCs) and the Laboratory Reports of analytical results are presented in Appendix III.

4.1 ASBESTOS CONTAINING MATERIALS (ACM)

Twenty-one (21) representative bulk samples of suspect materials that could potentially contain asbestos were collected from the AREB.

No representative bulk samples of suspect materials that could potentially contain asbestos were collected from the 600 Volt AEB.

Three (3) representative bulk samples of suspect materials that could potentially contain asbestos were collected from the 480 Volt AEB.

Suspect asbestos samples were analyzed by iATL in accordance with PLM: Bulk Asbestos Building Materials EPA 600 R 93 / 116. 1993.

The analytical results for asbestos content of the bulk material samples are presented in the Laboratory Reports, included in Appendix III.

Based on WSP's professional opinion and WorkSafeBC accepted protocols, the vermiculite insulation as observed within the concrete masonry unit (CMU) walls of the 480 Volt AEB is assumed to contain asbestos and by WorkSafeBC criteria is herein classified as an asbestos-containing material.

Based on WSP's professional opinion, the following materials were assumed not to contain asbestos during this survey and were classified as non-asbestos materials:

- Dimensional lumber;
- Green corrugated fiberglass panels; and
- Metals including structural steel, metal flashing, wall penetration metal framing, railings, roof access ladder, hoist travel lift, and Sea-Container (C-Can).

4.2 LEAD BASED PAINTS (LBP)

Fifteen (15) representative bulk surface coating samples suspected to contain elevated lead were collected from the three buildings.

Suspect elevated lead content surface coating samples (paints) were analyzed by iATL in accordance with ASTM D3335-85A "Standard Method to Test for Low Concentrations of Lead in Paint by Atomic Absorption Spectrophotometry".

The analytical results for lead content of the bulk surface coating samples are presented in the Laboratory Reports, included in Appendix III.

BC Environmental Regulations and WorkSafeBC Guidelines require leachate testing prior to disposal of lead based paints on non-metallic surfaces.

Representative samples of the whole waste (i.e. a core sample including the substrate and paint OR a cross-section of the paint covered substrate) were submitted for the toxicity characteristic leaching procedure (TCLP).

The bulk samples were analyzed by International Asbestos Testing Laboratories (IATL) following methods that comply with the WorkSafeBC Occupational Health and Safety Regulations and Hazardous Waste Regulation as defined by the BC Ministry of Environment. Samples were subjected to acid leaching and the extract was analyzed for substances appropriate to the protocol. TCLP is a sample extraction method for chemical analysis employed as an analytical method to simulate leaching in a landfill. The purpose of the TCLP analysis is to characterize the painted substrate materials with potentially elevated lead content and to facilitate permitted disposal site requirements.

The results of the TCLP testing were compared to the BC Ministry of Environment Hazardous Waste Criteria of 5.0 mg/L for Lead. The completed Chain-of-Custodies (COCs) and the Laboratory Reports of analytical results are included in Appendix III.

4.3 LEAD PRODUCTS

The three buildings were visually reviewed for the presence of lead-containing building products. No samples were collected of these materials.

4.4 MOULD AND OTHER MICROBIAL CONTAMINANTS

The three buildings were visually reviewed for the presence of water damage and suspected mould growth. They were also visually reviewed for other microbial contaminants including animal wastes. No samples were collected.

4.5 CRYSTALLINE SILICA

The three buildings were visually reviewed for the presence of concrete or mineral-composite building materials which may contain crystalline silica. No samples were collected for analysis of silica content.

4.6 OTHER HAZARDOUS MATERIALS

The three buildings were visually reviewed for the presence of fluorescent light ballasts and tubes which could contain mercury or PCBs; equipment which might contain ODS-containing halons or refrigerants; smoke detectors and exit signs which may contain RAM; and any stored flammable or explosive materials. No additional samples were collected.

5 REGULATORY FRAMEWORK

The details of the regulatory frameworks for ACM, LBP, PCB, mercury, RAM, and ODS are found in Appendix IV.

6 HAZARDOUS MATERIALS RESULTS

The results of the PHMS are summarized below. Site Plans are attached in Appendix I. Photographs taken during the site visit are presented in Appendix II. The completed Chain-of-Custodies (COCs) and the Laboratory Reports of analytical results are presented in Appendix III.

6.1 ASBESTOS CONTAINING MATERIALS (ACM)

Notes: *Italic Red Text indicates that asbestos was detected below the WorkSafeBC 0.5% criteria.*

Bold Red Text indicates that asbestos was detected above the WorkSafeBC 0.5% criteria.

Table 1 Asbestos Content Results

SAMPLE LOCATION	MATERIAL SAMPLED	SAMPLE ID	CONTENT/TYPE
AREB General Electric Motor Control Centre	Protective Shield	17A-AREB-01	None Detected for asbestos
AREB Southeast Door	Core Insulation	17A-AREB-02	None Detected for asbestos
AREB Southwest Double Door	**Core Insulation**	**17A-AREB-03**	**70% Chrysotile**
AREB Interior Ceiling Area	Grey Mastic on Supply Ducting	17A-AREB-04A	None Detected for asbestos
AREB Interior Northeast Wall Area	**Light Grey Mastic on Exhaust Vent**	**17A-AREB-04B**	**PC 1.2% Chrysotile**
AREB Interior Northeast Wall	Fire Stop On Copper Line	17A-AREB-05	None Detected for asbestos
AREB Interior Northeast Wall	Fire Stop On Gas Line	17A-AREB-06	None Detected for asbestos
AREB Interior Northeast Wall	Block Opening Fire Stop About Original 8 Electrical Lines	17A-AREB-07	None Detected for asbestos
AREB Interior Northeast Wall	Block Opening Fire Stop About Updated 8 Electrical Lines	17A-AREB-08	None Detected for asbestos
AREB Southwest Exterior Grounds	**Cement Conduit Pipe For Original 8 Electrical Lines**	**17A-AREB-09**	**15% Chrysotile 10% Crocidolite**
AREB Southwest Exterior Grounds	Cement Plug in Plastic Pipe For Updated 8 Electrical Lines	17A-AREB-10	None Detected for asbestos

SAMPLE LOCATION	MATERIAL SAMPLED	SAMPLE ID	CONTENT/TYPE
AREB Northwest Wall South Portion	Mortar Set Between Concrete Masonry Unit	17A-AREB-11	None Detected for asbestos
AREB Southeast Wall South Portion	Mortar Set Between Concrete Masonry Unit	17A-AREB-12	None Detected for asbestos
AREB Northwest Wall South Portion	Concrete Masonry Unit	17A-AREB-13	None Detected for asbestos
AREB Southeast Wall South Portion	Concrete Masonry Unit	17A-AREB-14	None Detected for asbestos
AREB Interior Ceiling Area	**Grey Paneling**	**17A-AREB-15**	**15% Chrysotile**
AREB Sea-Container Interior	**Bronze Sink Undercoating Painted White**	**17A-AREB-16**	**PC 1.7% Chrysotile**
AREB Exterior Hoist Deck Area	*Heavy Weave Fabric*	*17A-AREB-17*	*PC 0.25% Chrysotile*
Southwest of AREB Near Large Diameter Pipe	Fine Weave Fabric	17A-AREB-18	None Detected for asbestos
AREB Roof Top Southwest Central Portion	**Multiple Roofing Layers**	**17A-AREB-19**	**20% Chrysotile in Base Layer (L7)**
AREB Roof Top Northeast Central Portion	**Multiple Roofing Layers**	**17A-AREB-20**	**PC 1.8% Chrysotile in Base Layer (L7)**
480 Volt AEB Exterior East Corner Wall	Concrete Masonry Unit	17A-480V-01	None Detected for asbestos
480 Volt AEB Exterior East Corner Wall	Mortar Set Between Concrete Masonry Unit	17A-480V-02	None Detected for asbestos
480 Volt AEB Exterior West Corner Roof	Concrete Roof Slab	17A-480V-03	None Detected for asbestos
480 Volt AEB Wall Voids	**Vermiculite**	**Not Sampled**	**Asbestos-Containing**

As of February 1, 2012, the definition of asbestos-containing material (ACM) for manufactured articles or other material, other than vermiculite insulation, includes materials that contain at least 0.5% asbestos, as determined by methods referenced in WorkSafeBC OHS Regulation section 6.1. According to WorkSafeBC, the definition of an asbestos-containing material is 0.5% by weight.

Vermiculite insulation containing any asbestos, as determined by the referenced method, is also an ACM. Base on WorkSafeBC amassed review of report findings and subsequent supplemental sampling and analysis, the applicable current province wide protocol is to assume that all vermiculite loose fill insulation is ascribed as asbestos containing.

Based on the representative sampling, corresponding IATL results of asbestos content, WorkSafeBC criteria, and site review assessment of visually similar materials, the following materials are herein extrapolated to be Asbestos-Containing:

- The core insulation within the southwest double doors of the AREB was found to contain 70% Chrysotile asbestos. The contents of the southeast door were None Detected for asbestos. Potential interior insulation contents of the single and double doors of the AREB addition were not accessible at the time of the Site review and accordingly their potential for asbestos content is undetermined;
- The light grey mastic on the exhaust vent located on the north wall of the AREB was found to contain PC 1.2% Chrysotile asbestos;
- The Cement Conduit Pipes for the original 8 electrical lines leading to and from the AREB were found to contain 15% Chrysotile asbestos and 10% Crocidolite. The series of original installation Cement Conduit Pipes were observed to be set into concrete blocks located on both the southwest and northeast exterior side of the AREB. Based on provided design drawings, these two groupings of original installation Cement Conduit Pipes are assumed to extend below ground to a depth of approximately 6.5 ft (2 m) below surface grade. The provided design drawings indicate that Cement Conduit Pipes do extend to and from the AREB at a depth of approximately 6.5 ft (2 m) below surface grade however details and/or additional drawings as to the potential distance(s) from the AREB were not available at the time of this report. Provided 1969-70 design drawings do show addition buried conduit piping which was not accessible at the time of the site visit and could potentially be asbestos-containing;
- The Grey Panelling covering the entire interior ceiling of the AREB was found to contain 15% Chrysotile asbestos;
- The Grey Base Layer of the multi-layered flat top roof of the AREB was found to contain 20% Chrysotile asbestos. Roof core sampling of the AREB was halted upon contacting and partially drilling through the suspect seventh (7th) layer due to weather egress prevention patching requirements for the continued active operational use of the electrical equipment within the AREB. It is suspected, but not confirmed, that the base layer of the sampled roofing layers is the same as that of the above-noted Grey Panelling covering the entire interior ceiling of the AREB;
- The Bronze Coloured Sink Undercoating (painted white) on the counter sink within the modified Sea-Container (C-Can) positioned approximately 1 m to the north of the addition to the AREB was found to contain PC 1.7% Chrysotile asbestos; and
- Observations through anchor bolt drill hole openings found vermiculite loose fill insulation to be present within the internal voids of the concrete masonry units (CMUs) comprising the walls of the 480 Volt AEB. Base on WorkSafeBC applicable current province wide protocol, the vermiculite insulation within the walls of the 480 Volt AEB is recognised as an asbestos containing material. [Based on the additional exploratory wall openings completed, the presence of vermiculite loose fill insulation is not suspected to be within the walls of either the AREB or the 600 Volt AEB.].

Based on the representative sampling of the Heavy Weave Fabric located adjacent to the exterior hoist deck, corresponding IATL results of asbestos content, asbestos was detected (PC 0.25% Chrysotile) but was below the WorkSafeBC 0.5% criteria. Due to the relative ease of access of this material, consideration should be given towards its removal based on commonly implemented safety principles for maintaining As Low As Reasonably Achievable (ALARA) risk of exposure.

Asbestos shielding may potentially be concealed within two (2) lighting fixtures positioned about the exterior of the AREB, one (1) lighting fixture under the canopy of the AREB exterior hoist deck, one (1) lighting fixture positioned on the exterior of the 480 Volt AEB, and one (1) lighting fixture positioned on the exterior of the 600 Volt AEB.

Based on the period of construction and Site review of the 600 Volt AEB, asbestos-containing building materials are not suspected to comprise or be present within the 600 Volt AEB.

6.2 LEAD BASED PAINTS (LBP)

WSP collected bulk material surface coating samples. The corresponding IATL laboratory results for lead content are as follows:

Notes: ***Bold italic text indicates paint is above 90 ppm (lead containing by Health Canada definition)***

Bold Red Text indicates lead concentrations detected above 0.06% criteria.

Table 2 Lead Based Paint Results

SAMPLE LOCATION	MATERIAL SAMPLED	SAMPLE ID	CONTENT/TYPE
AREB Floor North Portion (Concrete with Steel)	**Grey on Green on Orange Paint**	**17L-AREB-01**	**18 % by Weight 180,000 ppm**
AREB Interior Side of CMU Walls	Grey White Paint	17L-AREB-02	0.0064 % by Weight 64 ppm
AREB Exterior Side of CMU Walls	**White Paint**	**17L-AREB-03**	**0.78 % by Weight 7,800 ppm**
AREB Southwest Door (Steel)	**Dark Grey Paint**	**17L-AREB-04**	**0.34 % by Weight 3,400 ppm**
AREB Southeast Door (Steel)	***Brown Paint***	***17L-AREB-05***	***0.055 % by Weight 550 ppm***
AREB Interior Transformer Bracket (Steel)	**Light Blue Paint**	**17L-AREB-06**	**0.75 % by Weight 7,500 ppm**
AREB Interior Ceiling Truss (Steel)	**Light Green Paint**	**17L-AREB-07**	**0.27 % by Weight 2,700 ppm**
AREB Southwest Double Door (Steel)	**Brown Layered Paint**	**17L-AREB-08**	**0.096% by Weight 960 ppm**
480 Volt AEB Exterior Concrete Soffit	***White on Brown Paint***	***17L-480V-00***	***0.013 % by Weight 130 ppm***
480 Volt AEB Exterior Side of CMU Walls	White Paint	17L-480V-01	<0.0065 % by Weight <65 ppm
480 Volt AEB Exterior Concrete Roof	**Tan Paint**	**17L-480V-02**	**0.081 % by Weight 810 ppm**
480 Volt AEB Interior Side of CMU Walls	**White Mint Paint**	**17L-480V-03**	**0.094 % by Weight 9400 ppm**

SAMPLE LOCATION	MATERIAL SAMPLED	SAMPLE ID	CONTENT/TYPE
480 Volt AEB Interior Concrete Floor	**Grey Paint**	**17L-480V-04**	**0.36 % by Weight 3,600 ppm**
AREB Hoist Area Exterior Structural Steel	**Blue Paint**	**17L-AREB-09**	**2.8 % by Weight 28,000 PPM**

Lead based paints are not specifically defined in the WorkSafeBC regulations. BC Environmental Regulations[1] and WorkSafeBC Guidelines[2] require leachate testing prior disposal of lead waste.

Health Canada and the US Consumer Product Safety Improvement Act both consider a lead-containing surface coating as a paint that contains over 0.009% (90 mg/kg) dry weight of lead. This corresponds to the concentration of lead in paint that may present risk to pregnant women and children.

To comply with WorkSafeBC regulations, if lead materials are identified at a site (this includes lead in paint), the employer must, before any renovation/demolition, have a qualified professional conduct a risk assessment and develop an exposure control plan, that contains safe work procedures, to protect workers that may be exposed to lead. When evaluating risk, the concentration of lead in paint and the activity must be considered together. In general, if aggressive techniques (i.e. cutting torch, abrasive blasting, and power grinders/sanders) are not used and if the lead concentration in paint is below 600 mg/kg[3], renovation/demolition workers are unlikely to be exposed to lead concentrations in air exceeding the 0.05 mg/m2 TWA limit.

Ten (10) of the fourteen (14) paints that were tested were found to have a lead content above 600 mg/kg. These include:

- Grey on Green on Orange Paint found on the interior concrete floor of the AREB;
- White Paint found on the exterior CMU walls of the AREB;
- Dark Grey Paint found on the west steel door of the AREB;
- Light Blue Paint found on the steel transformer bracketry within the AREB;
- Light Green Paint on the interior steel ceiling trusses of the AREB;
- Brown Layered Paint found on the south steel double doors of the AREB;
- Tan Paint on the exterior concrete roof of the 480 Volt AEB;
- White-Mint Paint on the interior CMU walls of the 480 Volt AEB;
- Grey Paint on the interior concrete floor of the 480 Volt AEB; and
- Blue Paint found on the exterior structural steel of the AREB Hoist Area.

[1] Hazardous Waste Regulation
[2] Lead-Containing Coats and Paintings - Preventing Exposure in the Construction Industry
[3] California division of Occupational Safety and Health requires an exposure control plan for concentrations above 600 mg/kg.

6.3 TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

BC Environmental Regulations and WorkSafeBC Guidelines require leachate testing prior to disposal of lead based paints on non-metallic surfaces. Representative samples of the whole waste (i.e. a core sample including the substrate and paint OR a cross-section of the paint covered substrate) were submitted for the toxicity characteristic leaching procedure (TCLP).

The WSP collected bulk material surface coating samples on substrate and the corresponding IATL laboratory results for total allowable concentration in waste extract for lead are as follows:

Notes: **Bold Red Text indicates leachate results with concentrations detected above Hazardous Waste Regulation 5mg/L criteria.**

Table 3 Summary of TCLP Testing for Lead Results

SAMPLE LOCATION	MATERIAL SAMPLED	SAMPLE ID	LEACHATE RESULT [PB(MG/L)]
AREB Interior Side of CMU Walls	Grey White Paint	17TCLP-AREB-01	Total Lead 64 ppm TCLP (mg/L) → NA
AREB Exterior Side of CMU Walls	White Paint	17TCLP-AREB-02	Total Lead 7800 ppm TCLP (mg/L) → 0.20
480 Volt AEB Exterior Concrete Roof	Tan Paint	17TCLP-480V-01	Total Lead 810 ppm TCLP (mg/L) → < 0.20
480 Volt AEB Exterior Side of CMU Walls	White Paint	17TCLP-480V-02	Total Lead < 65 ppm TCLP (mg/L) → NA

"All painted metallic demolition components are not characterized as hazardous waste so long as the paint is not removed from the painted surfaces."[4] However, the BC MOE encourages generators, of this waste type, to manage the waste at metal recyclers rather than by landfilling.

This method complies with the Hazardous Waste Regulation as defined by the BC Ministry of Environment. The total allowable concentration in waste extract for lead as defined in the Hazardous Waste Regulation is <5mg/L.

The lead leachate testing results for the four above tabulated bulk substrate samples with elevated lead-content paint layers were below the BC Ministry of Environment Special Waste criteria of 5 mg/L and therefore may be disposed of as non-hazardous waste.

[4] BC MOE Technical Guidance 4, Environmental Management Act Applications, Guideline To Managing Lead-Containing Construction and Demolition Waste In BC, Version 1.0, January 2015

6.4 LEAD PRODUCTS

The two (2) interior emergency light fixtures mounted to the walls of the AREB have associated battery packs. These battery packs are anticipated to be lead-containing.

Component solder on wire connections of electric component and on sweated joints between copper pipes and fittings in the building are anticipated to potentially be lead containing.

Lead flashing like materials were not apparent on the three rooftops.

Vent pipes and potentially associated lead collars were not apparent on the three roof tops.

6.5 MOULD AND OTHER MICROBIAL CONTAMINANTS

Suspect mould like odour was apparent within the AREB addition and within the adjacent modified Sea-Container (C-Can)

Mould growth is anticipated on the underside the AREB wooden deck platform, particularly in proximity to the soil interface.

Rodent droppings were readily apparent about various areas of the concrete floor within the AREB and its addition.

6.6 POLYCHLORINATED BIPHENYLS (PCB)

Based on the period of original construction, fluorescent light ballasts present within the AREB and 480 Volt AEB potentially contain PCBs. [The 1999 date of construction of the 600 Volt AEB was subsequent to the discontinued use of PCB-containing capacitors in lamp ballasts.]

Canadian General Electric (CGE) Rapid Start Ballasts with product code "17A240T" were observed within the AREB and 480 Volt AEB.

CGE ballasts with product codes ending in the letter T may contain PCBs as the use of the final letter T spanned the time period from when PCBs were used in ballasts to when they were discontinued. CGE ballasts manufactured before in March 1978 could contain PCB capacitors.

Accordingly, unmounting of a ballast was required in order to obtain the stamped date code located on the back of the ballast housing. The stamped date code for CGE ballasts is interpreted by reversing the first two numbers to determine the year of manufacture. The last two number represent the month of manufacture[5].

The examined CGE product code "17A240T" ballast as obtained from the ceiling of the AREB with stamped dated code "0702" was determined to be manufactured in February 1970 and therefore is expected to have a PCB-containing capacitor. Prior to disposal, the balance of the CGE product code "17A240T" ballasts from the AREB and 480 Volt AEB should be unmounted, checked for stamp date codes, and disposed of as PCB containing if determined to be manufactured prior to March 1978.

[5] Environmental Protection Series, Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2 (revised) August 1991, Environment Canada publication.

6.7 MERCURY AND HEAVY METALS

Fluorescent light tubes present within the three buildings contain mercury vapour.

Mercury vapour in the range of approximately 10 to 50 mg is commonly present in fluorescent light tubes ranging in length from 0.61 to 2.44 m (2 to 8 ft.)[6].

Exterior light fixtures on the exteriors of the three Site buildings potentially contain metal halide bulbs with heavy metal contents.

Thermostat controls for the three buildings were not accessible for review of potential mercury content at the time of the Site visit.

6.8 OZONE DEPLETING SUBSTANCES (ODS)

The AREB ceiling mounted air conditioning unit labelled 75-350 D65-690-1-3 was tagged as having 8 lbs of R-22 (difluoromonochloromethane) refrigerant a known hydrochlorofluorocarbon (HCFC) with relatively low ozone depletion potential of 0.055. However R-22 is a known greenhouse gas with a warming potential 1,800 times that of carbon dioxide. Its future use and reuse are referenced in the Montreal Protocol on Substances that Deplete the Ozone Layer.

The AREB roof top mounted heating, ventilation, and air conditioning (HVAC) unit labelling is weather worn and difficult to read. The charged contents appeared to be labelled as R-22 however the content amount is no longer discernable.

A domestic style refrigerator was observed within the modified Sea-Container (C-Can). Domestic style refrigerators commonly contain potential ODS refrigerants.

Potential ODS containing equipment was not apparent within the 480 Volt AEB and the 600 Volt AEB.

6.9 RADIOACTIVE MATERIALS (RAM)

Radioactive materials are potentially present within building smoke detectors. However, there were no observations of ceiling mounted smoke detectors noted within the three buildings. Review of other types of monitoring detectors was beyond the scope of this investigation.

6.10 CRYSTALLINE SUBSTANCES

It is anticipated Crystalline Silica is present within the concrete and blocks associated with the three building located on Site. Concrete foundation slabs, concrete masonry units (CMUs), and mortar are the primary construction materials for the three Site buildings. The AREB also has four external concrete blocks used to secure the four groupings of 8 electrical lines. The 480 Volt AEB and the 600 Volt AEB also have concrete slab flat top roofs.

[6] http://www.newmoa.org/prevention/mercury/imerc/factsheets/lighting.cfm

6.11 FLAMMABLE, EXPLOSIVE, OR POTENTIALLY TOXIC/HAZARDOUS MATERIALS

Chemical storage of potential flammable or explosive materials was not apparent within the AREB, 480 Volt AEB, or 600 Volt AEB. Two banks of large format capacitors were observed within the AREB. "WARNING" labelling on the large format capacitors provides instruction for disconnection. Additional smaller capacitors are anticipated to be associated with the electrical equipment within the three buildings on Site.

7 RECOMMENDATIONS

Based on our review of building materials, and the laboratory results, WSP has the following recommendations.

- Safe work procedures must be followed when cutting or grinding brick facia, stone facia, mortars, grouts, hard board siding, and concrete cement that are assumed to contain crystalline silica.
- A risk assessment for asbestos-containing materials must be performed prior to renovation or demolition work beginning to determine the exposure risk to workers and other persons as per OHS Guideline G20.112;
- All asbestos-containing materials must be removed using safe work practices and procedures prior to demolition activities. The WorkSafeBC publication "Safe Work Practices for Handling Asbestos" and the Occupational Health and Safety (OHS) Guideline G6.8 describes acceptable practices;
- If a paint coating is encountered during demolition activities that has not been discussed or analyzed it should be considered lead containing until sampling can demonstrate otherwise.
- A risk assessment for paints containing lead at concentrations above 90 mg/kg must be performed prior to renovation or demolition work beginning to determine the exposure risk to workers and other persons as per OHS Regulations 6.58.1 through 6.69
- Fluorescent light tubes, compact fluorescents, and metal halide bulbs containing mercury and/or heavy metals should be recycled when removed from service. The Light Recycle website provides a list of recycling facilities on their website, at http://www.lightrecycle.ca/.
- Prior to demolition, all electrical equipment and light ballasts should be checked for PCB content prior to disposal. The identified PCB containing ballasts and any potential PCB containing transformers if so encountered should be handled transferred, and disposed of appropriately as hazardous waste.
- Safe work procedures should be followed when working in proximity to or removing mould-contaminated materials and animal waste (rodent droppings).
- The AREB 1.) Interior ceiling mounted air conditioning unit; 2.) Roof top mounted heating, ventilation, and air conditioning (HVAC) unit; and 3.) Associated C-Can domestic refrigerator with charged contents should be degassed by a certified refrigerant technician as required by British Columbia's Ozone Depleting Substances Regulation, prior to disposal.
- Smoke detectors or other equipment with RAMs if so encountered should be recycled when removed from service. AlarmRecycle is a recycling program for used or expired smoke and carbon monoxide (CO) alarms. Since October 1, 2011, BC residents have been able to drop off their smoke and CO alarms for recycling at AlarmRecycle drop-off locations across BC.
- WSP should be notified if any suspect asbestos-containing material or hazardous materials not identified in this report are exposed or encountered during demolition of the survey buildings. Suspect materials should be considered hazardous pending further review.
- Retain a copy of this report and provide it to any contractors who may be undertaking demolition work in the building as required by Section 20.112 of the WorkSafeBC regulations.

8 CLOSURE

No hazardous materials survey can wholly eliminate uncertainty regarding the potential for recognized hazardous materials conditions at the site. Performance of a standardized hazardous material survey protocol is intended to reduce, but not eliminate uncertainty regarding the potential for recognized hazardous materials at the site, given reasonable limits of time and cost.

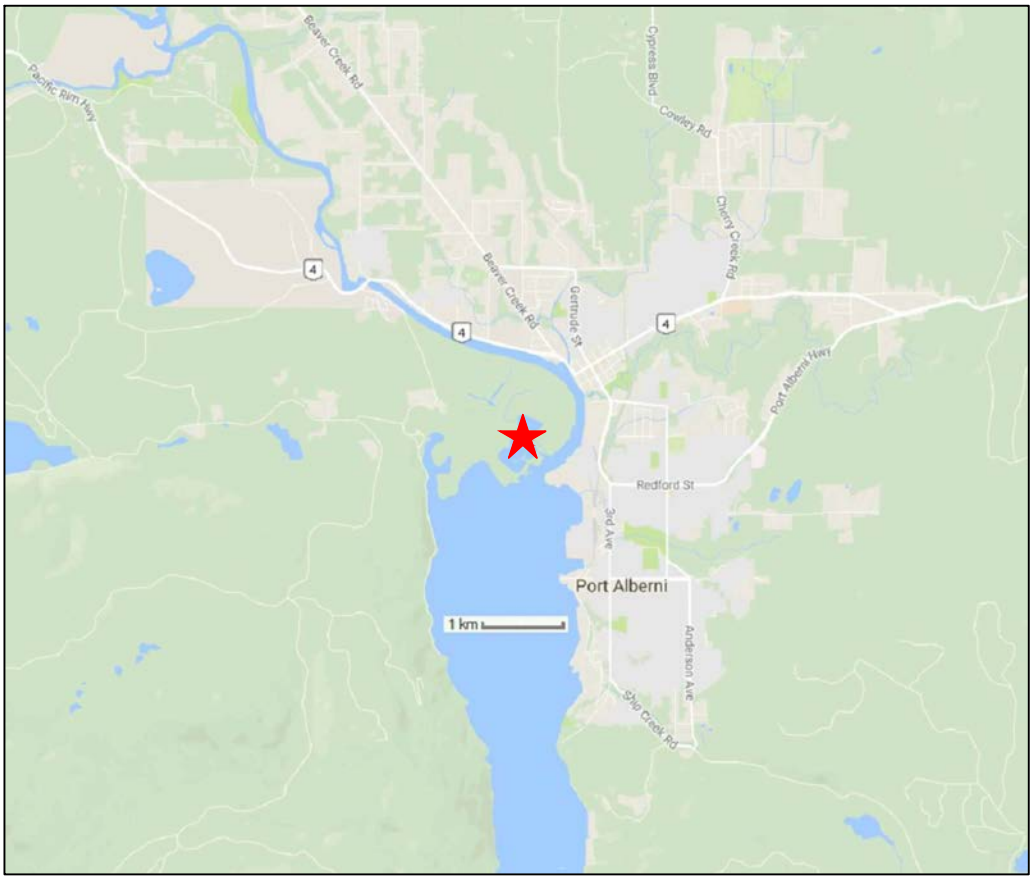
This report has been prepared by WSP exclusively for Associated Engineering Ltd. and is intended to provide a survey of the potential hazardous materials associated with the three electrical buildings of the Port Alberni Waste Water Treatment Plant located in Port Alberni, BC.

The conclusions made in this report reflect WSP's best judgment in light of the information available at the time of preparation. No other warranty, expressed or implied, is made. Any use which a third party makes of this report, or any reliance on or decisions to be made or actions based on it, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report. The standard limitations of this report are specified in Appendix V.

APPENDIX

I

FIGURES



LEGEND

★ – SUBJECT SITE

WSP Canada Inc.
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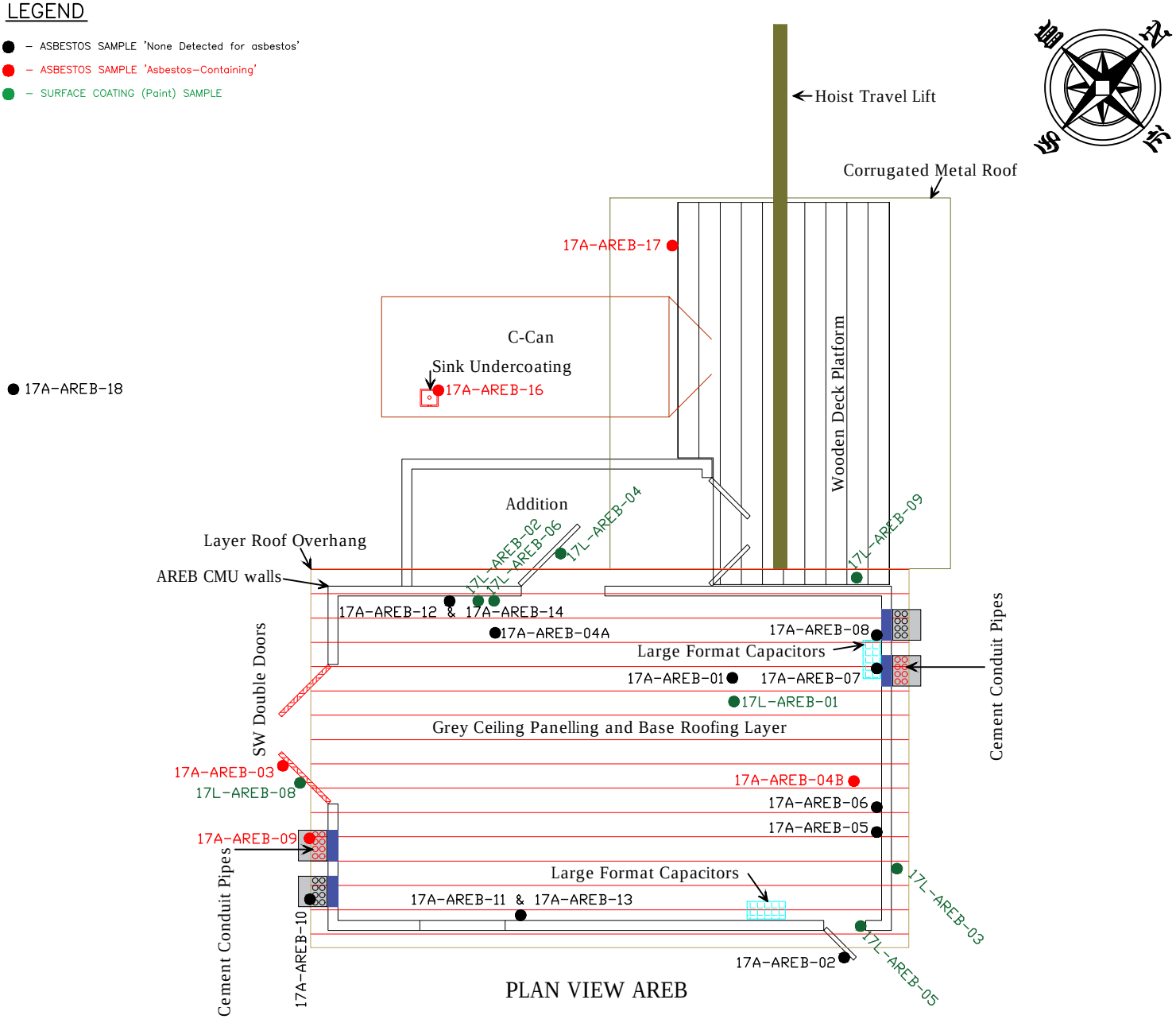
E: victoria@levelton.com
www.wspgroup.com

TITLE:	Site Location Plan
PROJECT:	Pre Demolition Hazardous Building Materials Survey Port Alberni Waste Water Treatment Plant
CLIENT:	Associated Engineering Ltd.

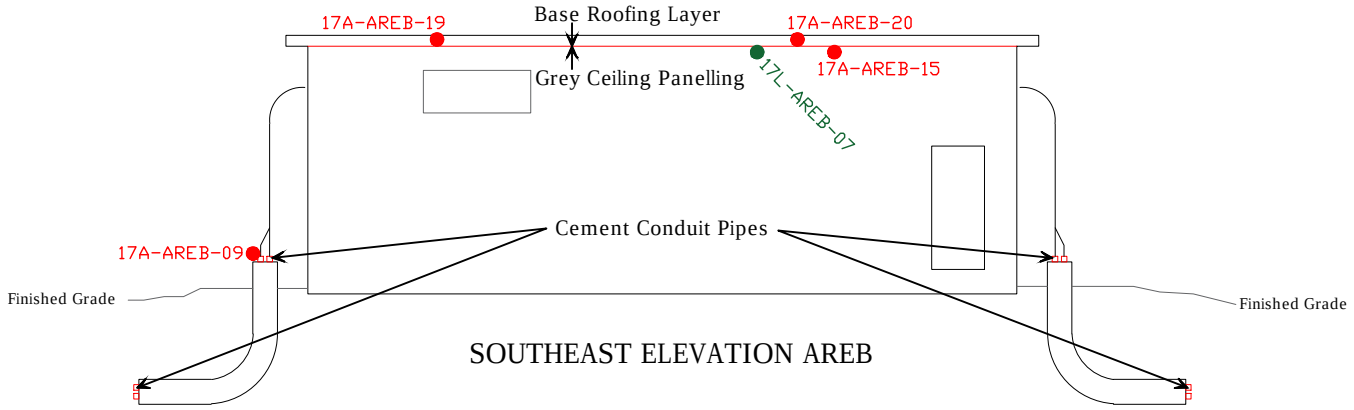
DES.	DR. GP
CH.	SCALE NTS
APP.	DATE Nov. 2017
FILE NO. 171-04753-00	
DWG. NO. FIGURE 1	

LEGEND

- ASBESTOS SAMPLE 'None Detected for asbestos'
- ASBESTOS SAMPLE 'Asbestos-Containing'
- SURFACE COATING (Paint) SAMPLE



PLAN VIEW AREB



SOUTHEAST ELEVATION AREB

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TITLE: Site Sampling Plan - Aeration Reservoir Electrical Building (AREB)

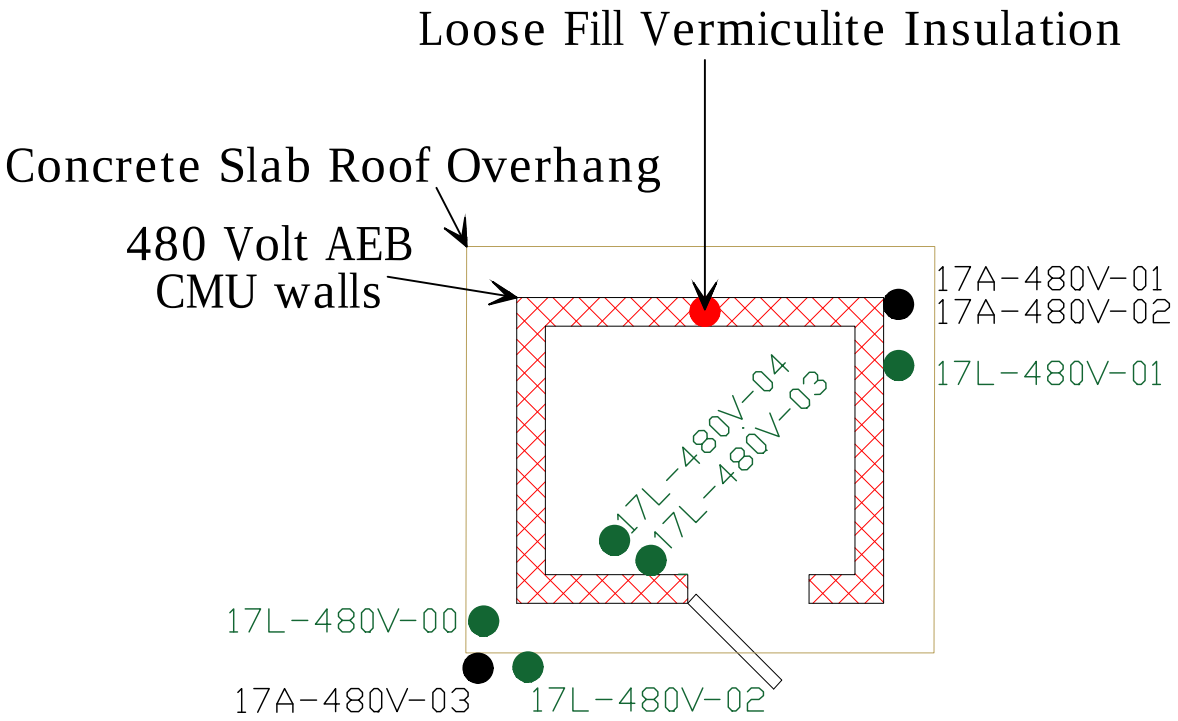
PROJECT: Pre Demolition Hazardous Building Materials Survey
Port Alberni Waste Water Treatment Plant

CLIENT: Associated Engineering Ltd.

DES.	DR. GP
CH.	SCALE NTS
APP.	DATE Nov. 2017
FILE NO. 171-04753-00	
DWG. NO. FIGURE 2	

LEGEND

- ASBESTOS SAMPLE 'None Detected for asbestos'
- ASBESTOS SAMPLE 'Asbestos-Containing'
- SURFACE COATING (Paint) SAMPLE



PLAN VIEW 480 Volt AEB

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TITLE: Site Sampling Plan - 480 Volt Aeration Electrical Building (AEB)

PROJECT: Pre Demolition Hazardous Building Materials Survey
Port Alberni Waste Water Treatment Plant

CLIENT: Associated Engineering Ltd.

DES.	DR. GP
CH.	SCALE NTS
APP.	DATE Nov. 2017
FILE NO. 171-04753-00	
DWG. NO. FIGURE 3	

APPENDIX

II

SITE PHOTOGRAPHS

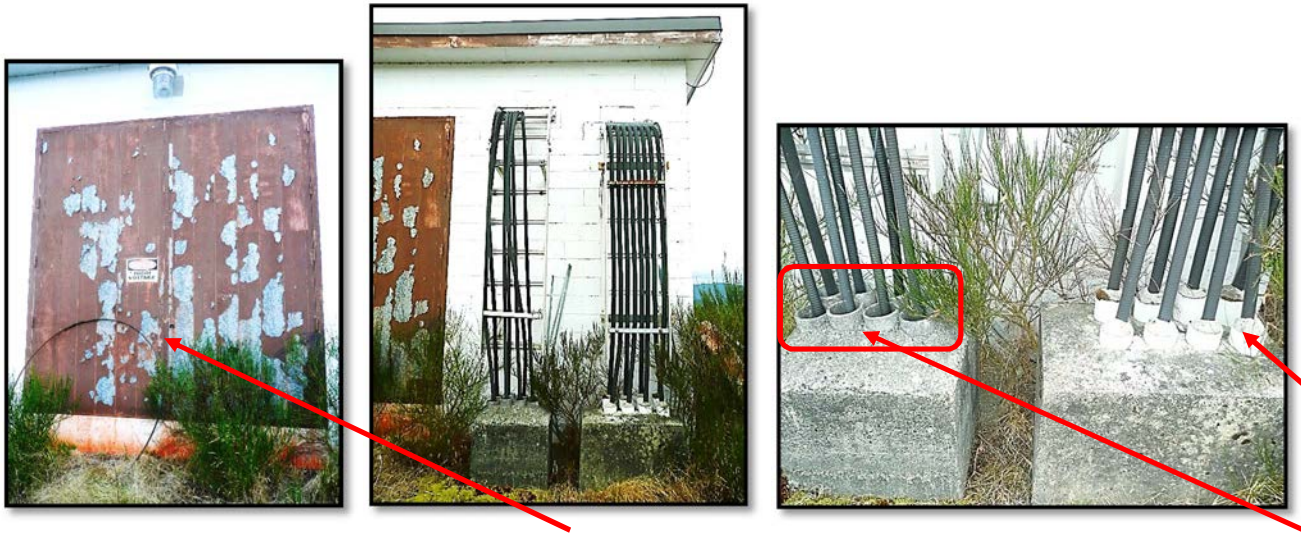
The former Catalyst Aeration Reservoir Electrical Building (AREB).

Looking west towards the southeast and northeast elevations.

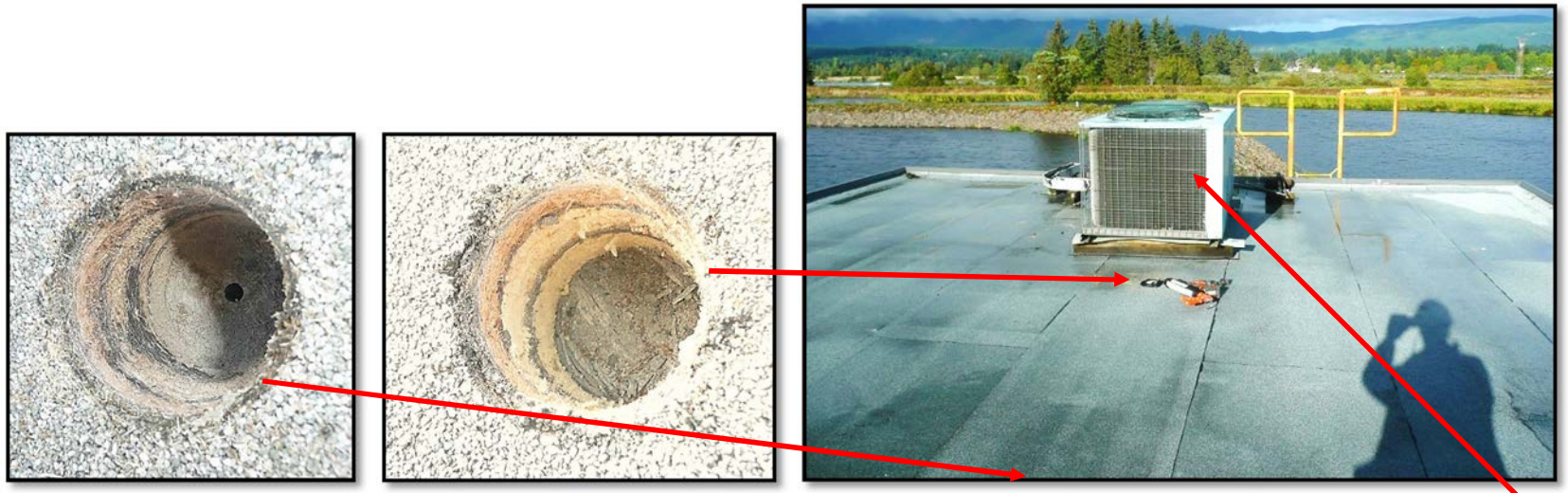
Looking southwest towards the northeast elevation with the deck and hoist travel lift.

From the deck looking towards the Addition and C-Can.

Looking northeast towards the southwest elevation, C-Can and Addition.



AREB southwest elevation asbestos-containing double steel doors (17A-AREB-03) and asbestos-containing cement conduit pipe (17A-AREB-09).
The cement plugs of the updated electrical conduits was 'None Detected' for asbestos (17A-AREB-10).



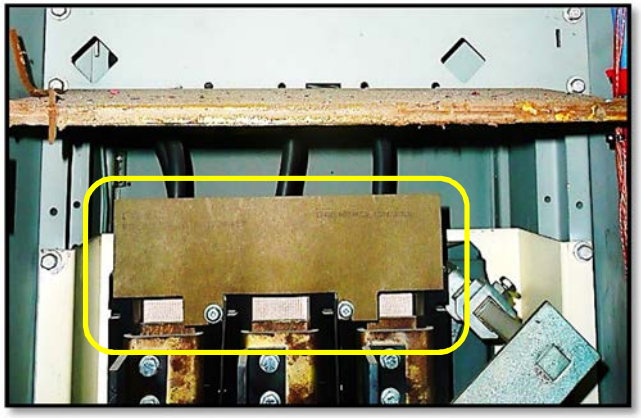
AREB - visible layers (base layer 7 of sample 17A-AREB-20 is asbestos-containing) of roof core sample locations and roof top R-22 containing HVAC unit.

PCB containing Canadian General Electric Rapid Start Ballasts with product code and date stamp code within AREB and 480 Volt AEB light fixtures.

Two banks of large format capacitors were observed within the AREB with “WARNING” labelling providing instruction for disconnection.

Light green paint on the interior steel ceiling trusses and asbestos-containing grey panelling (Sample 17A-AREB-15) covering the interior ceiling of the AREB.

Sample 17A-AREB-04A - grey mastic on supply ducting was 'None Detect' for asbestos.



Sample 17A-AREB-01 - AREB General Electric motor control centre protective shield was 'None Detect' for asbestos.

The two (2) interior emergency light fixtures mounted to the walls of the AREB have associated lead containing battery packs.

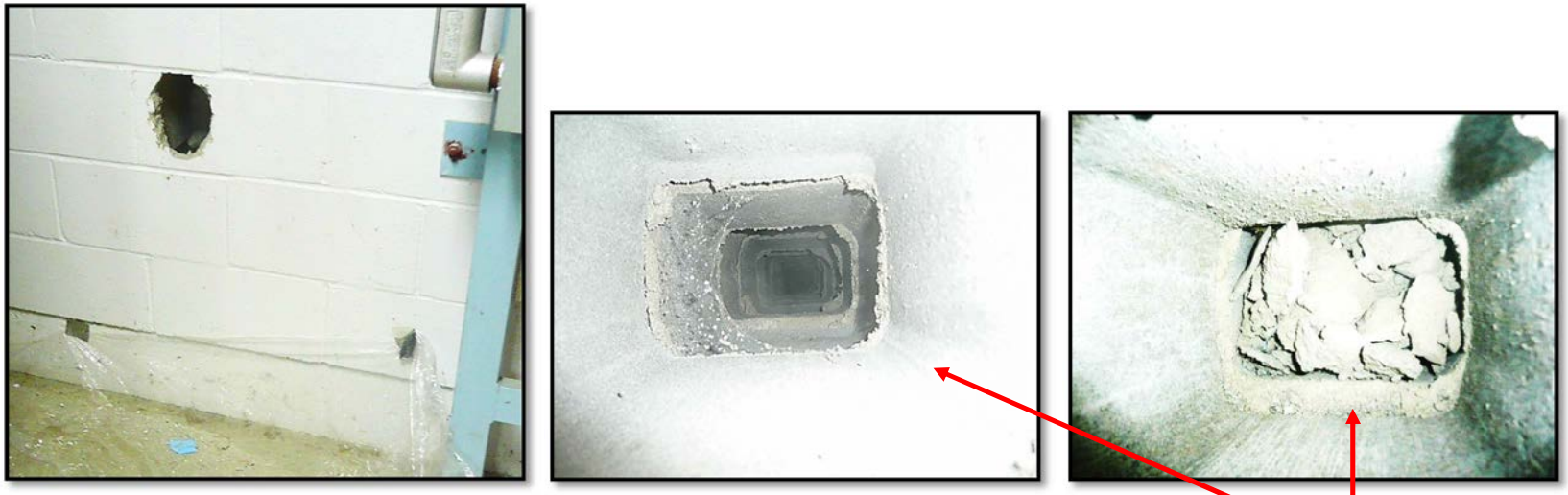
None PCB transformers atop light blue painted steel bracketry within the AREB.

Exterior light fixtures on the exteriors of the three Site buildings potentially contain metal halide bulbs with heavy metal contents.

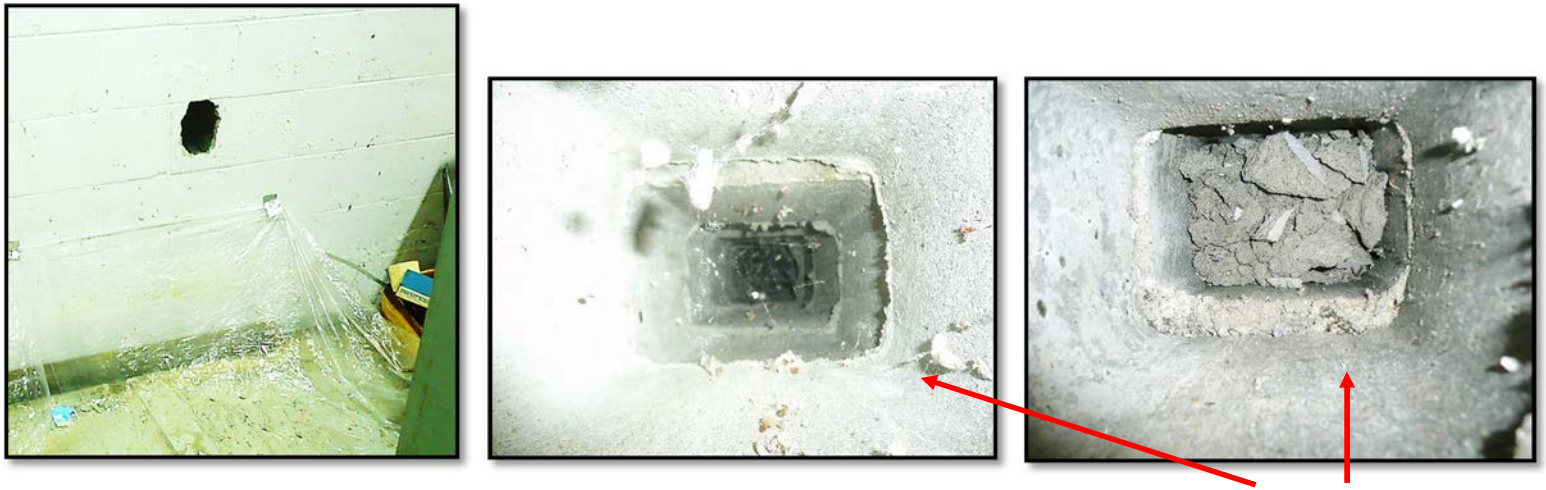
Sample 17A-AREB-18 -The heavy weave fabric located adjacent to the exterior hoist deck, has an asbestos content PC 0.25% Chrysotile.

Sample 17A-AREB-17 -The fine weave fabric located southwest of the AREB was None Detected for asbestos.

Rodent droppings were readily apparent about various areas of the concrete floor within the AREB and its addition.

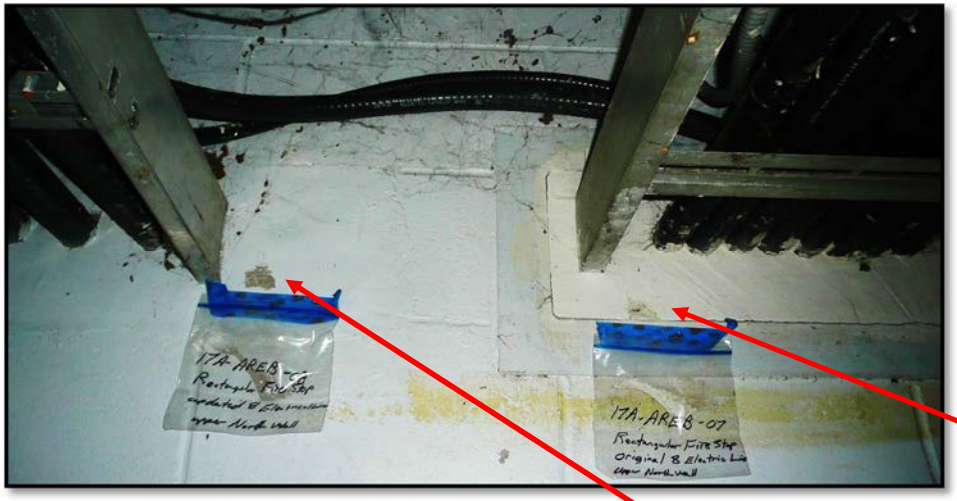


Observations through the exploratory opening made in northwest wall of the AREB found no vermiculite either up or down within the void.
The concrete masonry units (17A-AREB-13) and mortar (17A-AREB-11) set between them were both 'None Detected' for asbestos.



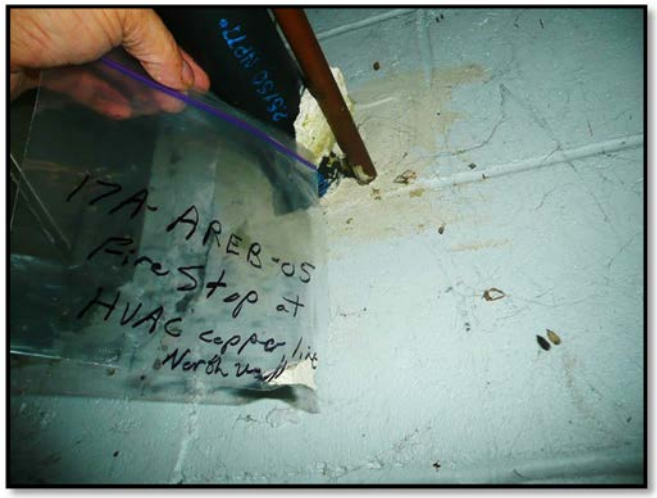
Observations through the exploratory opening made in southeast wall of the AREB found no vermiculite either up or down within the void.
The concrete masonry units (17A-AREB-14) and mortar (17A-AREB-12) set between them were both 'None Detected' for asbestos.

The AREB ceiling mounted air conditioning unit labelled 75-350 D65-690-1-3 was tagged as having 8 lbs of R-22. The light grey mastic on the exhaust vent (sample 17A-AREB-04B) located on the northeast wall of the AREB was found to contain PC 1.2% Chrysotile asbestos.



The AREB two block opening fire stop materials about the updated 8 electrical lines (17A-AREB-08) and original 8 electrical lines (17A-AREB-07) were both 'None Detected' for asbestos.

Sample 17A-AREB-06 - fire stop at the gas line on the northeast wall of the AREB was 'none Detected' for asbestos.

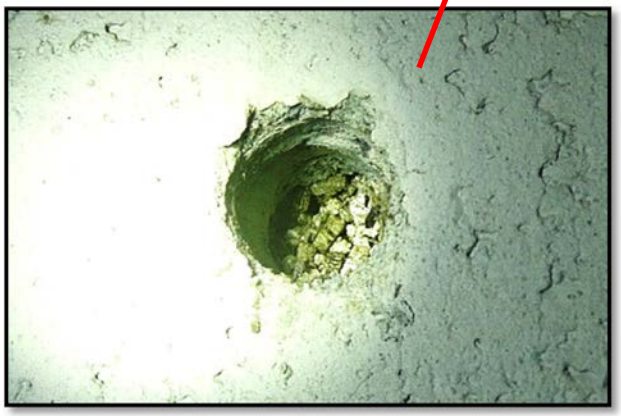


Sample 17A-AREB-05 - fire stop at the copper line on the northeast wall of the AREB was 'none Detected' for asbestos.

The AREB Sea-Container asbestos-containing bronze sink undercoating (sample 17A-AREB-16) painted white.

The larger more recent westward 600 Volt Aeration Electrical Building (AEB).

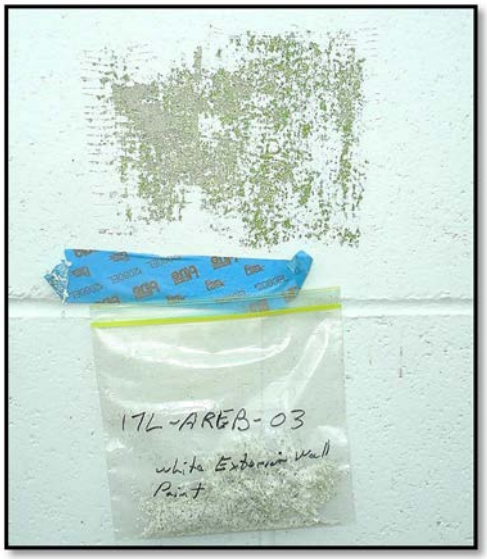
The smaller older eastward 480 Volt Aeration Electrical Building (AEB). The concrete slab roof (17A-480V-03), masonry units (17A-480V-01) and mortar (17A-480V-02) set between them were both 'None Detected' for asbestos.



The vermiculite insulation as observed within the concrete masonry unit (CMU) walls of the 480 Volt AEB is assumed to contain asbestos and by WorkSafeBC criteria is classified as an asbestos-containing material.

Sample 17L-AREB-01 - Grey on Green on Orange Paint on the floor of the AREB.

Sample 17L-AREB-02 - Grey White Paint on the interior side of the CMU walls of the AREB.

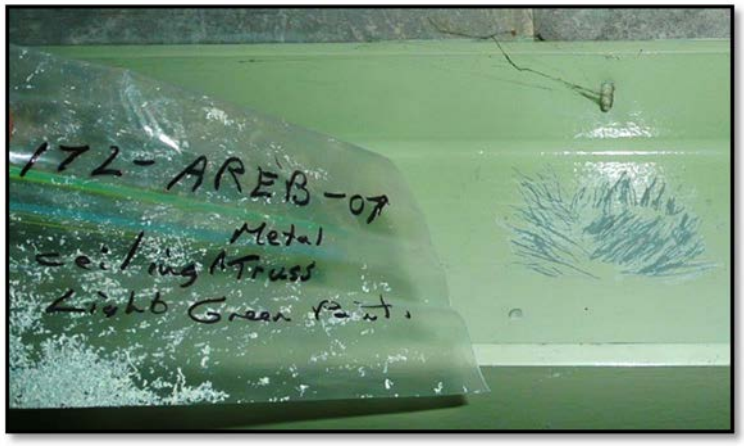


Sample 17L-AREB-03 - White Paint on the exterior side of the CMU walls of the AREB.

Sample 17L-AREB-04 - Dark Grey Paint on the southwest door of the AREB.

Sample 17L-AREB-05 - Brown Paint on the southeast door of the AREB.

Sample 17L-AREB-06 - Light Blue Paint on the Interior Transformer Brackets of the AREB.



Sample 17L-AREB-07 - Light Green Paint on the interior ceiling trusses of the AREB.

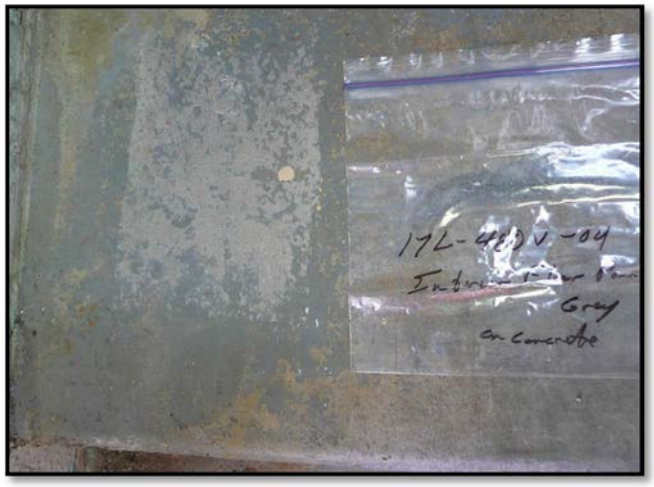
Sample 17L-AREB-8 - Brown Paint on the southwest double doors of the AREB.

Sample 17L-480V-00 - White on Brown Paint on the soffit of the 480 Volt AEB.

Sample 17L-480V-01 - White Paint on the exterior CMU walls of the 480 Volt AEB.

Sample 17L-480V-02 - Tan Paint on the exterior roof of the 480 Volt AEB.

Sample 17L-480V-03 - White-Mint Paint on the interior CMU walls of the 480 Volt AEB.



Sample 17L-480V-04 - Grey Paint on the floor of the 480 Volt AEB.

Sample 17L-AREB-9 - Blue Paint found on the exterior structural steel of the AREB Hoist Area.

APPENDIX

III

CHAIN OF CUSTODIES AND LABORATORY RESULTS

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

9000 Commerce Parkway, Suite B • Mount Laurel, NJ 08054
Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Chain of Custody

–Bulk Asbestos –

Contact Information

Client Company:	WSP Canada Inc.	**Project Number:**	171-04753-00
Office Address:	760 Enterprise Crescent	**Project Name:**	HMS WWTP Upgrade
City, State, Zip:	Victoria, BC, Canada V8Z 6R4	**Primary Contact:**	Gordon Philippe
Fax Number:	250-475-2211	**Office Phone:**	250-475-1000
Email Address:	Gordon.Philippe@WSP.com	**Cell Phone:**	250-360-6537

PLM Instructions:

- ☒ PLM: Bulk Asbestos Building Materials EPA 600 R-93/116, 1993
- ☐ PLM: Bulk Asbestos Building Materials EPA 600 M-4/82-020, 1982
- ☐ PLM: Bulk Asbestos Building Materials NIOSH 9002, 1985
- ☐ PLM: Bulk Asbestos Building Materials NYSDOH-ELAP 198.1, 2002
- ☐ PLM: Bulk Asbestos Building Materials NYSDOH-ELAP 198.6, 2010
- ☐ TEM: Bulk Asbestos Building Materials NYSDOH-ELAP 198.4, 2009

- ☐ PLM: Point Counting
  - ☐ PC: via ELAP 198.1
  - ☐ PC: 400 Points
  - ☐ PC: 800 Points *
  - ☐ PC: 1600 Points *
- ☐ PLM: Instructions for Multi-Layered Samples
  - ☐ Analyze and Report All Separable Layers per EPA 600
  - ☐ Report Composite for Drywall Systems per NESHAP
  - ☐ Report All Layers and Composite Where Applicable
  - ☐ Only Analyze and Report Specifically Noted Layer
- ☐ PLM: Analyze Until Positive (Positive Stop)
  - ☐ AUP: by Homogenous Area as Noted
  - ☐ AUP: by Material Type as Noted
- ☐ PLM: NOB via 198.6
  - ☐ PLM: Friable via EPA 600 2.3
  - ☐ If <1% by PLM, to TEM via 198.4 *
  - ☐ If <1% by PLM, Hold for Instructions
- ☐ PLM: Non-Building Material *,** (Dust, Wipe, Tape)
  - ☐ Soil or Vermiculite Analysis *
  - ☐ CARB 435

Special Instructions: _____

** Additional charge and turnaround may be required* *** Alternative Method (ex: EPA 600/R-04/004) may be recommended by Laboratory*

Turnaround Time

Preliminary Results Requested Date: _____ (Specific date / time) ☐ Verbal ☒ Email ☐ Fax

☐ 10 Day ☐ 5 Day ☐ 3 Day ☒ 2 Day ☐ 1 Day* ☐ 12 Hour** ☐ 6 Hour** ☐ RUSH**

* End of next business day unless otherwise specified. ** Matrix Dependent. ***Please notify the lab before shipping***

Chain of Custody

Relinquished (Name/Organization):	Gordon/WSP	Date:	Oct 12,2017	Time:	17:00
Received (Name / iATL):		Date:		Time:	
Sample Login (Name / iATL):		Date:		Time:	
Analysis(Name(s) / iATL):	Edie Smith	Date:	10/20/17	Time:	OCT 17 2017
QA/QC Review (Name / iATL):	Edie 10-20-17	Date:		Time:	
Archived / Released: _____	QA/QC InterLAB Use: _____	Date:		Time:	

RECEIVED

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INTERNATIONAL
ASBESTOS TESTING LABORATORIES

9000 Commerce Parkway, Suite B • Mount Laurel, NJ 08054
Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Sample Log

–Bulk Asbestos –

Client: WSP Canada Inc. Project: 171-04753-00/HMS WWTP Upgrade

Sampling Date/Time: 6 October 2017

Bulk Asbestos Sample Log			
Client Sample #	**iATL #**	**Location/Description**	**Notes**
17A-AREB-01	6366337	Gen Elec Motor Control Centre/ Protective Shield	
17A-AREB-02	6366338	E Door/Core Insulation (fiberglass)	
17A-AREB-03	6366339	S Double Door/Core Insulation (Air Cell)	
17A-AREB-04A	6366340	Interior Ceiling/Grey Supply Duct Mastic	
17A-AREB-04B	6366341	Interior N Wall/Light Grey Exhaust Vent Mastic	
17A-AREB-05	6366342	N Wall HVAC Copper Line/Fire Stop	
17A-AREB-06	6366343	N Wall HVAC Gas Line/Fire Stop	
17A-AREB-07	6366344	N Wall Original 8 Elec/Block Opening Fire Stop	
17A-AREB-08	6366345	N Wall Update 8 Elec/Block Opening Fire Stop	
17A-AREB-09	6366346	S Exterior Original 8 Elec/Cement Conduit Pipe	
17A-AREB-10	6366347	S Exterior Update 8 Elec Plastic Conduit/Cement Plug	
17A-AREB-11	6366348	W Wall S Portion/Mortar	
17A-AREB-12	6366349	E Wall S Portion/Mortar	
17A-AREB-13	6366350	W Wall S Portion/Cinder Block	
17A-AREB-14	6366351	E Wall S Portion/Cinder Block	
17A-AREB-15	6366352	Interior Ceiling/Paneling	

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Sample Log

–Bulk Asbestos –

Client: WSP Canada Inc. Project: 171-04753-00/HMS WWTP Upgrade

Sampling Date/Time: 6 October 2017

Bulk Asbestos Sample Log			
Client Sample #	**iATL #**	**Location/Description**	**Notes**
17A-AREB-16	6366353	West C-Can Interior/White painted Bronze Sink Undercoating	
17A-AREB-17	6366354	Dock Hoist/Heavy Weave Fabric	
17A-AREB-18	6366355	Near S Large Dia HDPE Pipe/Fine Weave Fabric	
17A-AREB-19	6366356	Roof South Central/Multiple Roofing Layers	
17A-AREB-20	6366357	Roof North Central/Multiple Roofing Layers	

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

9000 Commerce Parkway Suite B
Mt. Laurel, New Jersey 08054
Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM Rev #2, 10/24/2017
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 6366337
Client No.: 17A-AREB-01

Analyst Observation: Green Fibrous
Client Description: Protective Shield

Location: Gen Elec. Motor Control Centre
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
40 Cellulose

Percent Non-Fibrous Material:
60

Lab No.: 6366338
Client No.: 17A-AREB-02

Analyst Observation: Tan Insulation
Client Description: Core Insulation (Fiberglass)

Location: E Door
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
99 Fibrous Glass

Percent Non-Fibrous Material:
1

Lab No.: 6366339
Client No.: 17A-AREB-03

Analyst Observation: Lt.Grey Insulation
Client Description: Core Insulation (Air Cell)

Location: S Double Door
Facility:

Percent Asbestos:
70 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
10 Cellulose

Percent Non-Fibrous Material:
20

Lab No.: 6366340
Client No.: 17A-AREB-04A

Analyst Observation: Grey Mastic
Client Description: Grey Supply Duct Mastic

Location: Interior Ceiling
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
2 Synthetic

Percent Non-Fibrous Material:
98

Lab No.: 6366341
Client No.: 17A-AREB-04B

Analyst Observation: Grey Mastic
Client Description: Light Grey Exhaust Vent Mastic

Location: Interior N Wall
Facility:

Percent Asbestos:
PC 1.2 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
98.8

Lab No.: 6366342
Client No.: 17A-AREB-05

Analyst Observation: Lt.Tan Insulation
Client Description: Firestop

Location: N Wall HVAC Copper Line
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
10 Cellulose
10 Fibrous Glass

Percent Non-Fibrous Material:
80

Analytical Method -**US EPA 600, R93-116**. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/20/2017
Signature:
Analyst: Ellen Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM Rev #2, 10/24/2017
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 6366343
Client No.: 17A-AREB-06

Analyst Observation: Lt.Tan Insulation
Client Description: Firestop

Location: N Wall HVAC Gas Line
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
10 Cellulose
5 Fibrous Glass

Percent Non-Fibrous Material:
85

Lab No.: 6366344
Client No.: 17A-AREB-07

Analyst Observation: Lt.Tan Insulation
Client Description: Block Opening Firestop

Location: N Wall Original 8 Elec.
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
10 Cellulose
10 Fibrous Glass

Percent Non-Fibrous Material:
80

Lab No.: 6366345
Client No.: 17A-AREB-08

Analyst Observation: Grey Insulation
Client Description: Block Opening Firestop

Location: N Wall Update 8 Elec.
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
7 Fibrous Glass

Percent Non-Fibrous Material:
93

Lab No.: 6366346
Client No.: 17A-AREB-09

Analyst Observation: Grey Cementitious
Client Description: Cement Conduit Pipe

Location: S.Exterior Original 8 Elec.
Facility:

Percent Asbestos:
15 *Chrysotile*
10 *Crocidolite*

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
75

Lab No.: 6366347
Client No.: 17A-AREB-10

Analyst Observation: Grey Cementitious
Client Description: Plastic Conduit/Cement Play

Location: S.Exterior Update 8 Elec.
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 6366348
Client No.: 17A-AREB-11

Analyst Observation: Grey Mortar
Client Description: Mortar

Location: W Wall S Portion
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -**US EPA 600, R93-116**. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/20/2017
Signature:
Analyst: Ellen Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM Rev #2, 10/24/2017
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 6366349 **Client No.:** 17A-AREB-12	**Analyst Observation:** Grey Mortar **Client Description:** Mortar	**Location:** E Wall S Portion **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 6366350 **Client No.:** 17A-AREB-13	**Analyst Observation:** Grey Mortar **Client Description:** Cinderblock	**Location:** W Wall S Portion **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 6366351 **Client No.:** 17A-AREB-14	**Analyst Observation:** Grey Mortar **Client Description:** Cinderblock	**Location:** E Wall S Portion **Facility:**
Percent Asbestos: *None Detected*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 100
Lab No.: 6366352 **Client No.:** 17A-AREB-15	**Analyst Observation:** Grey Cementitious **Client Description:** Paneling	**Location:** Interior Ceiling **Facility:**
Percent Asbestos: ***15*** *Chrysotile*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 85
Lab No.: 6366353 **Client No.:** 17A-AREB-16	**Analyst Observation:** Brown Fibrous **Client Description:** White Painted Bronze Sink Undercoating	**Location:** West C-Can Interior **Facility:**
Percent Asbestos: ***PC 1.7*** *Chrysotile*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 98.3
Lab No.: 6366354 **Client No.:** 17A-AREB-17	**Analyst Observation:** White/Tan Wrap/ Caulk **Client Description:** Heavy Weave Fabric	**Location:** Dock Hoist **Facility:**
Percent Asbestos: ***PC 0.25*** *Chrysotile*	Percent Non-Asbestos Fibrous Material: None Detected	Percent Non-Fibrous Material: 99.75

Analytical Method -**US EPA 600, R93-116**. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/20/2017
Signature:
Analyst: Ellen Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

9000 Commerce Parkway Suite B
Mt. Laurel, New Jersey 08054
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Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM Rev #2, 10/24/2017
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 6366355
Client No.: 17A-AREB-18

Analyst Observation: Grey Wrap
Client Description: Fine Weave Fabric

Location: Near S Large Dia HDPE Pipe
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
30 Synthetic

Percent Non-Fibrous Material:
70

Lab No.: 6366356
Client No.: 17A-AREB-19

Analyst Observation: Brown/Black/White Tar / Insulation
Client Description: Multiple Roofing Layers

Location: Roof South Central
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
55 Cellulose

Percent Non-Fibrous Material:
45

Lab No.: 6366356(L2)
Client No.: 17A-AREB-19

Analyst Observation: Tan Insulation
Client Description: Multiple Roofing Layers

Location: Roof South Central
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
100 Cellulose

Percent Non-Fibrous Material:
None Detected

Lab No.: 6366356(L3)
Client No.: 17A-AREB-19

Analyst Observation: Black/Yellow Felt/Foam
Client Description: Multiple Roofing Layers

Location: Roof South Central
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
8 Cellulose
2 Fibrous Glass

Percent Non-Fibrous Material:
90

Lab No.: 6366356(L4)
Client No.: 17A-AREB-19

Analyst Observation: Yellow/Black Foam/ Tar
Client Description: Multiple Roofing Layers

Location: Roof South Central
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
3 Fibrous Glass
12 Cellulose

Percent Non-Fibrous Material:
85

Lab No.: 6366356(L5)
Client No.: 17A-AREB-19

Analyst Observation: Grey/Yellow Felt/Foam
Client Description: Multiple Roofing Layers

Location: Roof South Central
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
20 Cellulose
10 Fibrous Glass

Percent Non-Fibrous Material:
70

Analytical Method -**US EPA 600, R93-116**. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/20/2017
Signature:
Analyst: Ellen Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM Rev #2, 10/24/2017
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 6366356(L6) **Analyst Observation:** Black Tar **Location:** Roof South Central
Client No.: 17A-AREB-19 **Client Description:** Multiple Roofing Layers **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	20 Cellulose	80

Lab No.: 6366356(L7) **Analyst Observation:** Grey Transite **Location:** Roof South Central
Client No.: 17A-AREB-19 **Client Description:** Multiple Roofing Layers **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
20 *Chrysotile*	None Detected	80

Note: Analyzed by E.Smith 10/24/17

Lab No.: 6366357 **Analyst Observation:** White/Black/Tan Tar **Location:** Roof North Central
Client No.: 17A-AREB-20 **Client Description:** Multiple Roofing Layers **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	20 Cellulose	80

Lab No.: 6366357(L2) **Analyst Observation:** Tan Insulation **Location:** Roof North Central
Client No.: 17A-AREB-20 **Client Description:** Multiple Roofing Layers **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	100 Cellulose	None Detected

Lab No.: 6366357(L3) **Analyst Observation:** Tan/Black Tar / Insulation **Location:** Roof North Central
Client No.: 17A-AREB-20 **Client Description:** Multiple Roofing Layers **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	95 Cellulose	5

Lab No.: 6366357(L4) **Analyst Observation:** Black/Tan Tar **Location:** Roof North Central
Client No.: 17A-AREB-20 **Client Description:** Multiple Roofing Layers **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	10 Cellulose	90

Analytical Method -**US EPA 600, R93-116**. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/20/2017
Signature:
Analyst: Ellen Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

9000 Commerce Parkway Suite B
Mt. Laurel, New Jersey 08054
Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM Rev #2, 10/24/2017
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 6366357(L5)
Client No.: 17A-AREB-20
Analyst Observation: Tan/Black Insulation
Client Description: Multiple Roofing Layers
Location: Roof North Central
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
97 Cellulose

Percent Non-Fibrous Material:
3

Lab No.: 6366357(L6)
Client No.: 17A-AREB-20
Analyst Observation: Tan/Black Insulation
Client Description: Multiple Roofing Layers
Location: Roof North Central
Facility:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
95 Cellulose

Percent Non-Fibrous Material:
5

Lab No.: 6366357(L7)
Client No.: 17A-AREB-20
Analyst Observation: Grey Powdery Insulation
Client Description: Multiple Roofing Layers
Location: Roof North Central
Facility:

Percent Asbestos:
PC 1.8 *Chrysotile*

Percent Non-Asbestos Fibrous Material:
7 Cellulose

Percent Non-Fibrous Material:
91.2

Note: Analyzed by E.Smith 10/24/17

Analytical Method -**US EPA 600, R93-116**. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/20/2017
Signature:
Analyst: Ellen Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

Appendix to Analytical Report

Customer Contact:
Analysis: US EPA 600, R93-116

This appendix seeks to promote greater understanding of any observations, exceptions, special instructions, or circumstances that the laboratory needs to communicate to the client concerning the above samples. The information below is used to help promote your ability to make the most informed decisions for you and your customers. Please note the following points of contact for any questions you may have.

iATL Customer Service: customerservice@iatl.com
iATL Office Manager: cdavis@iatl.com
iATL Account Representative: Shirley Clark
Sample Login Notes: See Batch Sheet Attached
Sample Matrix: Bulk Building Materials
Exceptions Noted: See Following Pages

General Terms, Warrants, Limits, Qualifiers:

General information about iATL capabilities and client/laboratory relationships and responsibilities are spelled out in iATL policies that are listed at www.iATL.com and ir our Quality Assurance Manual per ISO 17025 standard requirements. The information therein is a representation of iATL definitions and policies for turnaround times, sample submittal, collection media, blank definitions, quantification issues and limit of detection, analytical methods and procedures, sub-contracting policies, results reporting options, fees, terms, and discounts, confidentiality, sample archival and disposal, and data interpretation.

iATL warrants the test results to be of a precision normal for the type and methodology employed for each sample submitted. iATL disclaims any other warrants, expressed or implied, including warranty of fitness for a particular purpose and warranty of merchantability. iATL accepts no legal responsibility for the purpose for which the client uses test results. Any analytical work performed must be governed by our Standard Terms and Conditions. Prices, methods and detection limits may be changed without notification. Please contact your Customer Service Representative for the most current information.

This confidential report relates only to those item(s) tested and does not represent an endorsement by NIST-NVLAP, AIHA LAP LLC, or any agency of local, state or province governments nor of any agency of the U.S. government.

Information Pertinent to this Report:

Analysis by US EPA 600 93-116: Determination of Asbestos in Bulk Building Materials by Polarized Light Microscopy (PLM).

Certifications:

- NIST-NVLAP No. 101165-0
- NY-DOH No. 11021
- AIHA-LAP, LLC No. 100188

Quantification at <0.25% by volume is possible with this method. (PC) Indicates Stratified Point Count Method performed. (PC-Trace) means that asbestos was detected but is not quantifiable under the Point Counting regimen. Analysis includes all distinct separable layers in accordance with EPA 600 Method. If not reported or otherwise noted, layer is either not present or the client has specifically requested that it not be analyzed (ex. analyze until positive instructions). Small asbestos fibers may be missed by PLM due to resolution limitations of the optical microscope. Therefore, PLM is not consistently reliable in detecting asbestos in non-friable organically bound (NOB) materials. Quantitative transmission electron microscopy (TEM) is currently the only method that can pronounce materials as non-asbestos containing.

Analytical Methodology Alternatives: Your initial request for analysis may not have accounted for recent advances in regulatory requirements or advances in technology that are routinely used in similar situations for other qualified projects. You may have the option to explore additional analysis for further information. Below are a few options, listed as the matrix followed by the appropriate methodology. Also included are links to more information on our website.

Bulk Building Materials that are Non-Friable Organically Bound (NOB) by Gravimetric Reduction techniques employing PLM and TEM: ELAP 198.6 (PLM-NOB), ELAP 198.4 (TEM-NOB)

Loose Fill Vermiculite Insulation, Attic Insulation, Zonolite (copyright), etc.: US EPA 600 R-4/004 (multi-tiered analytical process)
Sprayed On Insulation/Fireproofing with Vermiculite (SOF-V): ELAP 198.8 (PLM-SOF-V)>

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Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client:	WSP Canada Inc	Report Date:	10/20/2017
	760 Enterprise Crescent	Report No.:	549885 - PLM
	Victoria BC V8Z 6R4	Project:	HMS WWTP Upgrade
		Project No.:	171-04753-00
Client:	WSP786		

Soil, sludge, sediment, aggregate, and like materials analyzed for asbestos or other elongated mineral particles (ex. erionite, etc.): ASTM D7521, CARB 435, and other options available

Asbestos in Surface Dust according to one of ASTM's Methods (very dependent on sampling collection technique – by TEM): ASTM D 5755, D5756, or D6480

Various other asbestos matrices (air, water, etc.) and analytical methods are available.

Disclaimers / Qualifiers:

There may be some samples in this project that have a "NOTE:" associated with a sample result. We use added disclaimers or qualifiers to inform the client about something that requires further explanation. Here is a list with highlighted disclaimers that may be pertinent to this project. For a full explanation of these and other disclaimers, please inquire at **customerservice@iatl.com**.

1) Note: No mastic provided for analysis.
2) Note: Insufficient mastic provided for analysis.
3) Note: Insufficient material provided for analysis.
4) Note: Insufficient sample provided for QC reanalysis.
5) Note: Different material than indicated on Sample Log / Description.
6) Note: Sample not submitted.
7) Note: Attached to asbestos containing material.
8) Note: Received wet.
9) Note: Possible surface contamination.
10) Note: Not building material. 1% threshold may not apply.
11) Note: Recommend TEM-NOB analysis as per EPA recommendations.
12) Note: Asbestos detected but not quantifiable.
13) Note: Multiple identical samples submitted, only one analyzed.
14) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.080%.
15) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.125%.

Recommendations for Vermiculite Analysis:

Several analytical protocols exist for the analysis of asbestos in vermiculite. These analytical approaches vary depending upon the nature of the vermiculite mineral being tested (e.g. un-processed gange, homogeneous exfoliated books of mica, or mixed mineral composites).Please contact your client representative for pricing and turnaround time options available.

iATL recommends initial testing using the EPA 600/R-93/116 method. This method is specifically designed for the analysis of asbestos in bulk building materials. It provides an acceptable starting point for primary screening of vermiculite for possible asbestos.

Results from this testing may be inconclusive. EPA suggests proceeding to a multi-tiered analysis involving wet separation techniques in conjunction with PLM and TEM gravimetric analysis (EPA 600/R-04/004).

Further information on this method and other vermiculite and asbestos issues can be found at the following: Agency for Toxic Substances and Disease Registry (ATSDR) www.atsdr.cdc.gov, United States Geological Survey (USGS) www.minerals.usgs.gov/minerals/, US EPA www.epa.gov/asbestos. The USEPA also has an informative brochure "Current Best Practices for Vermiculite Attic Insulation" EPA 747F03001 May 2003, that may assist the health and remediation professional.

The following is a summary of the analytical process outlines in the EPA 600/R-04/004 Method:

1)**Analytical Step/Method:** Initial Screening by PLM, EPA 600R-93/116
Requirements/Comments: Minimum of 0.1 g of sample. ~0.25% LOQ for most samples.

2)**Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.

3)**Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Floats" only.

4)**Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.

5)**Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549885 - PLM
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Suspension" only.

LOQ, Limit of Quantitation estimates for mass and volume analyses.
*With advance notice and confirmation by the laboratory.
**Approximately 1 Liter of sample in double-bagged container (~9x6 inch bag of sample).

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

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Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Chain of Custody

–Bulk Asbestos –

Contact Information

Client Company:	WSP Canada Inc.	**Project Number:**	171-04753-00
Office Address:	760 Enterprise Crescent	**Project Name:**	HMS WWTP Upgrade
City, State, Zip:	Victoria, BC, Canada V8Z 6R4	**Primary Contact:**	Gordon Philippe
Fax Number:	250-475-2211	**Office Phone:**	250-475-1000
Email Address:	Gordon.Philippe@WSP.com	**Cell Phone:**	250-360-6537

PLM Instructions:

- ☒ PLM: Bulk Asbestos Building Materials EPA 600 R-93/116, 1993
- ☐ PLM: Bulk Asbestos Building Materials EPA 600 M-4/82-020, 1982
- ☐ PLM: Bulk Asbestos Building Materials NIOSH 9002, 1985
- ☐ PLM: Bulk Asbestos Building Materials NYSDOH-ELAP 198.1, 2002
- ☐ PLM: Bulk Asbestos Building Materials NYSDOH-ELAP 198.6, 2010
- ☐ TEM: Bulk Asbestos Building Materials NYSDOH-ELAP 198.4, 2009

- ☐ PLM: Point Counting
  - ☐ PC: via ELAP 198.1
  - ☐ PC: 400 Points
  - ☐ PC: 800 Points *
  - ☐ PC: 1600 Points *
- ☐ PLM: Instructions for Multi-Layered Samples
  - ☐ Analyze and Report All Separable Layers per EPA 600
  - ☐ Report Composite for Drywall Systems per NESHAP
  - ☐ Report All Layers and Composite Where Applicable
  - ☐ Only Analyze and Report Specifically Noted Layer
- ☐ PLM: Analyze Until Positive (Positive Stop)
  - ☐ AUP: by Homogenous Area as Noted
  - ☐ AUP: by Material Type as Noted
- ☐ PLM: NOB via 198.6
  - ☐ PLM: Friable via EPA 600 2.3
  - ☐ If <1% by PLM, to TEM via 198.4 *
  - ☐ If <1% by PLM, Hold for Instructions
- ☐ PLM: Non-Building Material*,** (Dust, Wipe, Tape)
  - ☐ Soil or Vermiculite Analysis*
  - ☐ CARB 435

Special Instructions: _____

** Additional charge and turnaround may be required* *** Alternative Method (ex: EPA 600/R-04/004) may be recommended by Laboratory*

Turnaround Time

Preliminary Results Requested Date: _____ (Specific date / time)

☐ Verbal ☒ Email ☐ Fax

☐ 10 Day ☐ 5 Day ☐ 3 Day ☒ 2 Day ☐ 1 Day* ☐ 12 Hour** ☐ 6 Hour** ☐ RUSH**

* End of next business day unless otherwise specified. ** Matrix Dependent. ***Please notify the lab before shipping***

Chain of Custody

Relinquished (Name/Organization):	Gordon/WSP	Date: Oct 12,2017	Time: 17:00
Received (Name / iATL):		Date:	Time:
Sample Login (Name / iATL):		Date:	Time:
Analysis(Name(s) / iATL):		Date: 10/20/17	Time: OCT 17 2017
QA/QC Review (Name / iATL):		Date: 10-20-17	Time:
Archived / Released: _____	QA/QC InterLAB Use: _____	Date:	Time:

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Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Sample Log

–Bulk Asbestos –

Client: WSP Canada Inc. Project: 171-04753-00/HMS WWTP Upgrade

Sampling Date/Time: 6 October 2017

Bulk Asbestos Sample Log			
Client Sample #	**iATL #**	**Location/Description**	**Notes**
17A-480V-01	6366358	Wall/Cinder Block	
17A-480V-02	6366359	Wall/Mortar	
17A-480V-03	6366360	Roof/Cement Slab	

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549886 - PLM
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 6366358 | **Analyst Observation:** Grey Cementitious | **Location:** Wall
Client No.: 17A-480V-01 | **Client Description:** Cinder Block | **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	None Detected	100

Lab No.: 6366359 | **Analyst Observation:** Grey Mortar | **Location:** Wall
Client No.: 17A-480V-02 | **Client Description:** Mortar | **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	None Detected	100

Lab No.: 6366360 | **Analyst Observation:** Grey Cementitious | **Location:** Roof
Client No.: 17A-480V-03 | **Client Description:** Cement Slab | **Facility:**

Percent Asbestos:	Percent Non-Asbestos Fibrous Material:	Percent Non-Fibrous Material:
None Detected	None Detected	100

Analytical Method -**US EPA 600, R93-116**. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/20/2017
Signature:
Analyst: Ellen Smith

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

iATL INTERNATIONAL
ASBESTOS TESTING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549886 - PLM
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

Appendix to Analytical Report

Customer Contact:
Analysis: US EPA 600, R93-116

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iATL Office Manager: cdavis@iatl.com
iATL Account Representative: Shirley Clark
Sample Login Notes: See Batch Sheet Attached
Sample Matrix: Bulk Building Materials
Exceptions Noted: See Following Pages

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iATL warrants the test results to be of a precision normal for the type and methodology employed for each sample submitted. iATL disclaims any other warrants, expressed or implied, including warranty of fitness for a particular purpose and warranty of merchantability. iATL accepts no legal responsibility for the purpose for which the client uses test results. Any analytical work performed must be governed by our Standard Terms and Conditions. Prices, methods and detection limits may be changed without notification. Please contact your Customer Service Representative for the most current information.

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This report shall not be reproduced except in full, without written approval of the laboratory.

Information Pertinent to this Report:

Analysis by US EPA 600 93-116: Determination of Asbestos in Bulk Building Materials by Polarized Light Microscopy (PLM).

Certifications:

- NIST-NVLAP No. 101165-0
- NY-DOH No. 11021
- AIHA-LAP, LLC No. 100188

Quantification at <0.25% by volume is possible with this method. (PC) Indicates Stratified Point Count Method performed. (PC-Trace) means that asbestos was detected but is not quantifiable under the Point Counting regimen. Analysis includes all distinct separable layers in accordance with EPA 600 Method. If not reported or otherwise noted, layer is either not present or the client has specifically requested that it not be analyzed (ex. analyze until positive instructions). Small asbestos fibers may be missed by PLM due to resolution limitations of the optical microscope. Therefore, PLM is not consistently reliable in detecting asbestos in non-friable organically bound (NOB) materials. Quantitative transmission electron microscopy (TEM) is currently the only method that can pronounce materials as non-asbestos containing.

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Bulk Building Materials that are Non-Friable Organically Bound (NOB) by Gravimetric Reduction techniques employing PLM and TEM: ELAP 198.6 (PLM-NOB), ELAP 198.4 (TEM-NOB)

Loose Fill Vermiculite Insulation, Attic Insulation, Zonolite (copyright), etc.: US EPA 600 R-4/004 (multi-tiered analytical process)
Sprayed On Insulation/Fireproofing with Vermiculite (SOF-V): ELAP 198.8 (PLM-SOF-V)>

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549886 - PLM
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

Soil, sludge, sediment, aggregate, and like materials analyzed for asbestos or other elongated mineral particles (ex. erionite, etc.): ASTM D7521, CARB 435, and other options available

Asbestos in Surface Dust according to one of ASTM's Methods (very dependent on sampling collection technique – by TEM): ASTM D 5755, D5756, or D6480

Various other asbestos matrices (air, water, etc.) and analytical methods are available.

Disclaimers / Qualifiers:

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1) Note: No mastic provided for analysis.
2) Note: Insufficient mastic provided for analysis.
3) Note: Insufficient material provided for analysis.
4) Note: Insufficient sample provided for QC reanalysis.
5) Note: Different material than indicated on Sample Log / Description.
6) Note: Sample not submitted.
7) Note: Attached to asbestos containing material.
8) Note: Received wet.
9) Note: Possible surface contamination.
10) Note: Not building material. 1% threshold may not apply.
11) Note: Recommend TEM-NOB analysis as per EPA recommendations.
12) Note: Asbestos detected but not quantifiable.
13) Note: Multiple identical samples submitted, only one analyzed.
14) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.080%.
15) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.125%.

Recommendations for Vermiculite Analysis:

Several analytical protocols exist for the analysis of asbestos in vermiculite. These analytical approaches vary depending upon the nature of the vermiculite mineral being tested (e.g. un-processed gange, homogeneous exfoliated books of mica, or mixed mineral composites).Please contact your client representative for pricing and turnaround time options available.

iATL recommends initial testing using the EPA 600/R-93/116 method. This method is specifically designed for the analysis of asbestos in bulk building materials. It provides an acceptable starting point for primary screening of vermiculite for possible asbestos.

Results from this testing may be inconclusive. EPA suggests proceeding to a multi-tiered analysis involving wet separation techniques in conjunction with PLM and TEM gravimetric analysis (EPA 600/R-04/004).

Further information on this method and other vermiculite and asbestos issues can be found at the following: Agency for Toxic Substances and Disease Registry (ATSDR) www.atsdr.cdc.gov, United States Geological Survey (USGS) www.minerals.usgs.gov/minerals/, US EPA www.epa.gov/asbestos. The USEPA also has an informative brochure "Current Best Practices for Vermiculite Attic Insulation" EPA 747F03001 May 2003, that may assist the health and remediation professional.

The following is a summary of the analytical process outlines in the EPA 600/R-04/004 Method:

1)**Analytical Step/Method:** Initial Screening by PLM, EPA 600R-93/116
Requirements/Comments: Minimum of 0.1 g of sample. ~0.25% LOQ for most samples.

2)**Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.

3)**Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Floats" only.

4)**Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.

5)**Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004

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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/20/2017
Report No.: 549886 - PLM
Project: HMS WWTP Upgrade
Project No.: 171-04753-00

Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Suspension" only.

LOQ, Limit of Quantitation estimates for mass and volume analyses.
*With advance notice and confirmation by the laboratory.
**Approximately 1 Liter of sample in double-bagged container (~9x6 inch bag of sample).

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Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Chain of Custody

– Environmental Lead –

Contact Information

Client Company:	WSP Canada Inc.	**Project Number:**	171-04753-00
Office Address:	760 Enterprise Crescent	**Project Name:**	LHMS M'akola Dev 731 Station
City, State, Zip:	Victoria, BC, Canada V8Z 6R4	**Primary Contact:**	Gordon Philippe
Fax Number:	250-475-2211	**Office Phone:**	250-475-1000
Email Address:	Gordon.Philippe@WSPgroup.com	**Cell Phone:**	250-360-6537

iATL is accredited by the National Lead Laboratory Accreditation Program (NLLAP) to perform analytical testing of environmental samples for lead (Pb). The accreditation is through AIHA-LAP, LLC and several other nationally recognized state programs.

Matrix/Method:

- [x] Paint by AAS: ASTM D3335-85a, 2009
- [ ] Wipe/Dust by AAS: SW 846: 3050B: 700B, 2010
- [ ] Air by AAS: NIOSH 7082, 1994
- [ ] Soil by AAS: EPA SW 846 (Soil)
- [ ] Water by AAS-GF: ASTM D3559-03D, US EPA 200.9
- [ ] Other Metals (Cd, Zn, Cr) by AAS
- [ ] Toxicity Characteristic Leaching Procedure (TCLP) by AAS: US EPA 1311
- [ ] Other _____

Special Instructions:

_____

_____

Turnaround Time

Preliminary Results Requested Date: _____ (Specific date / time) ☐ Verbal ■ Email ☐ Fax

☐ 10 Day ☐ 5 Day ☐ 3 Day ■ 2 Day ☐ 1 Day* ☐ 12 Hour** ☐ 6 Hour** ☐ RUSH**

* End of next business day unless otherwise specified. ** Matrix Dependent. ***Please notify the lab before shipping***

Chain of Custody

Relinquished (Name/Organization):	Gordon / WSP	Date: Oct 13	Time: 10:00
Received (Name / iATL):		Date:	Time:
Sample Login (Name / iATL):		Date:	Time:
Analysis(Name(s) / iATL):	10/19/17	Date:	Time:
QA/QC Review (Name / iATL):	MW 10/19/17	Date:	Time: 2017
Archived / Released: _____	QA/QC InterLAB Use: _____	Date:	Time:

iATL
INTERNATIONAL
ASBESTOS TESTING LABORATORIES

9000 Commerce Parkway, Suite B • Mount Laurel, NJ 08054
Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Sample Log

–Environmental Lead –

Client: WSP Canada Inc. Project: 171-04753-00/HMS WWTP Upgrade

Sampling Date/Time: 6 October 2017

Client Sample #	iATL #	Location/ Description	Flow Rate	Start End	Sampling time (min)	Area (ft2) Volume (L)	Results ( )
17L-AREB-01	6366603	Grey on Green on Orange floor					
17L-AREB-02	6366604	Grey White interior					
17L-AREB-03	6366605	White Exterior					
17L-AREB-04	6366606	Dark Grey W Door					
17L-AREB-05	6366607	Brown E Door					
17L-AREB-06	6366608	Light Blue Transformer Bracket					
17L-AREB-07	6366609	Light Green Ceiling Truss					
17L-AREB-08	6366610	Brown Layered S Double Door					
17L-480V-00	6366611	White on Brown Soffit					
17L-480V-01	6366612	White Exterior Wall					
17L-480V-02	6366613	Tan on Concrete Roof					
17L-480V-03	6366614	White Mint Interior Wall					
17L-480V-04	6366615	Grey Interior Floor					
17L-AREB-09	6366616	Blue Exterior Steel					

* = *Insufficient Sample Provided to Perform QC Reanalysis (<200mg)*
** = *Insufficient Sample Provided to Analyze (<50mg)* ***= *Matrix / Substrate Interference Possible*
FB = Method Requires the submittal of blank(s). ML = Multi Layered Sample. May result in inconsistent results.
These **preliminary results** are issued by iATL to expedite procedures by clients based upon the above data. iATL assumes that all of the sampling methods and data upon which these results are based, has been accurately supplied by the client. These results may not have been reviewed by the Laboratory Director. Final Certificate of Analysis will follow these preliminary results. The signed COA is to be considered the official results. All EPA, HUD, and NJDEP conditions apply.

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Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/19/2017
Report No.: 549914 - Lead Paint Rev #2, 10/20/2017
Project: HMS WWTP Upgrade
Project No.: 17104753-00

LEAD PAINT SAMPLE ANALYSIS SUMMARY

Lab No.: 6366603 **Description:** Grey On Green On Orange Paint **Result (% by Weight):** 18
Client No.: 17L-AREB-01 **Location:** Floor, 6-Oct-17 **Result (ppm):** 180000
Comments:

Lab No.: 6366604 **Description:** Grey White Paint **Result (% by Weight):** 0.0064
Client No.: 17L-AREB-02 **Location:** Interior, 6-Oct-17 **Result (ppm):** 64
Comments:

Lab No.: 6366605 **Description:** White Paint **Result (% by Weight):** 0.78
Client No.: 17L-AREB-03 **Location:** Exterior, 6-Oct-17 **Result (ppm):** 7800
Comments:

Lab No.: 6366606 **Description:** Dark Grey Paint **Result (% by Weight):** 0.34
Client No.: 17L-AREB-04 **Location:** W Door, 6-Oct-17 **Result (ppm):** 3400
Comments:

Lab No.: 6366607 **Description:** Brown Paint **Result (% by Weight):** 0.055
Client No.: 17L-AREB-05 **Location:** E Door, 6-Oct-17 **Result (ppm):** 550
Comments:

Lab No.: 6366608 **Description:** Light Blue Paint **Result (% by Weight):** 0.75
Client No.: 17L-AREB-06 **Location:** Transformer Bracket, 6-Oct-17 **Result (ppm):** 7500
Comments:

Lab No.: 6366609 **Description:** Light Green Paint **Result (% by Weight):** 0.27
Client No.: 17L-AREB-07 **Location:** Ceiling Truss, 6-Oct-17 **Result (ppm):** 2700
Comments:

Lab No.: 6366610 **Description:** Brown Layered Paint **Result (% by Weight):** 0.096
Client No.: 17L-AREB-08 **Location:** S Double Door, 6-Oct-17 **Result (ppm):** 960
Comments:

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/19/2017
Signature: Chad Shaffer
Analyst: Chad Shaffer

Approved By: Frank E. Ehrenfeld, III
Laboratory Director

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Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/19/2017
Report No.: 549914 - Lead Paint Rev #2, 10/20/2017
Project: HMS WWTP Upgrade
Project No.: 17104753-00

LEAD PAINT SAMPLE ANALYSIS SUMMARY

Lab No.:	6366611	**Description:**	White On Brown Paint	**Result (% by Weight):**	0.013
Client No.:	17L-480V-00	**Location:**	Soffit, 6-Oct-17	**Result (ppm):**	130
				Comments:	

Lab No.:	6366612	**Description:**	White Paint	**Result (% by Weight):**	<0.0065
Client No.:	17L-480V-01	**Location:**	Exterior Wall, 6-Oct-17	**Result (ppm):**	<65
				Comments:	

Lab No.:	6366613	**Description:**	Tan Paint	**Result (% by Weight):**	0.081
Client No.:	17L-480V-02	**Location:**	On Concrete Roof, 6-Oct-17	**Result (ppm):**	810
				Comments:	

Lab No.:	6366614	**Description:**	White Mint Paint	**Result (% by Weight):**	0.094
Client No.:	17L-480V-03	**Location:**	Interior Wall, 6-Oct-17	**Result (ppm):**	940
				Comments:	

Lab No.:	6366615	**Description:**	Grey Paint	**Result (% by Weight):**	0.36
Client No.:	17L-480V-04	**Location:**	Interior Floor, 6-Oct-17	**Result (ppm):**	3600
				Comments:	

Lab No.:	6366616	**Description:**	Blue Paint	**Result (% by Weight):**	2.8
Client No.:	17L-AREB-09	**Location:**	Exterior Steel, 6-Oct-17	**Result (ppm):**	28000
				Comments:	

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/19/2017
Signature: Chad Shaffer
Analyst: Chad Shaffer

Approved By: Frank E. Ehrenfeld, III
Laboratory Director

9000 Commerce Parkway Suite B
Mt. Laurel, New Jersey 08054
Telephone: 856-231-9449
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CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/19/2017
Report No.: 549914 - Lead Paint
Project: HMS WWTP Upgrade
Project No.: 17104753-00

Appendix to Analytical Report:

Customer Contact:
Analysis: ASTM D3335-85a

This appendix seeks to promote greater understanding of any observations, exceptions, special instructions, or circumstances that the laboratory needs to communicate to the client concerning the above samples. The information below is used to help promote your ability to make the most informed decisions for you and your customers. Please note the following points of contact for any questions you may have.

iATL Customer Service: customerservice@iatl.com
iATL Office Manager: cdavis@iatl.com
iATL Account Representative: Shirley Clark
Sample Login Notes: See Batch Sheet Attached
Sample Matrix: Paint
Exceptions Noted: See Following Pages

General Terms, Warrants, Limits, Qualifiers:

General information about iATL capabilities and client/laboratory relationships and responsibilities are spelled out in iATL policies that are listed at www.iATL.com and ir our Quality Assurance Manual per ISO 17025 standard requirements. The information therein is a representation of iATL definitions and policies for turnaround times, sample submittal, collection media, blank definitions, quantification issues and limit of detection, analytical methods and procedures, sub-contracting policies, results reporting options, fees, terms, and discounts, confidentiality, sample archival and disposal, and data interpretation.

iATL warrants the test results to be of a precision normal for the type and methodology employed for each sample submitted. iATL disclaims any other warrants, expressed or implied, including warranty of fitness for a particular purpose and warranty of merchantability. iATL accepts no legal responsibility for the purpose for which the client uses test results. Any analytical work performed must be governed by our Standard Terms and Conditions. Prices, methods and detection limits may be changed without notification. Please contact your Customer Service Representative for the most current information.

This confidential report relates only to those item(s) tested and does not represent an endorsement by NIST-NVLAP, AIHA LAP LLC, or any agency of local, state or province governments nor of any agency of the U.S. government.

Information Pertinent to this Report:

Analysis by ASTM D3335-85a by AAS

Certification:
- National Lead Laboratory Program (NLLAP): AIHA-LAP, LLC No. 100188
- NYSDOH-ELAP No. 11021

Regulatory limit is 0.5% lead by weight (EPA/HUD guidelines). Recommend multiple sampling for all samples less than regulatory limit for confirmation.
All results are based on the samples as received at the lab. iATL assumes that appropriate sampling methods have been used and that the data upon which these results are based have been accurately supplied by the client.
Method Detection Limit (MDL) per EPA Method 40CFR Part 136 Apendix B.
Reporting Limit (RL) based upon Lowest Standard Determined (LSD) in accordance with AIHA-ELLAP policies.
LSD=0.2 ppm MDL=0.005% by weight. RL= 0.010% by weight (based upon 100 mg sampled).

Disclaimers / Qualifiers:

There may be some samples in this project that have a "NOTE:" associated with a sample result. We use added disclaimers or qualifiers to inform the client about something that requires further explanation. Here is a complete list with highlighted disclaimers pertinent to this project. For a full explanation of these and other disclaimers, please inquire at **customerservice@iatl.com.**

* Insufficient sample provided to perform QC reanalysis (<200 mg)

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Telephone: 856-231-9449
Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/19/2017
Report No.: 549914 - Lead Paint
Project: HMS WWTP Upgrade
Project No.: 17104753-00

** Not enough sample provided to analyze (<50 mg)

*** Matrix / substrate interference possible.

IATL International Asbestos Testing Laboratories

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Telephone: 856-231-9449 Fax: 856-231-9818
INFO@IATL.COM

DAILY QUALITY CONTROL DATA

LEAD SAMPLE ANALYSIS

(DATE: 10 / 19 / 17)

Standard	Total Lead (mg)	Percent Recovery **
Reagent Blank	0.000	< LOQ
Blank Spike	0.500	97
Lab Control Std	1.730	103
Matrix Spike - LBP *	0.37	99
Matrix Spike - Wipe *	0.32	102
Matrix Spike - Soil *	0.294	102
Matrix spike - Air *	0.050	104
2.5 ppm Standard	0.25	98
10.0 ppm Standard	1.0	101
40.0 ppm Standard	4.0	99

AIHA-LAP, LLC No. 100188 **NYSDOH-ELAP No. 11021**

Analysis Method: ASTM D3335-85A
NIOSH 7082
EPA SW846 3050B 7000B

Comments: IATL assumes that all sampling complies with accepted methods.
All client supplied sampling data is assumed to be correct when calculating results.
Detection limit based upon 0.2 mg/L reporting limit and sample size.
* NIST Traceable.
** 80-120% acceptable limits.

Analyzed By: R. Chad Shaffer
Date: 10/19/17

Approved By: Frank E. Ehrenfeld, III
Laboratory Director

AAS.DailyQC.005

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Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Chain of Custody

– Environmental Lead –

Contact Information

Client Company:	WSP Canada Inc.	**Project Number:**	171-04753-00
Office Address:	760 Enterprise Crescent	**Project Name:**	HMS WWTP Upgrade
City, State, Zip:	Victoria, BC, Canada V8Z 6R4	**Primary Contact:**	Gordon Philippe
Fax Number:	250-475-2211	**Office Phone:**	250-475-1000
Email Address:	Gordon.Philippe@WSPgroup.com	**Cell Phone:**	250-360-6537

iATL is accredited by the National Lead Laboratory Accreditation Program (NLLAP) to perform analytical testing of environmental samples for lead (Pb). The accreditation is through AIHA-LAP, LLC and several other nationally recognized state programs.

Matrix/Method:

- ☐ Paint by AAS: ASTM D3335-85a, 2009
- ☐ Wipe/Dust by AAS: SW 846: 3050B: 700B, 2010
- ☐ Air by AAS: NIOSH 7082, 1994
- ☐ Soil by AAS: EPA SW 846 (Soil)
- ☐ Water by AAS-GF: ASTM D3559-03D, US EPA 200.9
- ☐ Other Metals (Cd, Zn, Cr) by AAS
- ☑ Toxicity Characteristic Leaching Procedure (TCLP) by AAS: US EPA 1311
- ☐ Other _____

Special Instructions:

_____

_____

Turnaround Time

Preliminary Results Requested Date: Hold until analysis of associated paint samples
Specific date / time

☐ Verbal ■ Email ☐ Fax

☐ 10 Day ■ 5 Day ☐ 3 Day ☐ 2 Day ☐ 1 Day* ☐ 12 Hour** ☐ 6 Hour** ☐ RUSH**

* End of next business day unless otherwise specified. ** Matrix Dependent. ***Please notify the lab before shipping***

Chain of Custody

Relinquished (Name/Organization):	Gordon / WSP	Date:	Oct 13 2107	Time:	10:00
Received (Name / iATL):		Date:		Time:	OCT 17 2017
Sample Login (Name / iATL):		Date:		Time:	
Analysis(Name(s) / iATL):		Date:		Time:	
QA/QC Review (Name / iATL):	10/23/17	Date:		Time:	
Archived / Released: _____ QA/QC InterLAB Use: _____		Date:		Time:	

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Phone: 877-428-4285/856-231-9449 • Fax: 856-231-9818

Sample Log

–Environmental Lead –

Client: WSP Canada Inc. Project: 171-04753-00/HMS WWTP Upgrade

Sampling Date/Time: 6 Oct 2107 Hold until analysis of associated lead paint samples

Client Sample #	iATL #	Location/ Description	Flow Rate	Start / End	Sampling time (min)	Area (ft2) Volume (L)	Results ( )
17TCLP-AREB-01	6366617	White Int on Block Wall					
17TCLP-AREB-02	6366618	White on Ext Block Wall					
17TCLP-480V-01	6366619	White on Concrete Roof					
17TCLP-480V-02	6366620	White on Ext Block Wall					
		OLCF = Original Lighthouse Concrete Foundation					

* = *Insufficient Sample Provided to Perform QC Reanalysis (<200mg)*
** = *Insufficient Sample Provided to Analyze (<50mg)* ***= *Matrix / Substrate Interference Possible*
...od Requires the submittal of blank(s). ML = Multi Layered Sample. May result in inconsistent results.

...iminary results are issued by iATL to expedite procedures by clients based upon the above data. iATL assumes that all of the sampling methods ...pon which these results are based, has been accurately supplied by the client. These results may not have been reviewed by the Laboratory Director. ...ificate of Analysis will follow these preliminary results. The signed COA is to be considered the official results. All EPA, HUD, and NJDEP ... apply.

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Email: customerservice@iatl.com

CERTIFICATE OF ANALYSIS

Client: WSP Canada Inc
760 Enterprise Crescent
Victoria BC V8Z 6R4

Client: WSP786

Report Date: 10/23/2017
Report No.: 549915 - Lead TCLP
Project: HMS WWTP Upgrade
Project No.: 17104753-00

LEAD TCLP SAMPLE ANALYSIS SUMMARY

Lab No.: 6366617 **Description:** **Total Lead (ppm):** 64
Client No.: 17TCLP-AREB-01 **Location:** White Interior Paint On Block Wall, 6-Oct-17 **Result (mg/L):** NA
Note: Samples containing less than (<) 100 mg/Kg Total Lead do not require TCLP analysis (Ref. 1311 Sec 1.2).

Lab No.: 6366618 **Description:** **Total Lead (ppm):** 7800
Client No.: 17TCLP-AREB-02 **Location:** White Exterior Paint On Block Wall, 6-Oct-17 **Result (mg/L):** 0.20

Lab No.: 6366619 **Description:** **Total Lead (ppm):** 810
Client No.: 17TCLP-480V-01 **Location:** White On Paint Concrete Roof, 6-Oct-17 **Result (mg/L):** <0.20

Lab No.: 6366620 **Description:** **Total Lead (ppm):** <65
Client No.: 17TCLP-480V-02 **Location:** White On Paint Exterior Block Wall, 6-Oct-17 **Result (mg/L):** NA
Note: Samples containing less than (<) 100 mg/Kg Total Lead do not require TCLP analysis (Ref. 1311 Sec 1.2).

Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 10/17/2017
Date Analyzed: 10/23/2017
Signature:
Analyst: Chad Shaffer

Approved By:
Frank E. Ehrenfeld, III
Laboratory Director

APPENDIX

IV

REGULATORY FRAMEWORK

REGULATORY FRAMEWORK

1. Occupational Health and Safety Regulation (Including amendments up to B.C. Reg. 195/2015),
2. Safe Work Practices for Handling Asbestos, WorkSafeBC, (Publication Date April 2017).
3. Hazardous Waste Regulation, BC Ministry Of Environment. (Including amendments up to B.C. Reg. 179/2016, July 19, 2016).
4. Ozone Depleting Substances and other Halocarbons Regulation. (Including amendments up to B.C. Reg. 317/2012, November 9, 2012).
5. BC Environmental Management Act SBC 2002 (As Current to June 22, 2016).
6. PCB Regulations, SOR / 2008-273, Canadian Environmental Protection Act.
7. Lead-Containing Paint and Coatings, Preventing Exposure in the Construction Industry, WorkSafeBC, June 2011.
8. BC Ministry of Environment Technical Guidance 4, Environmental Management Act Applications, Guideline To Managing Lead-Containing Construction and Demolition Waste In BC, Version 1.0, January 2015
9. Federal Register, 40 CFR Part 745 Lead; Identification of Dangerous Levels of Lead; Final Rule, Environmental Protection Agency, January 5, 2001
10. Transportation of Dangerous Goods Regulations SOR / 2016-95, Transportation of Dangerous Goods Act.

.

APPENDIX

V

STANDARD LIMITATIONS

TERMS OF REFERENCE FOR HAZARDOUS MATERIALS AND OCCUPATIONAL HEALTH AND SAFETY REPORTS ISSUED BY WSP CANADA INC.

1. STANDARD OF CARE

WSP Canada Inc. ("WSP") prepared and issued this report (the "Report") for its client (the "Client") in accordance with generally-accepted consulting practices for the hazardous materials and occupational health and safety disciplines. No other warranty, expressed or implied, is made. Unless specifically stated in the Report, the Report does not address environmental issues.

The terms of reference for hazardous materials and occupational health and safety reports issued by WSP (the "Terms of Reference") contained in the present document provide additional information and caution related to standard of care and the use of the Report. The Client should read and familiarize itself with these Terms of Reference.

2. COMPLETENESS OF THE REPORT

All documents, records, drawings, correspondence, data, files and deliverables, whether hard copy, electronic or otherwise, generated as part of the services for the Client are inherent components of the Report and, collectively, form the instruments of professional services (the "Instruments of Professional Services"). The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, the communications between WSP and the Client, and to any other reports, writings, proposals or documents prepared by WSP for the Client relative to the specific site described in the Report, all of which constitute the Report.

TO PROPERLY UNDERSTAND THE INFORMATION, OBSERVATIONS, FINDINGS, SUGGESTIONS, RECOMMENDATIONS AND OPINIONS CONTAINED IN THE REPORT, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WSP CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT AND ITS VARIOUS COMPONENTS.

3. BASIS OF THE REPORT

WSP prepared the Report for the Client for the specific objectives and purpose that the Client described to WSP. The applicability and reliability of any of the information, observations, findings, suggestions, recommendations and opinions contained in the Report are only valid to the extent that there was no material alteration to or variation from any of the said descriptions provided by the Client to WSP unless the Client specifically requested WSP to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information, observations, findings, suggestions, recommendations and opinions contained in the Report, or any component forming the Report, are for the sole use and benefit of the Client and the team of consultants selected by the Client for the specific project that the Report was provided. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION OR COMPONENT WITHOUT THE WRITTEN CONSENT OF WSP. WSP will consent to any reasonable request by the Client to approve the use of this Report by other parties designated by the Client as the "Approved Users". As a condition for the consent of WSP to approve the use of the Report by an Approved User, the Client must provide a copy of these Terms of Reference to that Approved User and the Client must obtain written confirmation from that Approved User that the Approved User will comply with these Terms of Reference, such written confirmation to be provided separately by each Approved User prior to beginning use of the Report. The Client will provide WSP with a copy of the written confirmation from an Approved User when it becomes available to the Client, and in any case, within two weeks of the Client receiving such written confirmation.

The Report and all its components remain the copyright property of WSP and WSP authorises only the Client and the Approved Users to make copies of the Report, but only in such quantities as are reasonably necessary for the use of the Report by the Client and the Approved Users. The Client and the Approved Users may not give, lend, sell or otherwise disseminate or make the Report, or any portion thereof, available to any party without the written permission of WSP. Any use which a third party makes of the Report, or any portion of the Report, is the sole responsibility of such third parties. WSP accepts no responsibility for damages suffered by any third party resulting from the use of the Report. The Client and the Approved Users acknowledge and agree to indemnify and hold harmless WSP, its officers, directors, employees, agents, representatives or sub-consultants, or any or all of them, against any claim of any nature whatsoever brought against WSP by any third parties, whether in contract or in tort, arising or related to the use of contents of the Report.

5. INTERPRETATION OF THE REPORT

a. **Hidden Conditions**: The Client acknowledges that subsurface and concealed conditions may vary from those encountered or reviewed. WSP can only comment on the conditions observed on the date(s) the assessment is performed. The work is limited to those areas of concern identified by the Client and/or outlined in our proposal. Other areas of concern may exist but were not investigated within the scope of this assessment.

b. **Reliance on information**: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site investigation and field review and on the basis of information provided to WSP. WSP has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, WSP cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

c. **Additional Involvement by WSP**: To avoid misunderstandings, WSP should be retained to assist other professionals to explain relevant hazardous materials and occupational health and safety findings and to review the hazardous materials and occupational health and safety aspects of the plans, drawings and specifications of other professionals relative to the services provided by WSP. To ensure compliance and consistency with the applicable hazardous materials and occupational health and safety codes, legislation, regulations, guidelines and generally-accepted practices, WSP should also be retained to provide field review services during the performance of any related work. Where applicable, it is understood that such field review services must meet or exceed the minimum necessary requirements to ascertain that the work being carried out is in general conformity with the recommendations made by WSP. Any reduction from the level of services recommended by WSP will result in WSP providing qualified opinions regarding adequacy of the work.

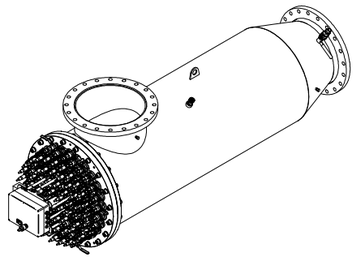
6. ALTERNATE REPORT FORMAT

When WSP submits both electronic and hard copy versions of the Instruments of Professional Services, the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding upon WSP. The hard copy versions submitted by WSP shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions; furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed and sealed versions of the Instruments of Professional Services maintained or retained, or both, by WSP shall be deemed to be the overall originals for the Project.

The Client agrees that the electronic file and hard copy versions of Instruments of Professional Services shall not, under any circumstances, no matter who owns or uses them, be altered by any party except WSP. The Client warrants that the Instruments of Professional Services will be used only and exactly as submitted by WSP.

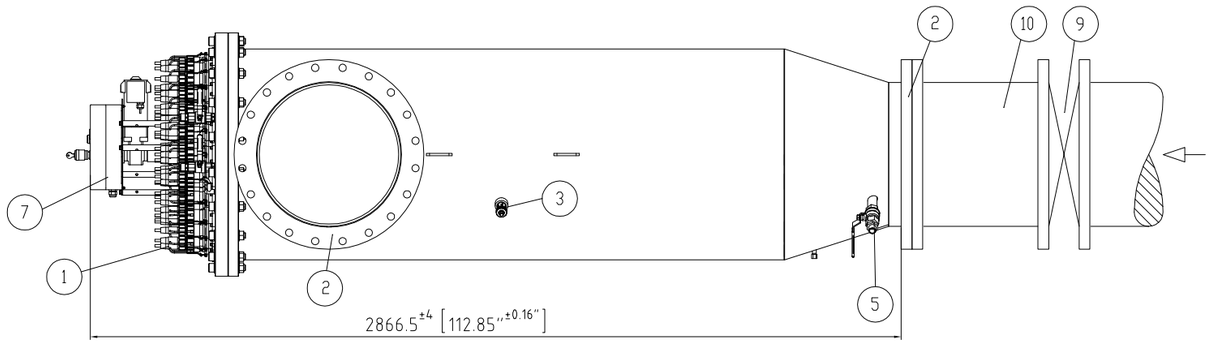
The Client recognizes and agrees that WSP prepared and submitted electronic files using specific software or hardware systems, or both. WSP makes no representation about the compatibility of these files with the current or future software and hardware systems of the Client, the Approved Users or any other party. The Client further agrees that WSP is under no obligation, unless otherwise expressly specified, to provide the Client, the Approved Users and any other party, or any or all of them, with specific software and hardware systems that are compatible with any electronic submitted by WSP. The Client further agrees that should the Client, an Approved User or a third party require WSP to provide specific software or hardware systems, or both, compatible with the electronic files prepared and submitted by WSP, for any reason whatsoever included but not restricted to an order from a court, then the Client will pay WSP for all reasonable costs related to the provision of the specific software or hardware systems, or both. The Client further agrees to indemnify and hold harmless WSP, its officers, directors, employees, agents, representative or sub-consultant, or any or all of them, against any claim or any nature whatsoever brought against WSP, whether in contract or in tort, arising or related to the provision or use or any specific software or hardware provided by WSP.

Appendix D – UV Disinfection System



LBX 1500e DN 500 / ANSI 20"

TOP VIEW/DRAUFSICHT



NOTES:

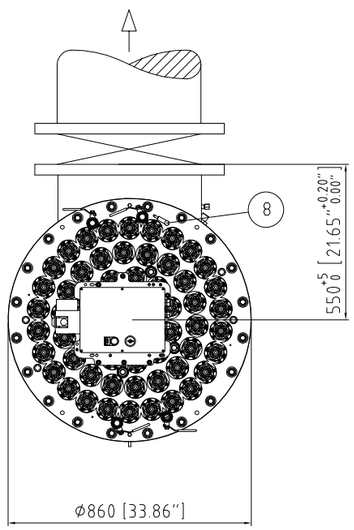
1. The dimensions given on this drawing are required to ensure correct installation operation and performance of the WEDECO UV equipment. All Modifications from this drawing must be approved by WEDECO.
2. Before installation of the UV Equipment all piping must be flushed to prevent objects like sand or stones from damaging components inside the UV vessel.
3. All flow isolation equipment is supplied by others.
4. All field wiring and conduits required to connect power and controls to the electrical enclosure and optional wiping unit shall be sized, supplied, and installed by others. All governing Local/state and national electrical codes/regulations apply (for example but not limited to state, local, CE, NEC, cUL)
5. All equipment shall be located in accordance with all state local, and national electrical codes and per dimensions shown on this drawing.
6. Protect your eyes and skin against UV light. Extended exposure causes sun burn and eye irritation.

ANMERKUNGEN:

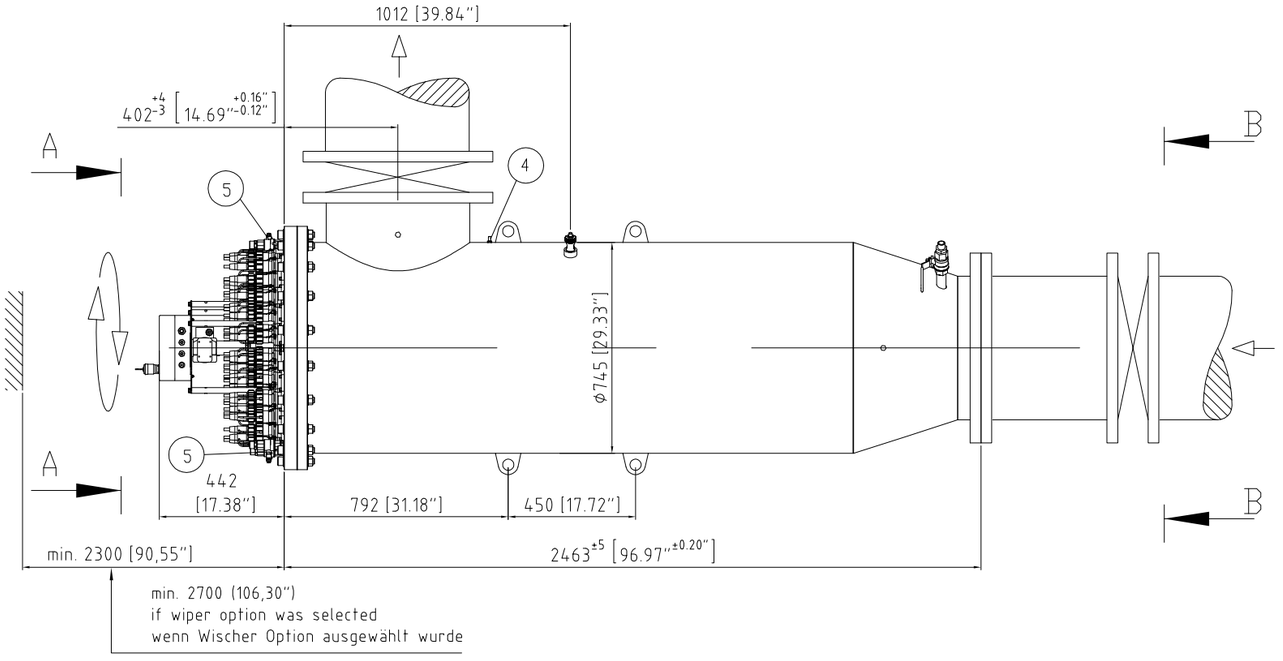
1. Alle Maßangaben dieser Zeichnung sind erforderlich, um eine korrekte Installation, Betrieb und Funktion sicher zu stellen. Alle Änderungen müssen von Wedeco genehmigt werden.
2. Vor der Installation der UV-Anlage müssen alle Rohrleitungen gespült werden, damit Sand, Steine o.ä. keine Komponenten im UV-Reaktor beschädigen können.
3. Alle Absperreinrichtungen sind nicht im Lieferumfang von Wedeco.
4. Alle Verkabelungen, Kabelkanäle und elektrische Anschlüsse des Schaltkastens, sind durch Dritte zu liefern und zu installieren. Alle lokal zutreffenden Gesetze, Normen und Regularien, (z.B. EN, IEC, NEC, cUL, etc.) sind zu berücksichtigen.
5. Die Anlage ist entsprechend den jeweils lokal gültigen Normen, Gesetze und Regularien und gemäß der angegebenen Dimensionen zu installieren.
6. UV-Licht kann Augen und Haut schädigen. Schützen Sie Augen und Haut.

VIEW/ ANSICHT A-A

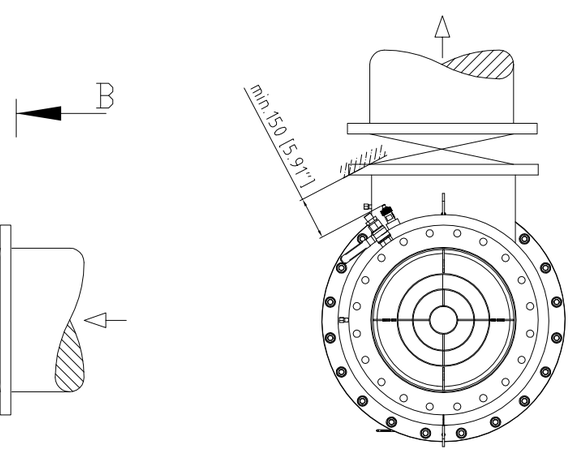
WITH OPTIONAL WIPER/
MIT OPTIONALEM WISCHER



FRONT VIEW/ VORDERANSICHT



VIEW/ ANSICHT B-B



MOUNTING/EINBAU: PREFERABLY HORIZONTAL/ BEVORZUGT HOTIZONTAL

LBX 1500e DN 500 / ANSI 20"

Item	Description / Beschreibung	Notes	Material
1	Lamp Connector/cable to electrical Cabinet / Lampenanschluß/ Kabel zum Schaltschrank	60 per Unit/ 60 je Einheit	
2	Inlet / outlet flanges / Eingangs- und Ausgangsflansch	DN500/PN10 EN 1092-1/02 or 20" ANSI B16.5 150 lbs.)	ASTM316 (1.4571)
3	UV Sensor	1 per Unit/1je Einheit, cable provided for connection to Cabinet Kabel für Anschluß an Schaltschrank bereitstellen	
4	Ground Connector / Erdungsanschluß		ASTM316 (1.4571)
5	Cleaning and drain/vent valve / Reinigungs-und Spülventil	3 per unit/ 3 je Einheit, R 1" Din 2999 (1" NPT with ANSI units)	ASTM316 (1.4571)
7	Wiping system (Optional)/Wischersystem (optional)	1 per Unit/ 1 je Einheit requires power and controls connection to Cabinet Anschluß an Schaltschrank erforderlich	
8	High temperature switch / Temperaturschalter	1 per Unit, cable provided for connection to Cabinet Kabel für Anschluß an Schaltschrank bereitstellen	
9	Isolation Valve/ Absperrarmatur	By Others/ durch Dritte	ASTM316 (1.4571) recommended
10	Streight Pipe length equal to 0.5 X pipe diameter/ Rohrlänge gleich 0,5 x Rohrdurchmesser	only required for butterfly type valves (by others) nur bei Absperrklappe erforderlich (durch dritte)	

Xylem Water Solutions Herford GmbH
Boschstr. 4 – 14, 32051 Herford, Germany
Tel. +49 5221 930-0, Fax +49 5221 930-222
Info@xyleminc.com
www.xyleminc.com

WEDECO a xylem brand

Project: LBX 1500e

Scale: 1:15

Title: GENERAL ARRANGEMENT DRAWING
UV REACTOR

	Date	Name
Drawn	20.11.2015	rluja
Chkd.		

Material : | Weight:

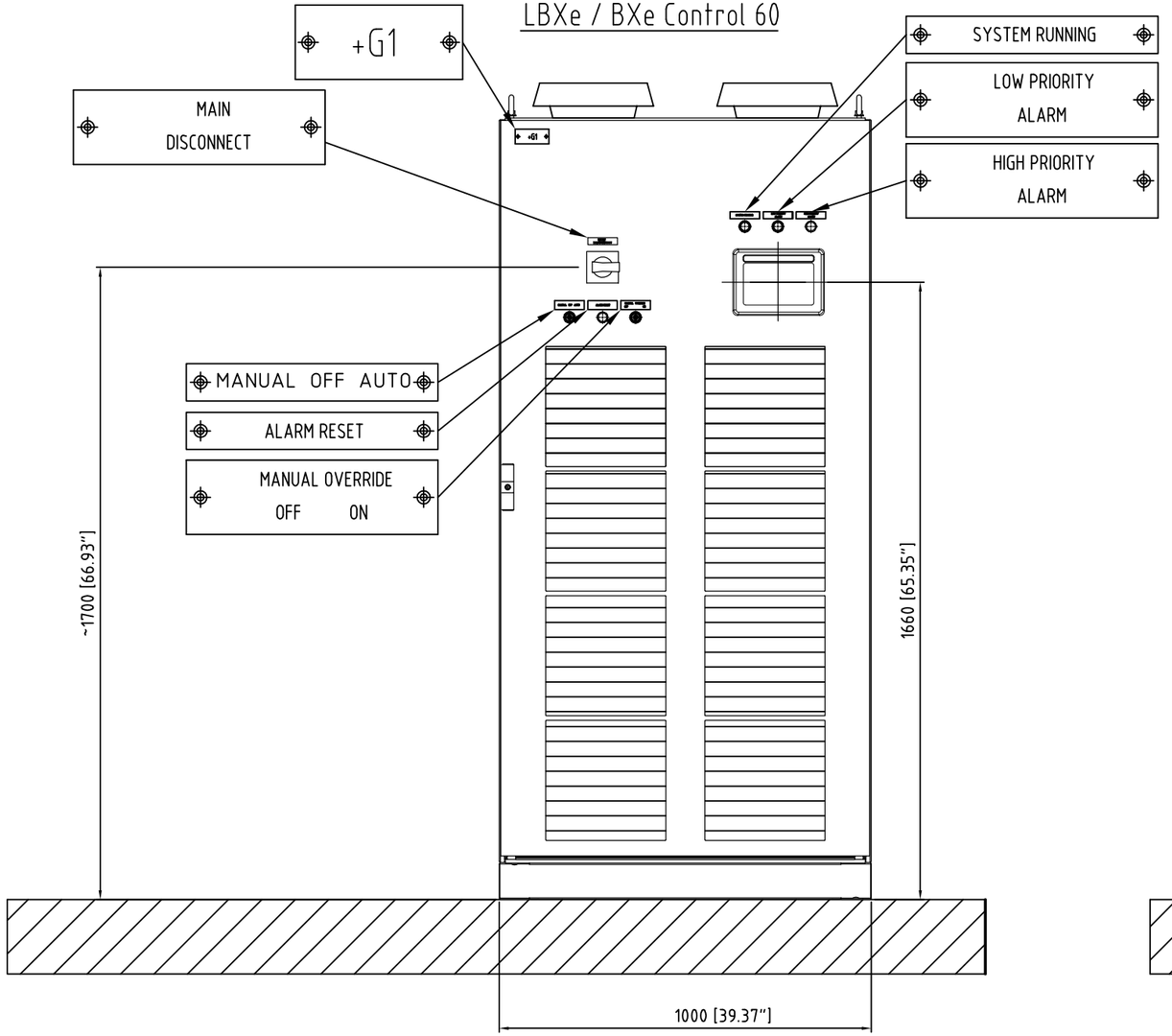
Article-ID: | Drawing-Nr.: U-97680-0 | sht

Rev.	Description	Date	Name
0			

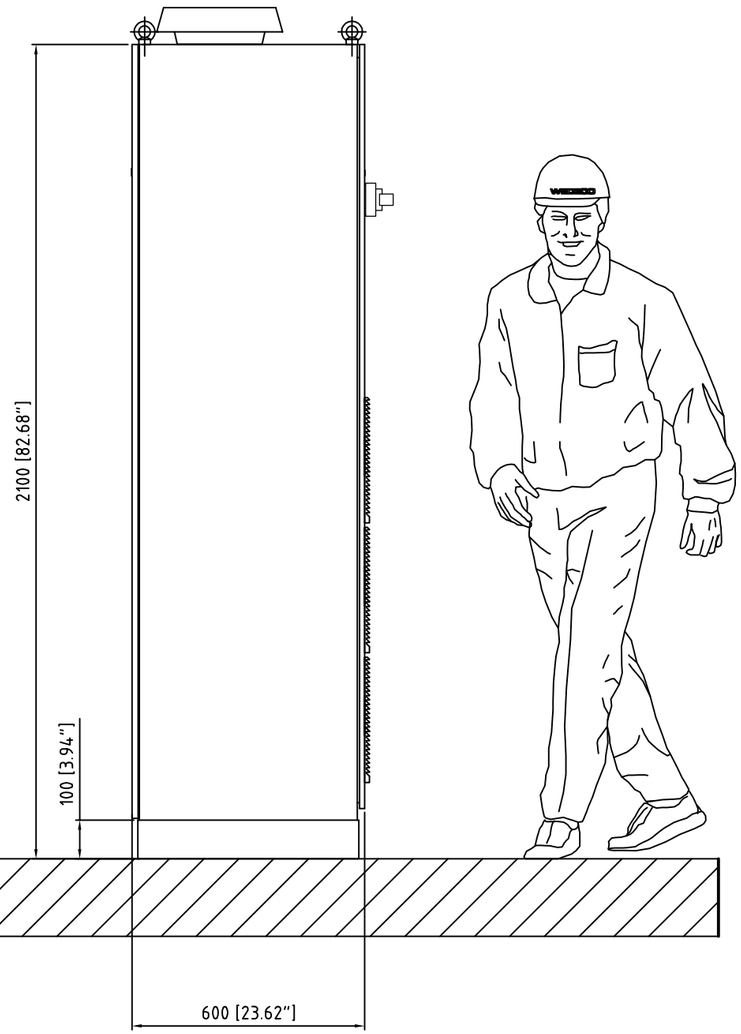
EDV Nr.U-97680.DWG | of

A2

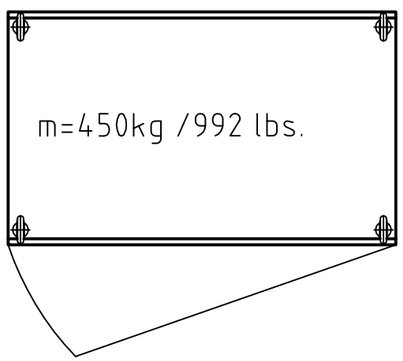
LBXe / BXe Control 60



Side view



Top view



NOTES:

1. The dimensions given on this drawing are required to ensure correct installation operation and performance of the WEDECO UV equipment. All Modifications from this drawing must be approved by WEDECO.
2. ALL field wiring and conduits required to connect power and controls to the electrical enclosure and optional wiping unit shall be sized, supplied, and installed by others. All governing Local/state and national electrical codes/regulations apply (for example but not limited to state, local, CE, NEC, cUL)
3. ALL equipment shall be located in accordance with all state local, and national electrical codes and per dimensions shown on this drawing.
4. Protect your eyes and skin against UV light. Extended exposure causes sun burn and eye irritation.

ANMERKUNGEN:

1. Alle Maßangaben dieser Zeichnung sind erforderlich, um eine korrekte Installation, Betrieb und Funktion sicher zu stellen. Alle Änderungen müssen von Wedeco genehmigt werden.
2. Alle Verkabelungen, Kabelkanäle und elektrische Anschlüsse des Schaltkastens, sind durch Dritte zu liefern und zu installieren. Alle lokal zutreffenden Gesetze, Normen und Regularien, (z.B. EN, IEC, NEC, cUL, etc.) sind zu berücksichtigen.
3. Die Anlage ist entsprechend den jeweils lokal gültigen Normen, Gesetze und Regularien und gemäß der angegebenen Dimensionen zu installieren.
4. UV-Licht kann Augen und Haut schädigen. Schützen Sie Augen und Haut.

Xylem Water Solutions Herford GmbH
Boschstr. 4.- 14, 32051 Herford, Germany
Tel. +49 5221 930-0, Fax +49 5221 930-222
Info@xyleminc.com
www.xyleminc.com

D-32051 Herford / Phone +49 5221 930-0

WEDECO a xylem brand

Project: LBXe \ BXe PLC cUL Type 12

Scale: 1:10

Title: Cabinet layout
cUL LBXe \ BXe Control 60

	Date	Name
Drawn	09.05.2013	Raymond
Chkd.		

Material: | Weight:

Article-ID: | Drawing-Nr.: Control 60 PLC FAN | sht

Rev.	Description	Date	Name

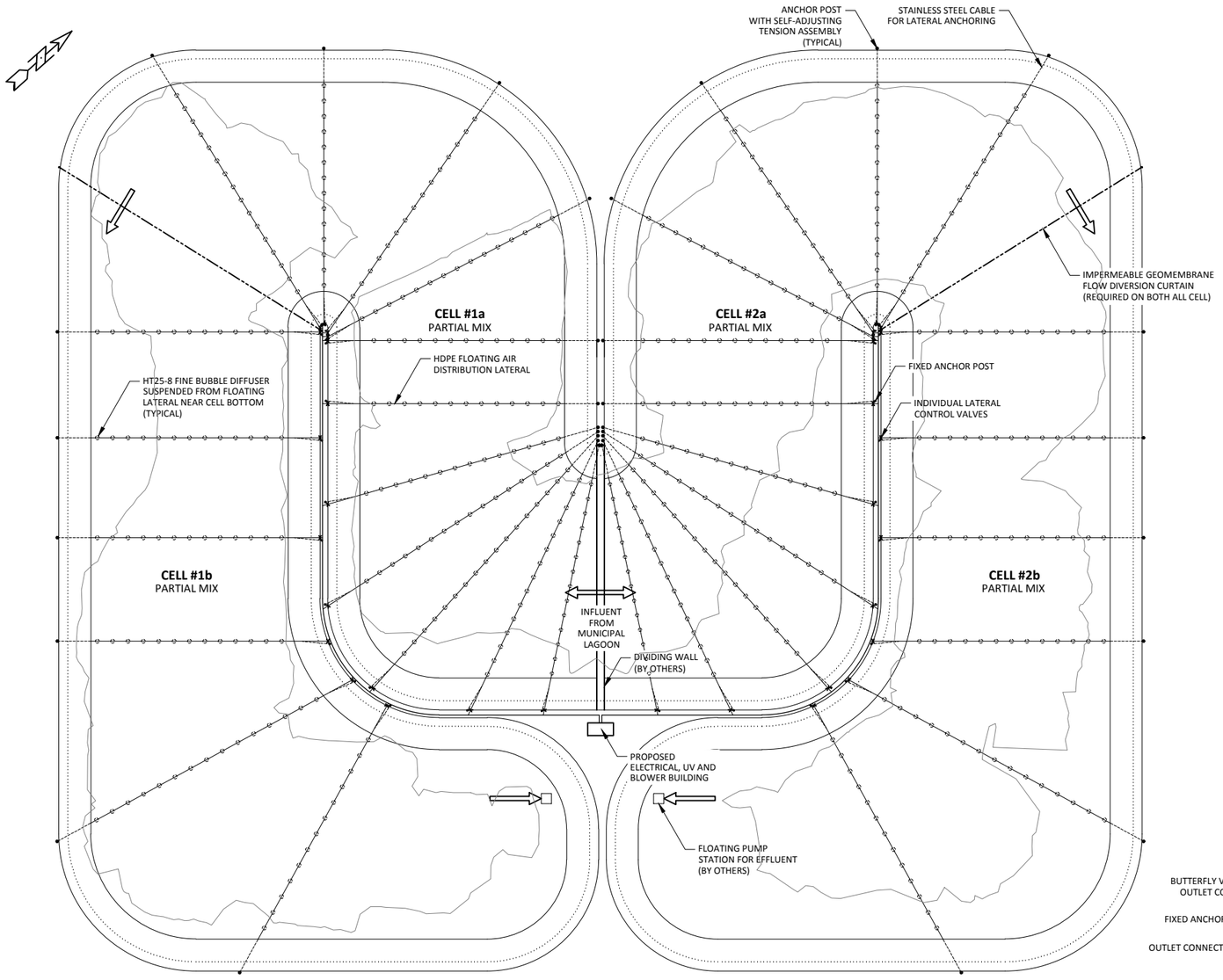
EDV Nr. U-XXXXX Control 60 PLC cUL12 LBXe.dwg | of

A2

Appendix E – Aeration System

PLOT SIZE: 610mm x 914mm (24" x 36")

REDUCED SIZE PLOT - DO NOT SCALE

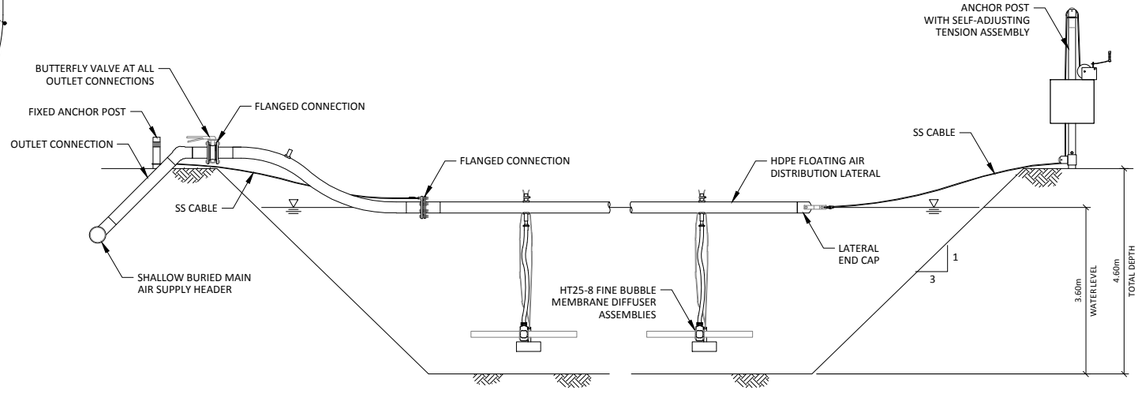


PROPOSED AERATION LAYOUT

SCALE: 1:1000

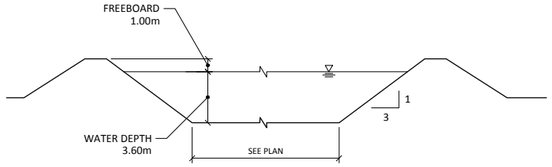
LOCATION PLAN

SCALE: N.T.S.



AERATED LAGOON SECTION

SCALE: N.T.S.



TYPICAL SECTION - AERATED CELLS

SCALE: N.T.S.

Nexom
technologies for cleaner water
5 Burks Way
Winnipeg, Manitoba
Canada R2J 3R8
888-426-8180
www.nexom.com

PROJECT: **PORT ALBERNI, BC**
PROPOSED WASTEWATER TREATMENT SYSTEM

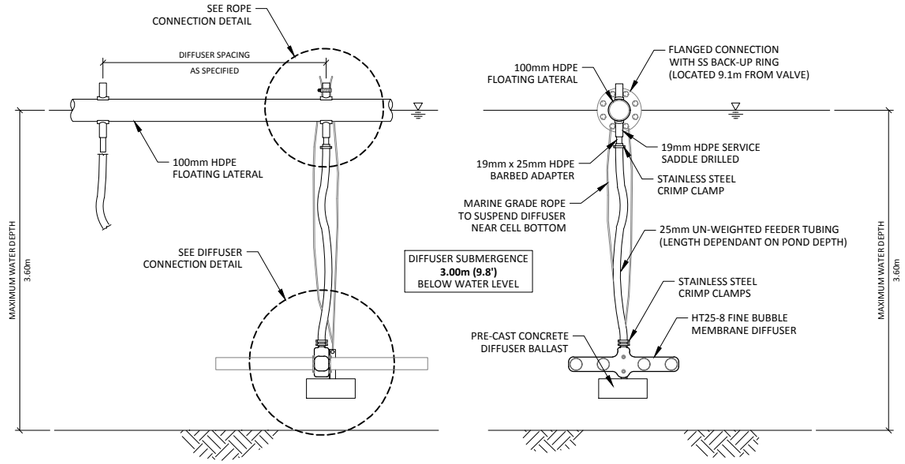
TITLE: OPTAER SYSTEM
AERATION LAYOUT, TYPICAL SECTION, LOCATION PLAN

DRAWN BY:	APPROVED BY:	SCALE:	DRAWING NO.	SHT.	REV.
AM	MH	AS NOTED	NE01	1 of 2	0

DATE: 2018/05/07 FILE # CD1550.07

PLOT SIZE: 610mm x 914mm (24" x 36")

REDUCED SIZE PLOT - DO NOT SCALE

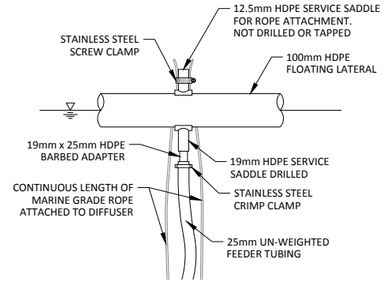


LATERAL DETAIL - ELEVATION

SCALE: 1:15

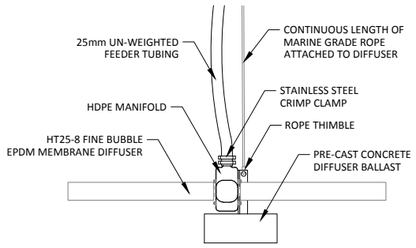
LATERAL DETAIL - SECTION

SCALE: 1:15



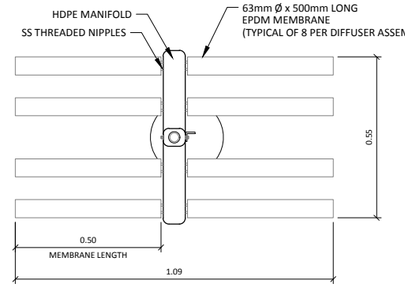
ROPE CONNECTION DETAIL

SCALE: N.T.S.



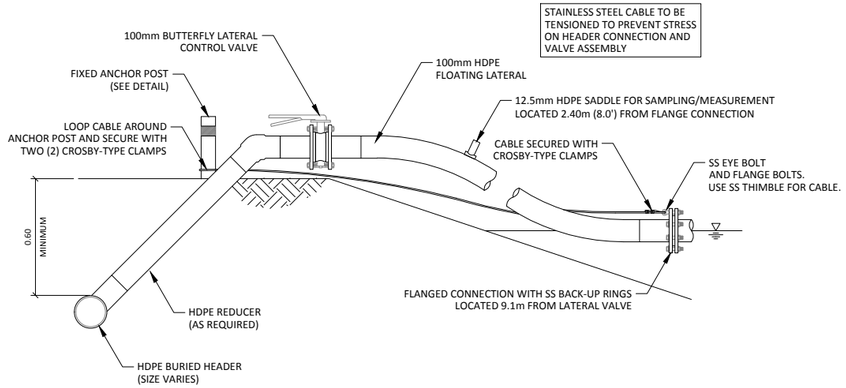
DIFFUSER CONNECTION DETAIL

SCALE: N.T.S.



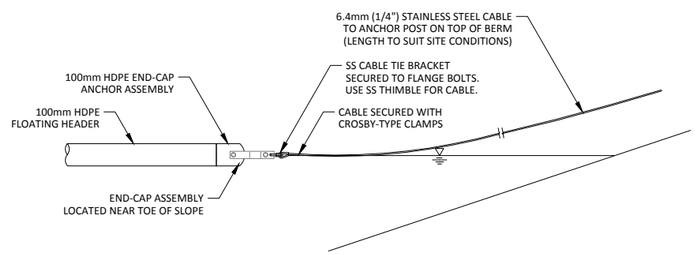
HT25-8 DIFFUSER - PLAN

SCALE: N.T.S.



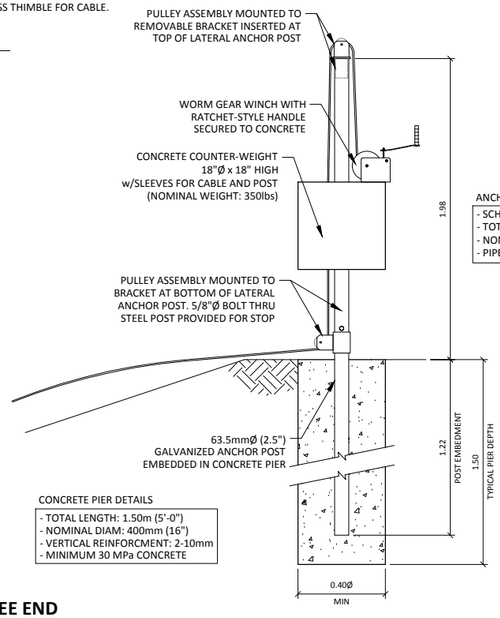
LATERAL DETAIL AT HEADER

SCALE: 1:15



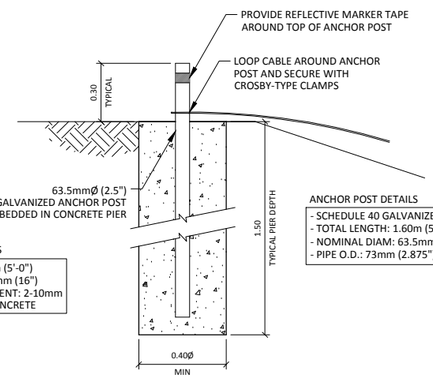
LATERAL DETAIL AT FREE END

SCALE: 1:15



ANCHOR POST DETAILS
- SCHEDULE 40 GALVANIZED
- TOTAL LENGTH: 3.20m (10'-6")
- NOMINAL DIAM: 63.5mm (2.5")
- PIPE O.D.: 73mm (2.875")

CONCRETE PIER DETAILS
- TOTAL LENGTH: 1.50m (5'-0")
- NOMINAL DIAM: 400mm (16")
- VERTICAL REINFORCMENT: 2-10mm
- MINIMUM 30 MPa CONCRETE



ANCHOR POST DETAILS
- SCHEDULE 40 GALVANIZED
- TOTAL LENGTH: 1.60m (5'-3")
- NOMINAL DIAM: 63.5mm (2.5")
- PIPE O.D.: 73mm (2.875")

CONCRETE PIER DETAILS
- TOTAL LENGTH: 1.50m (5'-0")
- NOMINAL DIAM: 400mm (16")
- VERTICAL REINFORCMENT: 2-10mm
- MINIMUM 30 MPa CONCRETE

FIXED ANCHOR POST AT HEADER DETAIL

SCALE: 1:15

Nexom technologies for cleaner water
5 Burks Way
Winnipeg, Manitoba
Canada R2J 3R8
888-426-8180
www.nexom.com

PROJECT: **PORT ALBERNI, BC**
PROPOSED WASTEWATER TREATMENT SYSTEM

TITLE: OPTAER SYSTEM
TYPICAL AERATION DETAILS

DRAWN BY:	APPROVED BY:	SCALE:	DRAWING NO.	SHT.	REV.
AM	MH	AS NOTED	NE02	2 of 2	0
DATE: 2018/05/07	FILE # CD1550.07				

CITY OF PORT ALBERNI, B.C.
WASTEWATER LAGOON
EXPANSION UPGRADES

PLOT DATE: 6/28/2018 10:55:00 AM
SAVE DATE: 6/28/2018 9:12:54 AM SAVED BY: DUALANJ
DWG PATH: p:\20172972\00_wstwtr_trtmnt_upg\working_dwgs\900_project_standards\2972-00-g-001.dwg

Associated Engineering
#500 - 2889 East 12th Avenue, Vancouver, British Columbia, V5M 4T5
Ph: 604 293 1411 Fax: 604 291 6163
www.ae.ca

THE CITY OF Port Alberni

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	C. BRUMPTON	A. MOLYNEAUX	ISSUED FOR TENDER

DRAWING	REVISION	SHEET
2972-00-G-001	0	1 /111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

SHEET LIST TABLE

DRAWING NAME	REVISION	DRAWING TITLE	DRAWING DESCRIPTION
GENERAL			
2972-00-g-001	0	COVER PAGE	
2972-00-g-002	0	DRAWING INDEX	
CIVIL			
2972-00-c-001	0	SITE PLAN	CIVIL GENERAL NOTES 1 OF 2
2972-00-c-002	0	SITE PLAN	CIVIL GENERAL NOTES 2 OF 2
2972-00-c-003	0	LEGEND	
2972-00-c-101	0	SITE GRADING	SCREEN BUILDING
2972-00-c-102	0	SITE GRADING	LAGOON BERM
2972-00-c-103	0	SITE GRADING	UV BUILDING
2972-00-c-104	0	SANITARY SEWER	STA 20+000 TO STA 20+300
2972-00-c-105	0	SANITARY SEWER	STA 10+000 TO STA 10+200
2972-00-c-106	0	SANITARY SEWER	STA 30+020 TO STA 30+340
2972-00-c-107	0	TEMPORARY SANITARY SEWER	STA 40+000 TO STA 40+170
2972-00-c-108	0	TEMPORARY SANITARY SEWER	STA 40+170 TO STA 40+400
2972-00-c-109	0	FORCE MAIN TIE-INS	
2972-00-c-110	0	WATERMAIN LAYOUT 1 OF 4	STA 50+000 - 50+270
2972-00-c-111	0	WATERMAIN LAYOUT 2 OF 4	STA 50+270 - 50+470
2972-00-c-112	0	WATERMAIN LAYOUT 3 OF 4	STA 50+470 - 50+750
2972-00-c-113	0	WATERMAIN LAYOUT 4 OF 4	STA 50+720 - 50+820
2972-00-c-114	0	INSTALLATION PHOTOS	
2972-00-c-501	0	DETAILS	1 OF 5
2972-00-c-502	0	DETAILS	2 OF 5
2972-00-c-503	0	DETAILS	3 OF 5
2972-00-c-504	0	DETAILS	4 OF 5
2972-00-c-505	0	DETAILS	5 OF 5
ARCHITECTURAL			
2972-00-a-101	0	UV BUILDING	FLOOR PLAN
2972-00-a-102	0	UV BUILDING	ROOF PLAN
2972-00-a-201	0	UV BUILDING	ELEVATION SHEET 1
2972-00-a-202	0	UV BUILDING	ELEVATION SHEET 2
2972-00-a-301	0	UV BUILDING	SECTIONS
2972-00-a-601	0	UV BUILDING	SCHEDULES
2972-00-a-111	0	SCREEN BUILDING	FLOOR PLAN
2972-00-a-112	0	SCREEN BUILDING	ROOF PLAN
2972-00-a-211	0	SCREEN BUILDING	ELEVATIONS
2972-00-a-311	0	SCREEN BUILDING	SECTIONS
2972-00-a-611	0	SCREEN BUILDING	SCHEDULES
STRUCTURAL			
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2972-00-s-002	0	UV BUILDING	GENERAL NOTES SHEET 2
2972-00-s-101	0	UV BUILDING	FOUNDATION PLAN
2972-00-s-102	0	UV BUILDING	PLATFORM LAYOUT PLAN
2972-00-s-103	0	UV BUILDING	ROOF LAYOUT PLAN
2972-00-s-201	0	UV BUILDING	MASONRY WALL REINFORCEMENT SHEET 1
2972-00-s-202	0	UV BUILDING	MASONRY WALL REINFORCEMENT SHEET 2
2972-00-s-301	0	UV BUILDING	SECTIONS
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2972-00-s-303	0	UV BUILDING	REINFORCEMENT SECTIONS SHEET 2
2972-00-s-304	0	UV BUILDING	REINFORCEMENT SECTIONS SHEET 3
2972-00-s-501	0	UV BUILDING	DETAILS SHEET 1
2972-00-s-502	0	UV BUILDING	DETAILS SHEET 2
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2972-00-s-012	0	SCREEN BUILDING	GENERAL NOTES SHEET 2
2972-00-s-111	0	SCREEN BUILDING	FOUNDATION PLAN
2972-00-s-112	0	SCREEN BUILDING	PLATFORM LAYOUT PLAN
2972-00-s-113	0	SCREEN BUILDING	ROOF LAYOUT PLAN
2972-00-s-211	0	SCREEN BUILDING	MASONY WALL ELEVATIONS
2972-00-s-311	0	SCREEN BUILDING	SECTIONS SHEET 1
2972-00-s-312	0	SCREEN BUILDING	SECTIONS SHEET 2
2972-00-s-313	0	SCREEN BUILDING	REINFORCEMENT SECTION SHEET 1
2972-00-s-314	0	SCREEN BUILDING	REINFORCEMENT SECTION SHEET 2
2972-00-s-315	0	SCREEN BUILDING	REINFORCEMENT SECTION SHEET 3
2972-00-s-511	0	SCREEN BUILDING	DETAILS SHEET 1
2972-00-s-512	0	SCREEN BUILDING	DETAILS SHEET 2
PROCESS MECHANICAL			
2972-00-d-001A	0	P&ID - LEGEND & SYMBOLS	SHEET 1 OF 2
2972-00-d-001B	0	P&ID - LEGEND & SYMBOLS	SHEET 2 OF 2
2972-00-d-003	0	HYDRAULIC PROFILE	SHEET 2
2972-00-d-002	0	HYDRAULIC PROFILE	SHEET 1
2972-00-d-004	0	P&ID - SCREENING	
2972-00-d-005	0	P&ID - BLOWERS	
2972-00-d-006	0	P&ID - AERATION SYSTEM	
2972-00-d-007	0	P&ID - EFFLUENT PUMPS I OF 2	
2972-00-d-009	0	P&ID - UV SHEET 1 OF 2	
2972-00-d-010	0	P&ID - UV SHEET 2 OF 2	
2972-00-d-101		NOT USED	
2972-00-d-102		NOT USED	
2972-00-d-121	0	SCREEN BUILDING	PLAN
2972-00-d-151	0	TREATMENT BUILDING	PLAN
2972-00-d-201		NOT USED	
2972-00-d-321	0	SCREEN BUILDING	SECTION SHEET 1
2972-00-d-351	0	TREATMENT BUILDING	SECTION SHEET 1
2972-00-d-352	0	TREATMENT BUILDING	SECTION SHEET 2
2972-00-d-501	0	DETAILS SHEET 1	
2972-00-d-502	0	DETAILS SHEET 2	
2972-00-d-503	0	DETAILS SHEET 3	
2972-00-d-504	0	DETAILS SHEET 4	
2972-00-d-561	0	EMERGENCY OVERFLOW STRUCTURE	STOP LOGS GA AND DETAILS
BUILDING MECHANICAL			
2972-00-m-121	0	SCREEN BUILDING	HVAC SYSTEM PLAN AND SECTION
2972-00-m-122	0	SCREEN BUILDING	PLUMBING PLAN
2972-00-m-151	0	TREATMENT BUILDING	HVAC SYSTEM PLAN
2972-00-m-152	0	TREATMENT BUILDING	PLUMBING PLAN
2972-00-m-351	0	TREATMENT BUILDING	SECTIONS
2972-00-m-601	0	SCHEDULES	
ELECTRICAL			
2972-00-e-101	0	SITE PLAN	
2972-00-e-121	0	SCREEN BUILDING	PLAN
2972-00-e-151	0	TREATMENT BUILDING	PLAN
2972-00-e-152	0	TREATMENT BUILDING	GROUNDING PLAN
2972-00-e-601	0	SINGLE LINE DIAGRAM	
2972-00-e-602	0	SCHEDULES	
2972-00-e-603	0	DETAILS	
INSTRUMENTATION			
2972-00-i-102	0	SCREEN BUILDING	INSTRUMENTATION LAYOUT
2972-00-i-103	0	TREATMENT BUILDING	INSTRUMENTATION LAYOUT
2972-00-i-104	0	TIDAL GAUGE	PLAN AND INTERCONNECTION
2972-00-i-201	0	COMMUNICATION BLOCK DIAGRAM	
2972-00-i-601	0	CP-100 CABINET LAYOUT	
2972-00-i-602	0	CP-100 POWER DISTRIBUTION & COMMUNICATIONS	TREATMENT BUILDING
2972-00-i-603	0	CP-100 SCADAPACK ON BOARD I/0 (I OF 2)	TREATMENT BUILDING
2972-00-i-604	0	CP-100 SCADAPACK ON BOARD I/0 (2 OF 2)	TREATMENT BUILDING
2972-00-i-605	0	CP-100 DIGITAL INPUTS 5403 EXPANSION RACK	TREATMENT BUILDING
2972-00-i-606	0	CP-100 DIGITAL OUTPUTS 5415 EXPANSION RACK	TREATMENT BUILDING
2972-00-i-611	0	SCREENING BUILDING	CP-200 LAYOUT
2972-00-i-612	0	CP-200 POWER DISTRIBUTION	
2972-00-i-613	0	CP-200 SCADAPACK ON BOARD I/0 (I OF 2)	SCREENING BUILDING
2972-00-i-614	0	CP-200 SCADAPACK ON BOARD I/0 (2 OF 2)	SCREENING BUILDING

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DATE: 2018-06-28, Adam Molyneaux

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. G. BRUMPTON
30001
June 28, 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	C. BRUMPTON	S. KE	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

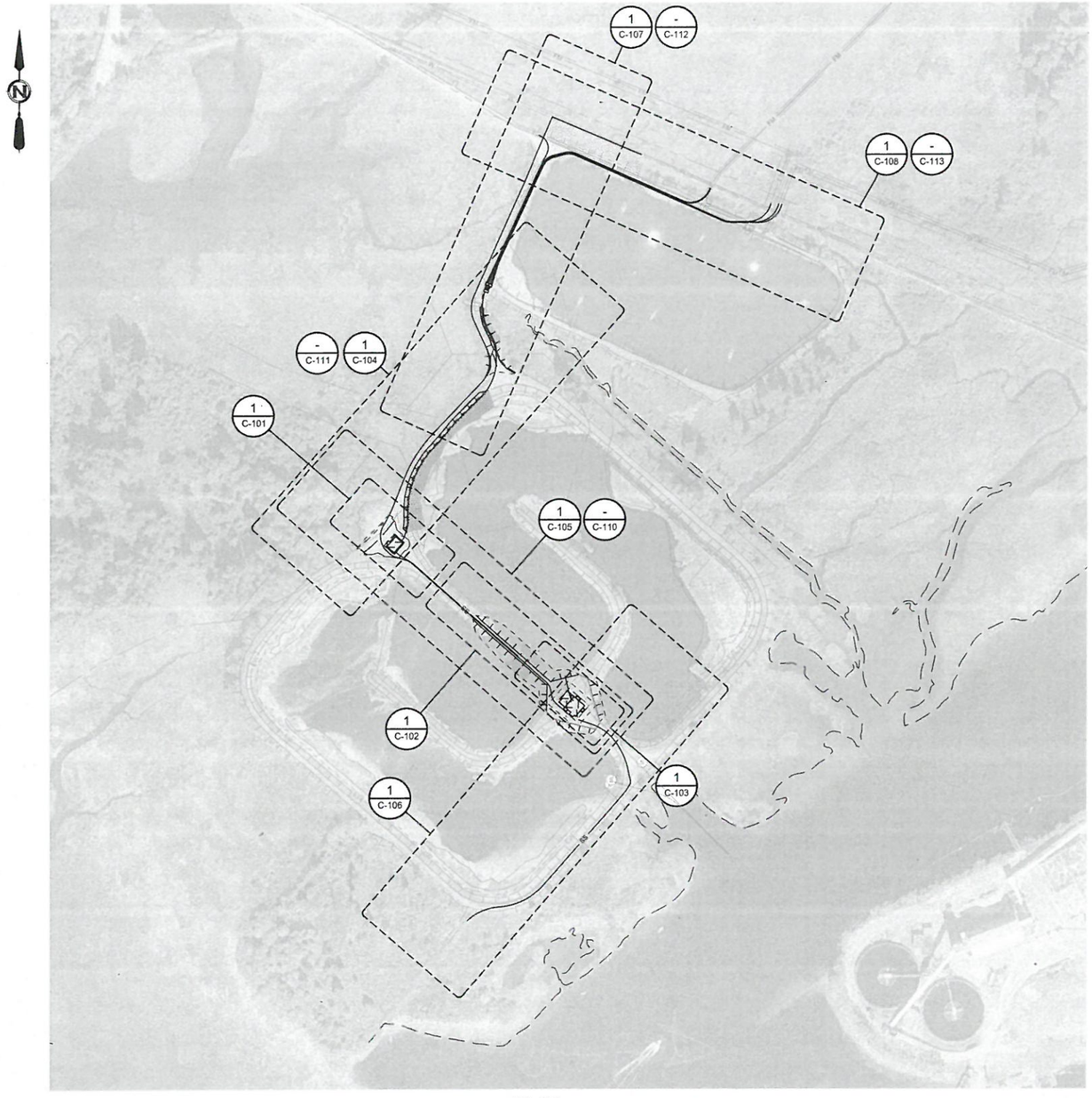
THE CITY OF Port Alberni

GENERAL
DRAWING INDEX

DRAWING	REVISION	SHEET
2972-00-G-002	0	2 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:2500

GENERAL NOTES:

1. ALL DIMENSIONS ARE SHOWN IN METRES (m) UNLESS OTHERWISE NOTED.
2. ALL PIPE DIMENSIONS ARE SHOWN IN MILLIMETRES (mm) UNLESS OTHERWISE NOTED.
3. ORIGINAL GROUND AND EXISTING SITE FEATURES BASED ON BATHYMETRIC SURVEY COMPLETED BY GRANT LAND SURVEY, DATED SEPTEMBER 23, 2016, AND TOPOGRAPHIC SURVEY COMPLETED BY ASSOCIATED ENGINEERING, DATED NOVEMBER 3, 2017.
4. COORDINATES SHOWN IN LOCAL, GROUND COORDINATE SYSTEM. TO CONVERT TO UTM ZONE 10 NAD83: SHIFT N 5452594.841, E 364495.260, SCALE FROM 0,0 BY 0.99981766.
5. ELEVATIONS ARE SHOWN IN METRIC GEODETIC DATUM DERIVED FROM ICM 87H341 ELEV 5.186 m.
6. ALL EXISTING UTILITY LOCATIONS TO BE CONFIRMED BY CONTRACTOR. ANTICIPATED LOCATIONS SHOWN.
7. SANITARY
   - 7.1. SANITARY PIPE ≤ 900 mm TO BE HDPE DR 26, BUTT FUSED.
   - 7.2. SANITARY PIPE > 900 mm TO BE HDPE DR 21, BUTT FUSED, UNLESS SHOWN OTHERWISE.
   - 7.3. ANCHOR BLOCKS ARE TO BE INSTALLED AS INDICATED IN THE DRAWINGS.

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. Z. SALLY
45124
28 Jun 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z.SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
SITE PLAN
CIVIL GENERAL NOTES 1 OF 2

DRAWING	REVISION	SHEET
2972-00-C-001	0	3 /111

IF NOT 50 mm ADJUST SCALES
50 mm

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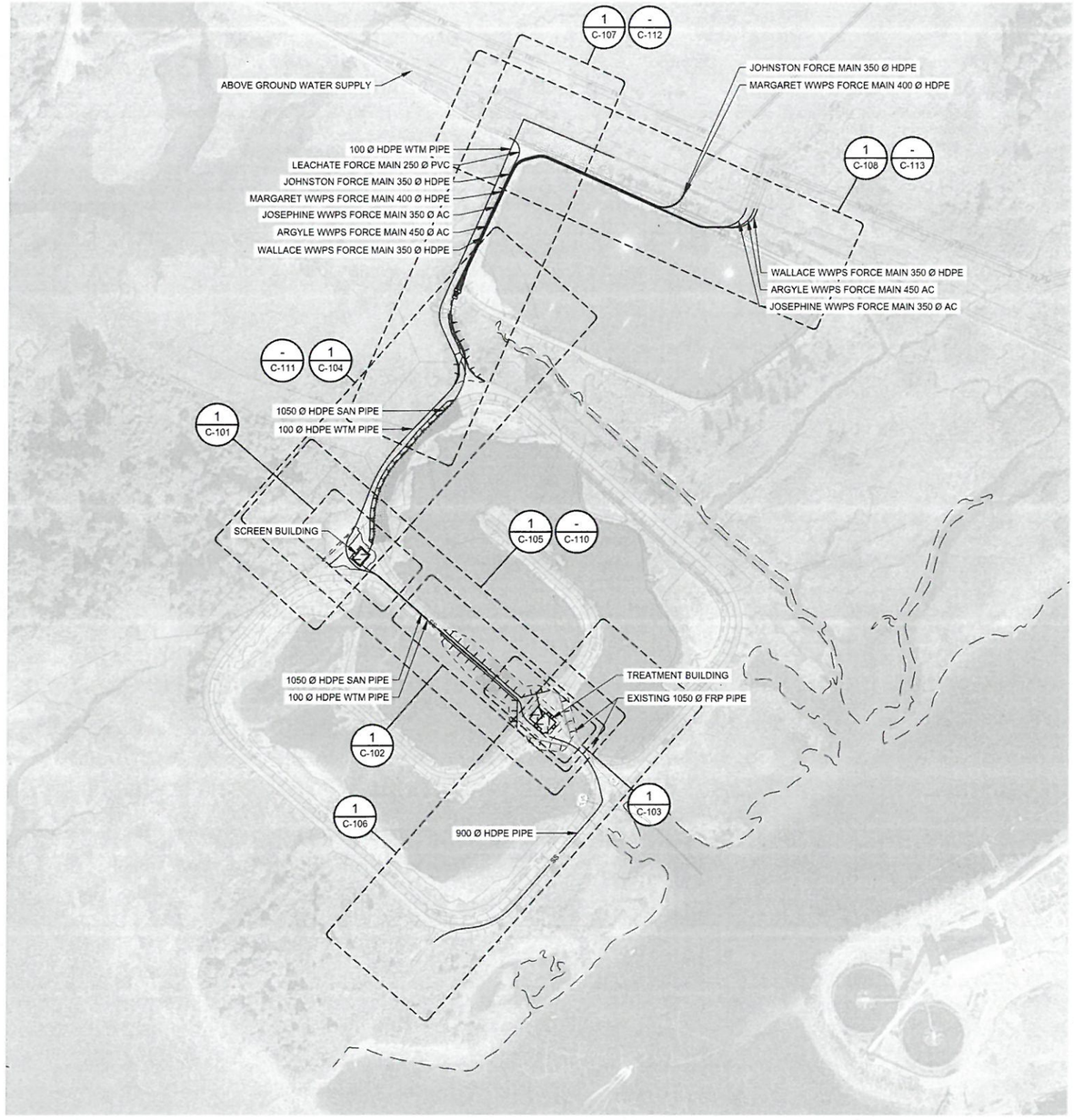

PLAN 1:2500

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P:\20172972\00_WstWtr_Trtmnt_Upg\Working_Dwgs\100_Civil\2972-00-c-001_002.dwg
DATE: 2018-06-27, Jhunn Dualan

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PROFESSIONAL ENGINEER
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M. Z. SALLY
45124
28 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
SITE PLAN
CIVIL GENERAL NOTES 2 OF 2

DRAWING	REVISION	SHEET
2972-00-C-002	0	4 /111

IF NOT 50 mm ADJUST SCALES
50 mm

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LINETYPES

ROAD	EXISTING	PROPOSED
CONTROL LINE		100+000
GRAVEL ROAD		

MISCELLANEOUS	EXISTING	PROPOSED
FENCE	X X	X X
SILT FENCE	O O	O O
ABANDONED PIPE	ABN	
RAILWAY		
BOTTOM OF BANK		
TOP OF BANK		
EDGE OF WATER	EW	
BUILDING		
DITCH		

CONTOUR
MAJOR
MINOR

PROPERTY
PARCEL / LOT LINE
EASEMENT
STATUTORY ROW
ROAD ROW

WATER	EXISTING	PROPOSED
WATER MAIN	W	W
WATER MAIN (PROFILE)		

STORM DRAINAGE	EXISTING	PROPOSED
CULVERT (Ø AND TYPE)	CP	CP
STORM SEWER	D	D

SANITARY SEWER	EXISTING	PROPOSED
SANITARY SEWER	SS	SS
SANITARY FORCEMAIN		FM

PROFILE VIEW	EXISTING	PROPOSED
GROUND		
WATER MAIN		
SANITARY SEWER		
STORM SEWER		

HATCH PATTERNS

- GABION WALL / BASKET
- CLEARING & GRUBBING / REMOVALS
- EARTH / NATIVE MATERIAL
- COLD PLANING / MILL / GRIND
- HYDRAULIC SEEDING
- GRAVEL
- WATER
- CONCRETE
- FILL
- RIP-RAP / DRAIN ROCK

SYMBOLS

MISCELLANEOUS	
SLOPE	% 1 2

STORM DRAINAGE	
CATCH BASIN	CB
CATCH BASIN / MANHOLE	CB
MANHOLE	D
CULVERT INLET	CI
CULVERT OUTLET	CO

SANITARY SEWER	
MANHOLE	S
VALVE CHAMBER	VC
FLOW DIRECTION	

WATERMAIN	EXISTING	PROPOSED
TEE FLANGE		
END CAP / PLUG		
GATE VALVE		
THRUST BLOCK		
45 DEGREE ELBOW		
90 DEGREE ELBOW		
WYE		
ENCASEMENT		
WATER LEVEL		
COUPLING		
REDUCER		

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PROFESSIONAL ENGINEER
M. Z. SALLY
45124
PROVINCE OF BRITISH COLUMBIA
29 JUNE 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	N/A	N/A	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: N/A

THE CITY OF Port Alberni

CIVIL
LEGEND

DRAWING	REVISION	SHEET
2972-00-C-003	0	5 / 111

IF NOT 50 mm ADJUST SCALES
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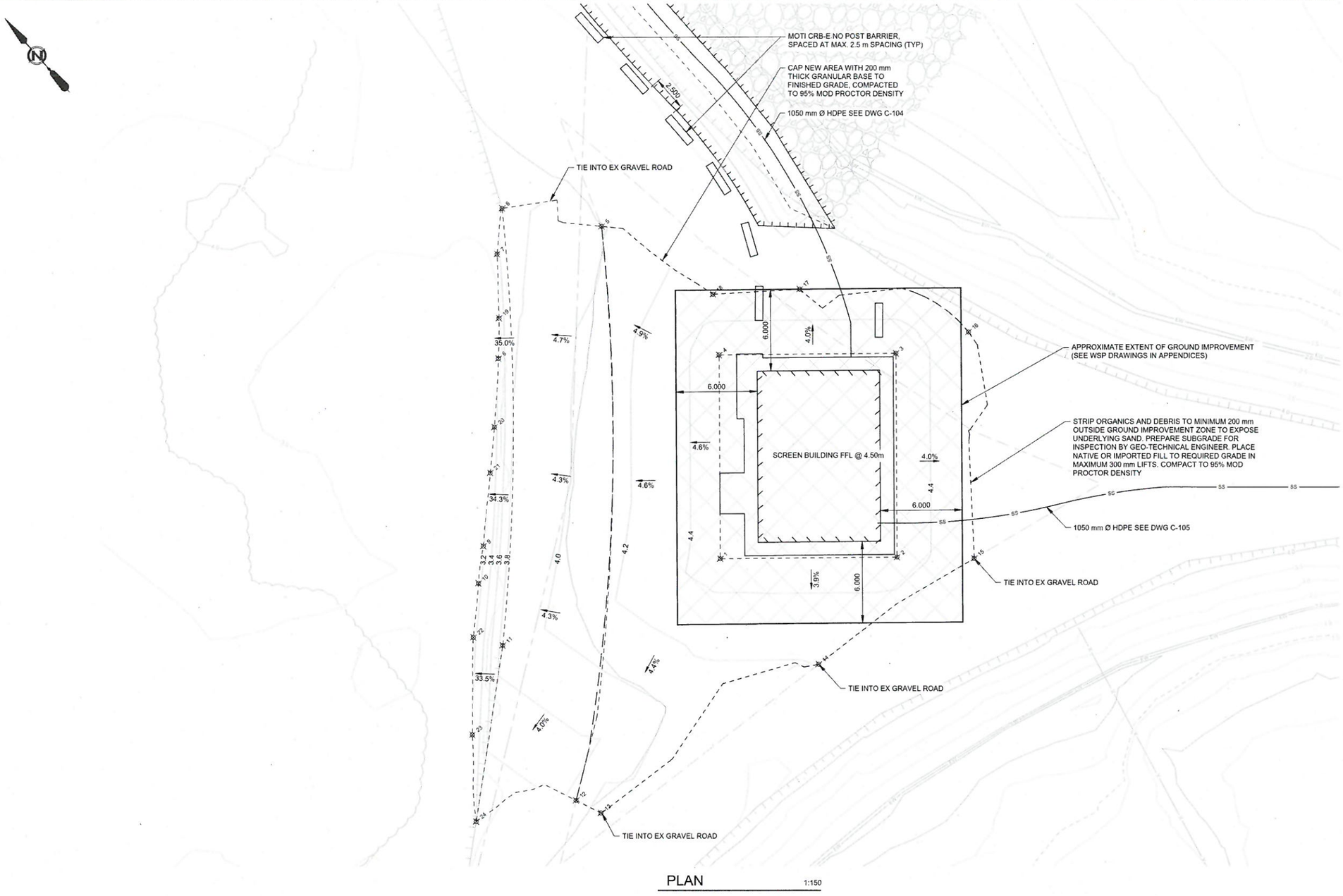

PLAN 1:150

POINT TABLE			
PNT#	NORTHING	EASTING	EX ELEV
1	5203.664	2760.385	3.77
2	5195.173	2770.229	4.27
3	5206.532	2780.027	4.33
4	5215.023	2770.183	4.00
5	5227.827	2769.929	3.94
6	5233.639	2765.326	3.71
7	5231.351	2762.845	3.52
8	5225.505	2757.860	3.44
9	5215.856	2747.927	3.18
10	5214.036	2745.860	3.13
11	5209.394	2744.197	3.21
12	5197.223	2740.721	3.80
13	5195.327	2741.473	4.09
14	5193.023	2760.709	4.20
15	5191.358	2774.427	4.28
16	5204.189	2785.073	4.30
17	5214.738	2777.817	4.39
18	5218.678	2772.786	4.25
19	5227.708	2759.844	3.49
20	5221.909	2754.311	3.34
21	5219.585	2751.860	3.26
22	5211.283	2742.955	3.14
23	5205.923	2738.172	3.22
24	5200.908	2734.162	3.41

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DATE: 2018-06-27, Jhunn Dualan

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. Z. SALLY # 45124
29 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
SITE GRADING
SCREEN BUILDING

DRAWING	REVISION	SHEET
2972-00-C-101	0	6 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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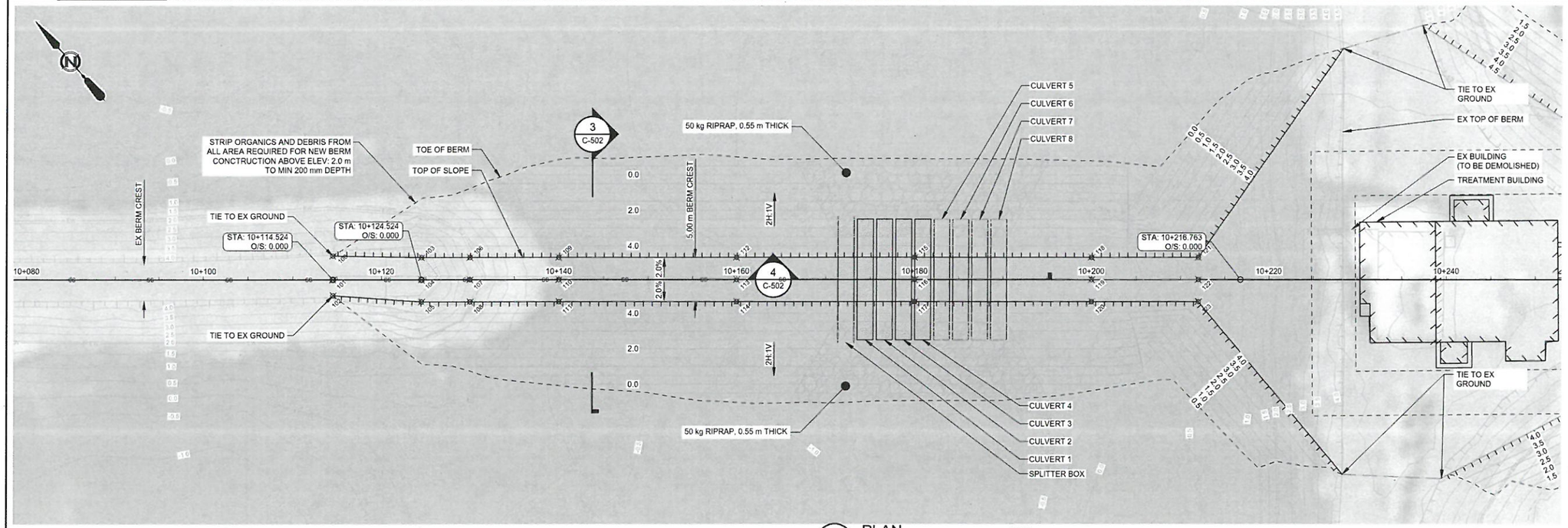
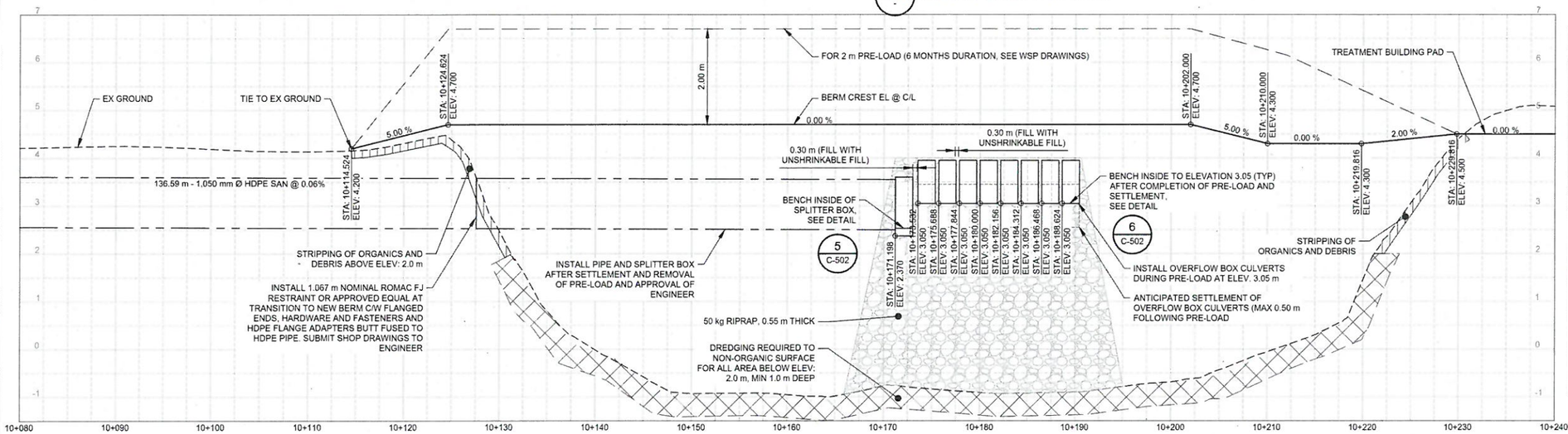


1 PLAN 1:250



2 PROFILE HZ: 1:250 VT: 1:50

POINT TABLE			
PNT#	NORTHING	EASTING	ELEV
100	5135.328	2850.191	4.20
101	5133.317	2848.424	4.20
102	5131.971	2847.240	4.18
103	5128.593	2857.585	4.65
104	5126.716	2855.935	4.70
105	5124.838	2854.284	4.65
106	5124.978	2861.698	4.65
107	5123.100	2860.048	4.70
108	5121.223	2858.398	4.65
109	5118.376	2869.209	4.65
110	5116.499	2867.559	4.70
111	5114.621	2865.909	4.65
112	5105.173	2884.231	4.65
113	5103.295	2882.581	4.70
114	5101.417	2880.931	4.65
115	5091.969	2899.253	4.65
116	5090.091	2897.603	4.70
117	5088.213	2895.953	4.65
118	5078.765	2914.275	4.65
119	5076.887	2912.625	4.70
120	5075.009	2910.975	4.65
121	5070.843	2923.289	4.15
122	5068.965	2921.638	4.30
123	5067.087	2919.988	4.15

NEW BERM

- DREDGED VOLUME (1.0 m DEPTH) = 2,557 m^3
- 10KG RIP-RAP BELOW WATER (ELEV: 0.0 m) (INCLUDE REPLACEMENT OF DREDGED VOLUME) = 3,957 m^3
- IMPORTED FILL ABOVE WATER = 5,305 M3
- PRE-LOAD VOLUME = XXXXX M^3

PIPE TABLE						
NAME	SIZE	LENGTH	SLOPE	MATERIAL	START	END
CULVERT 1	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5088.659 E: 2888.932 INV: 3.05	N: 5098.874 E: 2897.910 INV: 3.05
CULVERT 2	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5087.236 E: 2890.551 INV: 3.05	N: 5097.451 E: 2899.530 INV: 3.05
CULVERT 3	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5085.813 E: 2892.170 INV: 3.05	N: 5096.028 E: 2901.149 INV: 3.05
CULVERT 4	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5084.389 E: 2893.790 INV: 3.05	N: 5094.604 E: 2902.768 INV: 3.05
CULVERT 5	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5093.181 E: 2904.388 INV: 3.05	N: 5082.966 E: 2895.409 INV: 3.05
CULVERT 6	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5091.758 E: 2906.007 INV: 3.05	N: 5081.543 E: 2897.028 INV: 3.05
CULVERT 7	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5080.119 E: 2898.648 INV: 3.05	N: 5090.334 E: 2907.626 INV: 3.05
CULVERT 8	1829 x 914 mm	13.60 m	0.00%	CONC BOX	N: 5078.696 E: 2900.267 INV: 3.05	N: 5088.911 E: 2909.246 INV: 3.05
SPLITTER BOX	1829 x 1220 mm	14.21 m	0.00%	CONC BOX	N: 5100.528 E: 2896.493 INV: 2.37	N: 5089.853 E: 2887.110 INV: 2.37

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DATE: 2018-06-28, Jhurm Dualan

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. Z. SALLY # 45124
28 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
SITE GRADING
LAGOON BERM

DRAWING	REVISION	SHEET
2972-00-C-102	0	7 /111

IF NOT 50 mm ADJUST SCALES
50 mm

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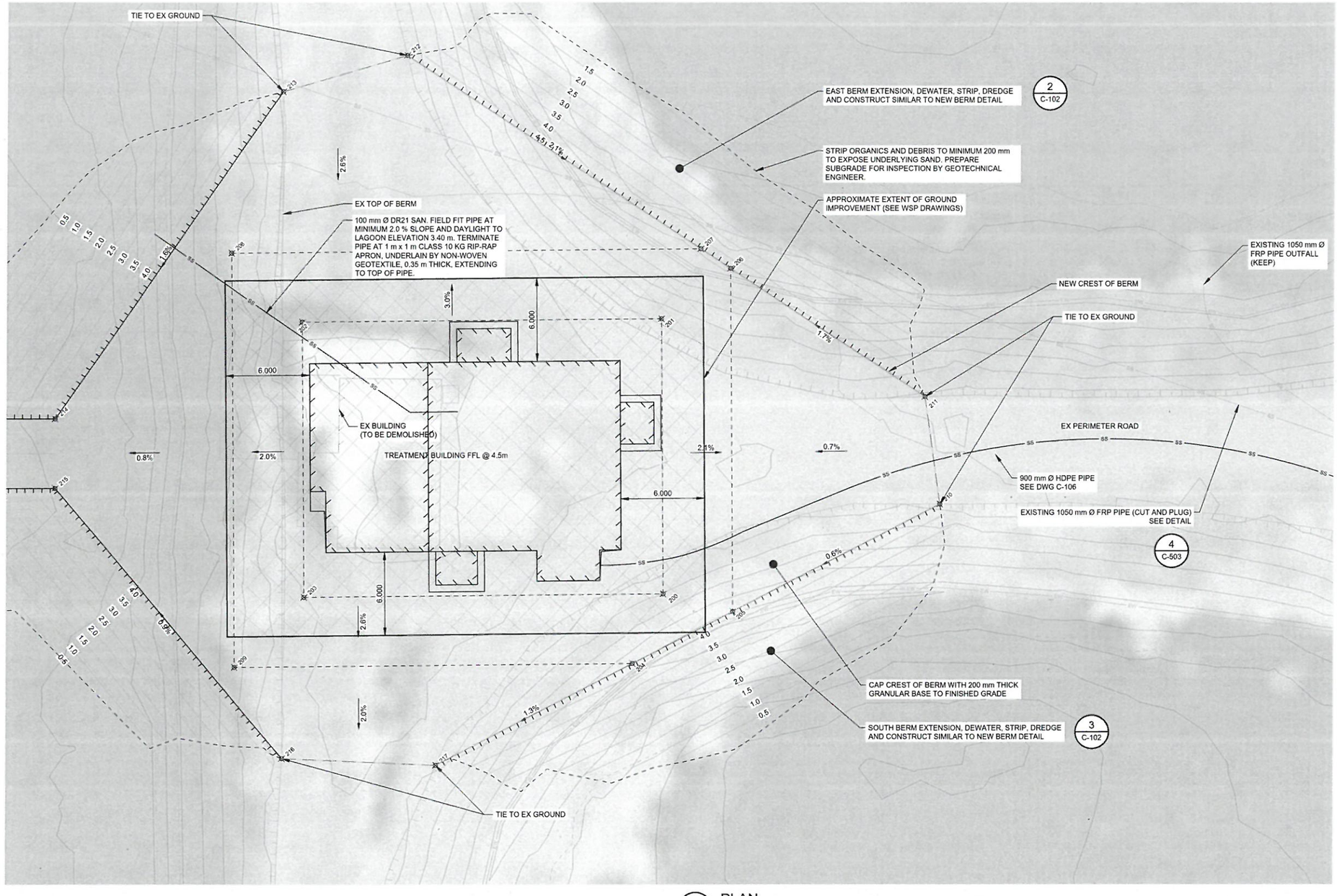

1 PLAN 1:150

POINT TABLE			
PNT#	NORTHING	EASTING	PR ELEV
200	5032.538	2947.797	3.48
201	5047.520	2960.719	3.89
202	5064.361	2941.194	4.90
203	5049.380	2928.271	4.48
204	5030.210	2942.840	2.18
205	5028.271	2950.719	2.05
206	5046.956	2966.836	1.92
207	5049.433	2966.156	1.91
208	5071.413	2940.674	3.35
209	5048.859	2921.220	3.32
210	5024.266	2966.995	4.07
211	5030.787	2971.277	4.58
212	5073.789	2959.468	4.84
213	5077.707	2951.079	4.60
214	5070.843	2923.289	0.15
215	5067.087	2919.988	0.02
216	5041.668	2919.444	4.14
217	5034.007	2927.412	4.09

SOUTH AND EAST BERM BERM EXTENSIONS

- REMOVAL/DREDGED VOLUME (1.0 m DEPTH) = 403 m^3
- 10 KG RIP-RAP BELOW WATER (ELEV: 0.0 m) = 0 m
- IMPORTED FILL ABOVE WATER (INCLUDE REPLACEMENT OF DREDGED VOLUME) = 1,323 m^3

P:\20172972\00_WatWtr_Trtmnt_Upg\Working_Dwgs\100_Civil\2972-00-c-103.dwg
DATE: 2018-06-28, Jhum Dualan

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PROFESSIONAL ENGINEER
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PROVINCE OF BRITISH COLUMBIA
28 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
SITE GRADING
UV BUILDING

DRAWING	REVISION	SHEET
2972-00-C-103	0	8 / 111

IF NOT 50 mm ADJUST SCALES
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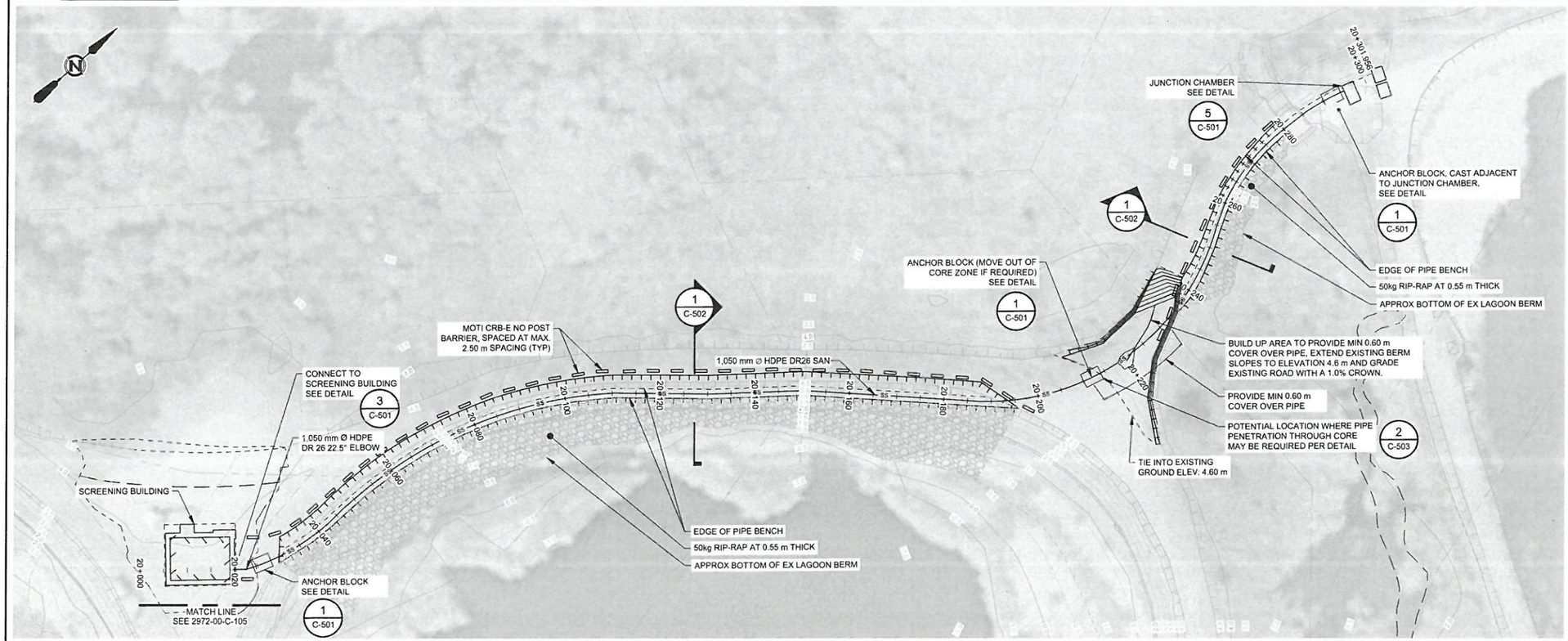
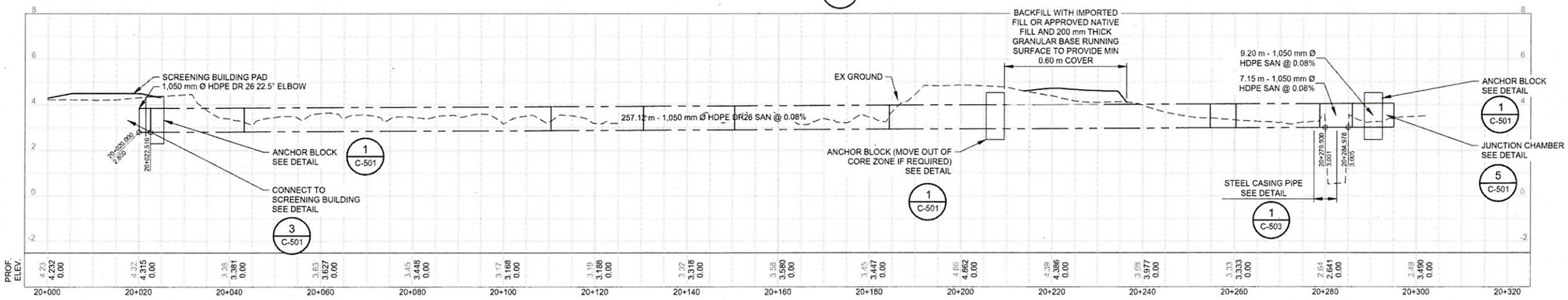


STATION TABLE		
STA	NORTHING	EASTING
20+000	5193.353	2764.302
20+005	5197.139	2767.567
20+010	5200.926	2770.833
20+015	5204.712	2774.099
20+020	5208.498	2777.364
20+025	5212.671	2780.020
20+030	5217.390	2781.664
20+035	5222.265	2782.766
20+040	5227.232	2783.312
20+045	5232.228	2783.259
20+050	5237.226	2783.153
20+055	5242.222	2783.325
20+060	5247.202	2783.775
20+065	5252.148	2784.500
20+070	5257.046	2785.500
20+075	5261.882	2786.770
20+080	5266.639	2788.306
20+085	5271.303	2790.105
20+090	5275.861	2792.161
20+095	5280.297	2794.466
20+100	5284.598	2797.015
20+105	5288.750	2799.799
20+110	5292.742	2802.809
20+115	5296.447	2806.166
20+120	5300.134	2809.542
20+125	5303.822	2812.918
20+130	5307.510	2816.295
20+135	5311.340	2819.509
20+140	5315.183	2822.706
20+145	5319.027	2825.904
20+150	5322.871	2829.102

STATION TABLE		
STA	NORTHING	EASTING
20+155	5326.412	2832.629
20+160	5329.924	2836.188
20+165	5333.437	2839.746
20+170	5336.949	2843.305
20+175	5340.462	2846.863
20+180	5343.974	2850.422
20+185	5347.473	2853.993
20+190	5351.083	2857.450
20+195	5355.018	2860.531
20+200	5359.240	2863.206
20+205	5363.707	2865.448
20+210	5368.374	2867.236
20+215	5373.196	2868.551
20+220	5378.124	2869.381
20+225	5383.111	2869.717
20+230	5388.106	2869.557
20+235	5393.061	2868.901
20+240	5397.926	2867.757
20+245	5402.654	2866.135
20+250	5407.197	2864.052
20+255	5411.522	2861.548
20+260	5415.914	2859.157
20+265	5420.596	2857.419
20+270	5425.460	2856.275
20+275	5430.426	2855.716
20+280	5435.424	2855.731
20+285	5440.416	2855.974
20+290	5445.343	2856.811
20+295	5450.162	2858.136
20+300	5454.910	2859.703

1 - PLAN 1:500



2 - PROFILE HZ: 1:500 VT: 1:100

P:\20172972\00_WstWtr_Trtmnt_Upgr\Working_Dwgs\100_Civil\2972-00-c-104.dwg
DATE: 2018-06-28, Jhum Dualan

Associated Engineering
Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
Ph. 604 293 1411 Fax. 604 291 6163
www.ae.ca

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. L. SALLY # 45124
28 JUNE 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

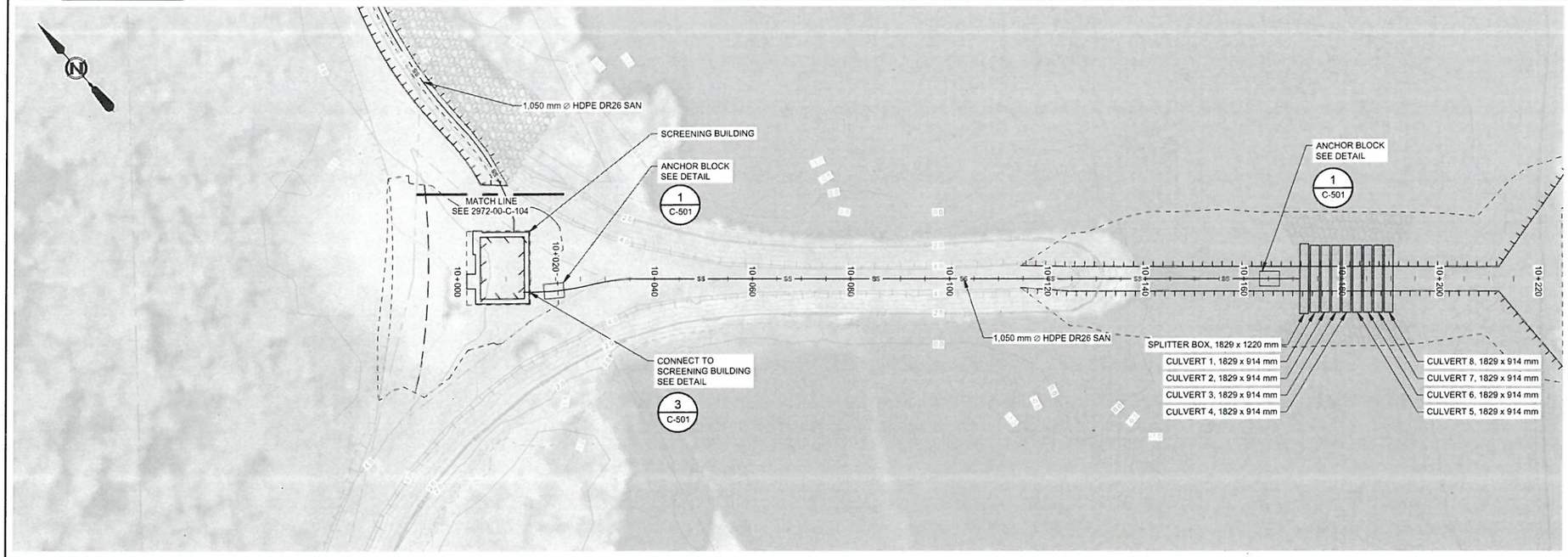
THE CITY OF Port Alberni

CIVIL
SANITARY SEWER
STA 20+000 TO STA 20+300

DRAWING	REVISION	SHEET
2972-00-C-104	0	9 /111

IF NOT 50 mm ADJUST SCALES
50 mm

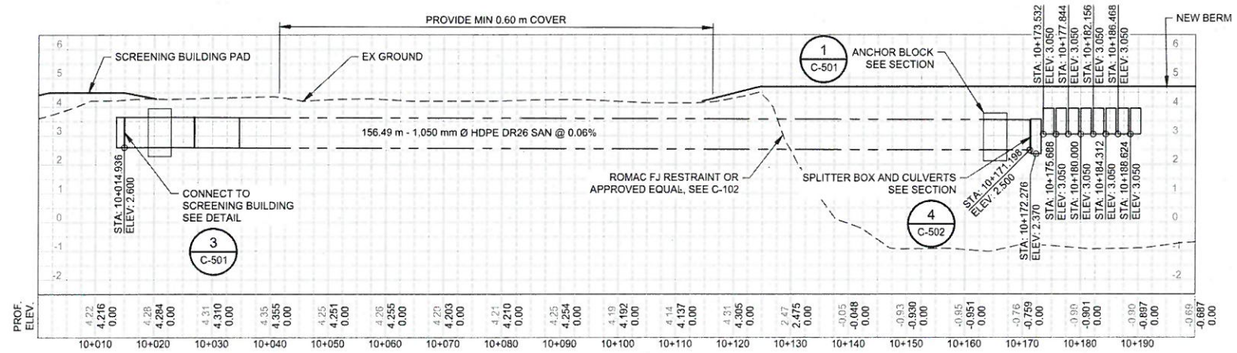
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 - PLAN 1:500

STATION TABLE		
STA	NORTHING	EASTING
10+000	5208.925	2762.405
10+005	5205.624	2766.160
10+010	5202.323	2769.916
10+015	5199.022	2773.672
10+020	5195.721	2777.427
10+025	5192.420	2781.182
10+030	5189.119	2784.938
10+035	5185.818	2788.694
10+040	5182.517	2792.449
10+045	5179.216	2796.204
10+050	5175.916	2799.960
10+055	5172.614	2803.716
10+060	5169.314	2807.471
10+065	5166.013	2811.226
10+070	5162.712	2814.982
10+075	5159.411	2818.738
10+080	5156.110	2822.493
10+085	5152.809	2826.248
10+090	5149.508	2830.004
10+095	5146.207	2833.760
10+100	5142.906	2837.515
10+105	5139.605	2841.270
10+110	5136.304	2845.026
10+115	5133.003	2848.782
10+120	5129.702	2852.537
10+125	5126.401	2856.292
10+130	5123.100	2860.048
10+135	5119.800	2863.804
10+140	5116.498	2867.559
10+145	5113.198	2871.314
10+150	5109.897	2875.070
10+155	5106.596	2878.826
10+160	5103.295	2882.581

STATION TABLE		
STA	NORTHING	EASTING
10+165	5099.994	2886.336
10+170	5096.693	2890.092
10+175	5093.392	2893.848
10+180	5090.091	2897.603
10+185	5086.790	2901.358
10+190	5083.489	2905.114
10+195	5080.188	2908.870
10+200	5076.887	2912.625
10+205	5073.586	2916.380
10+210	5070.285	2920.136
10+215	5066.984	2923.892
10+220	5063.684	2927.647



2 - PROFILE HZ: 1:500 VT: 1:100

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DATE: 2018-06-28, Jhunn Dualan

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. Z. SALLY # 45124
28 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

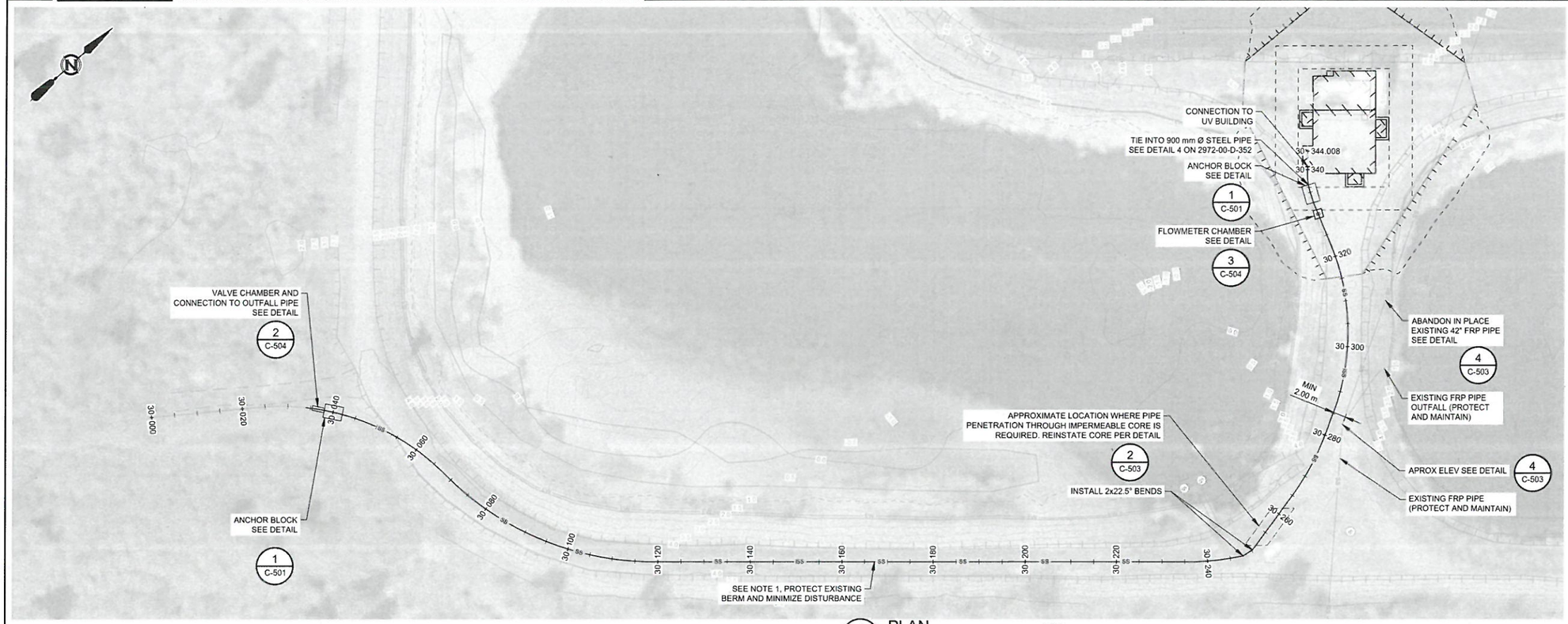
THE CITY OF Port Alberni

CIVIL
SANITARY SEWER
STA 10+000 TO STA 10+200

DRAWING	REVISION	SHEET
2972-00-C-105	0	10 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

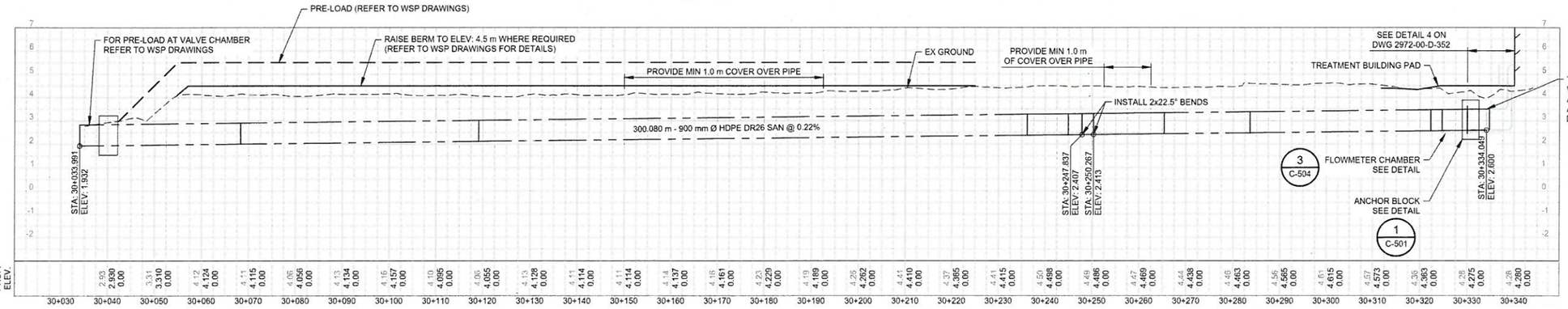
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



STATION TABLE		
STA	NORTHING	EASTING
30+020	4827.045	2833.224
30+025	4831.103	2836.145
30+030	4834.950	2839.336
30+035	4838.459	2842.894
30+040	4841.596	2846.786
30+045	4844.328	2850.970
30+050	4846.629	2855.407
30+055	4848.475	2860.052
30+060	4849.849	2864.857
30+065	4850.736	2869.776
30+070	4851.181	2874.755
30+075	4851.826	2879.712
30+080	4852.855	2884.604
30+085	4854.261	2889.401
30+090	4856.036	2894.074
30+095	4858.169	2898.594
30+100	4860.647	2902.935
30+105	4863.456	2907.071
30+110	4866.578	2910.975
30+115	4869.994	2914.624
30+120	4873.679	2918.001
30+125	4877.453	2921.281
30+130	4881.228	2924.560
30+135	4885.002	2927.840
30+140	4888.776	2931.119
30+145	4892.550	2934.399
30+150	4896.324	2937.678
30+155	4900.099	2940.958
30+160	4903.873	2944.237
30+165	4907.647	2947.517
30+170	4911.421	2950.796
30+175	4915.196	2954.076
30+180	4918.970	2957.355

STATION TABLE		
STA	NORTHING	EASTING
30+185	4922.744	2960.635
30+190	4926.518	2963.914
30+195	4930.292	2967.194
30+200	4934.067	2970.474
30+205	4937.841	2973.753
30+210	4941.615	2977.032
30+215	4945.389	2980.312
30+220	4949.164	2983.592
30+225	4952.938	2986.871
30+230	4956.712	2990.151
30+235	4960.486	2993.430
30+240	4964.358	2996.592
30+245	4968.519	2999.360
30+250	4973.093	3001.132
30+255	4977.970	3000.111
30+260	4982.843	2998.991
30+265	4987.716	2997.871
30+270	4992.536	2996.550
30+275	4997.201	2994.756
30+280	5001.668	2992.513
30+285	5006.070	2990.142
30+290	5010.343	2987.550
30+295	5014.336	2984.544
30+300	5018.009	2981.155
30+305	5021.325	2977.415
30+310	5024.251	2973.364
30+315	5026.756	2969.040
30+320	5028.822	2964.488
30+325	5030.491	2959.775
30+330	5032.108	2955.044
30+335	5033.853	2950.360
30+340	5036.640	2946.256

1 PLAN 1:500



2 PROFILE HZ: 1:500 VT: 1:100

NOTES:

1. SANITARY PIPE TO BE INSTALLED AFTER SETTLEMENT AND REMOVAL OF PRE-LOAD AND APPROVAL OF ENGINEER.
2. CONTRACTOR TO INSTALL PIPE WITH SUPPORT WALLS TO AVOID DISTURBANCE TO SILT, PEAT AND ORGANIC BERM CORE (SEE DETAIL 3 / C-503)

P:\20172972\00_Wst\Wtr_Trtmnt_Upg\Working_Dwgs\100_Civil\2972-00-c-106.dwg
DATE: 2018-06-28, Jhurm Dualan

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. L. SALLY
#45124
28 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

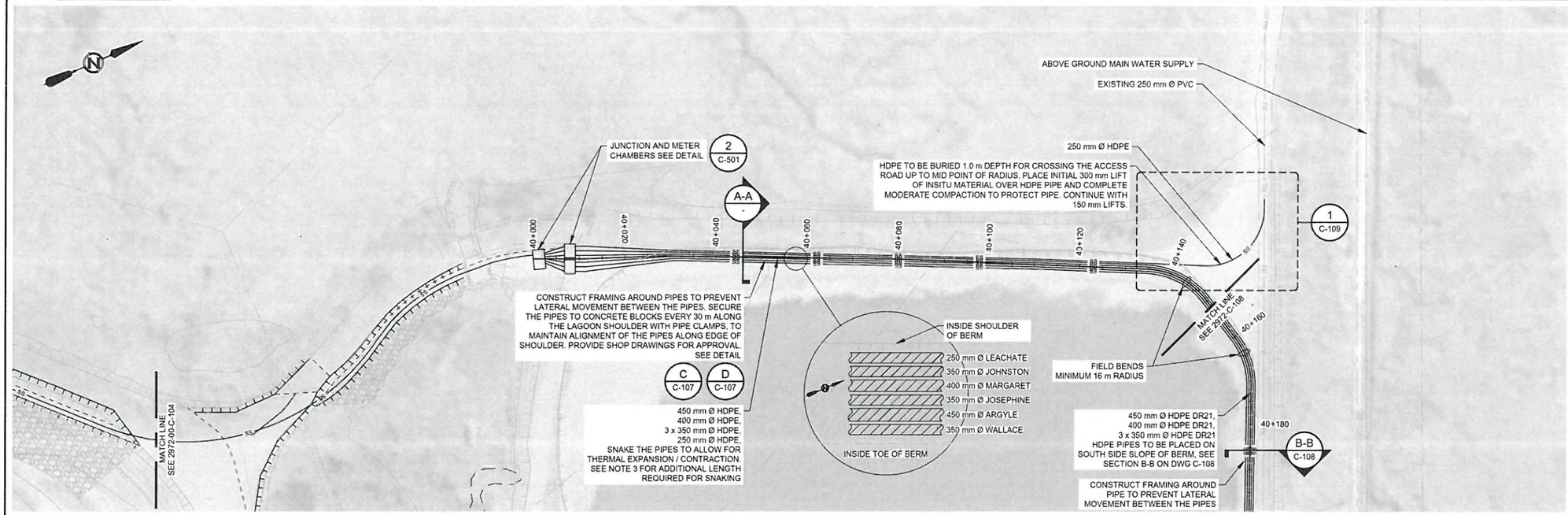
THE CITY OF Port Alberni

CIVIL
SANITARY SEWER
STA 30+020 TO STA 30+340

DRAWING	REVISION	SHEET
2972-00-C-106	0	11 / 111

IF NOT 50 mm ADJUST SCALES — 50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

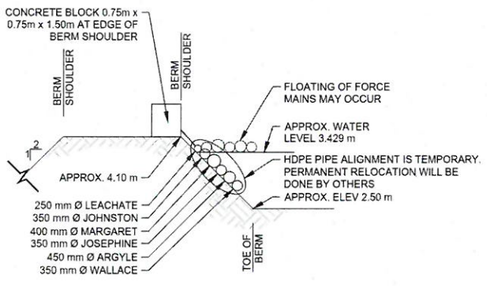


1 - PLAN 1:500

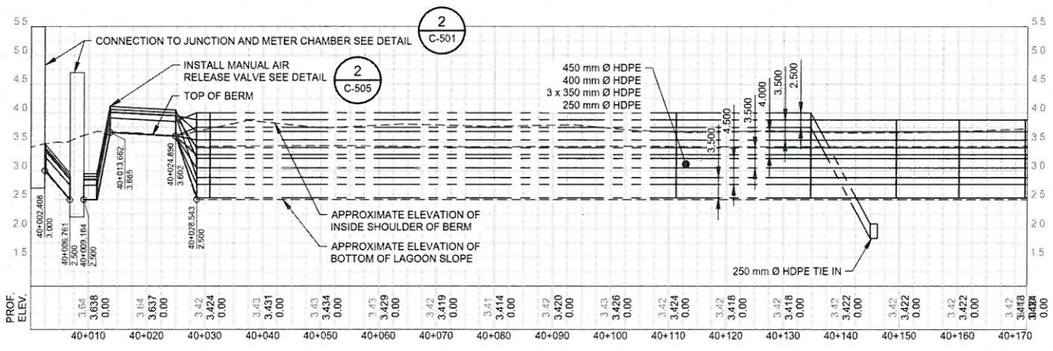
STATION TABLE		
STA	NORTHING	EASTING
40+000	5449.934	2858.913
40+005	5454.528	2860.888
40+010	5459.121	2862.864
40+015	5463.764	2864.718
40+020	5468.426	2866.525
40+025	5473.088	2868.332
40+030	5477.712	2870.228
40+035	5482.274	2872.274
40+040	5486.841	2874.310
40+045	5491.408	2876.345
40+050	5495.975	2878.381
40+055	5500.542	2880.416
40+060	5505.109	2882.452
40+065	5509.676	2884.487
40+070	5514.243	2886.522
40+075	5518.810	2888.558
40+080	5523.374	2890.598
40+085	5527.885	2892.755
40+090	5532.396	2894.911
40+095	5536.907	2897.068
40+100	5541.418	2899.225
40+105	5545.929	2901.382
40+110	5550.440	2903.539
40+115	5554.951	2905.696
40+120	5559.462	2907.852
40+125	5563.972	2910.009
40+130	5568.483	2912.166
40+135	5572.993	2914.325
40+140	5577.077	2917.179
40+145	5580.155	2921.096

STATION TABLE		
STA	NORTHING	EASTING
40+150	5581.970	2925.737
40+155	5583.232	2930.575
40+160	5584.493	2935.413
40+165	5585.088	2940.360
40+170	5584.220	2945.265

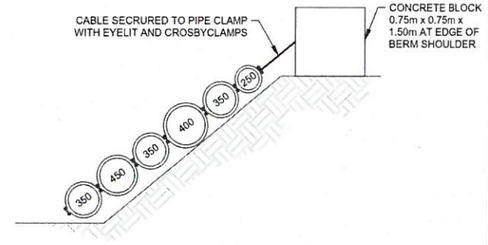
C C-107 DETAIL NTS — SNAKED HDPE PIPE



A-A C-107 SECTION NTS



2 - PROFILE HZ: 1:500 VT: 1:50



D C-107 DETAIL NTS — SECURED PIPES TO CONCRETE BLOCK

NOTES:

1. COORDINATED SHUT OFF OF FORCEMAINS AND PUMP STATIONS WITH THE CITY.
2. MATERIAL
   SANITARY MAIN ≥ 900 mm HDPE PIPE - DR26; BUTT FUSED
   SANITARY MAIN < 900 mm HDPE PIPE - DR21; BUTT FUSED
   WATER MAIN HDPE - DR17; BUTT FUSED
3. ADDITIONAL LENGTH REQUIRED FOR SNAKING:

LEACHATE	5m
JOHNSTON	7m
MARGARET	7m
JOSEPHINE	8m
WALLACE	8m
ARGYLE	8m

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www.ae.ca

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — L. A. MACRAE # 33335
June 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

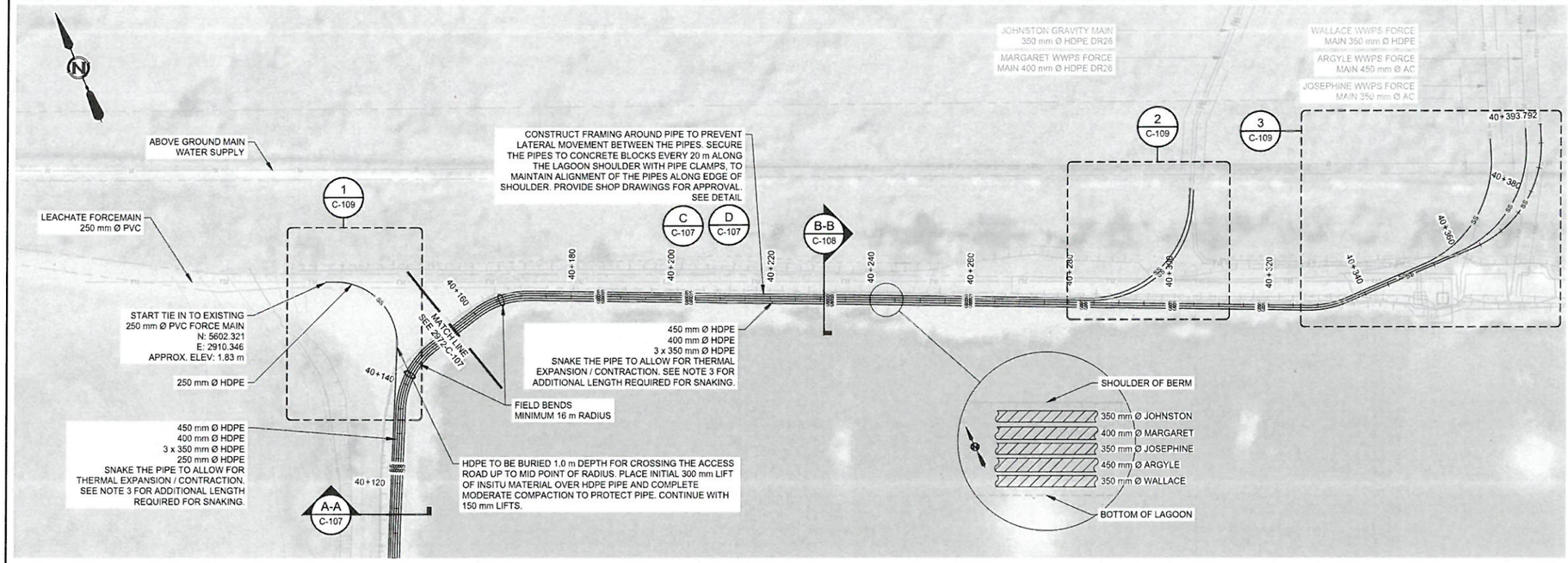
THE CITY OF Port Alberni

CIVIL
TEMPORARY SANITARY SEWER
STA 40+000 TO STA 40+170

DRAWING	REVISION	SHEET
2972-00-C-107	0	12/111

IF NOT 50 mm ADJUST SCALES
50 mm

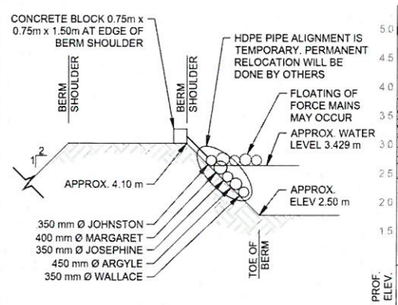
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



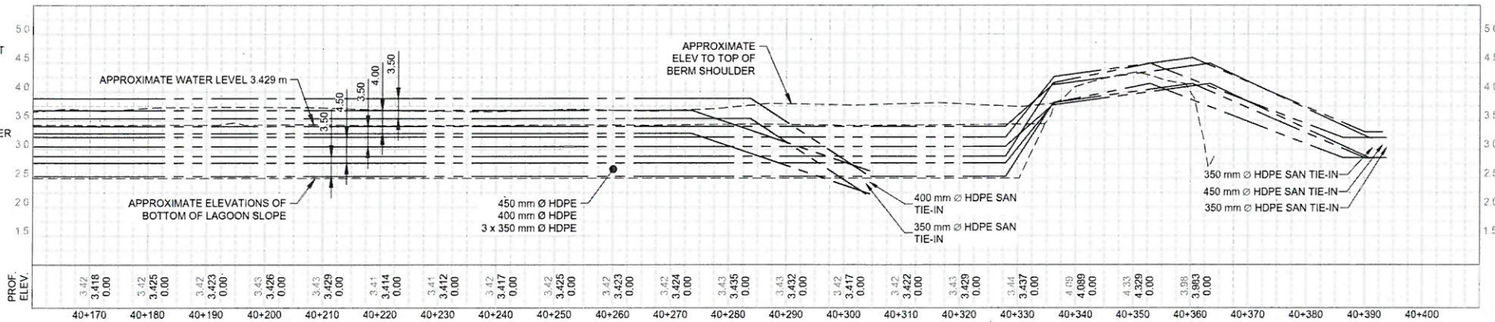
1 PLAN 1:500

STATION TABLE		
STA	NORTHING	EASTING
40+170	5584.220	2945.265
40+175	5582.258	2949.862
40+180	5580.221	2954.428
40+185	5578.184	2958.995
40+190	5576.148	2963.561
40+195	5574.111	2968.128
40+200	5572.075	2972.694
40+205	5570.038	2977.260
40+210	5568.001	2981.827
40+215	5565.965	2986.393
40+220	5563.928	2990.960
40+225	5561.892	2995.526
40+230	5559.855	3000.093
40+235	5557.818	3004.659
40+240	5555.782	3009.226
40+245	5553.745	3013.792
40+250	5551.709	3018.358
40+255	5549.672	3022.925
40+260	5547.636	3027.491
40+265	5545.599	3032.058
40+270	5543.562	3036.624
40+275	5541.526	3041.190
40+280	5539.489	3045.757
40+285	5537.453	3050.323
40+290	5535.416	3054.890
40+295	5533.380	3059.456
40+300	5531.343	3064.023
40+305	5529.306	3068.589
40+310	5527.270	3073.156
40+315	5525.233	3077.722

STATION TABLE		
STA	NORTHING	EASTING
40+320	5523.197	3082.288
40+325	5521.160	3086.855
40+330	5519.124	3091.421
40+335	5517.663	3096.190
40+340	5517.367	3101.173
40+345	5517.367	3106.173
40+350	5517.367	3111.173
40+355	5517.367	3116.173
40+360	5517.367	3121.173
40+365	5517.367	3126.173
40+370	5517.957	3131.125
40+375	5519.754	3135.777
40+380	5522.646	3139.840
40+385	5526.452	3143.061
40+390	5530.936	3145.247



B-B C-108 SECTION NTS



2 PROFILE HZ: 1:500 VT: 1:50

NOTES:

1. COORDINATE SHUT OFF OF FORCEMAINS AND PUMP STATIONS WITH THE CITY.
2. MATERIAL
   SANITARY MAIN ≥ 900 mm HDPE PIPE - DR26; BUTT FUSED
   SANITARY MAIN < 900 mm HDPE PIPE - DR21; BUTT FUSED
   WATER MAIN HDPE - DR17; BUTT FUSED
3. ADDITIONAL LENGTH REQUIRED FOR SNAKING:
   LEACHATE 5m
   JOHNSTON 7m
   MARGARET 7m
   JOSEPHINE 8m
   WALLACE 8m
   ARGYLE 8m

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DATE: 2018-06-28, Jhurm Dualan

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. MACRAE
33335
June 29/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

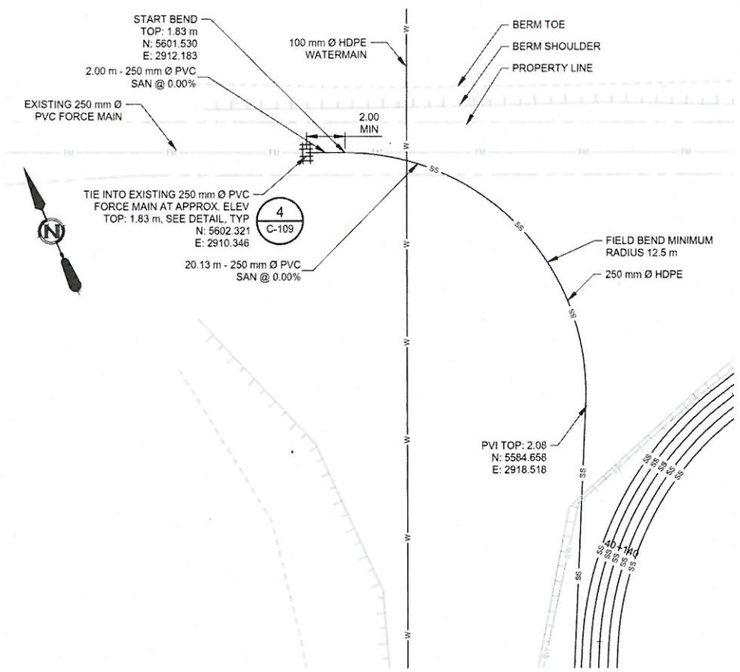
THE CITY OF Port Alberni

CIVIL
TEMPORARY SANITARY SEWER
STA 40+170 TO STA 40+400

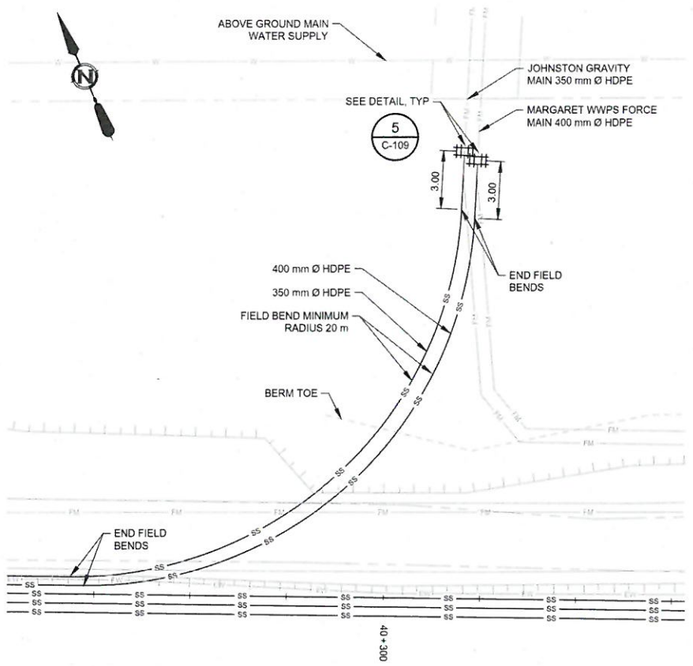
DRAWING	REVISION	SHEET
2972-00-C-108	0	13 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

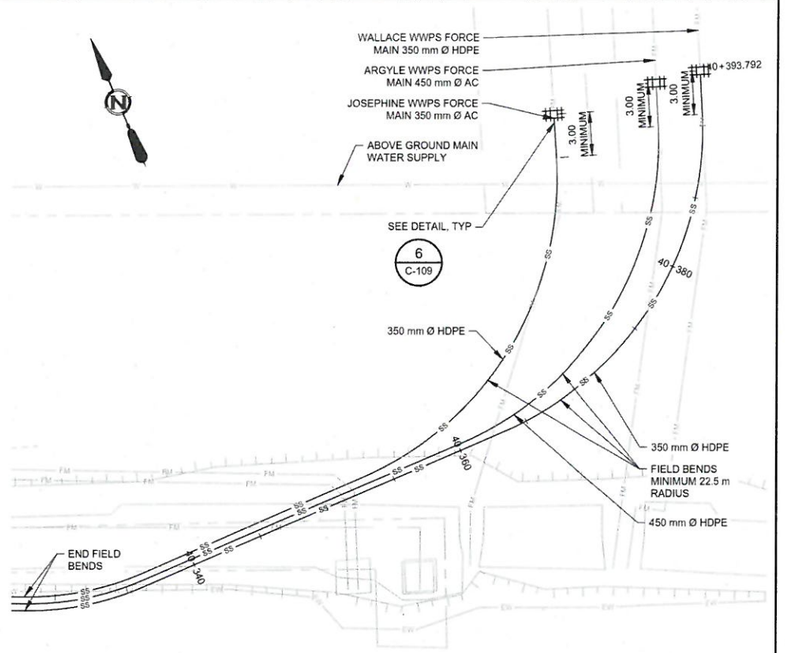
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



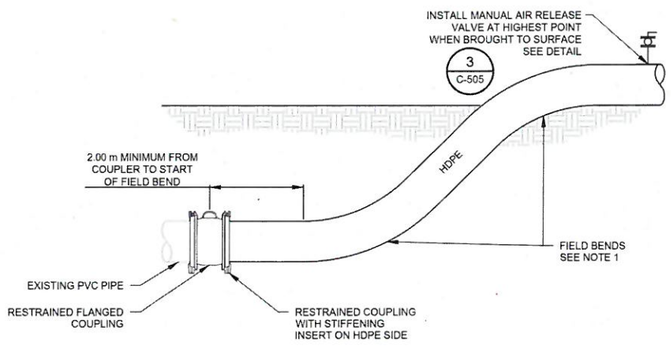
1 C-108 **PLAN** 1:150



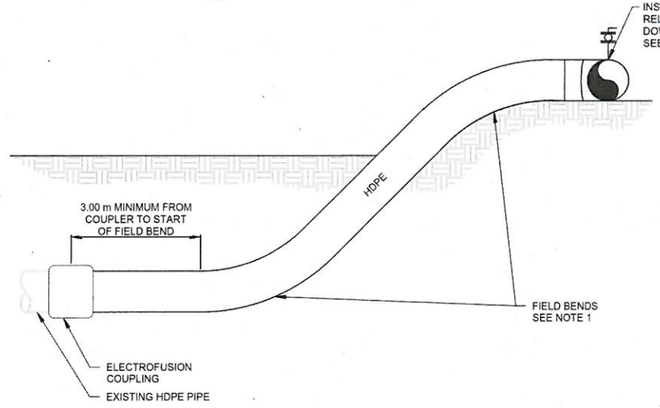
2 C-108 **PLAN** 1:150



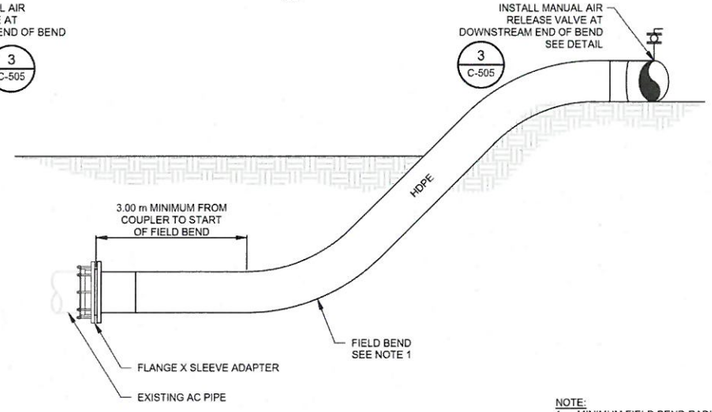
3 C-108 **PLAN** 1:200



4 C-109 **DETAIL** NTS
TIE-IN TO PVC



5 C-109 **DETAIL** NTS
TIE-IN TO HDPE



6 C-109 **DETAIL** NTS
TIE-IN TO AC

NOTE:
1. MINIMUM FIELD BEND RADII
   -450 mm Ø - 22.5 m
   -400 mm Ø - 20 m
   -350 mm Ø - 17.5 m
   -250 mm Ø - 12.5 m
2. PIPE <900 DR21

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DATE: 2018-06-28, Jhurm Dualan

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. MACRAE
33335
June 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

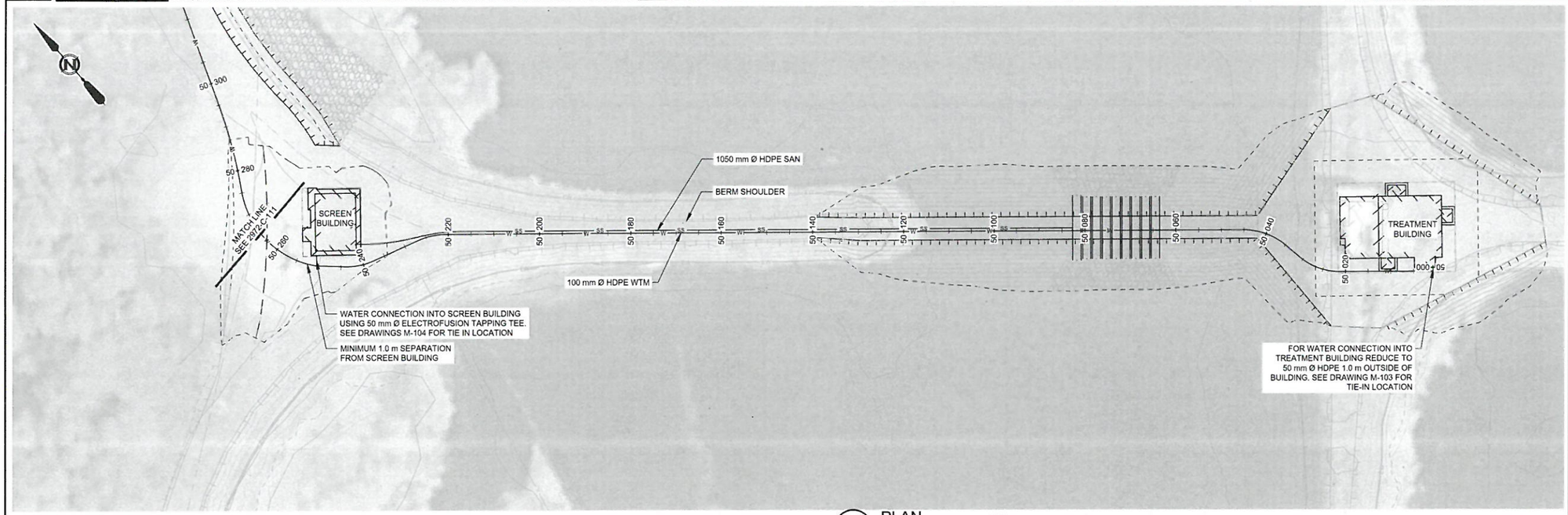
THE CITY OF Port Alberni

CIVIL
FORCE MAIN TIE-INS

DRAWING	REVISION	SHEET
2972-00-C-109	0	14 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

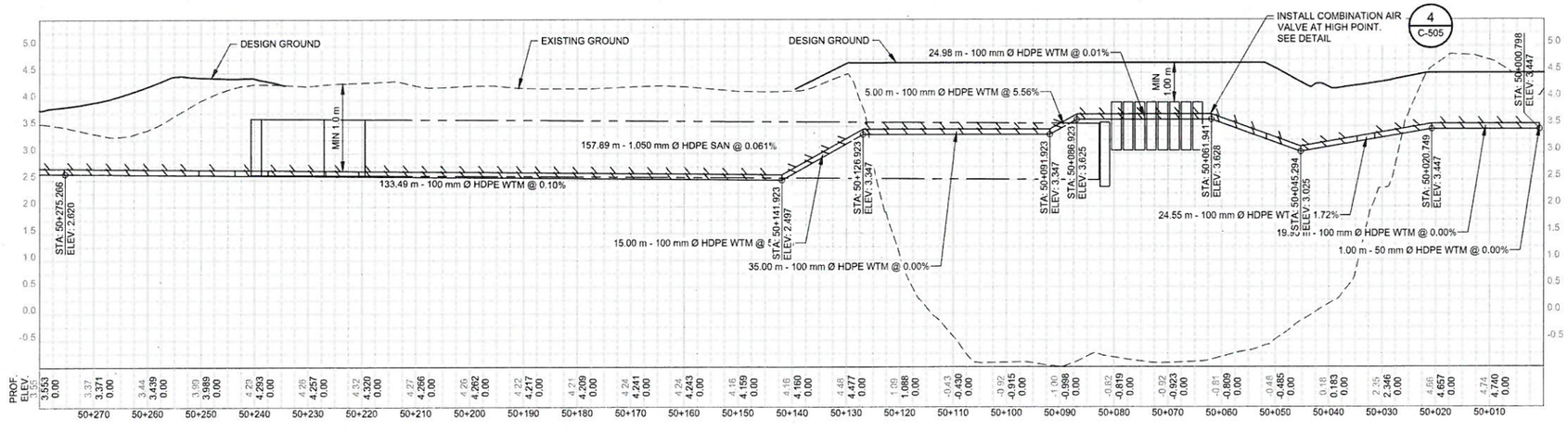
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 - PLAN 1:500

STATION TABLE		
STA	NORTHING	EASTING
50+000	5036.567	2944.657
50+005	5038.742	2940.974
50+010	5042.043	2937.218
50+015	5045.344	2933.463
50+020	5048.645	2929.707
50+025	5052.319	2926.346
50+030	5056.911	2924.435
50+035	5061.852	2923.678
50+040	5066.560	2922.065
50+045	5070.461	2919.000
50+050	5073.784	2915.246
50+055	5077.085	2911.491
50+060	5080.386	2907.735
50+065	5083.687	2903.980
50+070	5086.988	2900.224
50+075	5090.289	2896.469
50+080	5093.590	2892.713
50+085	5096.891	2888.958
50+090	5100.192	2885.202
50+095	5103.493	2881.447
50+100	5106.794	2877.691
50+105	5110.095	2873.936
50+110	5113.396	2870.180
50+115	5116.697	2866.425
50+120	5119.998	2862.669
50+125	5123.299	2858.914
50+130	5126.600	2855.158
50+135	5129.900	2851.403
50+140	5133.202	2847.647
50+145	5136.502	2843.892

STATION TABLE		
STA	NORTHING	EASTING
50+150	5139.803	2840.136
50+155	5143.104	2836.381
50+160	5146.405	2832.625
50+165	5149.706	2828.870
50+170	5153.007	2825.114
50+175	5156.308	2821.359
50+180	5159.609	2817.603
50+185	5162.910	2813.848
50+190	5166.211	2810.092
50+195	5169.512	2806.337
50+200	5172.813	2802.581
50+205	5176.114	2798.826
50+210	5179.415	2795.070
50+215	5182.716	2791.315
50+220	5186.016	2787.559
50+225	5188.766	2783.411
50+230	5190.333	2778.666
50+235	5191.808	2773.888
50+240	5193.417	2769.159
50+245	5196.243	2765.062
50+250	5199.817	2761.565
50+255	5203.959	2758.796
50+260	5208.671	2757.164
50+265	5213.641	2756.749
50+270	5218.559	2757.577



2 - PROFILE HZ: 1:500 VT: 1:50

NOTES:

1. 100 mm Ø WTR AND 1050 mm Ø HDPE SAN TO BE INSTALLED INTO COMMON TRENCH
2. MATERIAL:
   - SANITARY MAIN HDPE PIPE - DR21; BUTT FUSED
   - WATER MAIN HDPE - DR17; BUTT FUSED

P:\2017\2972\00_Wst\Wtr_T.dmt_Ltyp\Working_Dwgs\100_Civil\2972-00-c-110.dwg
DATE: 2018-06-28, Jhurn Dualan

Associated Engineering
Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
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www.ae.ca

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. MACRAE
33335
June 27/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

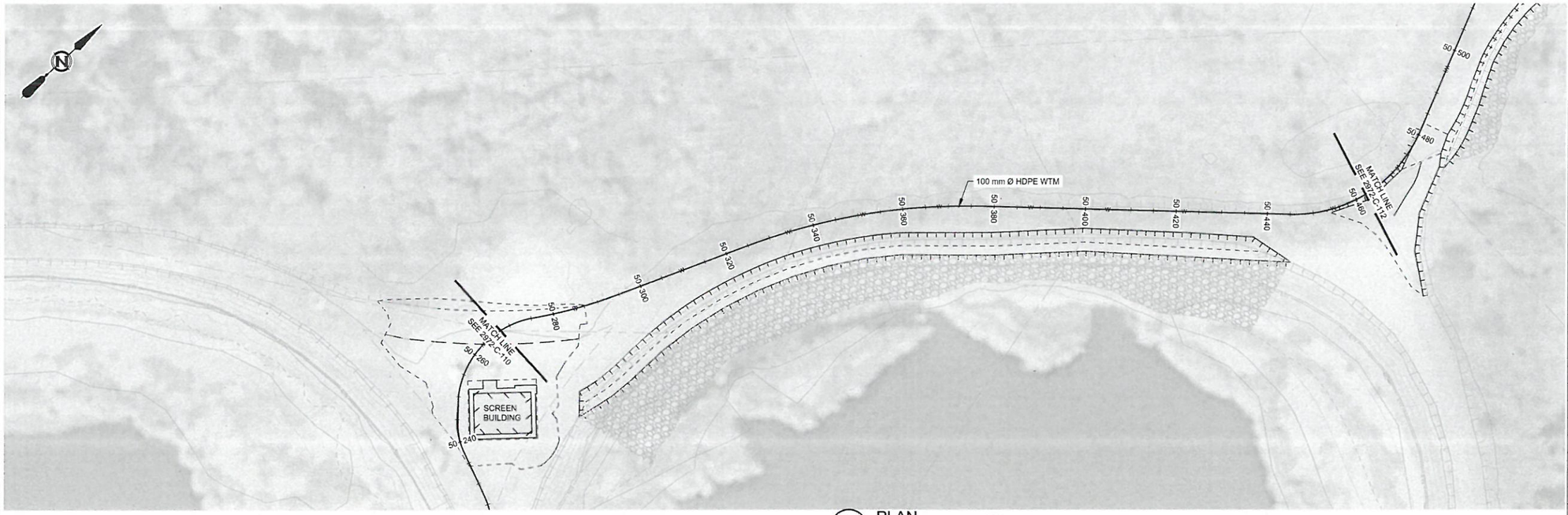
THE CITY OF Port Alberni

CIVIL
WATERMAIN LAYOUT 1 OF 4
STA 50+000 - 50+270

DRAWING	REVISION	SHEET
2972-00-C-110	0	15 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

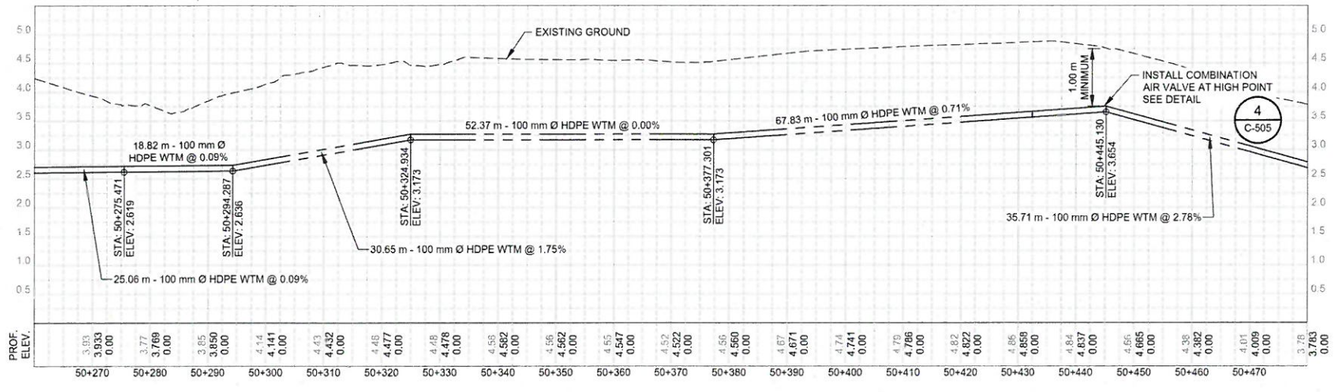
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 - PLAN 1:500

STATION TABLE		
STA	NORTHING	EASTING
50+270	5218.559	2757.577
50+275	5223.119	2759.595
50+280	5227.398	2762.181
50+285	5231.797	2764.556
50+290	5236.310	2766.708
50+295	5240.924	2768.634
50+300	5245.572	2770.474
50+305	5250.221	2772.316
50+310	5254.870	2774.157
50+315	5259.518	2775.998
50+320	5264.167	2777.839
50+325	5268.816	2779.680
50+330	5273.429	2781.608
50+335	5277.967	2783.706
50+340	5282.425	2785.970
50+345	5286.796	2788.397
50+350	5291.074	2790.984
50+355	5295.254	2793.727
50+360	5299.330	2796.623
50+365	5303.296	2799.667
50+370	5307.147	2802.856
50+375	5310.878	2806.184
50+380	5314.502	2809.629
50+385	5318.112	2813.088
50+390	5321.722	2816.547
50+395	5325.333	2820.006
50+400	5328.943	2823.466
50+405	5332.554	2826.924
50+410	5336.164	2830.384
50+415	5339.774	2833.843

STATION TABLE		
STA	NORTHING	EASTING
50+420	5343.385	2837.302
50+425	5346.995	2840.761
50+430	5350.605	2844.220
50+435	5354.216	2847.679
50+440	5357.826	2851.138
50+445	5361.436	2854.597
50+450	5365.305	2857.756
50+455	5369.645	2860.227
50+460	5374.336	2861.941
50+465	5379.247	2862.850
50+470	5384.240	2862.930



2 - PROFILE HZ: 1:500 VT: 1:50

NOTE:
MATERIAL:
- SANITARY MAIN HDPE PIPE - DR21
- WATER MAIN HDPE - DR17

P:\20172972\00_WstWtr_Trtmnt_Upgr\Working_Dwgs\100_Civil\2972-00-c-111.dwg
DATE: 2018-06-28, Jhum Dustin

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
L. A. MACRAE
33335
Jun 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

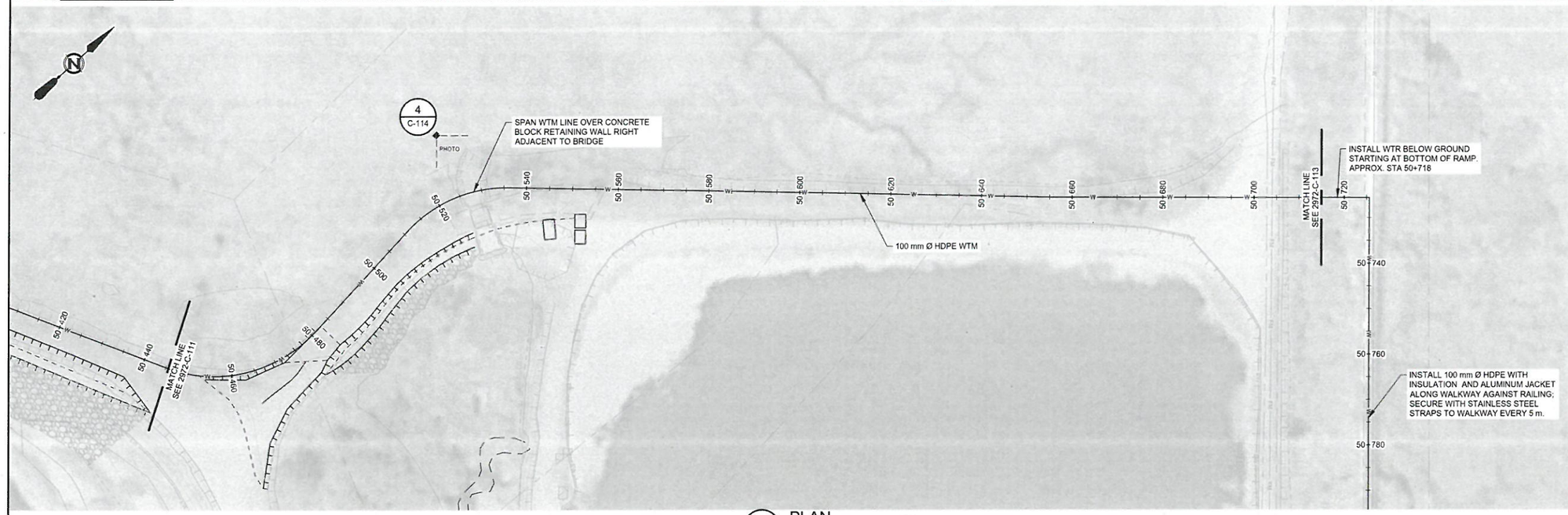
THE CITY OF Port Alberni

CIVIL
WATERMAIN LAYOUT 2 OF 4
STA 50+270 - 50+470

DRAWING	REVISION	SHEET
2972-00-C-111	0	16 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

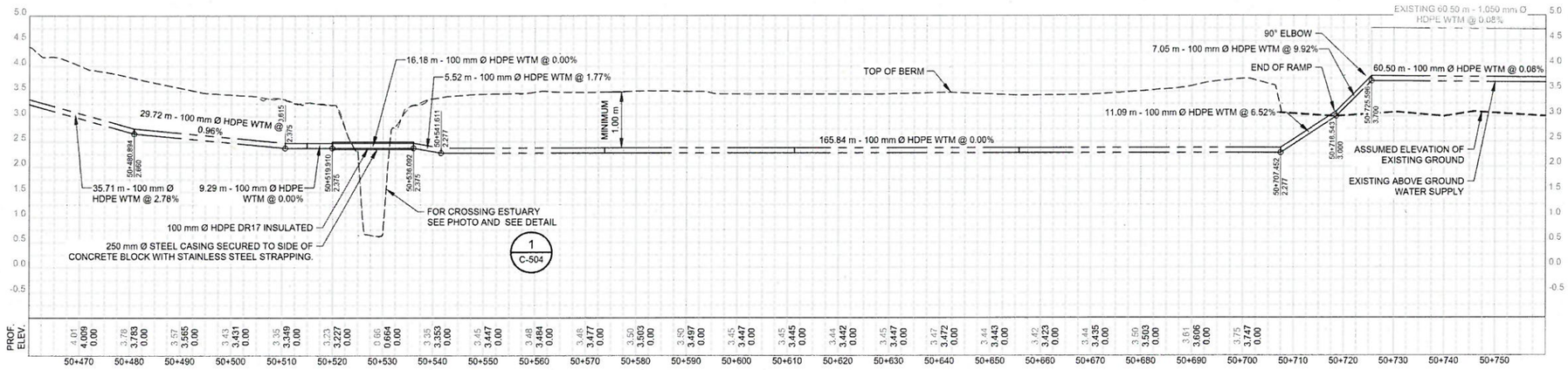
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 - PLAN 1:500

STATION TABLE		
STA	NORTHING	EASTING
50+470	5384.240	2862.930
50+475	5389.177	2862.178
50+480	5393.920	2860.614
50+485	5398.467	2858.533
50+490	5403.008	2856.440
50+495	5407.548	2854.347
50+500	5412.089	2852.254
50+505	5416.630	2850.161
50+510	5421.171	2848.068
50+515	5425.831	2846.272
50+520	5430.724	2845.268
50+525	5435.714	2845.089
50+530	5440.666	2845.741
50+535	5445.441	2847.206
50+540	5450.020	2849.214
50+545	5454.590	2851.240
50+550	5459.161	2853.267
50+555	5463.732	2855.293
50+560	5468.303	2857.320
50+565	5472.874	2859.346
50+570	5477.445	2861.373
50+575	5482.016	2863.399
50+580	5486.587	2865.426
50+585	5491.158	2867.452
50+590	5495.728	2869.479
50+595	5500.300	2871.506
50+600	5504.870	2873.532
50+605	5509.441	2875.559
50+610	5514.012	2877.585
50+615	5518.579	2879.621
50+620	5523.144	2881.660

STATION TABLE		
STA	NORTHING	EASTING
50+625	5527.709	2883.700
50+630	5532.274	2885.739
50+635	5536.840	2887.779
50+640	5541.405	2889.818
50+645	5545.970	2891.858
50+650	5550.535	2893.897
50+655	5555.100	2895.936
50+660	5559.698	2897.902
50+665	5564.301	2899.854
50+670	5568.904	2901.807
50+675	5573.506	2903.760
50+680	5578.109	2905.713
50+685	5582.712	2907.665
50+690	5587.315	2909.618
50+695	5591.918	2911.571
50+700	5596.521	2913.524
50+705	5601.124	2915.476
50+710	5605.727	2917.429
50+715	5610.330	2919.382
50+720	5614.933	2921.334
50+725	5619.536	2923.287
50+730	5618.364	2927.574
50+735	5616.411	2932.177
50+740	5614.459	2936.780
50+745	5612.506	2941.383
50+750	5610.553	2945.986



2 - PROFILE HZ: 1:500 VT: 1:50

NOTE:
MATERIAL:
- SANITARY MAIN HDPE PIPE - DR21
- WATER MAIN HDPE - DR17
- WATER MAIN TO HAVE ALUMINUM JACKET WHERE ABOVE GROUND ON WALKWAY

P:\20172972\00_WatWtr_Trtmnt_Upg\Working_Dwgs\100_Civil\2972-00-c-112.dwg
DATE: 2018-06-28, Jhum Dudani

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. MACRAE
33335

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

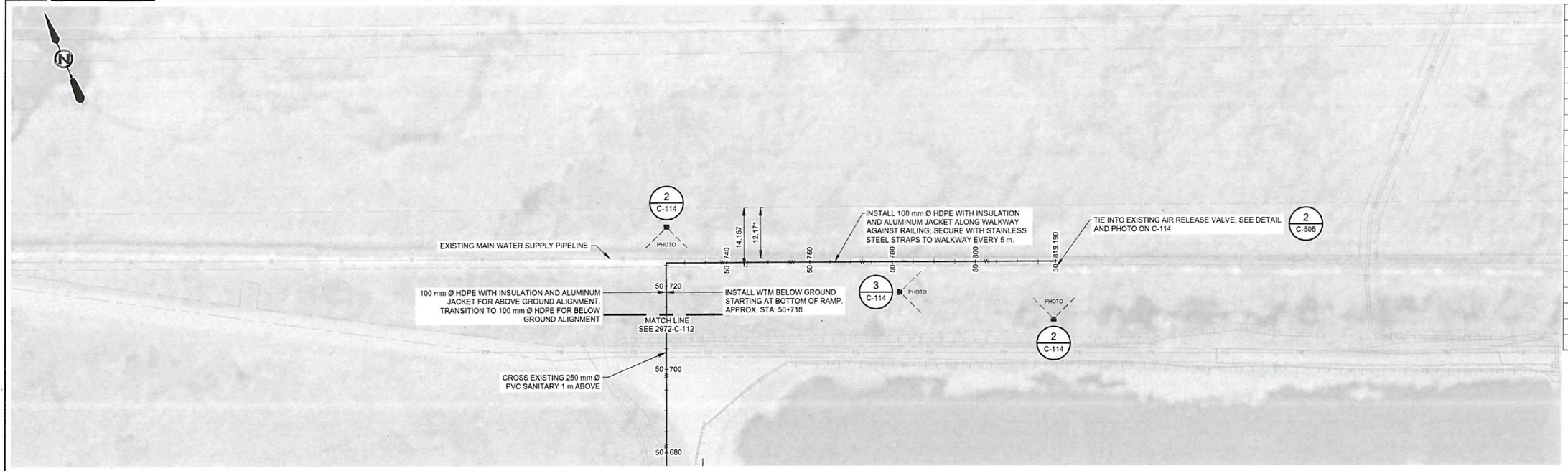
THE CITY OF Port Alberni

CIVIL
WATERMAIN LAYOUT 3 OF 4
STA 50+470 - 50+750

DRAWING	REVISION	SHEET
2972-00-C-112	0	17 / 111

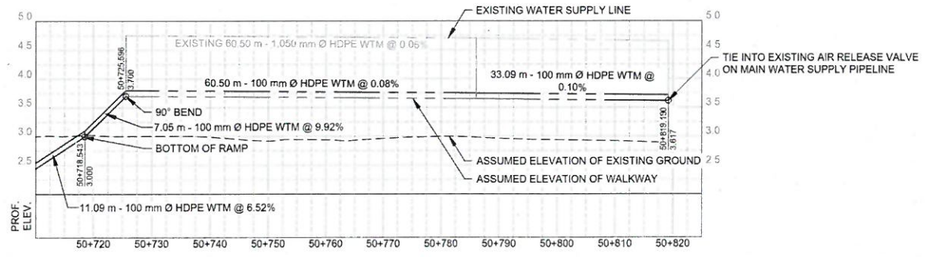
IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 PLAN 1:500

STATION TABLE		
STA	NORTHING	EASTING
50+720	5614.933	2921.334
50+725	5619.536	2923.287
50+730	5618.364	2927.574
50+735	5616.411	2932.177
50+740	5614.459	2936.780
50+745	5612.506	2941.383
50+750	5610.553	2945.986
50+755	5608.600	2950.589
50+760	5606.648	2955.192
50+765	5604.695	2959.795
50+770	5602.742	2964.398
50+775	5600.790	2969.000
50+780	5598.837	2973.604
50+785	5596.884	2978.206
50+790	5594.931	2982.809
50+795	5592.979	2987.412
50+800	5591.026	2992.015
50+805	5589.073	2996.618
50+810	5587.120	3001.221
50+815	5585.168	3005.824



2 PROFILE HZ: 1:500 VT: 1:50

NOTE:
MATERIAL:
- SANITARY MAIN HDPE PIPE - DR21
- WATER MAIN HDPE - DR17
- WATER MAIN TO HAVE ALUMINUM JACKET ABOVE GROUND ON WALKWAY

P:\20172972\00_WaWw_Trtmnt_Upg\Working_Dwgs\100_Civil\2972-00-c-113.dwg
DATE: 2018-06-28, Jhurm Dualan

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA MACRAE # 33335
June 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

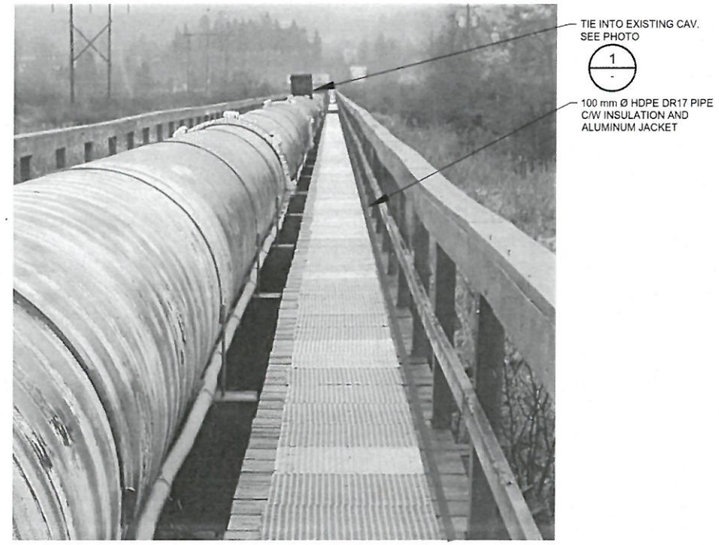
THE CITY OF Port Alberni

CIVIL
WATERMAIN LAYOUT 4 OF 4
STA 50+720 - 50+820

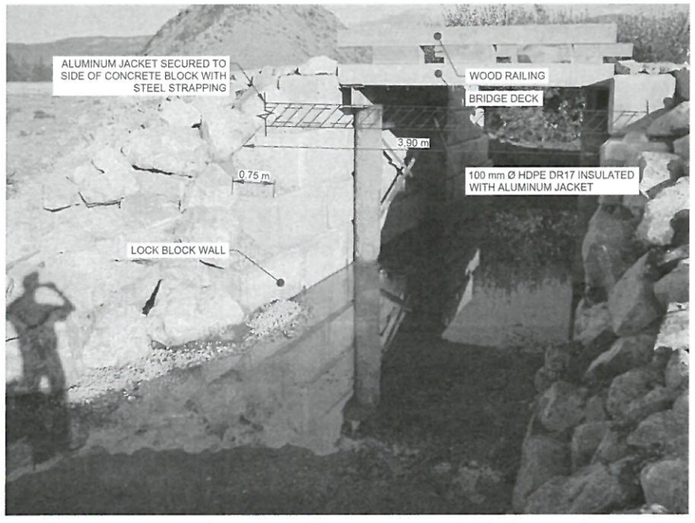
DRAWING	REVISION	SHEET
2972-00-C-113	0	18 / 111

1 - PHOTO NTS

2 - PHOTO NTS



3 - PHOTO NTS



4 - PHOTO NTS

NOTE:
REFER TO DETAIL 1/504 FOR MORE INFORMATION

NOTES:

1. PIPE SHALL BE INSTALLED WITH 50 mm THICK POLYURETHANE FOAM COMPLETE WITH BLACK POLYETHYLENE JACKET WITH UV INHIBITOR AND ALUMINUM JACKET.
2. INSULATION AND ALUMINUM JACKET TO EXTEND 0.50 m BELOW GROUND.
3. PHOTOS ARE FOR REFERENCE TO BETTER EXPLAIN DESIGN. MAY BE DIFFERENT IN THE FIELD.

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
L. A. MACRAE
33335
ENGINEER
2018/06/28

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

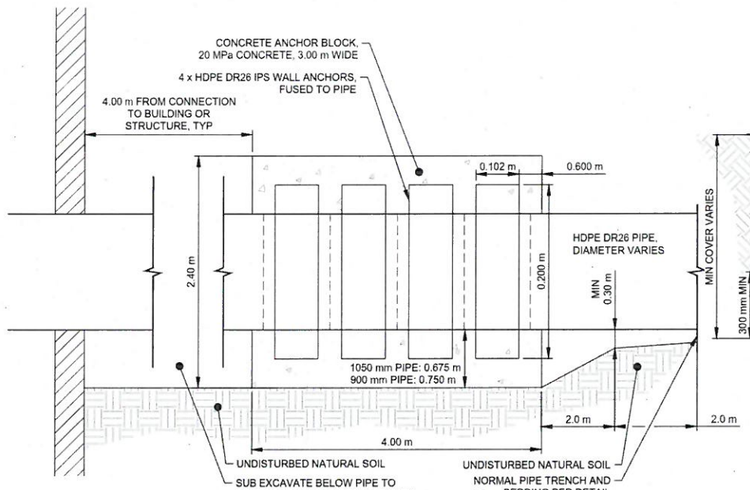
THE CITY OF Port Alberni

CIVIL
INSTALLATION PHOTOS

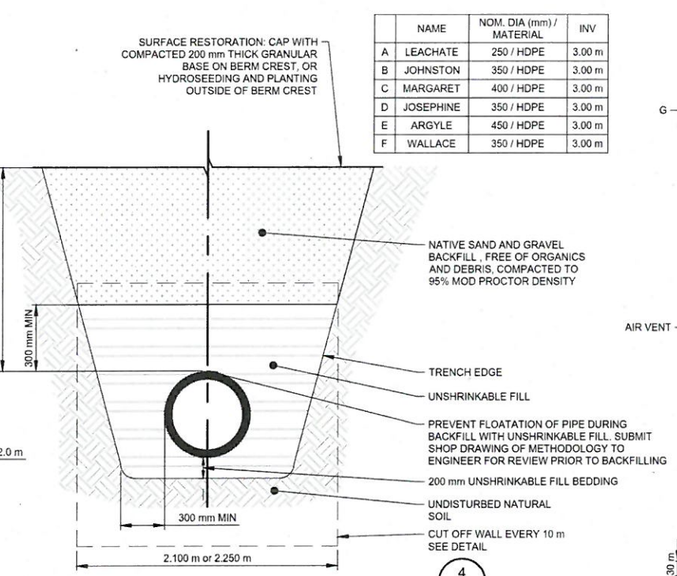
DRAWING	REVISION	SHEET
2972-00-C-114	0	19 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

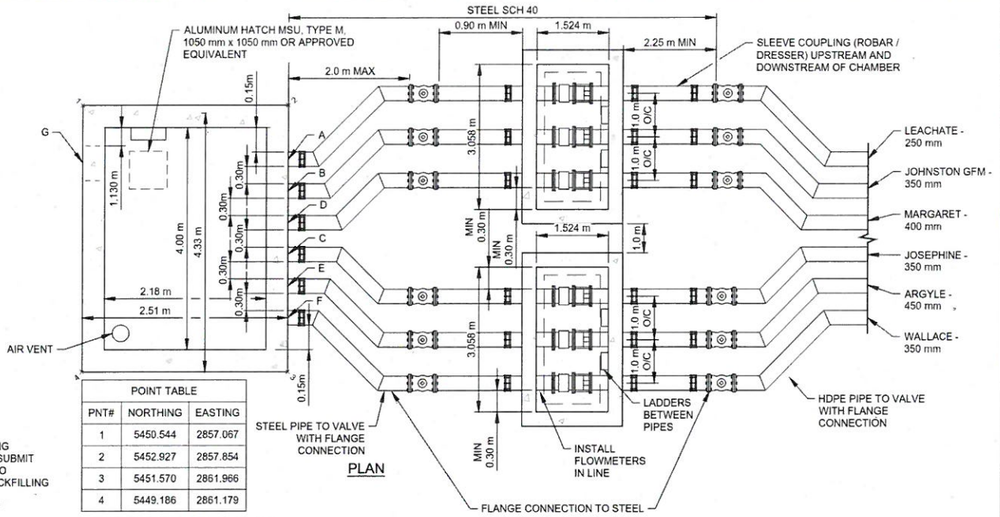


1 DETAIL NTS
ANCHOR BLOCK SANITARY OR HDPE PIPE

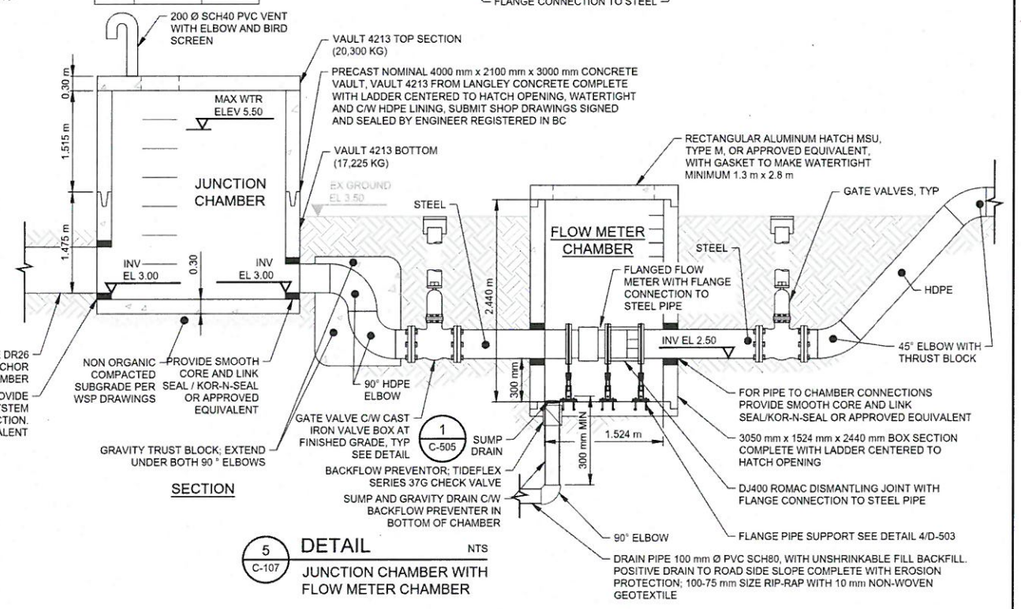


	NAME	NOM. DIA (mm) / MATERIAL	INV
A	LEACHATE	250 / HDPE	3.00 m
B	JOHNSTON	350 / HDPE	3.00 m
C	MARGARET	400 / HDPE	3.00 m
D	JOSEPHINE	350 / HDPE	3.00 m
E	ARGYLE	450 / HDPE	3.00 m
F	WALLACE	350 / HDPE	3.00 m

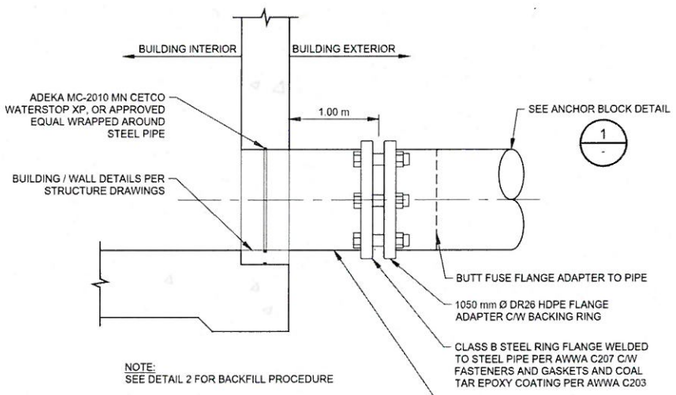
2 DETAIL NTS
SANITARY AND WATERMAIN PIPE TRENCH, TYP



POINT TABLE		
PNT#	NORTHING	EASTING
1	5450.544	2857.067
2	5452.927	2857.854
3	5451.570	2861.966
4	5449.186	2861.179

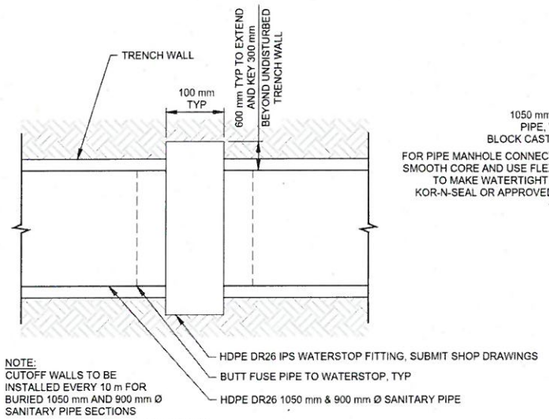


5 C-107 DETAIL NTS
JUNCTION CHAMBER WITH FLOW METER CHAMBER



NOTE:
SEE DETAIL 2 FOR BACKFILL PROCEDURE

3 DETAIL NTS
SCREENING BUILDING PIPE WALL PENETRATION



NOTE:
CUTOFF WALLS TO BE INSTALLED EVERY 10 m FOR BURIED 1050 mm AND 900 mm Ø SANITARY PIPE SECTIONS

4 DETAIL NTS
PIPE CUTOFF WALL, TYP

NOTES:

1. INSTALL FLOW METER CHAMBER SO NOT WITHIN ACCESS ROAD WIDTH. OFFSET TO JUNCTION CHAMBER AS REQUIRED.
2. INSTALL FABRICATED FITTINGS AS REQUIRED TO TIE INTO FLOW METER AND JUNCTION CHAMBER.
3. CHAMBER BEDDING TO BE PER WSP DRAWINGS
4. BEFORE TIE-IN OF 6 HDPE PIPES TO JUNCTION FLOW METER CHAMBER UPSTREAM VALVES, CONTRACTOR MUST COORDINATE WITH CITY TO LOWER LAGOON ELEVATION TEMPORARILY.
5. SEE DRAWING 2972-00-I-104 FOR FLOW METER INFORMATION.

P:\20172972\00_WstWtr_Trtmnt_Upgd\Working_Dwgs\100_Civil\2972-00-c-501.dwg
DATE: 2018-06-28, Jhunn Dudan

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PROFESSIONAL ENGINEER
K. MACRAE
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ENGINEER
27/06/18

PROFESSIONAL ENGINEER
M. Z. SALLY
45124
BRITISH COLUMBIA
ENGINEER
27 June 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

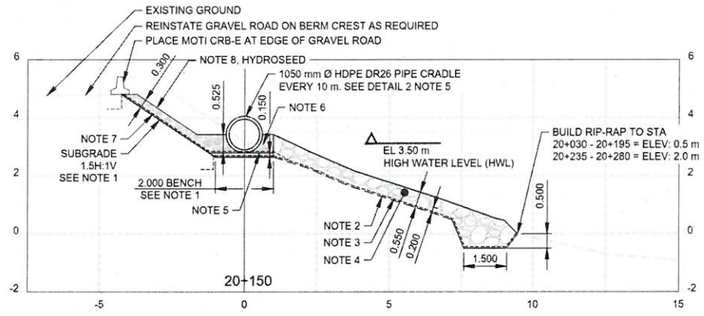
THE CITY OF Port Alberni

CIVIL
DETAILS
1 OF 5

DRAWING	REVISION	SHEET
2972-00-C-501	0	20 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

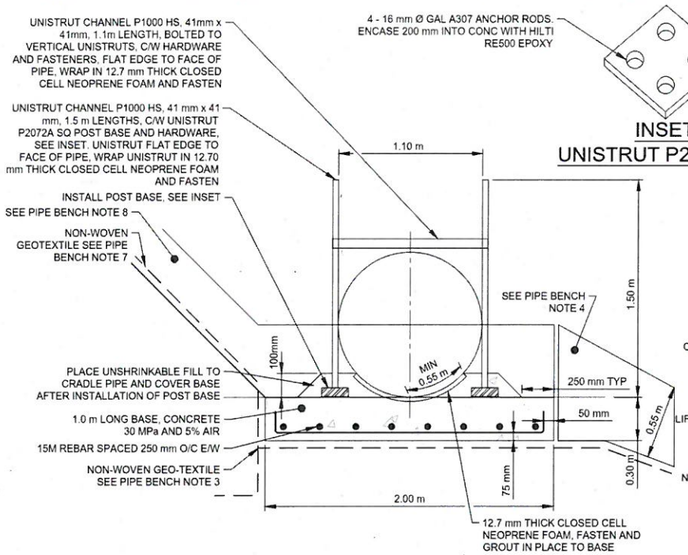
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PIPE BENCH NOTES (NOTES ARE IN ORDER OF ANTICIPATED CONSTRUCTION SEQUENCE)

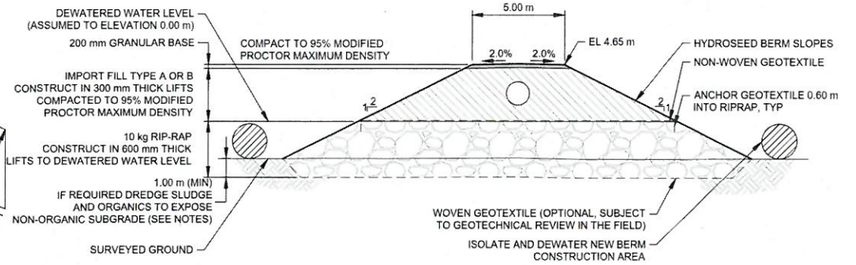
1. DEWATER OR LOWER LAOON WATER ELEVATION AS REQUIRED. EXCAVATE INTO EXISTING SIDE OF BERM AND PREPARE SMOOTH SUBGRADE. PIPE INVERT ELEVATION AND ℄ ALIGNMENT ARE VERTICAL AND HORIZONTAL CONTROL LINES. BENCH SUBGRADE ELEVATION IS 150mm BELOW PIPE INVERT ELEVATION. BENCH CUT SLOPE IS 1.5H:1V.
2. STRIP MIN 200mm AND REMOVE SURFICIAL ZONE OF ORGANICS, VEGETATION, SLUDGE, AND DEBRIS TO EXPOSE UNDERLYING SAND AND GRAVEL, ON BERM SIDE SLOPE BELOW PIPE BENCH.
3. PLACE NON-WOVEN GEOTEXTILE ON STRIPPED NON-ORGANIC SUBGRADE ON BERM SIDE SLOPE BELOW BENCH. GEOTEXTILE TO BE INSTALLED WITH MIN 0.5m DEEP ANCHOR TRENCH AT UP SLOPE SIDE OF BENCH. INSTALL IN CONTINUOUS LENGTH TO LAGOON BERM TOE. MIN 0.5m OVERLAP AT SEAMS.
4. PLACE 50kg RIPRAP ON NON-WOVEN GEOTEXTILE BELOW BENCH, 0.55m THICK. PROTECT GEOTEXTILE FROM PUNCTURE. DAMAGED GEOTEXTILE SHALL BE REPLACED AT CONTRACTOR'S COST.
5. PLACE 150mm THICK CLEAR CRUSH FOR PIPE BEDDING ON NON-WOVEN GEOTEXTILE ACROSS 2.0m WIDE BENCH, AND COVER WITH NON-WOVEN GEOTEXTILE, MIN 0.5m OVERLAP AT EDGES. EVERY 10m, INSTALL PIPE CRADLE SEE DETAIL 2/C-502.
6. INSTALL PIPE ON NON-WOVEN GEOTEXTILE AND BEDDING ON BENCH, SHAPE BEDDING AND GEOTEXTILE STRUCTURE UNDERNEATH TO FIRMLY SUPPORT HAUNCHES OF PIPE.
7. PLACE NON-WOVEN GEOTEXTILE ON PREPARED SUBGRADE SLOPE. ANCHOR GEOTEXTILE IN MIN 0.5m DEEP ANCHOR TRENCH AT TOP OF SLOPE. INSTALL IN CONTINUOUS LENGTH TO BENCH, WITH MIN 0.5m OVERLAP AT SEAMS AND EDGES.
8. PLACE IMPORTED FILL TYPE B MIN 300mm THICK ON THE NON-WOVEN GEOTEXTILE ON SLOPE AND ON BENCH AROUND PIPE. SHAPE AND COMPACT THE TYPE B FILL AROUND PIPE, UP TO SPRINGLINE. HOE PACK THE TYPE B FILL PERPENDICULAR TO FACE AND COMPACT TO 95% MODIFIED PROCTOR MAXIMUM DRY DENSITY. HYDROSEED FINISHED SLOPE.

1 / C-104 **SECTION** 1:100
PIPE BENCH
STA 20+030 TO STA 20+195
STA 20+235 TO STA 20+280



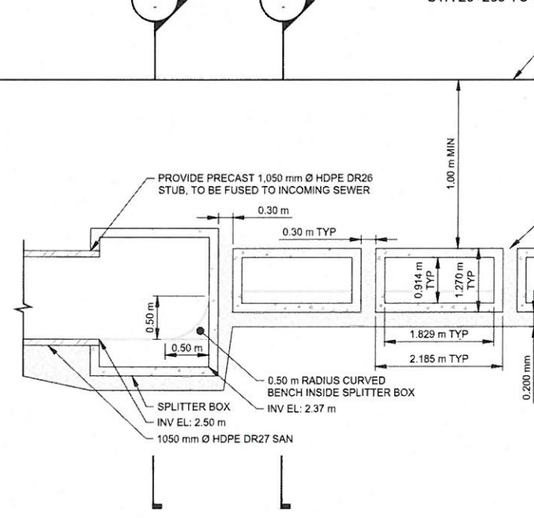
INSET
UNISTRUT P2072A SQ

2 / - **DETAIL** NTS
PIPE CRADLE

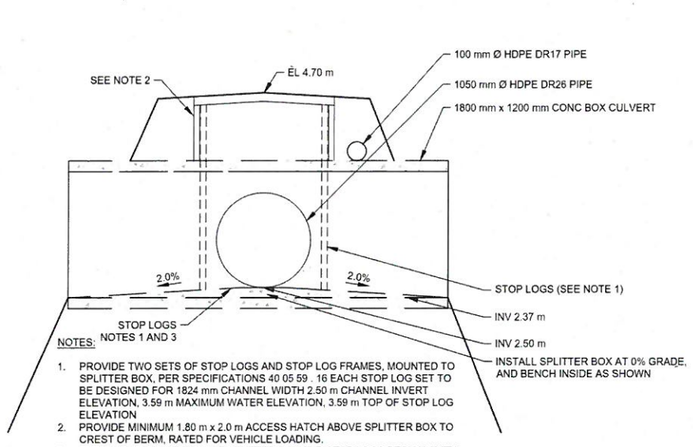


NOTES:
1. SUBGRADE TO BE INSPECTED BY GEO-TECHNICAL ENGINEER PRIOR TO COMMENCING FILL PLACEMENT. PROVIDE 72 HOURS NOTICE TO ENGINEER PRIOR TO INSPECTION
2. FOR NEW BERM PRE-LOAD, REFER TO WSP DRAWINGS

3 / C-102 **SECTION** NTS
NEW BERM

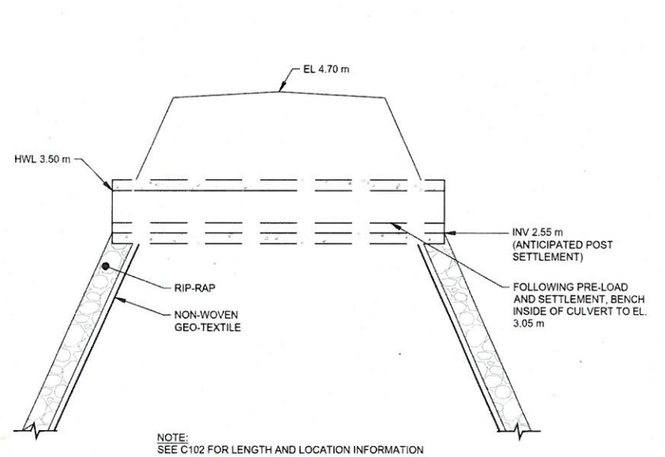


4 / C-102 **SECTION** NTS
SPLITTER BOX



NOTES:
1. PROVIDE TWO SETS OF STOP LOGS AND STOP LOG FRAMES, MOUNTED TO SPLITTER BOX, PER SPECIFICATIONS 40 05 59 . 16 EACH STOP LOG SET TO BE DESIGNED FOR 1824 mm CHANNEL WIDTH 2.50 m CHANNEL INVERT ELEVATION, 3.59 m MAXIMUM WATER ELEVATION, 3.59 m TOP OF STOP LOG ELEVATION
2. PROVIDE MINIMUM 1.80 m x 2.0 m ACCESS HATCH ABOVE SPLITTER BOX TO CREST OF BERM, RATED FOR VEHICLE LOADING.
3. SUBMIT SHOP DRAWINGS OF SPLITTER BOX AND STOP LOGS DESIGN, WITH FRAME EMBEDMENT DETAIL PER DETAILS 1 AND 2 ON 2972-00-D-321. SHOP DRAWINGS FOR SPLITTER BOX TO BE SIGNED AND SEALED BY ENGINEER REGISTERED WITH APEG BC.
4. SEE C-102 FOR LENGTH AND LOCATION INFORMATION.

5 / - **SECTION** NTS
SPLITTER BOX



NOTE:
SEE C102 FOR LENGTH AND LOCATION INFORMATION

6 / - **SECTION** NTS
TYP OVERFLOW CULVERT

P:\20172972\00_WstWtr_Trtmnt_Upgr\Working_Dwgs\100_Civil\2972-00-c-501.dwg
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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. K. D. WOO # 34152
June 28, 2018
PIPE CRADLE

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. Z. SALLY # 45124
28 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
DETAILS
2 OF 5

DRAWING	REVISION	SHEET
2972-00-C-502	0	21 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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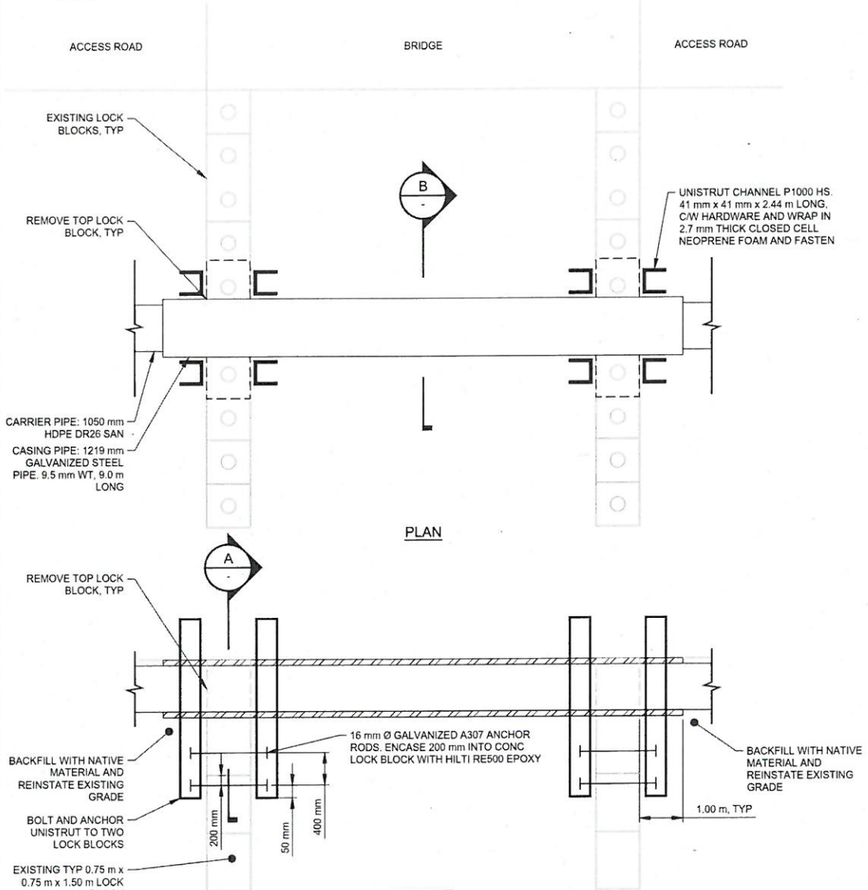
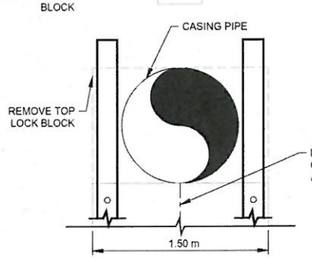
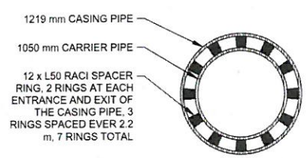


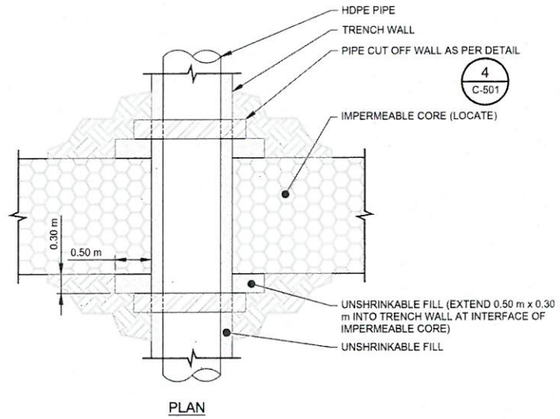


A - SECTION NTS
CASING PIPE

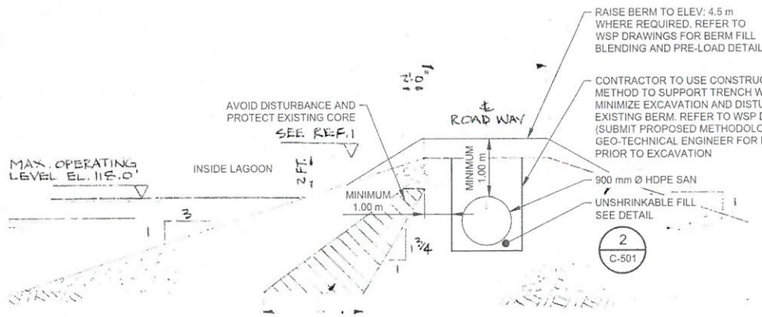


B - SECTION NTS
SPACER RINGS

1 / C-104 DETAIL NTS
PIPE BRIDGE

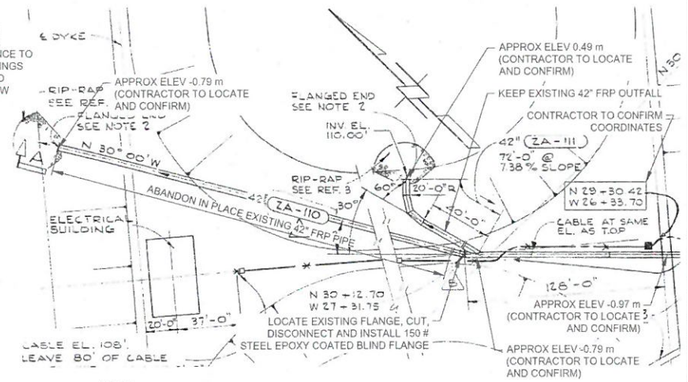


2 - DETAIL NTS
PIPE CORE PENETRATION DETAIL



NOTE:
SKETCH ABOVE TAKEN FROM DRAWING 13000_E-13,007 REV E OF THE WW_UPGRADES AS-BUILT DRAWINGS

3 - DETAIL NTS
TYPICAL SANITARY INSTALLATION (APPROX. STA 30+040 TO 30+300)



NOTE:
SKETCH ABOVE TAKEN FROM DRAWING 13000_E-13,025 REV E OF THE WW_UPGRADES AS-BUILT DRAWINGS

4 - DETAIL NTS
FRP PIPE ABANDON DETAIL

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. K. D. WOO
34152
JUN 28 2018
FOR PIPE RESTRAINT.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. Z. SALLY
45124
28 JUN 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	Z. SALLY	A. MOLYNEAUX	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

CIVIL
DETAILS
3 OF 5

DRAWING	REVISION	SHEET
2972-00-C-503	0	22 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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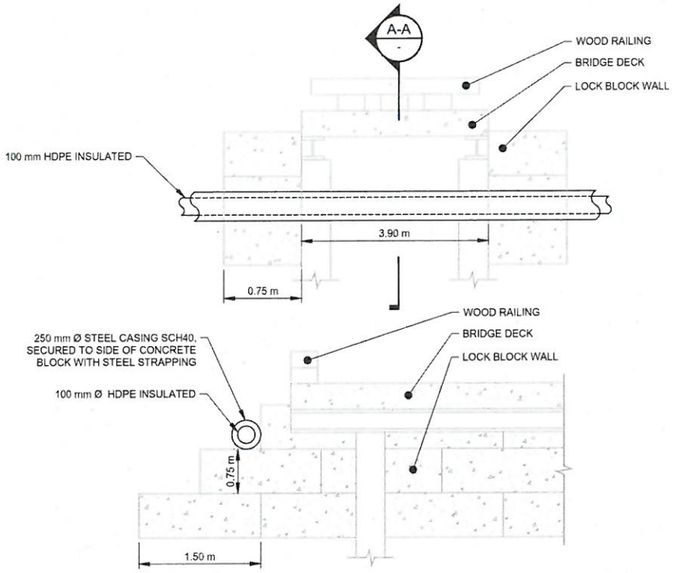
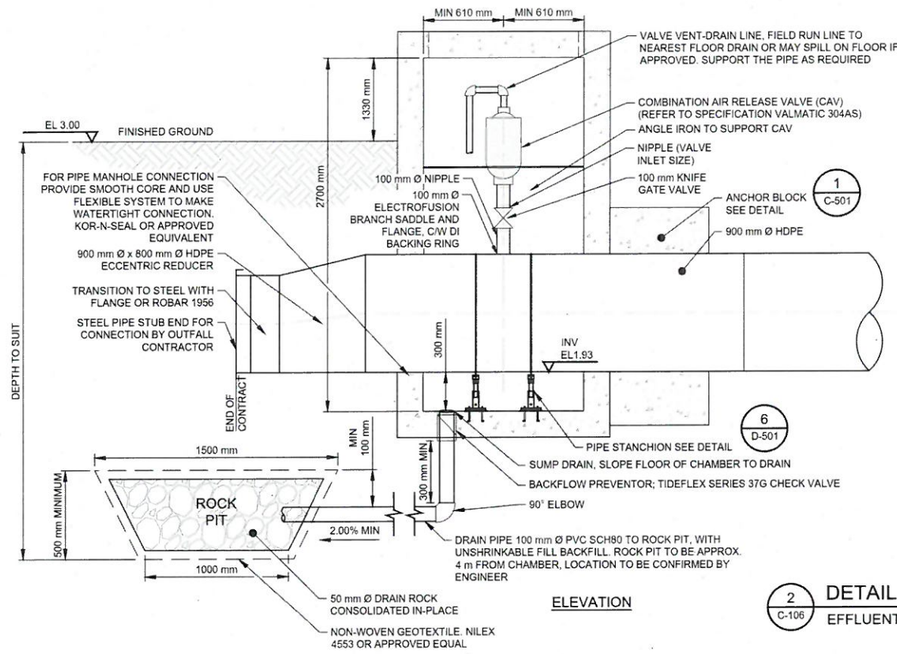
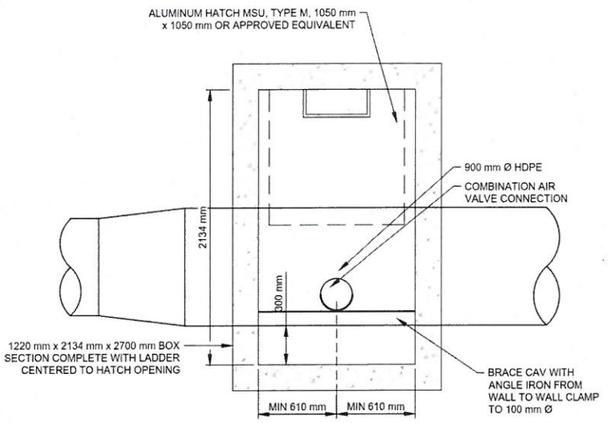


A-A

1 C-112 **DETAIL** NTS
100 mm Ø HDPE DR17 WTR - BRIDGE CROSSING



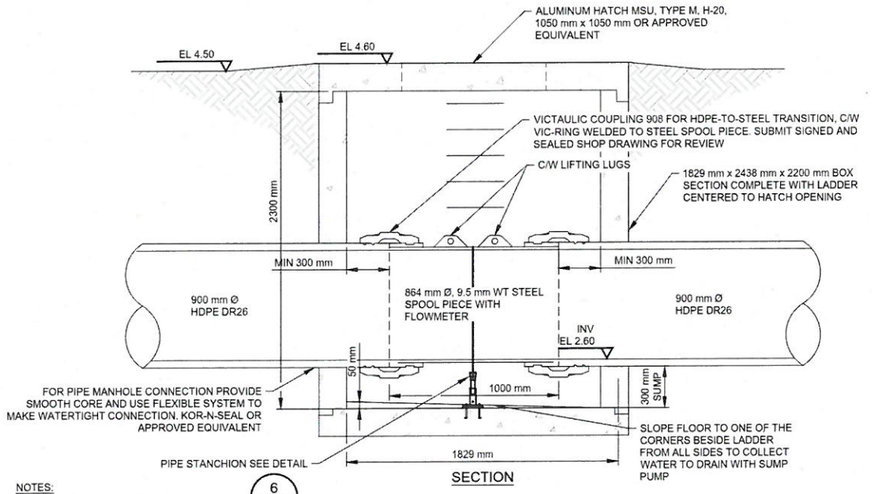
ELEVATION



PLAN

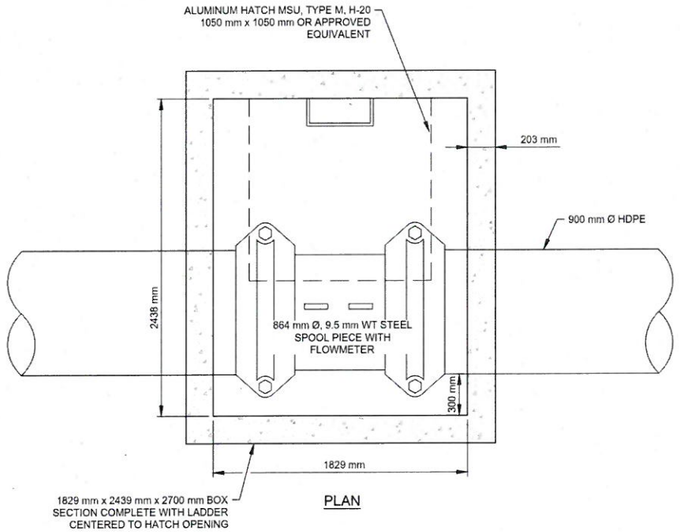
NOTE:
CHAMBER BEDDING TO BE 200 mm OF ONE INCH CRUSHED GRAVEL

2 C-106 **DETAIL** NTS
EFFLUENT AIR VALVE CHAMBER



SECTION

NOTES:
1. CHAMBER BEDDING TO BE AS PER WSP DRAWINGS.
2. SEE DRAWING 2972-00-I-103 FOR FLOWMETER INFORMATION.



PLAN

3 C-106 **DETAIL** NTS
EFFLUENT FLOW METER CHAMBER

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PROFESSIONAL ENGINEER
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L. MACRAE
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Jun 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUNE27	L. MACRAE	A. MOLYNEAUX	ISSUED FOR TENDER

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WASTEWATER LAGOON EXPANSION UPGRADES

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SCALE: AS SHOWN

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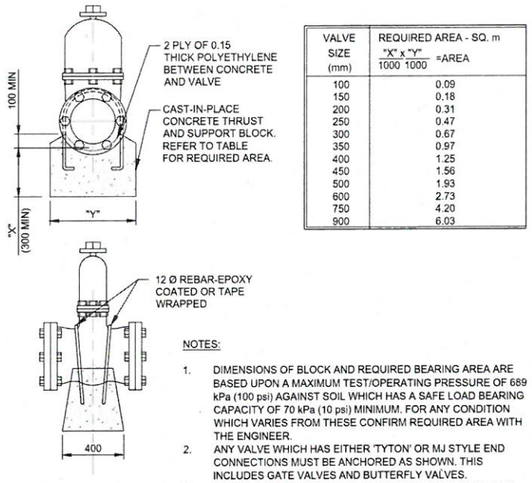
DETAILS
4 OF 5

DRAWING	REVISION	SHEET
2972-00-C-504	0	23 / 111

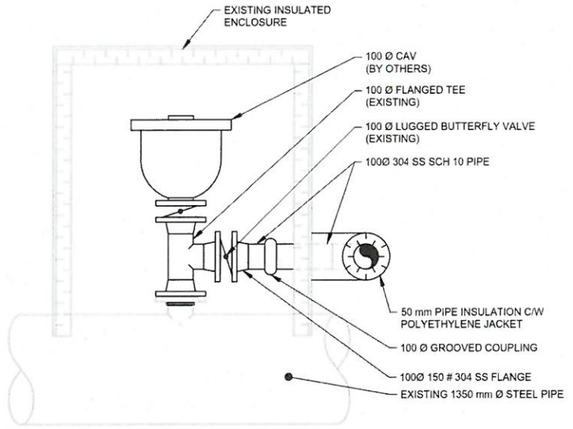


VALVE SIZE (mm)	REQUIRED AREA - SQ. m "X" x "Y" / 1000 1000 =AREA
100	0.09
150	0.18
200	0.31
250	0.47
300	0.67
350	0.97
400	1.25
450	1.56
500	1.93
600	2.73
750	4.20
900	6.03

NOTES:

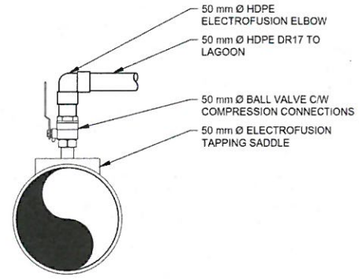
1. DIMENSIONS OF BLOCK AND REQUIRED BEARING AREA ARE BASED UPON A MAXIMUM TEST/OPERATING PRESSURE OF 689 kPa (100 psi) AGAINST SOIL WHICH HAS A SAFE LOAD BEARING CAPACITY OF 70 kPa (10 psi) MINIMUM. FOR ANY CONDITION WHICH VARIES FROM THESE CONFIRM REQUIRED AREA WITH THE ENGINEER.
2. ANY VALVE WHICH HAS EITHER 'TYTON' OR MJ STYLE END CONNECTIONS MUST BE ANCHORED AS SHOWN. THIS INCLUDES GATE VALVES AND BUTTERFLY VALVES.
3. COAT BURIED METALLIC OBJECTS WITH DENSO PASTE AND TAPE OR APPROVED EQUIVALENT.

1 / - DETAIL NTS
VALVE ANCHORING

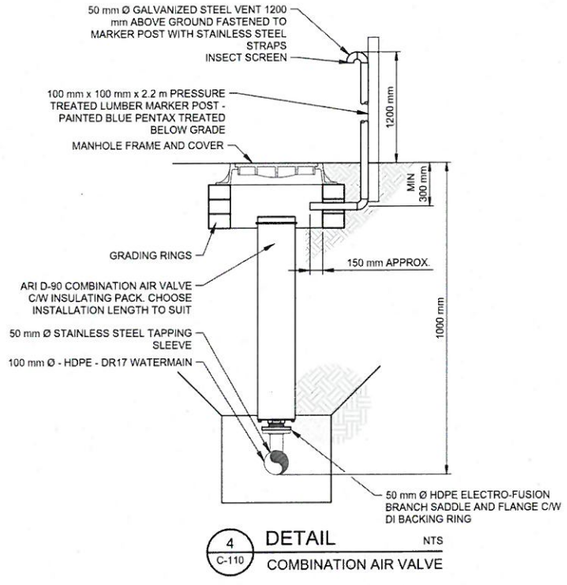


NOTE:
REFER TO PHOTO 1/C-114

2 / C-113 DETAIL NTS
COMBINATION AIR VALVE AT TIE-IN



3 / - DETAIL NTS
MANUAL AIR RELEASE VALVE, TYP



4 / C-110 DETAIL NTS
COMBINATION AIR VALVE

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WASTEWATER LAGOON EXPANSION UPGRADES

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SCALE: AS SHOWN

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CIVIL
DETAILS
5 OF 5

DRAWING	REVISION	SHEET
2972-00-C-505	0	24 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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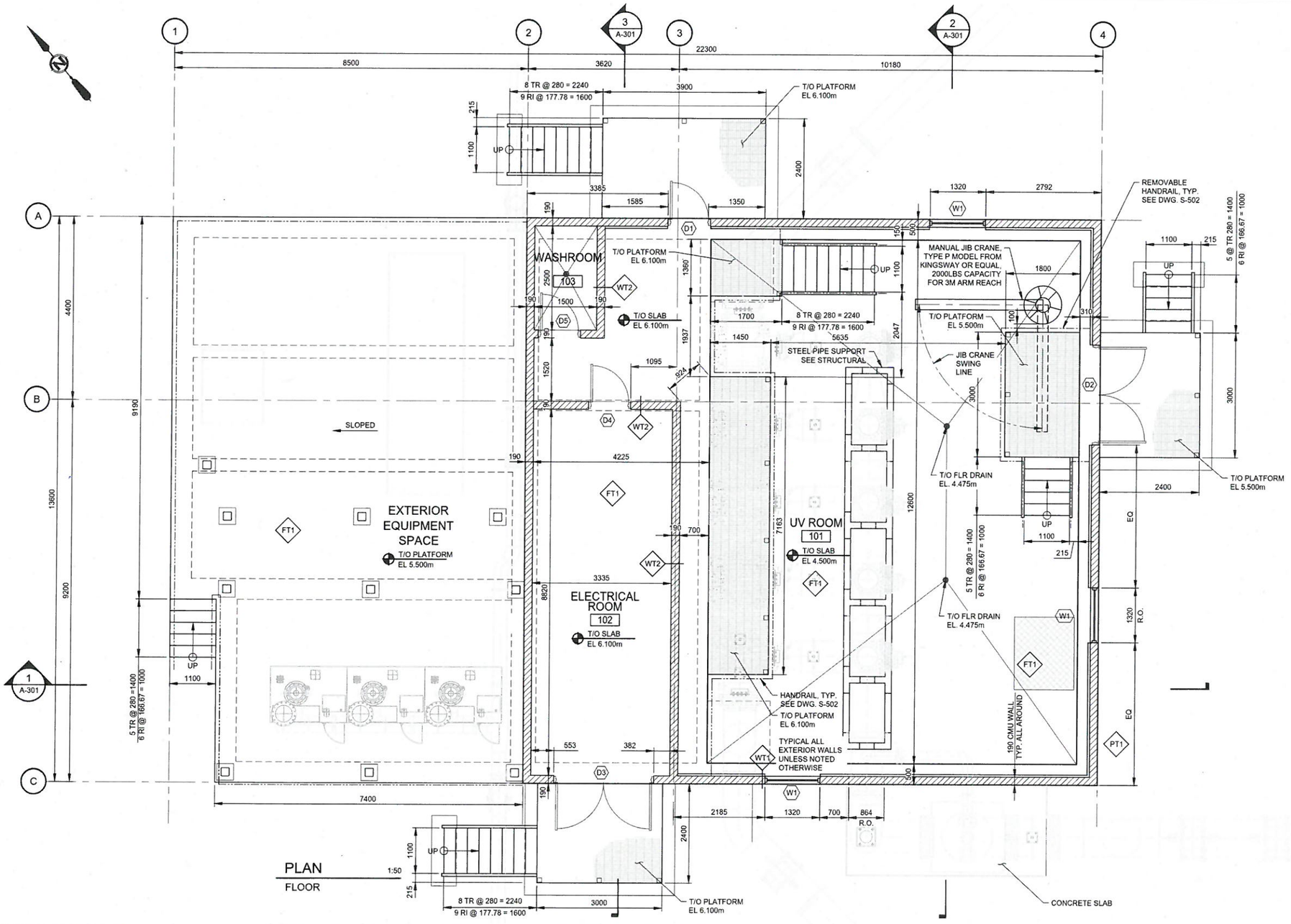

PLAN
FLOOR
1:50

WALL TYPES LEGEND

WT1 — EXTERIOR WALL
-190 CONCRETE MASONRY UNIT
-METAL Z-GIRTS (20 Ga.)
-50 RIGID INSULATION (R12)
-VAPOR BARRIER (BLUESKIN PEEL & STICK)
-12 GYPSUM

WT2 — INTERIOR WALL
-190 CONCRETE MASONRY UNIT, SMOOTH FACE

FLOOR TYPES LEGEND

FT1 -CONCRETE FLOOR STRUCTURE

ROOF TYPES LEGEND

RT1
-SBS CAP SHEET AND BASE SHEET BY SOPREMA OR APPROVED EQUAL
-12mm OVERLAY BOARD
-100 RIGID INSULATION (R20)
-16mm FIBRE BOARD SET IN HOT ASPHALT
- 38mmx1.22 STEEL DECK
- 610mm DEEP OWSJ 24LH10 OR EQUAL
- 12mm TYPE-C GYPSUM ON STEEL STUD BACKING

PARAPET TYPES LEGEND

PT1
-PRE-FINISHED METAL CLADDING FASCIA
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-190 MASONRY BLOCK (SMOOTH FACE)
-51 RIGID INSULATION (R12)
-VAPOR BARRIER
-16 PRESSURE TREATED PLYWOOD
-SBS ROOFING SYSTEM

NOTE:
ALL SBS ROOFING TO BE INSTALLED TO RCABC SPECIFICATION FOR A 5 YEAR WARRANTY.

P:\2017\2972\00_WstWtr_Trtmnt_Upgr\Working_Dwgs\200_Architectural\2972-00-a-101.dwg
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PROFESSIONAL ENGINEER
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M. K. D. WOO
34152
JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	J. COPE	H. DUALAN JR	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

ARCHITECTURAL
UV BUILDING
FLOOR PLAN

DRAWING	REVISION	SHEET
2972-00-A-101	0	25 /111

IF NOT 50 mm ADJUST SCALES
50 mm

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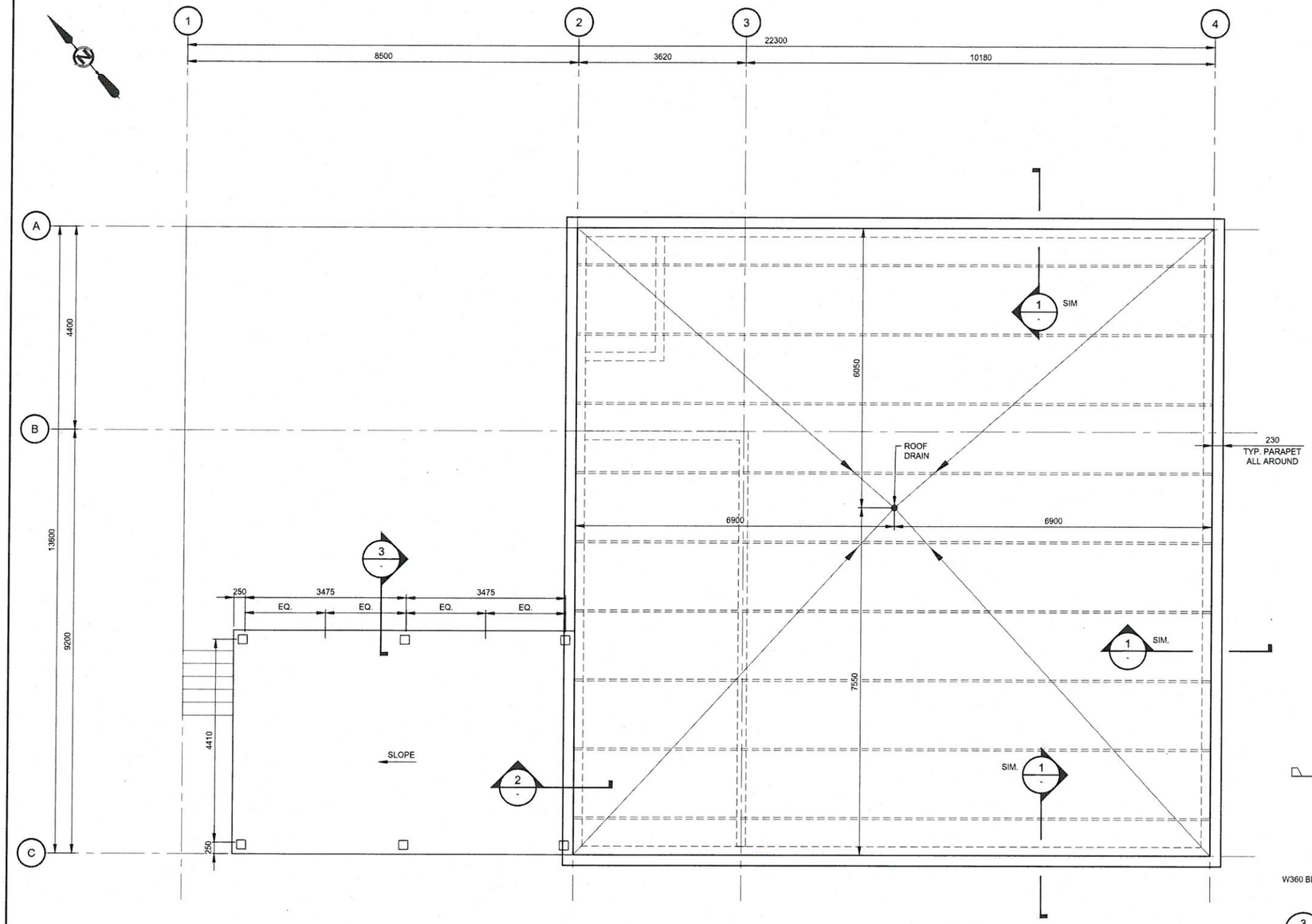
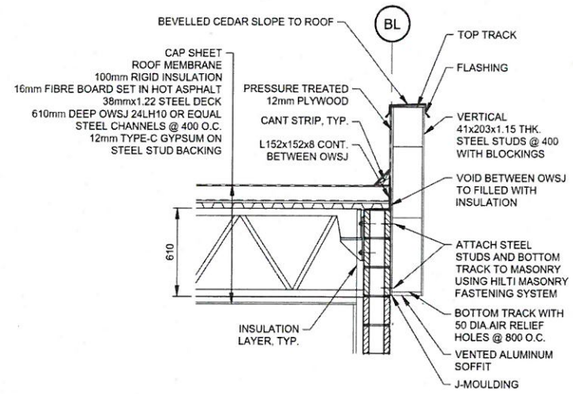
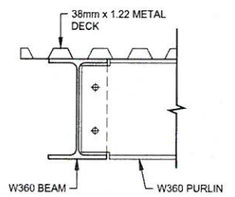


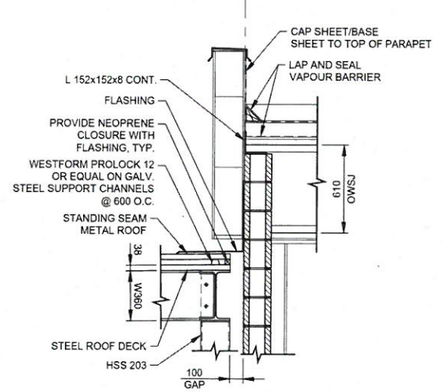
PLAN 1:50
ROOF



1 SECTION 1:20
ROOF AND PARAPET
(SIDE WALL)



3 SECTION 1:10



2 SECTION 1:20
ROOF AND PARAPET
(SIDE WALL)

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0	2018JUN27	J. COPE	H. DUALAN JR	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

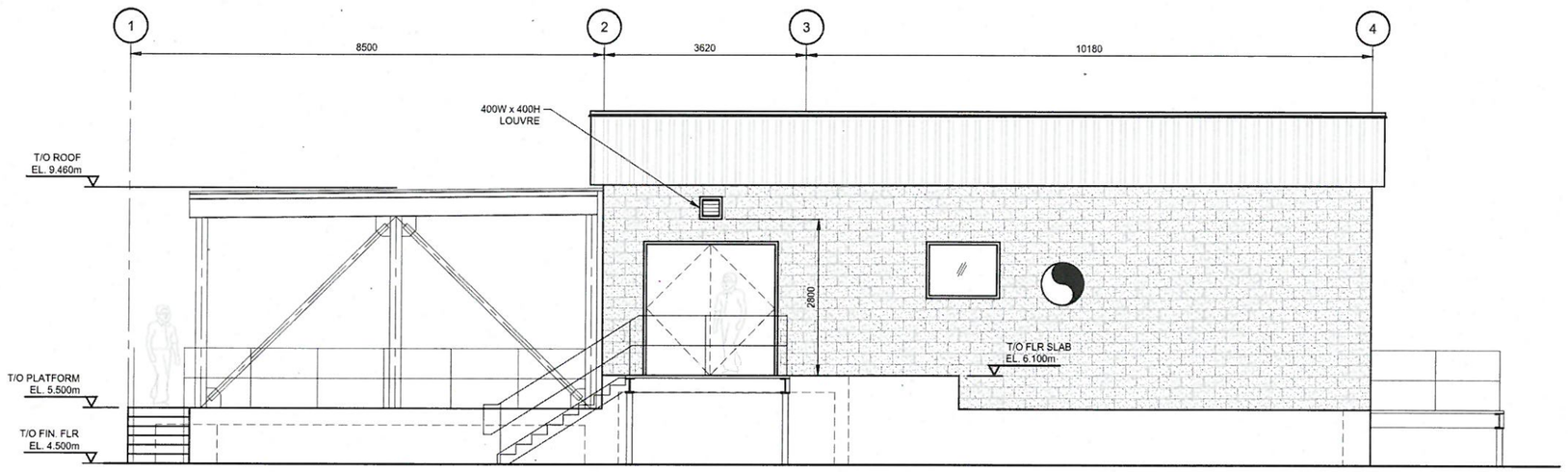
20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

ARCHITECTURAL
UV BUILDING
ROOF PLAN

DRAWING	REVISION	SHEET
2972-00-A-102	0	26 / 111



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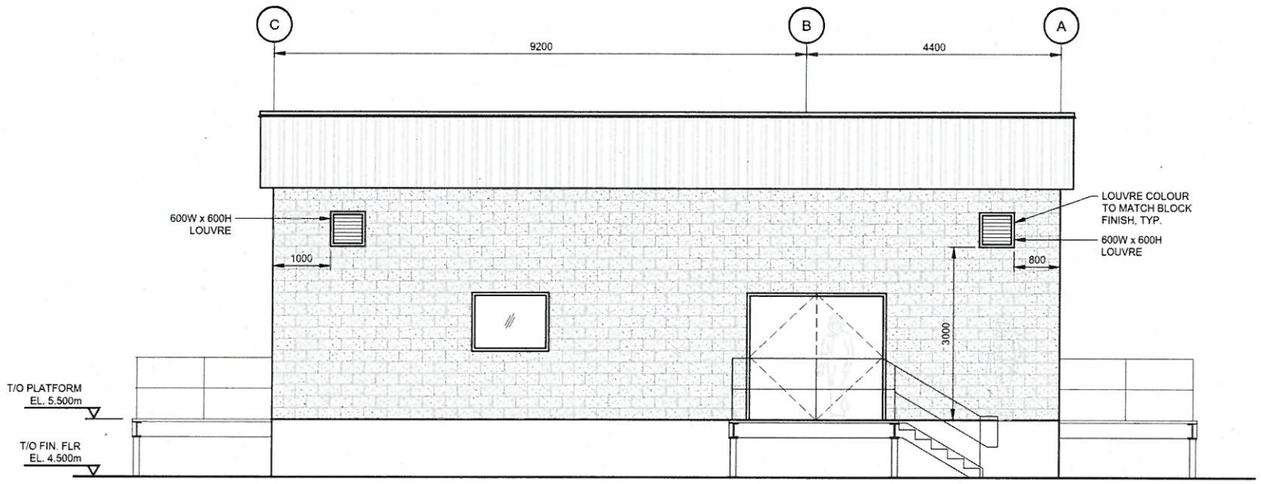
SOUTH



ELEVATION 1:50
EAST

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WASTEWATER LAGOON
EXPANSION UPGRADES

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ELEVATION SHEET 1

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2972-00-A-201	0	27 / 111

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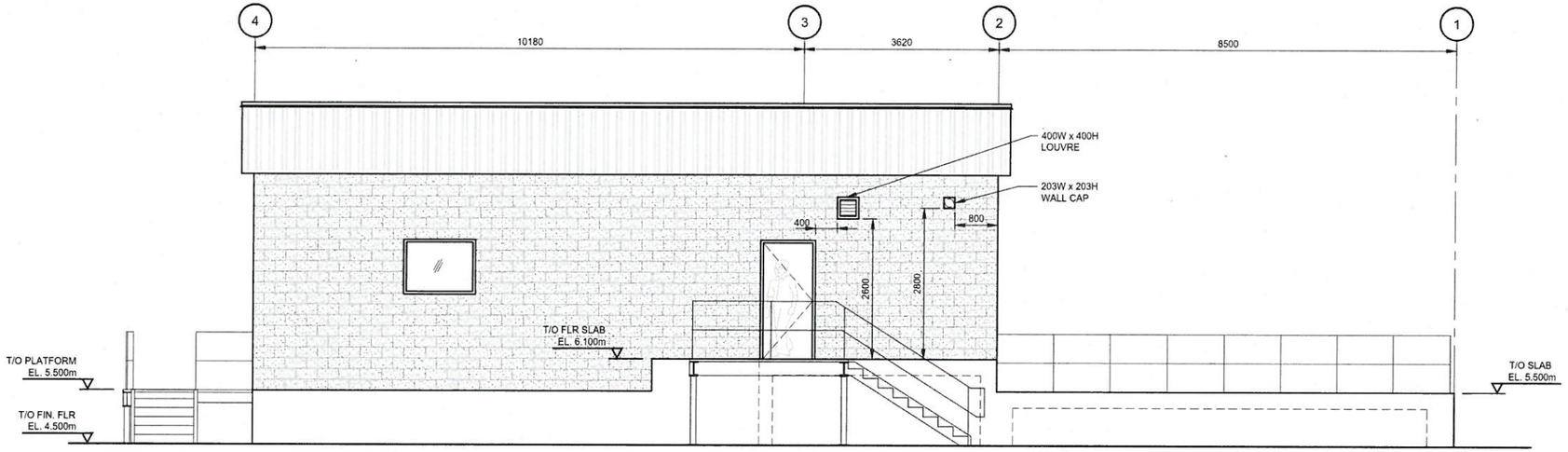

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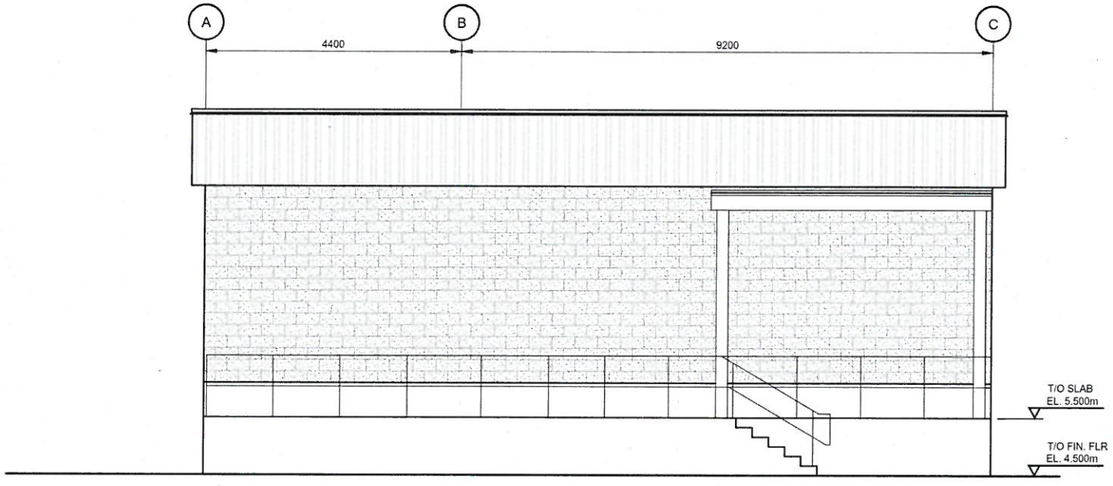

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WEST

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ELEVATION SHEET 2

DRAWING	REVISION	SHEET
2972-00-A-202	0	28 / 111

IF NOT 50 mm ADJUST SCALES
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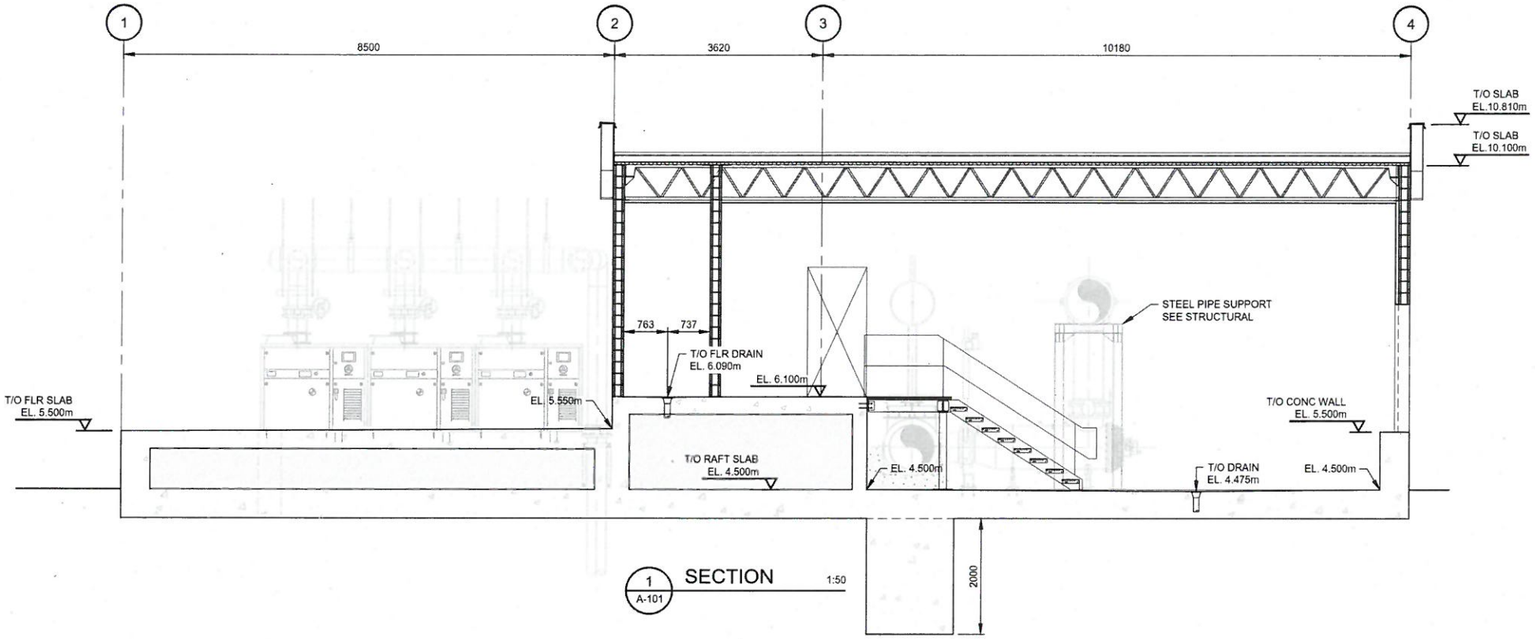
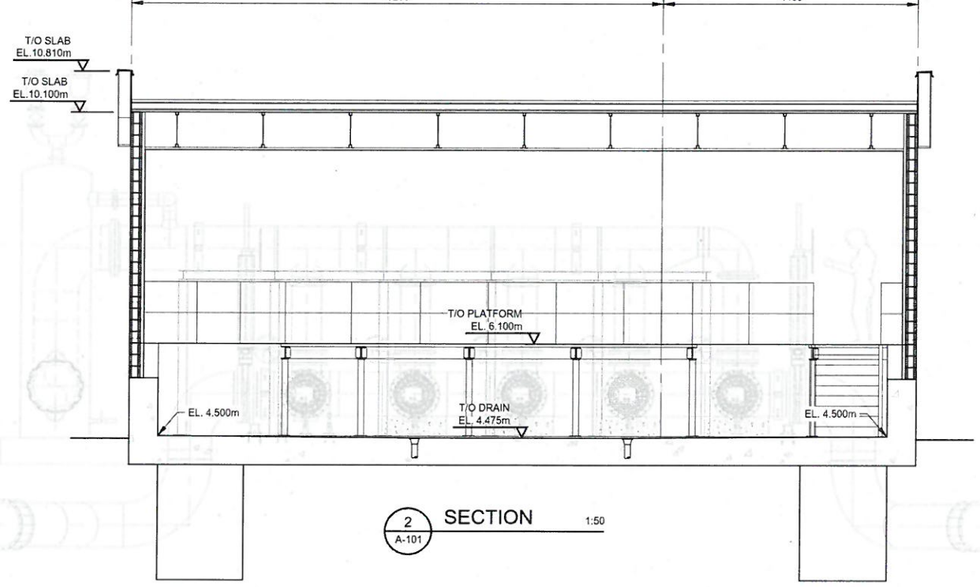


1 A-101 SECTION 1:50



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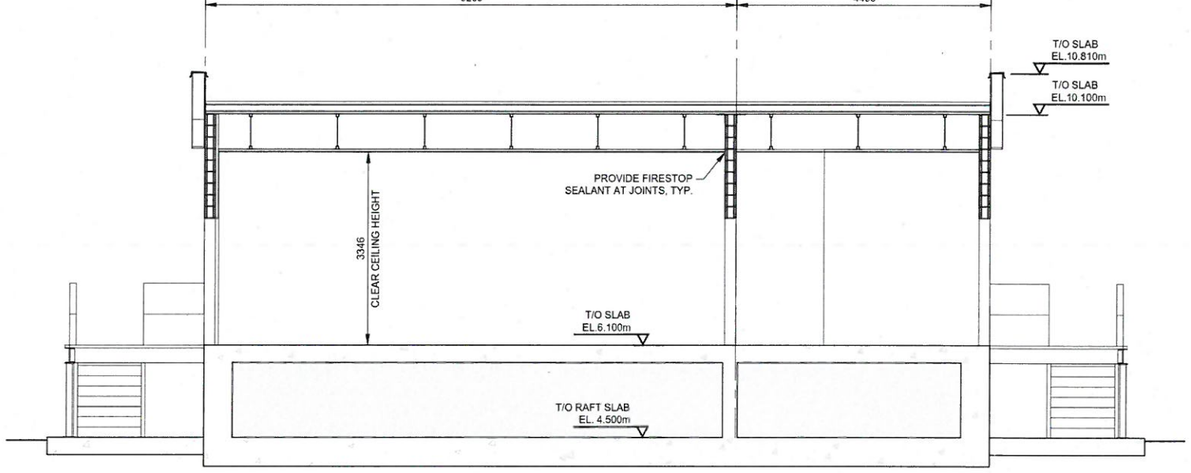

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SECTIONS

DRAWING	REVISION	SHEET
2972-00-A-301	0	29 / 111

DOOR SCHEDULE

DOOR No.	LOCATION		DOOR									HARDWARE										FIRE RATING (MINS)	REMARKS
	FROM	TO	TYPE	ACTION	LITE / GLASS	INSUL.	LOUVER	NOM. WIDTH	NOM. HEIGHT	DOOR ROUGH OPENING	FINISH	THRESHOLD	WEATHER STRIPPING	DOOR STOP	HOLD OPEN	HINGES	CLOSER	LOCKSET	KICKPLATE	DOOR SWEEP	ASTRAGAL		
D1	UV ROOM	EXTERIOR	2	-	-	YES	-		-	1025 x 2185	PAINT	* YES	YES	YES	YES	1 1/2 PR	YES	** ENTRANCE LOCK RIM EXIT DEVICE	YES	-	-	1 HR	-
D2	UV ROOM	EXTERIOR	3	-	-	YES	-		-	1830 x 2185	PAINT	* YES	YES	YES	YES	3 PR	YES	** ENTRANCE LOCK RIM EXIT DEVICE	YES	-	YES	1 HR	-
D3	ELECTRICAL ROOM	EXTERIOR	3	-	-	YES	-		-	1830 x 2489	PAINT	* YES	YES	YES	YES	3 PR	YES	** ENTRANCE LOCK RIM EXIT DEVICE	YES	-	YES	1 HR	-
D4	ELECTRICAL ROOM	UV ROOM	2	-	-	NO	-		-	1025 x 2185	PAINT	-	-	-	-	1 1/2 PR	-	OFFICE	-	-	-	1 HR	-
D5	WASHROOM	UV ROOM	2	-	-	NO	YES		-	1025 x 2185	PAINT	-	-	-	-	1 1/2 PR	-	PRIVACY	-	-	-	-	-

* THRESHOLD (PEMKO 270A OR SIMILAR APPROVED)

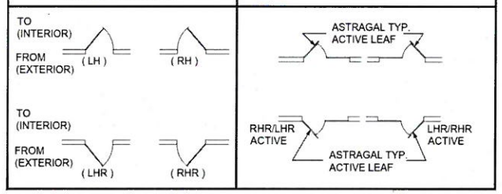
** LOCKSET & DEAD BOLT KEYED TO ABLOY KEY SYSTEM

DOOR TYPES

TYPE 1	TYPE 2	TYPE 3
		
INSULATED METAL WITH PRESSED STEEL FRAME 2134 HIGH	NON INSULATED METAL WITH PRESSED STEEL FRAME 2134 HIGH	INSULATED METAL WITH PRESSED STEEL FRAME 2438 HIGH

DOOR HANDING

SINGLE DOORS



NOTES :

1. FOR GENERAL NOTES SEE DWG. S-001.
2. DOORS MUST HAVE PERMANENT LABEL TO CONFIRM 1.0 HR MIN. FIRE RATING.

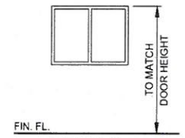
DOOR ABBREVIATIONS:

MW	MASONRY WALL
PS	PRESSED STEEL FRAME
STL	STEEL FRAME
SW	STUD WALL

WINDOW SCHEDULE

NO.	LOCATION	TYPE	MAT'L	SIZE (WxH)	GLASS	FRAME		NOTES
						SIZE	MAT'L	
W1	UV ROOM	A	AL	1220x920	3mm CLEAR	52x127	AL	DOUBLE GLAZED

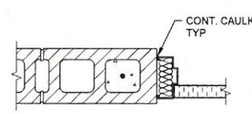
NOTE: KANE SECURITY SCREENS TO BE PROVIDED



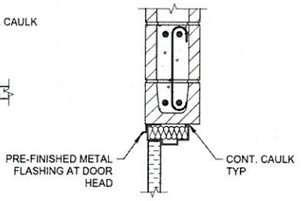
TYPE A

ROOM FINISH SCHEDULE

ROOM NAME	FLOOR		WALLS								CEILING		DOORS	FRAMES
			NORTH		EAST		SOUTH		WEST					
	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH		
UV ROOM	CONCRETE	HARDENER NATURAL GREY COLOR	BLOCK/CONC	2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	BLOCK FILLER, PRIMER & 2 COATS ACRYLIC LATEX COLOR BY OWNER	STRUCTURAL STEEL DECK	PRIMER & 2 COATS ALKYD PAINT MATT WHITE	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER
ELECTRICAL ROOM	CONCRETE	HARDENER NATURAL GREY COLOR	BLOCK/CONC	BLOCK FILLER, PRIMER & 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	BLOCK FILLER, PRIMER & 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	2 COATS ACRYLIC LATEX COLOR BY OWNER	STRUCTURAL STEEL DECK	PRIMER & 2 COATS ALKYD PAINT MATT WHITE	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER
WASHROOM	CONCRETE	HARDENER NATURAL GREY COLOR	BLOCK/CONC	2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	BLOCK FILLER, PRIMER & 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	BLOCK FILLER, PRIMER & 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	2 COATS ACRYLIC LATEX COLOR BY OWNER	STRUCTURAL STEEL DECK	PRIMER & 2 COATS ALKYD PAINT MATT WHITE	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER
EXTERIOR EQUIPMENT	CONCRETE	HARDENER NATURAL GREY COLOR												



DOOR JAMB



DOOR HEAD

A - DETAIL 1:10

TYPICAL PRESSED STEEL DOOR FRAME DETAILS

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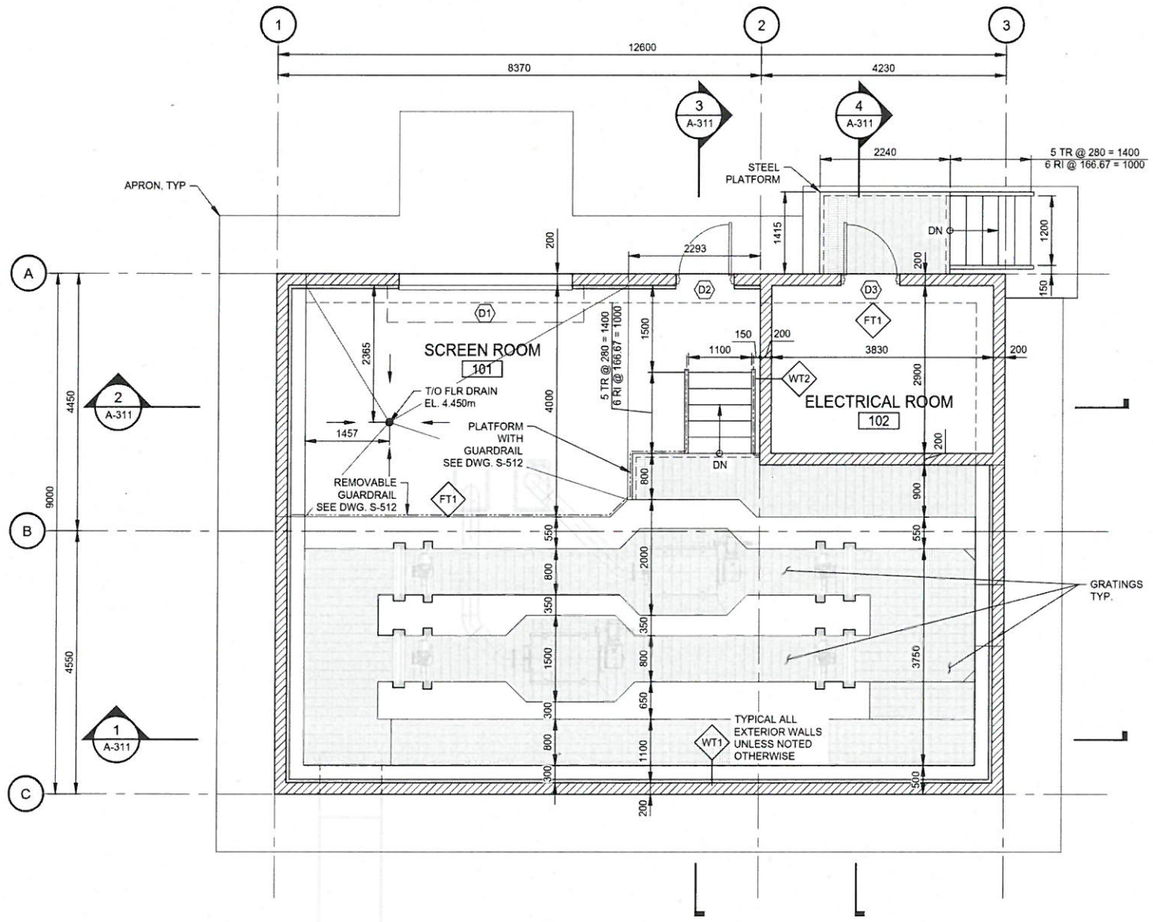

PLAN 1:50
FLOOR

WALL TYPES LEGEND

WT1 — EXTERIOR WALL
- -190 CONCRETE MASONRY UNIT
- -METAL Z-GIRTS (20 Ga.)
- -50 RIGID INSULATION (R12)
- -VAPOR BARRIER (BLUESKIN PEEL & STICK)
- -12mm GYPSUM

WT2 — INTERIOR WALL
- -190 CONCRETE MASONRY UNIT, SMOOTH FACE

FLOOR TYPES LEGEND

FT1 — -CONCRETE FLOOR STRUCTURE

ROOF TYPES LEGEND

RT1
- -SBS CAP SHEET AND BASE SHEET BY SOPREMA OR APPROVED EQUAL
- -100 RIGID INSULATION (R20)
- -16 FIBRE BOARD SET IN HOT ASPHALT
- -38x1.22 STEEL DECK
- -610mm DEEP OWSJ 24LH10 OR EQUAL
- -12mm TYPE-C GYPSUM ON STEEL STUD BACKING

PARAPET TYPES LEGEND

PT1
- -PRE-FINISHED METAL CLADDING FASCIA
- -51 RIGID INSULATION (R12)
- -VAPOR BARRIER
- -190 MASONRY BLOCK (SMOOTH FACE)
- -51 RIGID INSULATION (R12)
- -VAPOR BARRIER.
- -16 PRESSURE TREATED PLYWOOD
- -SBS ROOFING SYSTEM

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FLOOR PLAN

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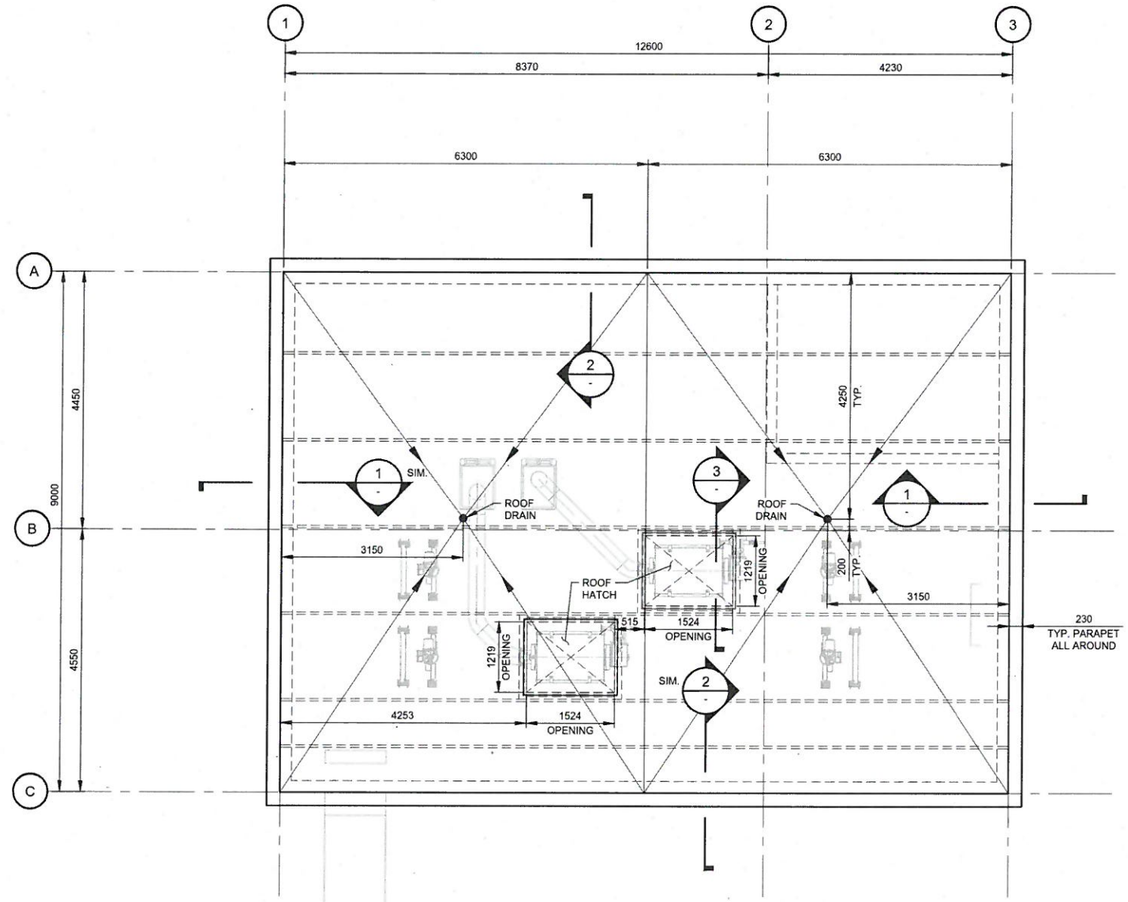
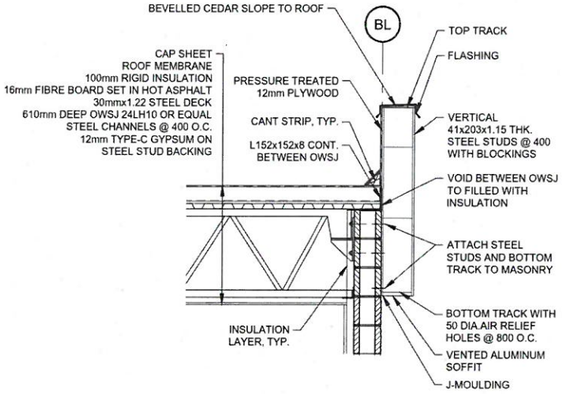
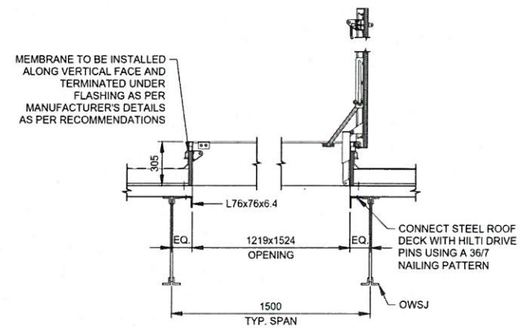


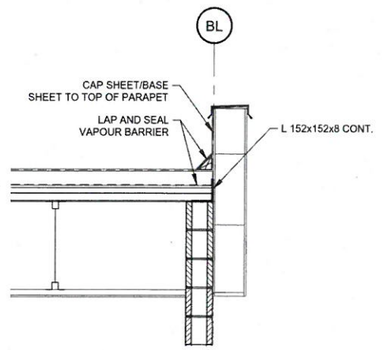
PLAN 1:50
FLOOR



1 / - SECTION 1:20
ROOF AND PARAPET
(SIDE WALL)



3 / - SECTION 1:20
ROOF HATCH



2 / - SECTION 1:20
ROOF AND PARAPET
(END WALL)

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ROOF PLAN

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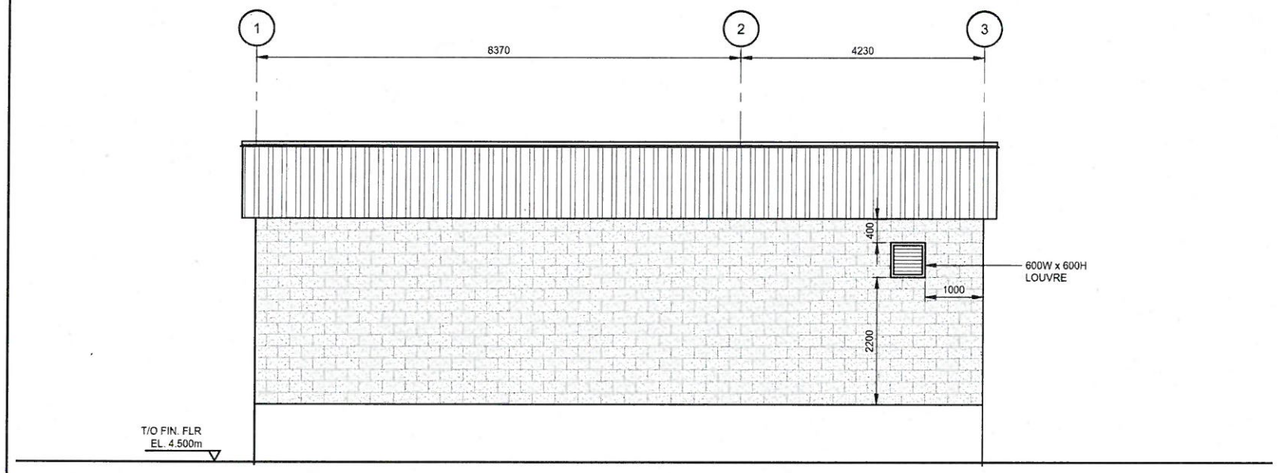

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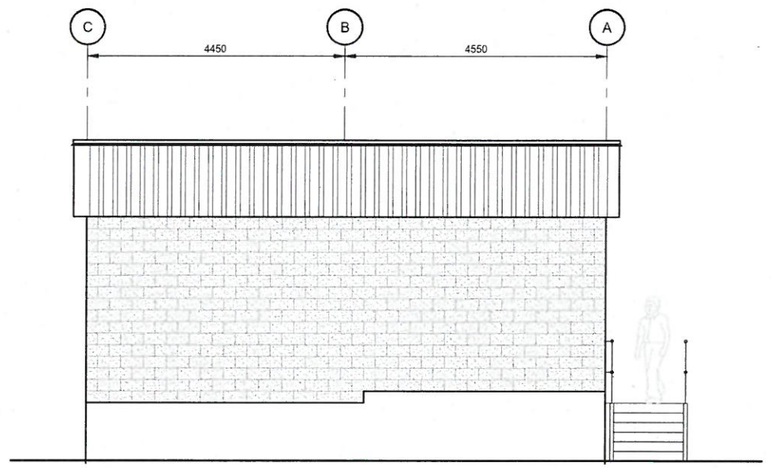
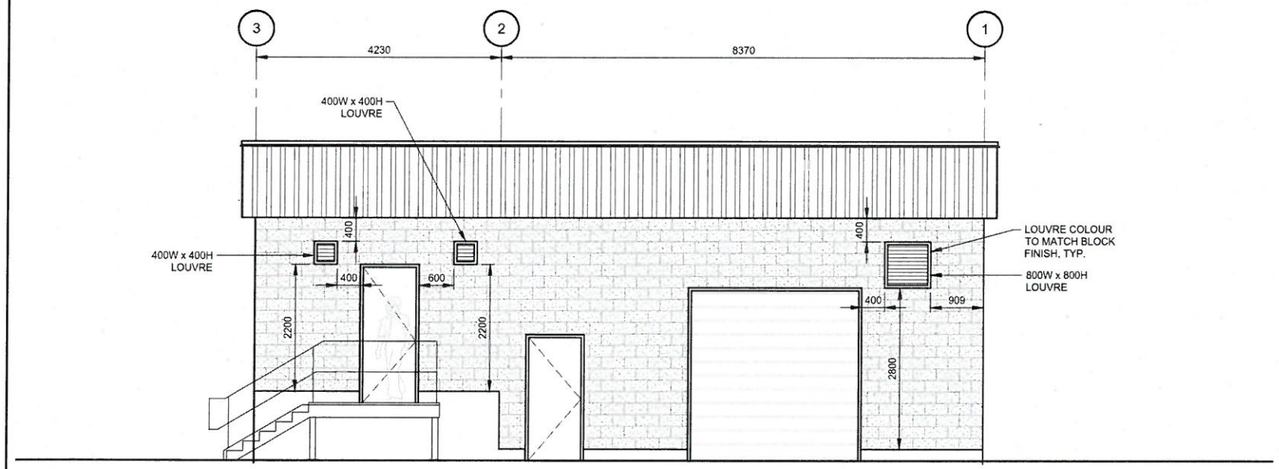


ELEVATION 1:50
EAST



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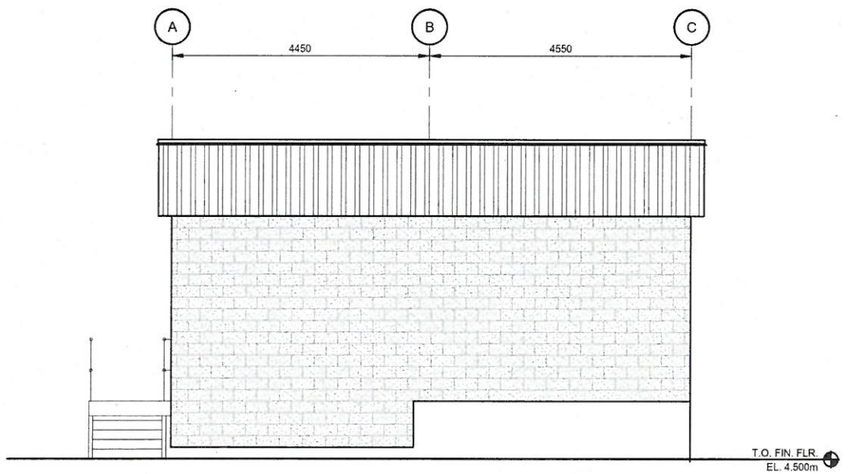
NORTH



ELEVATION 1:50
WEST

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EXPANSION UPGRADES

20172972-00

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SCREEN BUILDING
ELEVATIONS

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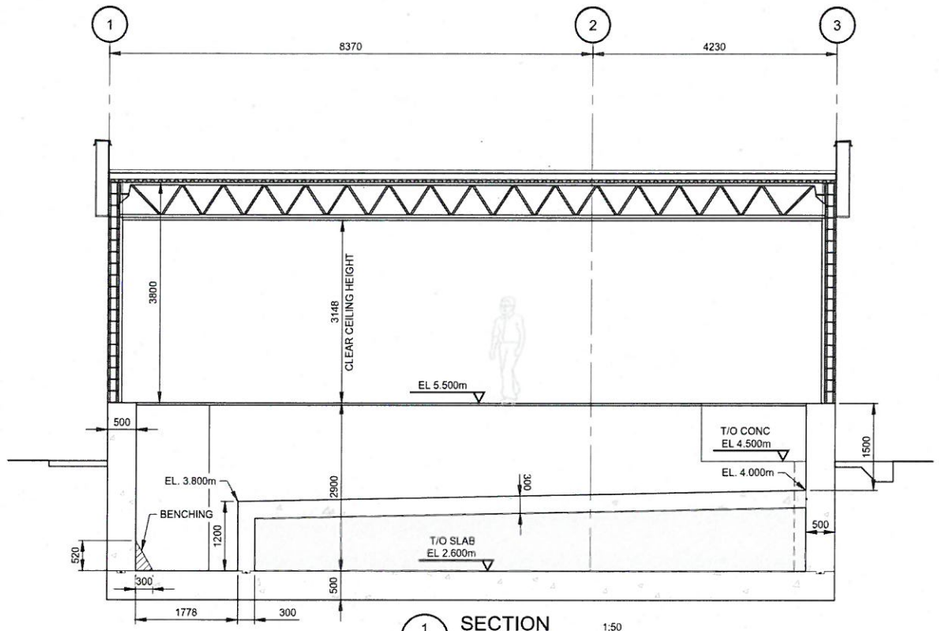
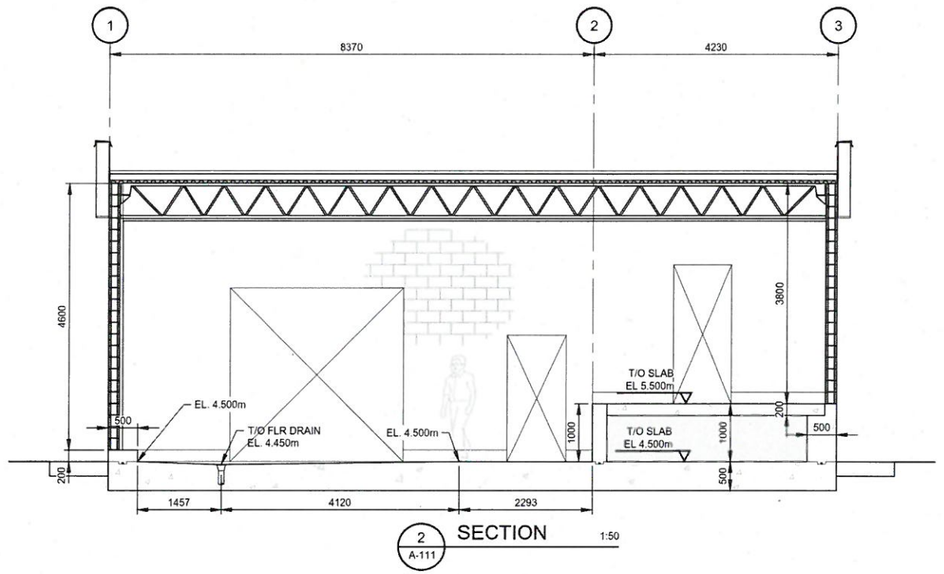


1 / A-111 SECTION 1:50



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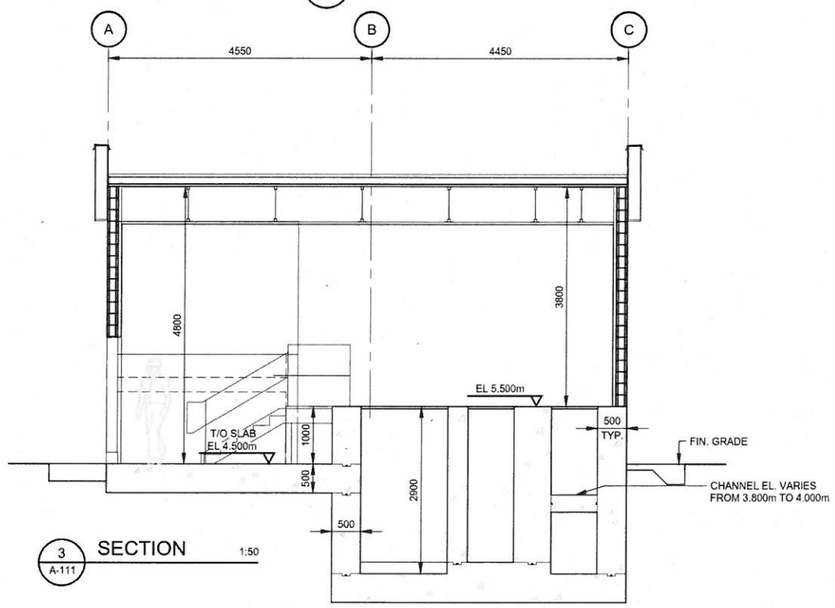
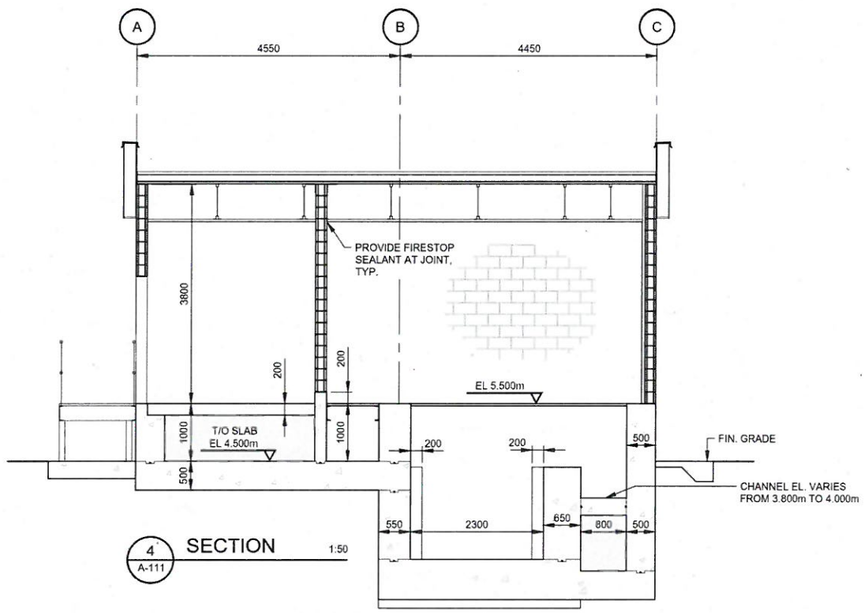


3 / A-111 SECTION 1:50



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WASTEWATER LAGOON
EXPANSION UPGRADES

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ARCHITECTURAL
SCREEN BUILDING
SECTIONS

DRAWING	REVISION	SHEET
2972-00-A-311	0	34 / 111

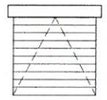
DOOR SCHEDULE

DOOR No.	LOCATION		DOOR									HARDWARE										FIRE RATING (MINS)	REMARKS
	FROM	TO	TYPE	ACTION	LITE / GLASS	INSUL.	LOUVER	NOM. WIDTH	NOM. HEIGHT	DOOR ROUGH OPENING	FINISH	THRESHOLD	WEATHER STRIPPING	DOOR STOP	HOLD OPEN	HINGES	CLOSER	LOCKSET	KICKPLATE	DOOR SWEEP	ASTRAGAL		
1	SCREEN ROOM	EXTERIOR	4	-	-	YES	-		-	3000 x 3000	-	-	-	-	-	-	-	-	-	-	-	1 HR	STEEL ROLL-UP, MANUAL OPERATED W/ LOCKS
2	SCREEN ROOM	EXTERIOR	2	-	-	YES	-		-	1016 x 2083	PAINT	* YES	YES	-	-	1 1/2 PR	YES	** ENTRANCE LOCK RIM EXIT DEVICE	YES	-	-	1 HR	-
3	ELECTRICAL ROOM	EXTERIOR	1	-	-	YES	-		-	1016 x 2490	PAINT	* YES	YES	-	-	1 1/2 PR	YES	** ENTRANCE LOCK RIM EXIT DEVICE	YES	-	-	1 HR	-

* THRESHOLD (PEMKO 270A OR SIMILAR APPROVED)

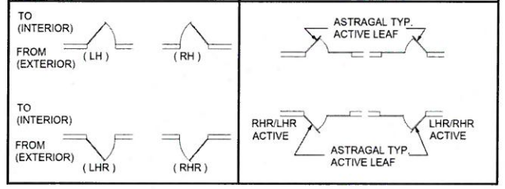
** LOCKSET & DEAD BOLT KEYED TO ABLOY KEY SYSTEM

DOOR TYPES

TYPE 1	TYPE 2	TYPE 3	TYPE 4
			
INSULATED METAL WITH PRESSED STEEL FRAME 2438 HIGH	INSULATED METAL WITH PRESSED STEEL FRAME 2034 HIGH	INSULATED METAL WITH PRESSED STEEL FRAME 2438 HIGH	ROLL UP DOOR 3000 WIDE x 3000 HIGH

DOOR HANDING

SINGLE DOORS

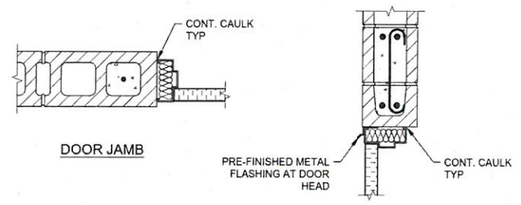


NOTES :

1. FOR GENERAL NOTES SEE DWG. S-001.
2. DOORS MUST HAVE PERMANENT LABEL TO CONFIRM 1.0 HR MIN. FIRE RATING.

DOOR ABBREVIATIONS:

MW	MASONRY WALL
PS	PRESSED STEEL FRAME
STL	STEEL FRAME
SW	STUD WALL



A - DETAIL 1:10
TYPICAL PRESSED STEEL DOOR FRAME DETAILS

ROOM FINISH SCHEDULE

ROOM NAME	FLOOR		WALLS								CEILING		DOORS	FRAMES
			NORTH		EAST		SOUTH		WEST					
	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH	MATERIAL	FINISH		
ELECTRICAL ROOM	CONCRETE	HARDENER NATURAL GREY COLOR	BLOCK/CONC	PLYWOOD 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	PLYWOOD 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	PLYWOOD 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	BLOCK FILLER, PRIMER & 2 COATS ACRYLIC LATEX COLOR BY OWNER	ACOUSTIC PANEL	MATT WHITE	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER
SCREEN ROOM	CONCRETE	HARDENER NATURAL GREY COLOR	BLOCK/CONC	PLYWOOD 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	PLYWOOD 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	PLYWOOD 2 COATS ACRYLIC LATEX COLOR BY OWNER	BLOCK/CONC	PLYWOOD PRIMER & 2 COATS ACRYLIC LATEX COLOR BY OWNER	ACOUSTIC PANEL	MATT WHITE	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER	ACID WASH, PRIMER AND 2 COATS HIGH GLOSS ALKYD PAINT COLOR BY OWNER

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. K. D. WOO # 34152
JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	J. COPE	H. DUALAN JR	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

ARCHITECTURAL
SCREEN BUILDING
SCHEDULES

DRAWING	REVISION	SHEET
2016-00-A-611	0	35 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

GENERAL NOTES:

1. THE GENERAL NOTES AND STRUCTURAL STANDARD DETAILS ARE GENERAL AND APPLY TO THE ENTIRE PROJECT EXCEPT WHERE THERE ARE SPECIFIC INDICATIONS TO THE CONTRARY.
2. READ THIS SET OF DRAWINGS IN CONJUNCTION WITH OTHER CONTRACT DOCUMENTS AND SPECIFICATIONS RELATING TO STRUCTURAL ENGINEERING AND OTHER DISCIPLINES. THESE DRAWINGS AND SPECIFICATIONS SHALL BE CONSIDERED AN INTEGRAL PART OF THE CONTRACT DOCUMENTS, NEITHER THE DRAWINGS NOR THE SPECIFICATIONS SHALL BE USED ALONE. CONTRACTOR SHALL REPORT OF ANY DISCREPANCIES IMMEDIATELY FOR CLARIFICATION TO THE ENGINEER. IN THE EVENT OF A DISCREPANCY BETWEEN THE VARIOUS DOCUMENTS, THE MORE STRINGENT PROVISIONS SHALL APPLY.
3. DESIGN AND CONTRUCTION TO BE IN ACCORDANCE WITH THE LATEST EDITION CODES, STANDARDS, RULES AND REGULATIONS (AND LOCAL AUTHORITIES HAVING JURISDICTION). THE LATEST EDITION CODE TO GOVERN EXCEPT WHERE OTHER APPLICABLE CODES OR THE FOLLOWING NOTES ARE MORE RESTRICTIVE.
4. DO NOT CONSTRUCT FROM THESE DRAWINGS UNLESS THEY ARE MARKED "ISSUED FOR CONSTRUCTION" IN THE REVISION COLUMN.
5. STRUCTURAL DIMENSIONS CONTROLLED BY OR RELATED TO ARCHITECTURAL, CIVIL, PROCESS MECHANICAL, BUILDING MECHANICAL, ELECTRICAL OR LANDSCAPING TO BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. CONTRACTOR SHALL REPORT OF ANY DISCREPANCIES AND CONFLICTS IMMEDIATELY FOR CLARIFICATION TO THE ENGINEER.
6. NO SLEEVES, DUCTS, PIPES OR OTHER OPENINGS SHALL PASS THROUGH STRUCTURAL MEMBERS EXCEPT WHERE DETAILED ON THE DRAWINGS. DO NOT CUT OR DRILL OPENINGS OR GROUPS OF OPENINGS THROUGH STRUCTURAL MEMBERS WITHOUT WRITTEN PERMISSION BY THE ENGINEER. CONTRACTOR TO PROVIDE APPROPRIATE ATTACHMENTS AND CONNECTIONS FOR MECHANICAL, ELECTRICAL, AND OTHER SERVICES WITHOUT CUTTING OR DRILLING.
7. FOR CONDITIONS NOT EXPLICITLY SHOWN, CONTRACTOR SHALL REQUEST FOR CLARIFICATION FROM THE ENGINEER.
8. BEFORE CONCRETING, ENSURE THAT ALL EMBEDDED ITEMS, SUCH AS ANCHOR BOLTS, SLEEVES AND WATER STOPS ARE IN POSITION AND SECURELY FASTENED IN PLACE TO THE SATISFACTION OF THE ENGINEER.

CONSTRUCTION:

1. THESE DRAWINGS SHOW THE REQUIREMENTS FOR PERMANENT AND COMPLETED STRUCTURE ONLY. CONTRACTOR IS RESPONSIBLE FOR DESIGNING AND PROVIDING ALL TEMPORARY WORKS INCLUDING BUT NOT LIMITED TO BRACING, FALSEWORK, SHORING, AND TEMPORARY SUPPORTS. TEMPORARY WORKS MUST BE CAPABLE OF TRANSFERRING ALL IMPOSED CONSTRUCTION AND DEAD LOADS WITHOUT EXCEEDING SPECIFIED DESIGN LOADS TO THE STRUCTURE. TEMPORARY WORKS TO BE DESIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROJECT PROVINCE/TERRITORY IN ACCORDANCE WITH WCB STANDARDS AND LOCAL RULES AND REGULATIONS.
2. THE CONTRACTOR WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY.
3. BUILDING CONTROL LINES, REFERENCE LINES, GRID LINES AND TEMPORARY BENCH MARKS TO BE CLEARLY IDENTIFIED AND MAINTAINED DURING THE ENTIRE CONSTRUCTION PERIOD.
4. ACCURACY OF THE SITE SURVEY AND LAYOUT IS THE RESPONSIBILITY OF THE CONTRACTOR. REMEDIAL ACTIONS RESULTING FROM INACCURACIES, ERRORS AND OMISSIONS WILL BE AT THE CONTRACTOR'S OWN EXPENSE.
5. ALL DIMENSIONS, ELEVATIONS AND SLOPES SHALL BE CHECKED AND VERIFIED WITH THE DRAWINGS AND EXISTING SITE CONDITIONS PRIOR TO CONSTRUCTION AND FABRICATION. DO NOT SCALE DRAWINGS.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFICATION OF ALL UNDERGROUND AND SUB-GRADE SERVICES PRIOR TO COMMENCING SITE WORK.
7. CONTRACTOR TO SUBMIT TO THE ENGINEER IN WRITING ALL PROPOSED ALTERNATE PRODUCTS, STRUCTURAL DETAILS, AND STRUCTURAL SYSTEMS, INCLUDING TECHNICAL SPECIFICATIONS, CALCULATIONS AND DATA SHEETS FOR REVIEW AND APPROVAL PRIOR TO COMMENCING WITH WORK. ALTERNATE PRODUCTS MUST HAVE DESIGN PROPERTIES EQUIVALENT TO OR GREATER THAN THOSE SPECIFIED ON THE DRAWINGS AND SPECIFICATIONS.

EXCAVATION & BACKFILL:

2. REFER TO GEOTECHNICAL REPORT PREPARED BY WSP CANADA INC., FILE # 171-04753-00, FOR DESCRIPTION OF EXISTING SOIL CONDITIONS AND SITE PREPARATION REQUIREMENTS.
3. ENSURE THE BOTTOM OF EXCAVATION IS UNDISTURBED SOIL, LEVEL AND FREE OF ALL LOOSE, SOFT OR ORGANIC MATTER AND IS PROTECTED AND KEPT DRY DURING EXCAVATION AND DURING CONCRETE PLACEMENT. THOROUGHLY COMPACT THE BASE OF THE EXCAVATION PRIOR TO FOUNDATION CONSTRUCTION IN ORDER TO DENSIFY THE SOIL LOOSENED BY THE EXCAVATION EQUIPMENT.
4. ENSURE THAT THE SOIL BELOW A FOUNDATION IS NOT ALLOWED TO FREEZE, EITHER DURING OR AFTER CONSTRUCTION. UNDER NO CIRCUMSTANCES SHALL CONCRETE BE PLACED ON FROZEN SOIL.
5. USE HAND-OPERATED COMPACTION EQUIPMENT WITHIN 1m OF WALLS AND FOOTINGS.
6. BACKFILL AGAINST GRADE BEAMS AND FOUNDATIONS AS SPECIFIED AFTER CONCRETE HAS ACHIEVED 20 MPa STRENGTH, AND AFTER APPROVAL FROM THE ENGINEER.
7. NOTIFY ENGINEER BEFORE COMMENCING WITH EXCAVATION. SOIL CONDITIONS SHALL BE APPROVED BY ENGINEER DURING EXCAVATION AND PRIOR TO CONSTRUCTION OF FORMWORK OR REINFORCEMENT FOR FOUNDATIONS.
8. TEST LAYER COMPACTION AS SPECIFIED, FREQUENCY AS FOLLOWS:
   - AT LEAST FOUR (4) RANDOM LOCATIONS FROM SAME LAYER, FOR AT LEAST THREE (3) LAYERS EQUALLY SPACED THROUGH DEPTH.
8. THE GEOTECHNICAL ENGINEER SHALL BE NOTIFIED A MINIMUM OF 24 HRS. BEFORE COMMENCEMENT OF EXCAVATION. SOIL CONDITIONS SHALL BE INSPECTED BY THE GEOTECHNICAL ENGINEER DURING EXCAVATION AND PRIOR TO CONSTRUCTION OF FORMWORK FOR FOUNDATIONS.

CONCRETE:

1. PERFORM CONCRETING WORK TO CAN/CSA A23.1.
2. TEST CONCRETE IN ACCORDANCE WITH CAN/CSA A23.2.
3. CONCRETE MIXES SHALL BE PROPORTIONED IN ACCORDANCE WITH CAN/CSA A23.2 TO MEET THE FOLLOWING REQUIREMENTS:

LOCATION	28 DAY COMP. STRENGTH (MPa) MIN	CEMENT TYPE	AIR %	SLUMP mm	NOMINAL COARSE. SIZE AGG. mm	EXP. COND.
BLDG RAFT SLAB	35	GU	4-7	60-100	20	C-1
CONC CHANNELS AND DIVIDING STRUCTURE	35	GU	4-7	60-100	20	A-1
APRON	35	GU	4-7	60-100	20	C-1
LEAN MIX	35	GU	4-7	60-100	20	C-1

- WATER/CEMENT RATIO FOR EXPOSURE CLASSES AS PER CAN/CSA A23.1
- MAX W/C = 0.45 MAX.
- WHERE SPECIFIED STRENGTH EXCEEDS THOSE IMPLIED BY EXPOSURE CLASS, SPECIFIED STRENGTH GOVERNS.
- ALL CONCRETE TO BE NORMAL WEIGHT 2400 kg/m³
- MIX DESIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW
- SUPPLEMENTAL FLYASH TO A MAXIMUM OF 30% MAY BE PERMITTED AT THE DISCRETION OF THE ENGINEER.
- SEE SPECIFICATIONS FOR OTHER TYPES OF CONCRETE REQUIREMENTS

4. STRENGTH OF CONCRETE TO BE DETERMINED BY FIELD-CURED CYLINDERS. ALTERNATE METHODS, IF ACCEPTABLE TO THE ENGINEER, MAY BE USED.
5. LOCATIONS & DETAILS OF CONSTRUCTION JOINTS NOT SHOWN ON DRAWINGS ARE TO BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION.
6. BEFORE CONCRETE PLACEMENT, ENSURE THAT ALL EMBEDDED ITEMS SUCH AS ANCHOR BOLTS, SLEEVES, AND WATER STOPS ARE IN POSITION AND SECURELY FASTENED IN PLACE TO THE SATISFACTION OF THE ENGINEER.
7. ANCHOR BOLTS AND DOWELS SHALL BE PLACED BEFORE CONCRETE IS POURED. TEMPLATES SHALL BE USED TO ENSURE CORRECT PLACEMENT OF ANCHOR BOLTS AND DOWELS. DOWELS TO MATCH VERTICAL BARS IN SIZE AND SPACING.
8. BEFORE PLACING CONCRETE, ENSURE THAT THE REINFORCING STEEL AND FORMS ARE CLEAN, FREE OF LOOSE SCALE, DIRT AND OTHER FOREIGN MATERIALS WHICH WOULD REDUCE THE BOND BETWEEN THE REINFORCING STEEL AND THE CONCRETE.
9. ALL EXPOSED CONCRETE CORNERS TO HAVE 20x20 CHAMFER.
10. SUBMIT TO THE ENGINEER FOR REVIEW AND APPROVAL NO LATER THAN THREE WEEKS PRIOR TO CONSTRUCTION:
    - REBAR SHOP DRAWINGS, METRIC
    - CONCRETE MIX DESIGN
    - DETAIL AND LOCATION OF CONSTRUCTION JOINTS

REINFORCED MASONRY:

1. ALL MATERIALS AND CONSTRUCTION METHODS SHALL BE IN ACCORDANCE WITH THE BRITISH COLUMBIA BUILDING CODE, LATEST EDITION AND THE FOLLOWING STANDARDS: CAN/CSA-S304.1 "MASONRY DESIGN FOR BUILDINGS", CAN/CSA-A370 "CONNECTORS FOR MASONRY" AND CAN/CSA-A371 "MASONRY CONSTRUCTION FOR BUILDINGS."
2. CONCRETE BLOCK UNITS SHALL BE STANDARD 190 METRIC UNITS CONFORMING TO THE REQUIREMENTS OF CAN/CSA-A165.1, CLASSIFICATION H/20/M
3. USE ONLY TYPE S MORTAR CONFORMING TO CSA A179.
4. REINFORCING FOR STANDARD 190 UNITS SHALL BE AS SHOWN ON DRAWINGS. JOINT REINFORCING TO BE NO. 9 GAUGE WIRE LADDER-TYPE @ 400 O/C.
5. CELLS TO BE GROUTED ARE TO BE KEPT CLEAN. CELLS SHALL BE GROUTED AT 1200mm LIFTS.
6. GROUT CELLS CONTAINING REINFORCEMENT, BOLTS OR EMBEDDED ITEMS. VIBRATE TO CONSOLIDATE AND COMPLETELY FILL CELLS.
7. MASONRY FILL SHALL BE 20 MPA @ 28 DAYS, SLUMP 250MM (+/- 30MM), 10MM MAX. AGGREGATE SIZE.
8. CONCRETE MASONRY UNITS SHALL BE LAID AS RUNNING BOND CONFIGURATION. INTERSECTING WALLS SHALL HAVE ALTERNATE INTERLOCKING COURSING.
9. ALL EXPOSED OR CONCEALED MORTAR JOINTS TO BE TOOLED CONCAVE.
10. ENGINEER TO INSPECT REINFORCING PRIOR TO CASTING GROUT FILL.

FIELD REVIEW AND TESTING:

1. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE WORK AND ENSURING CONFORMANCE TO DRAWINGS AND CONTRACT DOCUMENTS PRIOR TO THE FIELD REVIEW OF THE ENGINEER.
2. THE CONTRACTOR SHALL GIVE REASONABLE ADVANCE NOTICE OF WHEN THE STRUCTURAL WORK IS GENERALLY COMPLETED AND READY FOR REVIEW. THE STRUCTURAL WORK CANNOT BE CONCEALED BY FINISHES OR OTHER MEANS WITHOUT PRIOR PERMISSION BY THE ENGINEER. THE CONTRACTOR SHALL NOTIFY THE ENGINEER AT LEAST 48 HOURS IN ADVANCE FOR THE FOLLOWING FIELD REVIEWS:
   - CONCRETE REINFORCEMENT BEFORE EACH CONCRETE POUR
   - STRUCTURAL STEEL FRAMING BEFORE CONCEALMENT
   - STEEL DECKING BEFORE CONCEALMENT
3. THE STRUCTURAL WORK MUST BE SUBSTANTIALLY COMPLETE AT THE TIME OF FIELD REVIEW. ANY WORK FOUND INCOMPLETE OR DEFICIENT AT THE TIME OF FIELD REVIEW MAY REQUIRE ADDITIONAL FIELD REVIEWS BY THE ENGINEER OR ADDITIONAL MATERIAL TESTING AT THE EXPENSE OF THE CONTRACTOR.
4. THE FIELD REVIEW IS CONDUCTED FOR THE SOLE PURPOSE OF ENSURING GENERAL CONFORMANCE TO THE DRAWINGS AND CONTRACT DOCUMENTS. THE REVIEW IS CONDUCTED AT ANY STAGE AT THE DISCRETION OF THE ENGINEER AND DOES NOT GUARANTEE THE WORK OF THE CONTRACTOR.

STRUCTURAL STEEL AND FABRICATIONS:

1. FABRICATE AND ERECT STRUCTURAL STEEL TO CSA CAN-S16.1. SUBMIT SHOP DRAWINGS SHOWING ALL DETAILS AND MATERIAL SPECIFICATIONS FOR REVIEW PRIOR TO FABRICATION.
2. PROVIDE STRUCTURAL STEEL TO CSA G40.21 WITH THE FOLLOWING GRADES:

WIDE FLANGE BEAMS AND COLUMNS:	350 W
CHANNELS AND ANGLES:	300 W
HSS SECTIONS (CLASS C):	350 W
STRUCTURAL BARS AND PLATES:	300 W
MISCELLANEOUS STEEL:	300 W

3. PROVIDE ERECTION BOLTS TO ASTM A325, MINIMUM 19mm DIAMETER. DESIGN BOLTED CONNECTIONS TO ASTM A325. TIGHTEN BOLTS BY THE "TURN OF NUT" METHOD TO BOLT TENSIONS SPECIFIED IN CSA S16.1. ANCHOR RODS TO ASTM A307 (UNLESS NOTED OTHERWISE).
4. WELD TO CSA W59 BY FABRICATORS CERTIFIED TO CSA W47.1 DIV.1 OR DIV. 2.1.1. WELDING OF REINFORCING SHALL CONFORM TO CSA W186.
5. MINIMUM WELDS FOR CONNECTIONS SHALL BE 6mm FILLET WELD AND WHERE EXPOSED IN FINISHED BUILDING, WELD SHALL BE GROUND SMOOTH.
6. NO BURNING OF HOLES SHALL BE ALLOWED IN STRUCTURAL STEEL.
7. ALL STEEL STUD TO CONFORM TO CAN/CSA-S136, 228 MPa MIN.
8. GALVANIZED STEEL TO BE HOT DIP GALVANIZED TO CSA-G-164.
9. NON-GALVANIZED STEEL TO BE PAINTED WITH A SUITABLE PAINT SYSTEM APPROVED BY ARCHITECT.
10. STEEL FABRICATOR SHALL DESIGN ALL STEEL-TO-STEEL CONNECTIONS INDICATED ON THE DRAWINGS. ALL CONNECTIONS SHALL BE SHOP WELDED AND FIELD BOLTED UNLESS NOTED OTHERWISE. DESIGN BOLTED CONNECTIONS ASSUMING THE BOLT THREADS INTERCEPT THE SHEAR PLANE. CONNECTIONS SHALL BE DESIGNED TO TRANSFER FORCES THROUGH THE CENTERLINE OF MEMBERS WITHOUT IMPOSING ROTATIONAL LOADS.
11. DESIGN CONNECTIONS FOR THE HIGHER OF THE FORCES AS INDICATED ON THE DRAWINGS OR FOR FACTORED END SHEAR OF A MINIMUM OF 60% OF THE TOTAL BEAM LOAD CAPACITY AS LISTED IN THE BEAM LOAD TABLES OF THE CISC HANDBOOK.
12. SUBMIT TO THE ENGINEER FOR REVIEW AND APPROVAL:
    - SHOP DRAWINGS AND CALCULATIONS SIGNED AND SEALED BY SUPPORTING REGISTERED PROFESSIONAL FOR THE CONNECTION DESIGN OF STEEL-TO-STEEL CONNECTIONS.
    - FIELD REVIEW REPORT FROM SUPPORTING REGISTERED PROFESSIONAL
    - SCHEDULES S-B AND S-C FROM SUPPORTING REGISTERED PROFESSIONAL

REINFORCEMENT:

1. REINFORCING STEEL: NEW DEFORMED BARS TO CSA G30.18, "BILLET" STEEL BARS FOR CONCRETE REINFORCEMENT, WITH MIN. YIELD STRENGTH OF 400WMPa. WELDED WIRE FABRIC TO CONFORM TO CSA G30.5 WITH MIN. YIELD STRENGTH OF 450MPa. PLACE REBAR TO CSA/CAN A23.1. REINFORCEMENT REQUIREMENTS ARE SHOWN ON DETAIL DRAWINGS. WHERE DETAILS OF BAR SIZING AND SPACING ARE NOT SHOWN, ALLOW FOR MINIMUM REINFORCEMENT IN ACCORDANCE WITH CSA/CAN A23.1
2. PROVIDE CLEAR CONCRETE COVER OVER REBAR AS FOLLOWS U.N.O.:

   CONCRETE PLACED DIRECTLY ON GROUND
   75mm

   FORMED SURFACES EXPOSED TO WEATHER & SEWAGE
   - WALLS AND SLABS
     50mm
   - BEAM PRINCIPAL REINFORCING
     50mm
   - BEAM STIRRUPS
     40mm

   TOP SLAB REINF. & BEAM STIRRUPS IN BUILDING
   40mm
   BOTTOM SLAB REINFORCING IN BUILDING
   40mm

   FORMED SURFACES EXPOSED TO EARTH
   50mm

3. REBAR SPLICE LENGTHS (UNLESS NOTED OTHERWISE):
   LENGTHS SHOWN ARE IN mm

REBARS		10M	15M	20M	25M	30M	35M
WALLS	HORIZONTAL	500	650	800	1300	1700	2000
	VERTICAL	400	400	650	1000	1300	1500
SLABS	TOP	500	700	900	1400	1700	2000
	BOTTOM	400	600	750	1100	1300	1500

4. LAP WIRE MESH REINFORCING 200mm AND MINIMUM 2 LONGITUDINAL MESH BARS.
5. UNLESS OTHERWISE NOTED, EDGE OF ALL SLABS SHALL HAVE 2-15M CONT. LAPPED 600mm
6. UNLESS NOTED OTHERWISE, ALL OPENINGS IN SLAB SHALL HAVE 2-15M BARS PARALLEL TO ALL EDGES EXTENDING BEYOND CORNERS 600mm
7. ALL REINFORCEMENT REQUIRED TO BE WELDED SHALL BE GRADE 400W (WELDABLE)
8. PLACE ADDITIONAL REINFORCEMENT AT ALL OPENINGS FOR PIPING, MECHANICAL AND ELECTRICAL EQUIPMENT, DOORS AND OTHER OPENINGS UNLESS NOTED OTHERWISE.
9. PLACE REINFORCING BARS SYMMETRICALLY OVER SUPPORTS AND SYMMETRICALLY IN SPANS UNLESS NOTED OTHERWISE.
10. UNLESS NOTED OTHERWISE, SLAB REINFORCING SHALL NOT BE CUT AT OPENINGS. SPREAD REINFORCING AROUND OPENINGS.
11. PROVIDE SUFFICIENT CHAIRS AND SUPPORT BARS TO MAINTAIN SPECIFIED CONCRETE COVER AND TO SECURE REINFORCING STEEL IN PLACE DURING CONCRETE PLACEMENT.
12. RESERVE MINIMUM OF 1% TOTAL VOLUME OF REINFORCEMENT TO BE USED AS DIRECTED BY THE ENGINEER FOR FIELD ADJUSTMENT.
13. REINFORCEMENT REQUIREMENTS ARE SHOWN ON DETAIL DRAWINGS. WHERE DETAILS OF BAR SIZING AND SPACING ARE NOT SHOWN, ALLOW FOR A MINIMUM 0.5% REINFORCING IN EACH DIRECTION, EACH FACE.

STRUCTURAL STEEL ELEMENTS:

1. DESIGNS OF PRIMARY AND SECONDARY STEEL ELEMENTS ARE NOT THE RESPONSIBILITY OF THE ENGINEER-OF-RECORD. SUCH COMPONENTS OF THE PROJECT SHALL BE DESIGNED, DETAILED, SPECIFIED AND REVIEWED IN THE FIELD BY A SUPPORTING REGISTERED PROFESSIONAL. EXAMPLES INCLUDE, BUT ARE NOT LIMITED TO:
   - HANDRAILS, GUARDRAILS AND RAILINGS, STAIR AND PLATFORM
   - CURTAIN WALL SYSTEMS, SKYLIGHTS AND GLAZING
   - INTERIOR AND EXTERIOR STEEL STUD WALLS
   - ROOFING SYSTEMS AND WALL CLADDING SYSTEMS
   - ANCHORAGE, SUPPORTS AND BRACINGS OF ELECTRICAL, PROCESS MECHANICAL AND BUILDING MECHANICAL SYSTEMS AND OTHER EQUIPMENT FOR BOTH GRAVITY AND LATERAL LOADS
   - ATTACHED AND FREE-STANDING SIGNAGE STRUCTURES
   - OPEN WEB STEEL JOISTS, STAIR, TOWERS, WALKWAYS, AND THEIR CORRESPONDING CONNECTIONS
2. STRUCTURAL DESIGN OF NON-STRUCTURAL AND ITS SECONDARY STRUCTURAL ELEMENTS IS TO BE PERFORMED BY SUPPORTING REGISTERED PROFESSIONAL RETAINED BY THE CONTRACTOR AND/OR SUPPLIER IN ACCORDANCE TO PART 4 OF THE BUILDING CODE.
3. IN ADDITION TO CONSTRUCTION TOLERANCE, NON-STRUCTURAL AND SECONDARY STRUCTURAL ELEMENTS ARE TO BE DESIGNED FOR VERTICAL DEFLECTIONS AND HORIZONTAL DEFLECTIONS OF THE PRIMARY STRUCTURE.
4. NON-STRUCTURAL AND SECONDARY STRUCTURAL ELEMENTS ARE TO BE DESIGNED TO MINIMIZE TORSIONAL LOADING TO THE PRIMARY STRUCTURAL ELEMENTS.
5. SUBMIT TO THE ENGINEER FOR REVIEW AND APPROVAL:
   - SHOP DRAWING AND CALCULATIONS SIGNED AND SEALED BY SUPPORTING REGISTERED PROFESSIONAL SHOWING THE ELEMENT, DESIGN LOADS, LOADS IMPOSED ON THE PRIMARY STRUCTURE, AND METHOD OF ATTACHMENT TO PRIMARY STRUCTURE
   - FIELD REVIEW REPORT FROM SUPPORTING REGISTERED PROFESSIONAL TO THE RESPECTIVE ELECTRICAL, BUILDING MECHANICAL, PROCESS MECHANICAL ENGINEER-OF-RECORD
   - SCHEDULES S-B AND S-C FROM SUPPORTING REGISTERED PROFESSIONAL TO THE RESPECTIVE ELECTRICAL, BUILDING MECHANICAL, PROCESS MECHANICAL ENGINEER-OF-RECORD.

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DATE: 2018-06-27, Jhunn Dualan

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PROVINCE OF BRITISH COLUMBIA
M. K. D. WOO
34152

JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	D. WOO	H. DUALAN JR	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
UV BUILDING
GENERAL NOTES SHEET 1

DRAWING	REVISION	SHEET
2972-00-S-001	0	36/111

IF NOT 50 mm ADJUST SCALES — 50 mm — SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

POST-INSTALLED ANCHORS

1) EXCEPT WHERE INDICATED ON THE DRAWINGS, POST-INSTALLED ANCHORS SHALL CONSIST OF THE FOLLOWING ANCHOR TYPES AS PROVIDED BY HILTI, INC. CONTACT HILTI AT (800) 879-8000 FOR PRODUCT RELATED QUESTIONS.

a) ANCHORAGE TO CONCRETE

i) ADHESIVE ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI HIT-HY 200 SAFE SET SYSTEM WITH THE HILTI HIT-Z ROD
(2) HILTI HIT-HY 200 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH HAS-E THREADED ROD
(3) HILTI HIT-RE 500v3 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH HAS-E THREADED ROD
(4) HILTI HIT-RE 500v3 SAFE SET SYSTEM WITH HILTI ROUGHENING TOOL (HIT RT) WITH HAS-E THREADED ROD PER ICC ESR-3814 FOR DIAMOND CORED HOLES

ii) MEDIUM DUTY MECHANICAL ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI KWIK HUS EZ AND KWIK HUS EZ-I SCREW ANCHORS PER ICC ESR-3027
(2) HILTI KWIK BOLT-TZ EXPANSION ANCHORS PER ICC ESR-1917
(3) HILTI KWIK BOLT 3 EXPANSION ANCHORS (UNCRACKED CONCRETE ONLY) PER ICC ESR-2302

iii) HEAVY DUTY MECHANICAL ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI HDA UNDERCUT ANCHORS PER ICC ESR 1546
(2) HILTI HSL-3 EXPANSION ANCHORS PER ICC ESR 1545

b) REBAR DOWELING INTO CONCRETE

i) ADHESIVE ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI HIT-HY 200 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH CONTINUOUSLY DEFORMED REBAR PER ICC ESR-3187
(2) HILTI HIT-HY 500v3 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH CONTINUOUSLY DEFORMED REBAR PER ICC ESR-3814
(3) HILTI HIT-RE 500v3 SAFE SET SYSTEM WITH HILTI ROUGHENING TOOL (HIT RT) WITH CONTINUOUSLY DEFORMED REBAR PER ICC ESR-3814 IN DIAMOND CORED HOLES

c) ANCHORAGE TO SOLID GROUTED MASONRY

i) ADHESIVE ANCHORS USE:
(1) HILTI HIT-HY 200 SAFE SET SYSTEM.
(2) STEEL ANCHOR ELEMENT SHALL BE HILTI HAS-E CONTINUOUSLY THREADED ROD OR CONTINUOUSLY DEFORMED STEEL REBAR

ii) MECHANICAL ANCHORS USE:
(1) HILTI KWIK BOLT-3 EXPANSION ANCHORS PER ICC ESR 1385

d) ANCHORAGE TO HOLLOW / MULTI-WYTHE MASONRY

i) ADHESIVE ANCHORS USE:
(1) HILTI HIT-HY 70 MASONRY ADHESIVE ANCHORING SYSTEM PER ICC ESR-3342.
(2) STEEL ANCHOR ELEMENT SHALL BE HILTI HAS-E CONTINUOUSLY THREADED ROD OR CONTINUOUSLY DEFORMED STEEL REBAR
(3) THE APPROPRIATE SIZE SCREEN TUBE SHALL BE USED PER ADHESIVE MANUFACTURER'S RECOMMENDATION

2) ANCHOR CAPACITY USED IN DESIGN SHALL BE BASED ON THE TECHNICAL DATA PUBLISHED BY HILTI OR SUCH OTHER METHOD AS APPROVED BY THE STRUCTURAL ENGINEER OF RECORD. SUBSTITUTION REQUESTS FOR ALTERNATE PRODUCTS MUST BE APPROVED IN WRITING BY THE STRUCTURAL ENGINEER OF RECORD PRIOR TO USE. CONTRACTOR SHALL PROVIDE CALCULATIONS DEMONSTRATING THAT THE SUBSTITUTED PRODUCT IS CAPABLE OF ACHIEVING THE PERFORMANCE VALUES OF THE SPECIFIED PRODUCT. SUBSTITUTIONS WILL BE EVALUATED BY THEIR HAVING AN ICC ESR SHOWING COMPLIANCE WITH THE RELEVANT BUILDING CODE FOR SEISMIC USES, LOAD RESISTANCE, INSTALLATION CATEGORY, AND AVAILABILITY OF COMPREHENSIVE INSTALLATION INSTRUCTIONS. ADHESIVE ANCHOR EVALUATION WILL ALSO CONSIDER CREEP, IN-SERVICE TEMPERATURE AND INSTALLATION TEMPERATURE.

3) INSTALL ANCHORS PER THE MANUFACTURER INSTRUCTIONS, AS INCLUDED IN THE ANCHOR PACKAGING.

4) OVERHEAD ADHESIVE ANCHORS MUST BE INSTALLED USING THE HILTI PROFI SYSTEM.

5) THE CONTRACTOR SHALL ARRANGE AN ANCHOR MANUFACTURER'S REPRESENTATIVE TO PROVIDE ONSITE INSTALLATION TRAINING FOR ALL OF THEIR ANCHORING PRODUCTS SPECIFIED. THE STRUCTURAL ENGINEER OF RECORD MUST RECEIVE DOCUMENTED CONFIRMATION THAT ALL OF THE CONTRACTOR'S PERSONNEL WHO INSTALL ANCHORS ARE TRAINED PRIOR TO THE COMMENCEMENT OF INSTALLING ANCHORS.

6) ANCHOR CAPACITY IS DEPENDANT UPON SPACING BETWEEN ADJACENT ANCHORS AND PROXIMITY OF ANCHORS TO EDGE OF CONCRETE. INSTALL ANCHORS IN ACCORDANCE WITH SPACING AND EDGE CLEARANCES INDICATED ON THE DRAWINGS.

7) EXISTING REINFORCING BARS IN THE CONCRETE STRUCTURE MAY CONFLICT WITH SPECIFIC ANCHOR LOCATIONS. UNLESS NOTED ON THE DRAWINGS THAT THE BARS CAN BE CUT, THE CONTRACTOR SHALL REVIEW THE EXISTING STRUCTURAL DRAWINGS AND SHALL UNDERTAKE TO LOCATE THE POSITION OF THE REINFORCING BARS AT THE LOCATIONS OF THE CONCRETE ANCHORS, BY HILTI FERROSCAN, GPR, X-RAY, CHIPPING OR OTHER MEANS.

8) PROOF LOADING PROGRAM

a) WHEN SUBSTITUTING EMBEDDED ANCHORAGE SYSTEM OR WHERE REQUIRED BY ENGINEER, A PROGRAM FOR ON-SITE PROOF LOADING, THAT IS, PROOF LOADING PROGRAM, TO BE CONDUCTED AS PART OF THE INSPECTION PROGRAM AT THE COST OF CONTRACTOR EXPENSE. THE PROOF LOADING PROGRAM SHALL CONFORM TO THE FOLLOWING MINIMUM REQUIREMENTS AS PER ACI 308
i) FREQUENCY OF PROOF LOADING BASED ON ANCHOR TYPE, DIAMETER, AND EMBEDMENT.
ii) PROOF LOADS BY ANCHOR TYPE, DIAMETER, EMBEDMENT, AND LOCATION
iii) ACCEPTABLE DISPLACEMENT AT PROOF LOAD.
iv) REMEDIAL ACTION IN THE EVENT OF FAILURE TO ACHIEVE PROOF LOAD OR EXCESSIVE DISPLACEMENT.
b) UNO, PROOF LOADS SHALL BE APPLIED AS CONFINED TENSION TEST (4.7.3.2). PROOF LOAD LEVELS SHALL NOT EXCEED THE LESSER OF 67% OF THE LOAD CORRESPONDING TO THE NOMINAL BOND STRENGTH AS CALCULATED FROM THE CHARACTERISTIC BOND STRESS FOR UNCRACKED CONCRETED MODIFIED FOR EDGE EFFECTS AND CONCRETE PROPERTIES OR 80% OF THE MINIMUM SPECIFIED ANCHOR ELEMENT YIELD STRENGTH. MAINTAIN THE PROOF LOAD AT THE REQUIRED LOAD LEVEL FOR A MINIMUM OF 10 SECONDS.

SHOP DRAWINGS AND SPECIALTY ENGINEER:

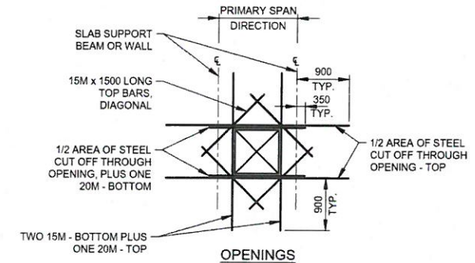
1. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE SHOP DRAWINGS AND ENSURING CONFORMANCE TO DRAWINGS AND CONTRACT DOCUMENTS PRIOR TO THE SHOP DRAWING REVIEW OF THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING ALL SUB-TRADES, SUBCONTRACTORS, SUPPLIERS AND SUPPORTING REGISTERED PROFESSIONALS.
2. SUBCONTRACTORS AND SUPPLIERS SHALL SUBMIT SHOP DRAWINGS TO THE ENGINEER AND CONTRACTOR FOR REVIEW PRIOR TO FABRICATION. SHOP DRAWINGS ARE TO BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROJECT PROVINCE/TERRITORY WHO WILL BE THE SUPPORTING REGISTERED PROFESSIONAL (SRP) RESPONSIBLE FOR THE DESIGN AND FIELD REVIEW OF THE PARTICULAR COMPONENT OR SYSTEM.
3. WHERE REQUIRED IN THE FOLLOWING SECTIONS, THE SUPPORTING REGISTERED PROFESSIONAL (SRP) SHALL CONDUCT FIELD REVIEWS DURING CONSTRUCTION AT THE DISCRETION OF THE SRP AND SUBMIT A WRITTEN FIELD REVIEW REPORT TO THE ENGINEER. THE SRP SHALL SUBMIT SEALED LETTERS OF ASSURANCE B AND C-B OR SCHEDULES S-B AND S-C FOR ASSURANCE OF DESIGN AND FIELD REVIEW OF THE PARTICULAR COMPONENT OR SYSTEM.
4. THE SHOP DRAWING REVIEW IS CONDUCTED FOR THE SOLE PURPOSE OF ENSURING GENERAL CONFORMANCE TO THE DESIGN CONCEPT. THE SHOP DRAWING REVIEW DOES NOT GUARANTEE THE SUBCONTRACTOR OR SUPPLIER'S DESIGN, DETAILS, QUANTITIES, DIMENSIONS, METHOD OF CONSTRUCTION, AND SAFETY MEASURES. THE CONTRACTOR IS RESPONSIBLE FOR ANY ERRORS/AND OR OMISSIONS IN THE SHOP DRAWINGS AND MEETING THE REQUIREMENTS OF THE CONSTRUCTION AND CONTRACT DOCUMENTS.
5. THE SHOP DRAWINGS SHALL INDICATE THE METHOD AND MEANS OF ATTACHMENT TO THE PRIMARY STRUCTURAL SYSTEM AS WELL AS THE DESIGN LOADS AND CRITERIA USED AS THE BASIS OF DESIGN OF THE PARTICULAR COMPONENT OR SYSTEM.

DESIGN DATA:

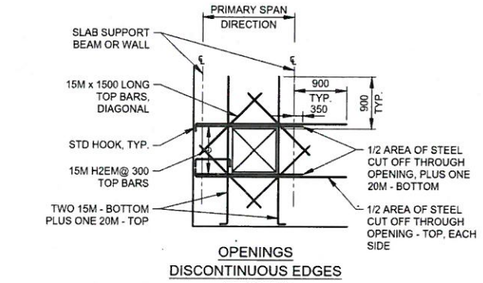
1. FOOTING FOUNDATIONS BEARING PRESSURE 70 kPa (ULS) ON NATIVE SILT
2. DESIGN LIVE LOADS (SERVICE):
   STAIRWAYS AND PLATFORM 4.8 kPa
   BUILDING FLOOR 4.8 kPa
3. SEISMIC LOADING:
   SITE CLASS D
   IMPORTANCE FACTOR Ie = 1.5
   Sa (0.2) 0.76
   Sa (0.5) 0.56
   Sa (1.0) 0.30
   Sa (2.0) 0.16
   MODIFICATION FACTORS (SEISMIC) Rd = 2.0
4. SNOW LOADING:
   IMPORTANCE FACTOR Is = 1.25
   GROUND SNOW LOAD Ss = 3.0 kPa
   RAIN LOAD Sr = 0.4 kPa
5. WIND LOADING:
   IMPORTANCE FACTOR Iw = 1.25
   WIND 1/10 q = 0.25 kPa
   WIND 1/50 q = 0.32 kPa
6. SUPERIMPOSED UV BUILDING ROOF DEAD LOAD 1.0 kPa

DESIGN CODES STANDARDS REGULATIONS:

- BRITISH COLUMBIA BUILDING CODE 2012



OPENINGS
CONTINUOUS EDGES
(SEE NOTE 1)



OPENINGS
DISCONTINUOUS EDGES
(SEE NOTE 1)

NOTES:

1. THIS DESIGN STANDARD APPLIES TO ADDITIONAL REINFORCING AROUND OPENINGS SMALLER THAN 1500 PERPENDICULAR TO THE SPAN DIRECTION, INCLUDING CIRCULAR OPENINGS LESS THAN 1500 DIAMETER. FOR ADDITIONAL REINFORCING AROUND LARGER OPENINGS SEE THE DRAWINGS.

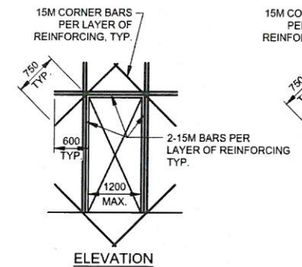
   A. THIS STANDARD DETAIL APPLIES TO OPENINGS LARGER THAN 300 BUT LESS THAN 1500 PERPENDICULAR TO THE SPAN DIRECTION. CIRCULAR OPENINGS 300 TO 1500 IN DIAMETER REQUIRE SIMILAR REINFORCING.

   B. OPENINGS LESS THAN 300 PERPENDICULAR TO THE SPAN DIRECTION AND LESS THAN 600 PARALLEL TO THE SPAN, SHALL NOT REQUIRE ADDITIONAL REINFORCING. ANY BARS CONFLICTING WITH THE OPENING SHALL BE DEFLECTED AROUND THE OPENING.

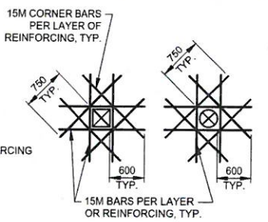
   C. OPENINGS LESS THAN 300 PERPENDICULAR TO THE SPAN DIRECTION AND GREATER THAN 600 PARALLEL TO THE SPAN, REQUIRE BOTH DIAGONAL AND PERPENDICULAR TO SPAN ADDITIONAL REINFORCING AS SHOWN ON THIS STANDARD DETAIL.

2. LIMITATIONS: THIS STANDARD IS NOT APPLICABLE FOR SLABS SUBJECT TO DYNAMIC OR HEAVY EQUIPMENT (AND/OR MACHINERY) LOADING.

1 - DETAIL N.T.S.
ADDITIONAL REINFORCEMENT AROUND OPENING IN CONCRETE SLAB

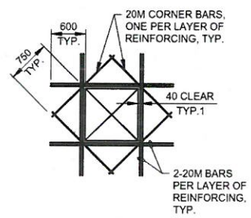


ELEVATION
ADDITIONAL REINFORCEMENT AT DOORWAYS

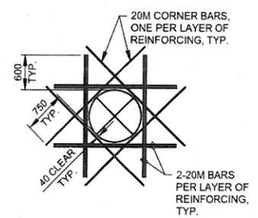


ELEVATION
AT WALL OPENINGS UP TO 300 MAXIMUM

2 - DETAIL N.T.S.
ADDITIONAL REINFORCEMENT AROUND OPENING IN CONCRETE WALL



ELEVATION
ADDITIONAL REINFORCEMENT AT WALL OPENINGS 300 TO 1200 MAXIMUM



ELEVATION
ADDITIONAL REINFORCEMENT AT CIRCULAR OPENINGS 300Ø TO 1200Ø MAXIMUM

NOTES:

1. THE NUMBER OF REINFORCING BARS CUT AT AN OPENING SHALL BE KEPT TO A MINIMUM. DEFLECT AS MANY BARS AROUND OPENING AS POSSIBLE.
2. REINFORCING BARS SHALL HAVE A MINIMUM 40mm CONCRETE COVER.
3. WHERE REINFORCING ON A DRAWING DIFFERS FROM THIS DESIGN STANDARD, THE DRAWING SHALL GOVERN.

3 - DETAIL N.T.S.
ADDITIONAL REINFORCEMENT AROUND OPENING IN CONCRETE WALL , U.N.O.

ONLY FOR : 32MPa CONCRETE , NORMAL WEIGHT
400MPa REINFORCING BAR

BAR SIZE	TOP BARS (mm)		OTHER BARS (mm)	
	CLASS A	CLASS B	CLASS A	CLASS B
10M	390	500	300	390
15M	550	710	420	550
20M	670	870	520	670
25M	1080	1400	830	1080
30M	1280	1660	990	1280
35M	1530	1990	1180	1530

NOTES:
1. TOP BARS ARE:
   a) ALL BARS IN CONCRETE WITH MORE THAN 300mm CONCRETE BELOW.
   b) ALL HORIZONTAL BARS IN WALLS.
2. PROVIDE CLASS B LAP UNLESS NOTED OTHERWISE. LAP SPLICE LENGTHS SHOWN IN THE TABLE ARE BASED ON HEAVIER CONFINED BARS.
3. TABLE APPLIES UNLESS SHOWN OTHERWISE.
4. DEVELOPMENT LENGTHS ARE EQUAL TO CLASS A LAP SPLICES.

4 - DETAIL N.T.S.
REINFORCING BAR TENSION LAP SPLICE TABLE

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PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — M. K. D. WOO # 34152 — JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	D. WOO	H. DUALAN JR	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

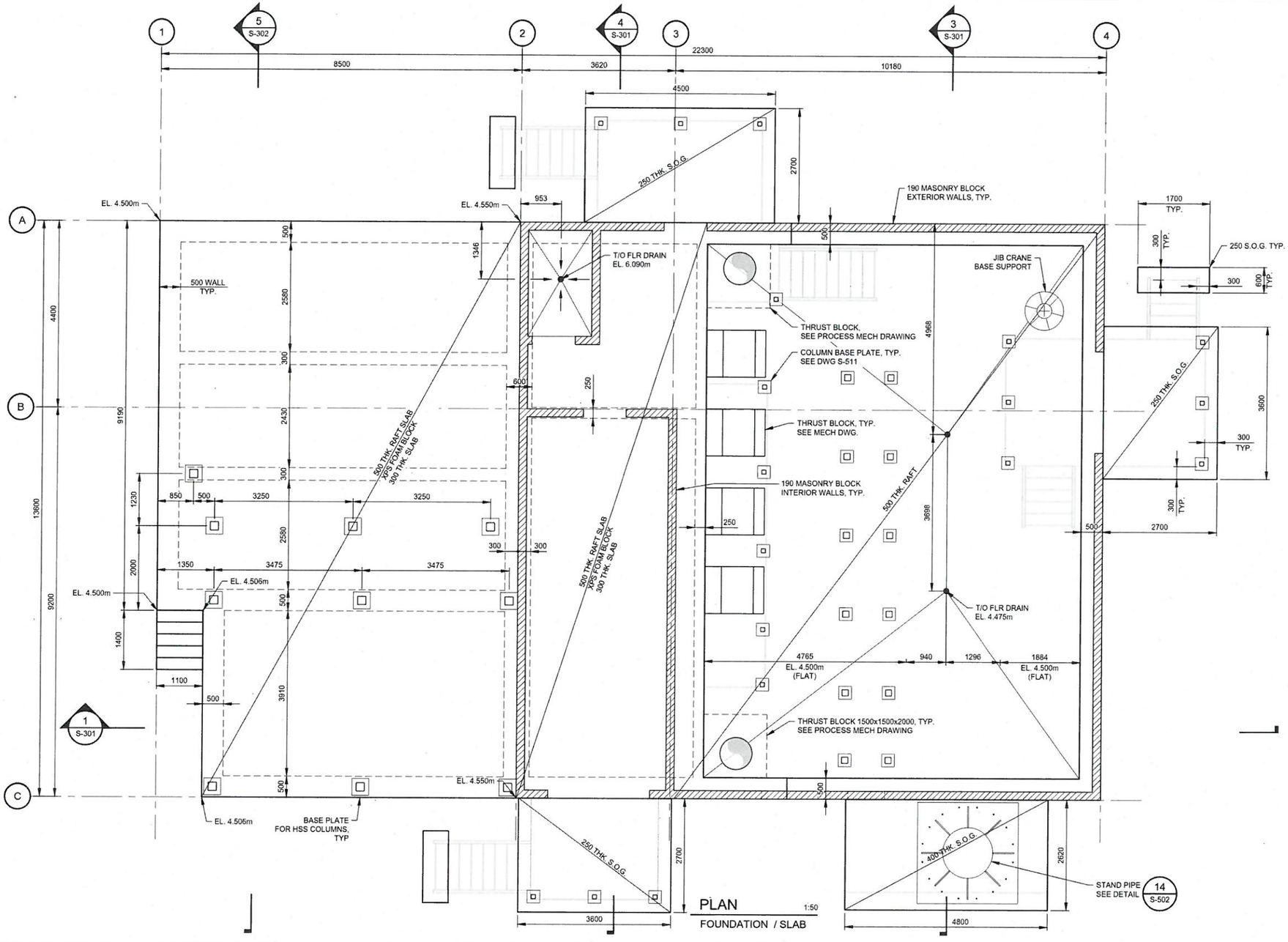
THE CITY OF Port Alberni

STRUCTURAL
UV BUILDING
GENERAL NOTES SHEET 2

DRAWING	REVISION	SHEET
2972-00-S-002	0	37 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:50
FOUNDATION / SLAB

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IF NOT 50 mm ADJUST SCALES
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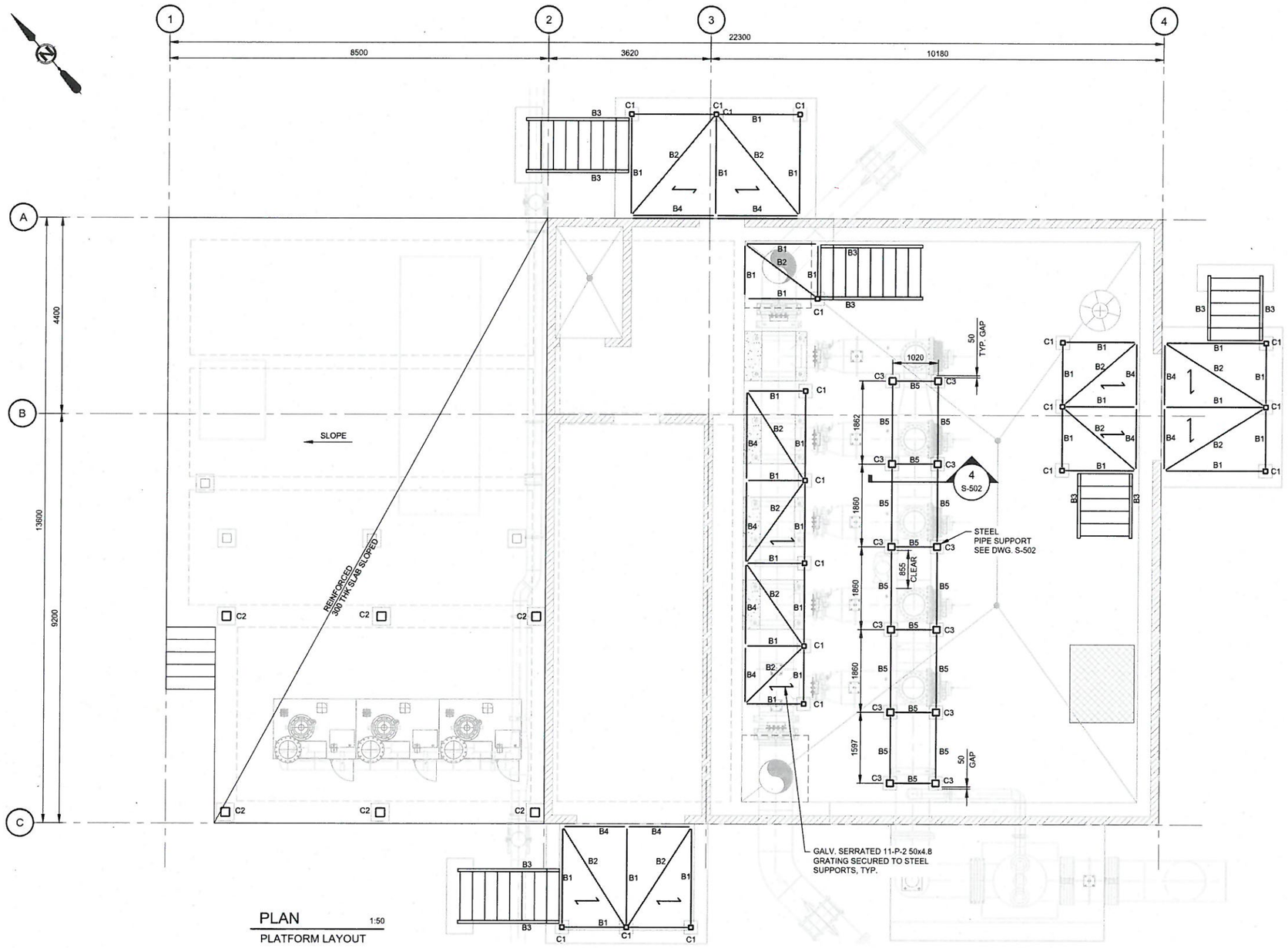

PLAN 1:50
PLATFORM LAYOUT

B1	W200x27
B2	L102x102x6.4
B3	W360x64
B4	L152x152x6.4
B5	W150x30
C1	HSS 127x127x8
C2	HSS 203x203X8
C3	HSS 152x152x13

STEEL FABRICATOR TO DESIGN AND PROVIDE STEEL CONNECTION AS SHOP DRAWING SUBMITTAL FOR REVIEW AND APPROVAL.

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PLATFORM LAYOUT PLAN

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2972-00-S-102	0	39 / 111

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50 mm

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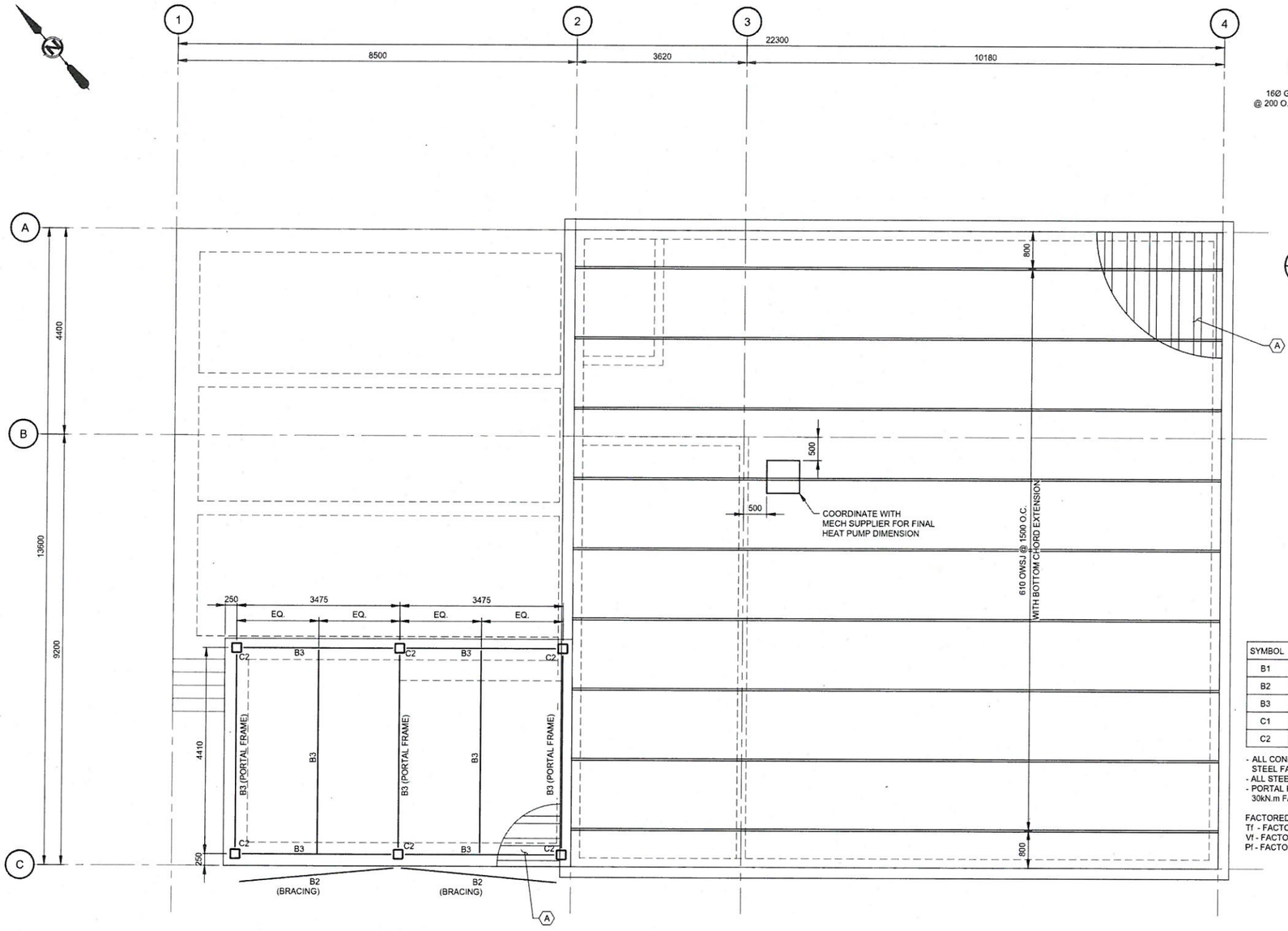
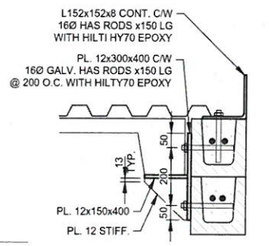
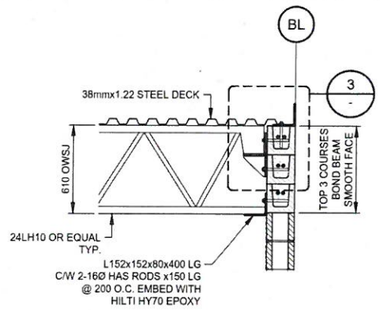


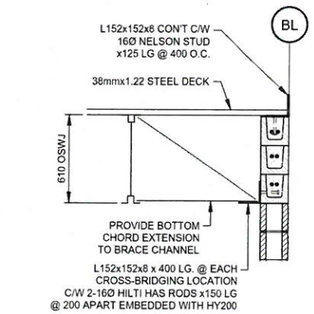
PLAN 1:50
ROOF LAYOUT



3 DETAIL 1:10



1 DETAIL 1:20
ROOF AND PARAPET
(SIDE WALL)



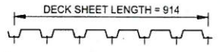
2 DETAIL 1:20
ROOF AND PARAPET
(END WALL)

SYMBOL	BEAMS	Pf	Tf	Vf
B1	W200x27			
B2	L102x102x6	35	-20	5
B3	W360x33	10	-10	50
C1	HSS127x127x8			
C2	HSS203x203x6.4	150	-5	10

- ALL CONNECTIONS TO BE DESIGNED BY STEEL FABRICATOR, SEE DWG. S-001.
- ALL STEEL TO BE GALVANIZED U.N.O.
- PORTAL FRAME TO BE DESIGNED FOR 30kN.m FACTORED MOMENT AT CORNERS.

FACTORED
Tf - FACTORED TENSION
Vf - FACTORED SHEAR FORCE
Pf - FACTORED COMPRESSIVE FORCE

ROOF DECK FASTENING PATTERNS					
ZONE	DECK THICKNESS (GAUGE)	FRAME FASTENER	FASTENING PATTERNS	SIDELAP FASTENER SPACING	MIN. FACTORED DECK SHEAR CAPACITY REQ'D
A	18	X-HSN24	36/7 (914/7)	150mm	14 kN/m



NOTES:

1. SEE GENERAL NOTES ON DWG. S-001
2. STEEL ROOF DECK: CANAM P3615 38 DP, PROFILE OR EQUIVALENT
3. FINISH: Z275 COATING, GRADE 230 MIN.
4. SHEET SPAN: 2 SPAN CONTINUOUS
5. FRAME CONNECTION: HILTI POWDER ACTUATED DRIVE PINS FRAME < 6 THK. HILTI X-ENP-19
6. SIDELAP CONNECTION: HILTI S-SLC 01 M HWH @ 150 O.C.
7. PERIMETER FASTENING:
   - PERPENDICULAR TO FLUTE: HILTI DRIVE PINS AT 36/7 FASTENING PATTERN
   - PARALLEL FLUTE: HILTI DRIVE PINS @ 150 O.C.
   - DRAG/TIE STRUT: HILTI DRIVE PINS @ 150 O.C.
8. SHEET END LAPS: MINIMUM 150mm LAP HILTI S-MD 12-24X1-5/8 M HWH5 RACING TIP-5 (RT5) 36/7 FASTENING PATTERN
9. OPENINGS: OPENINGS < 1000x1000 FRAME WITH L51x51x6.4
10. DECK SUPPLIER TO CONFIRM ON P.ENG SEALED SHOP DWGS THAT DECKING SUPPLIED MEETS SPECIFIED GRAVITY LOADS AND THE MIN. FACTORED DECK SHEAR CAPACITIES ABOVE.
11. STEEL DECK DIAPHRAGM HAS BEEN DESIGNED WITH RdRo=1.3
12. MIN. FACTORED DECK SHEAR CAPACITY TO BE NO LESS THAN 14 kN/m U.N.O.
13. DECKING CONTRACTOR SHALL ARRANGE FOR A HILTI REPRESENTATIVE TO VISIT THE SITE AND PROVIDE APPLICABLE TRAINING TO ALL INSTALLERS.
14. INSTALLATION OF ROOF DECK TO BE REVIEWED ON SITE BY A QUALIFIED INSPECTOR RETAINED BY THE DECK CONTRACTOR.

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EXPANSION UPGRADES

20172972-00

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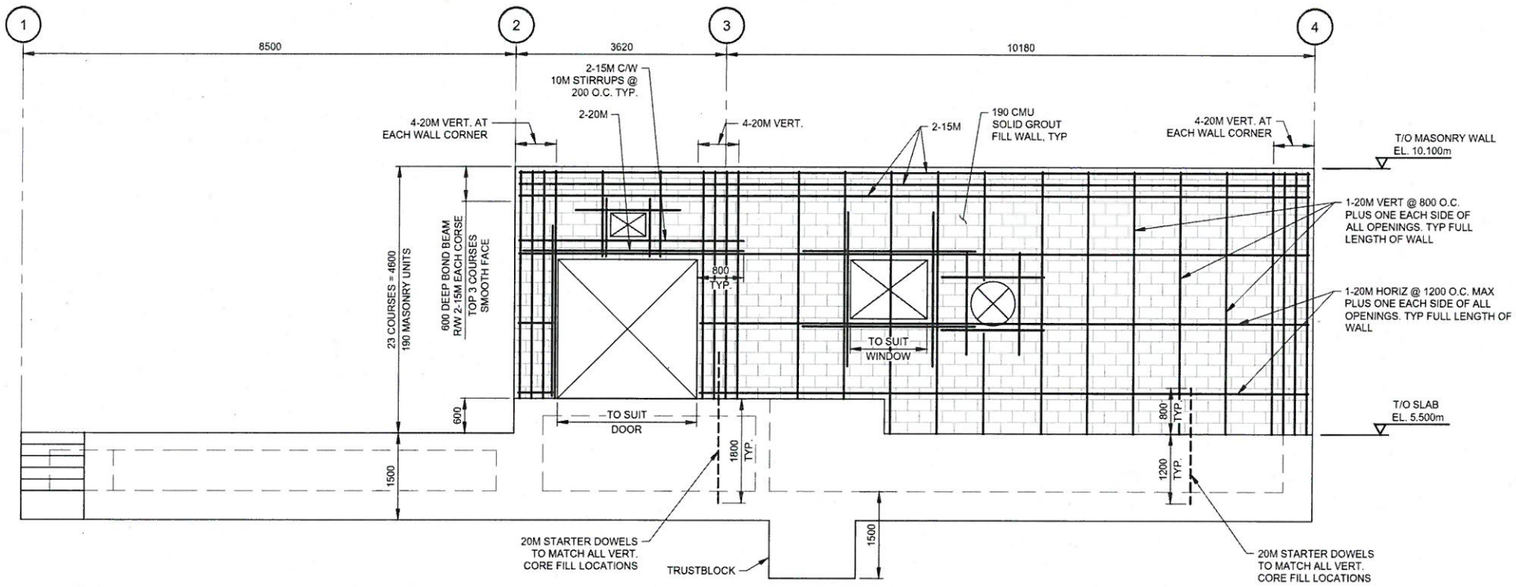
ROOF LAYOUT PLAN

DRAWING	REVISION	SHEET
2972-00-S-103	0	40 / 111

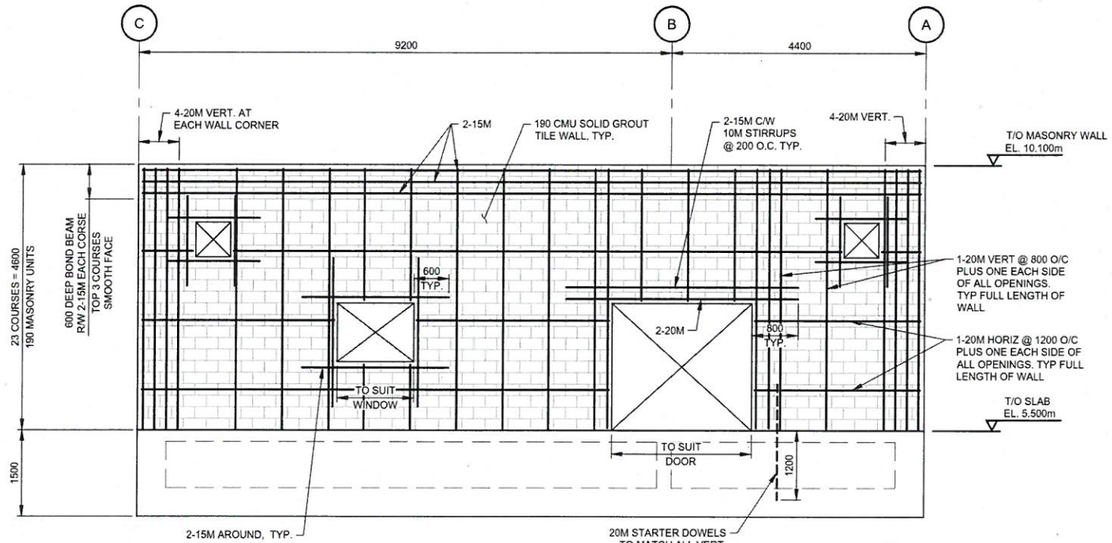
IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



ELEVATION 1:50

MASONRY WALL - SOUTH



ELEVATION 1:50

MASONRY WALL - EAST

P:\20172972\00_WetWtr_Trtmnt_Upg\Working_Dwgs\300_Structural\2972-00-s-201.dwg
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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
UV BUILDING
MASONRY WALL REINFORCEMENT SHEET 1

DRAWING	REVISION	SHEET
2972-00-S-201	0	41 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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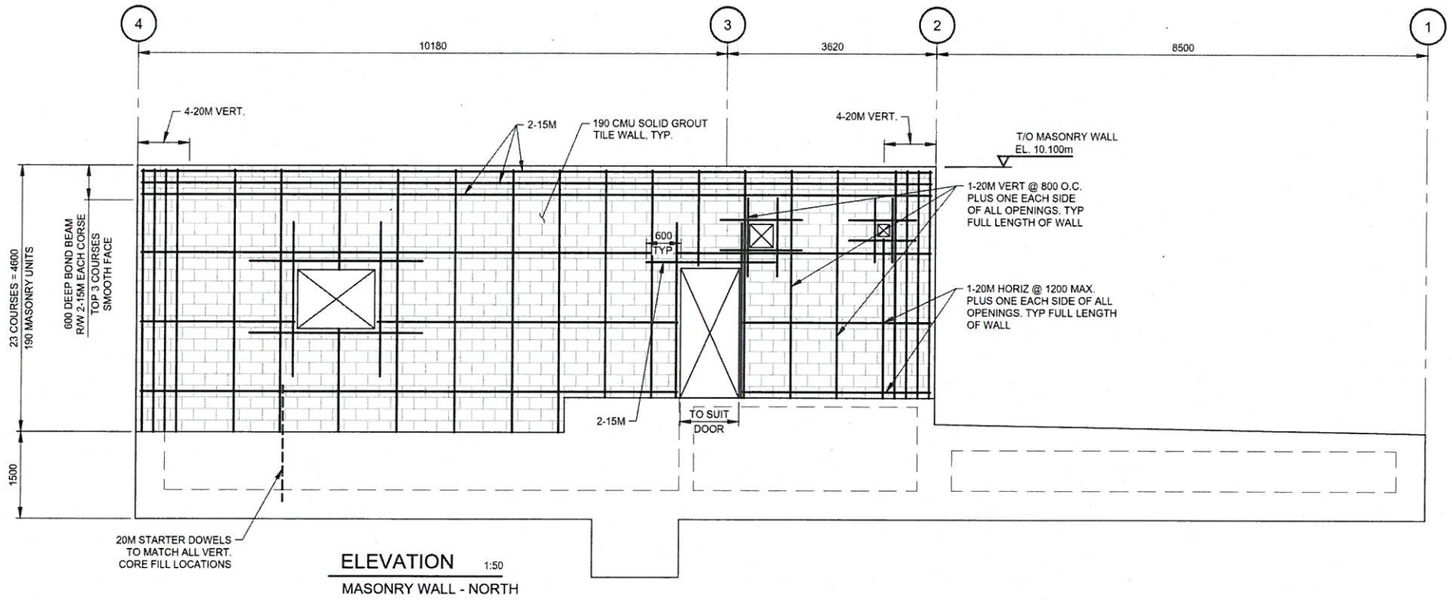
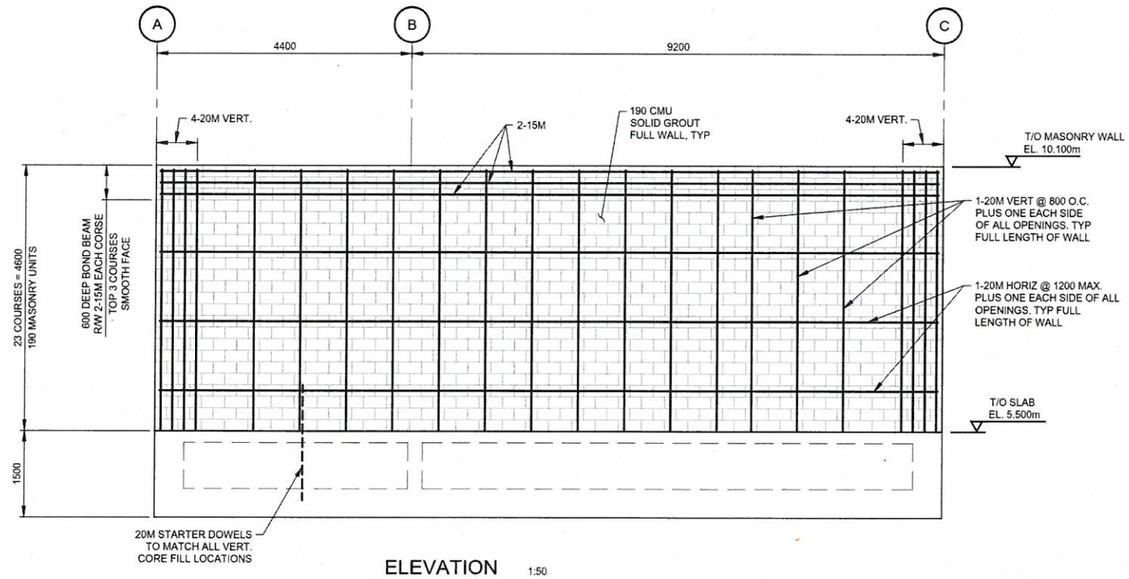


ELEVATION 1:50
MASONRY WALL - NORTH



ELEVATION 1:50
MASONRY WALL - WEST

P:\20172972\00_Wst\Wr_Trtmnt_Upgd\Working_Dwgs\300_Structural\2972-00-s-202.dwg
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20172972-00

SCALE: AS SHOWN

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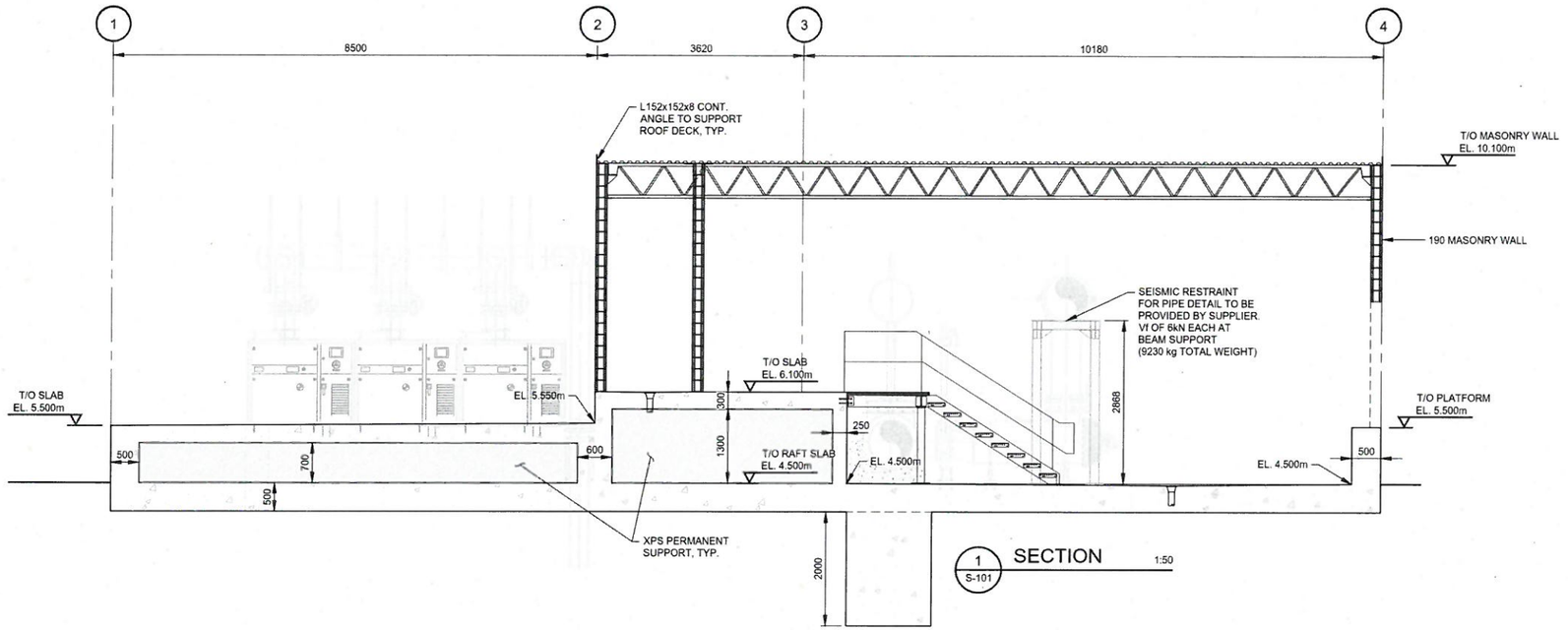
STRUCTURAL
UV BUILDING
MASONRY WALL REINFORCEMENT SHEET 2

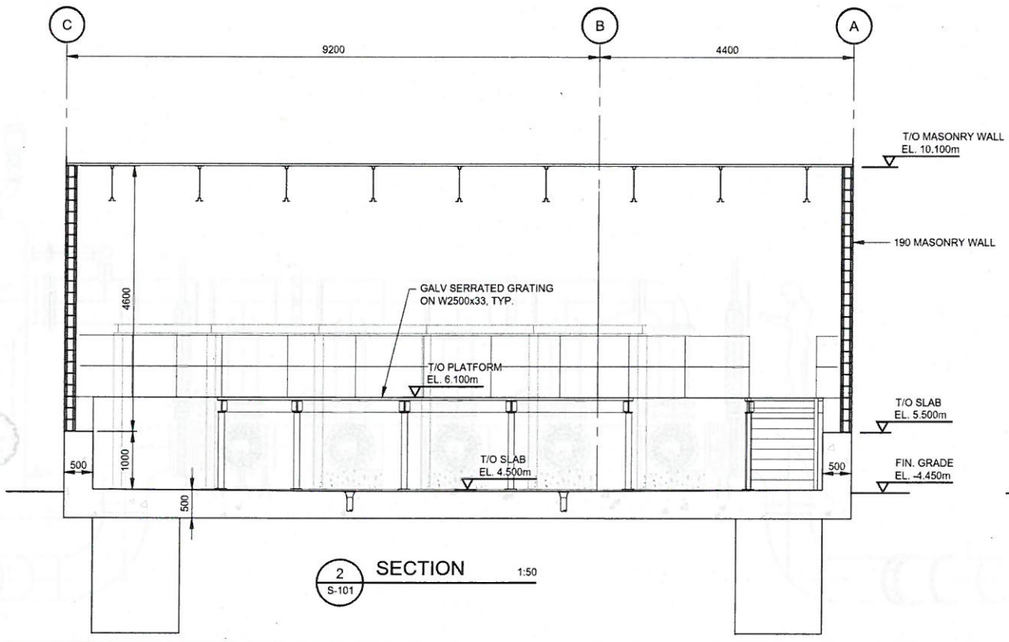
DRAWING	REVISION	SHEET
2972-00-S-202	0	42 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

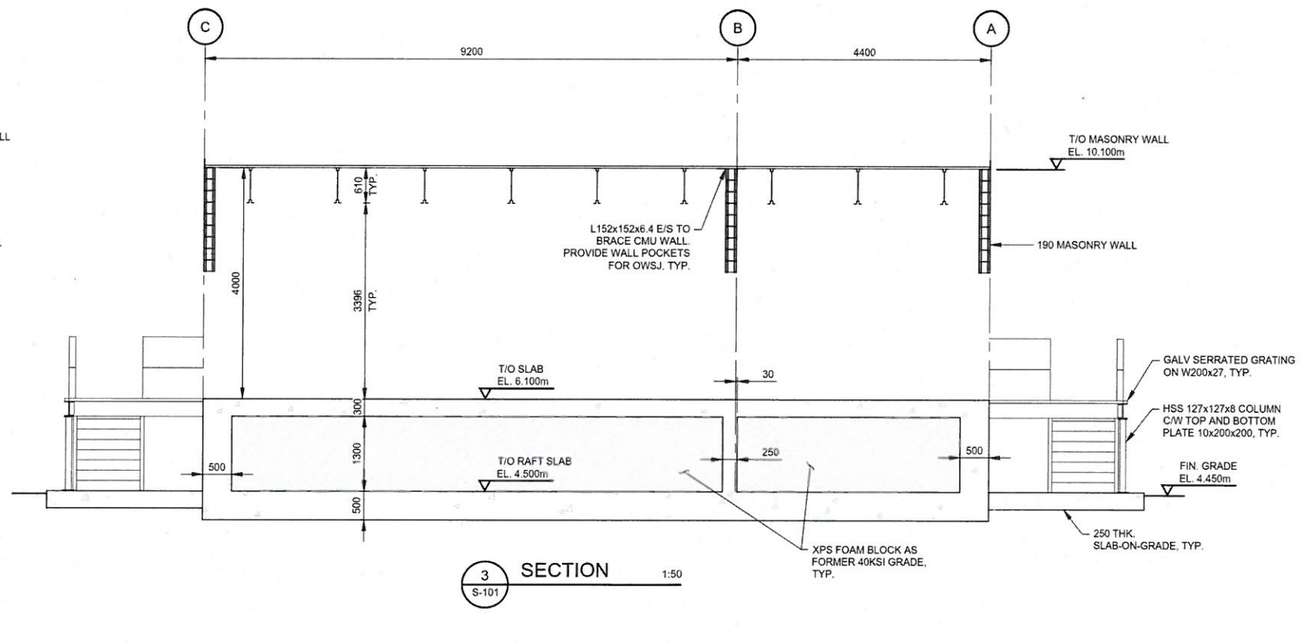
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS; TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 / S-101 SECTION 1:50



2 / S-101 SECTION 1:50



3 / S-101 SECTION 1:50

P:\20172972\00_WasWtr_Trtmnt_Upgr\Working_Dwgs\300_Structural\2972-00-s-301.dwg
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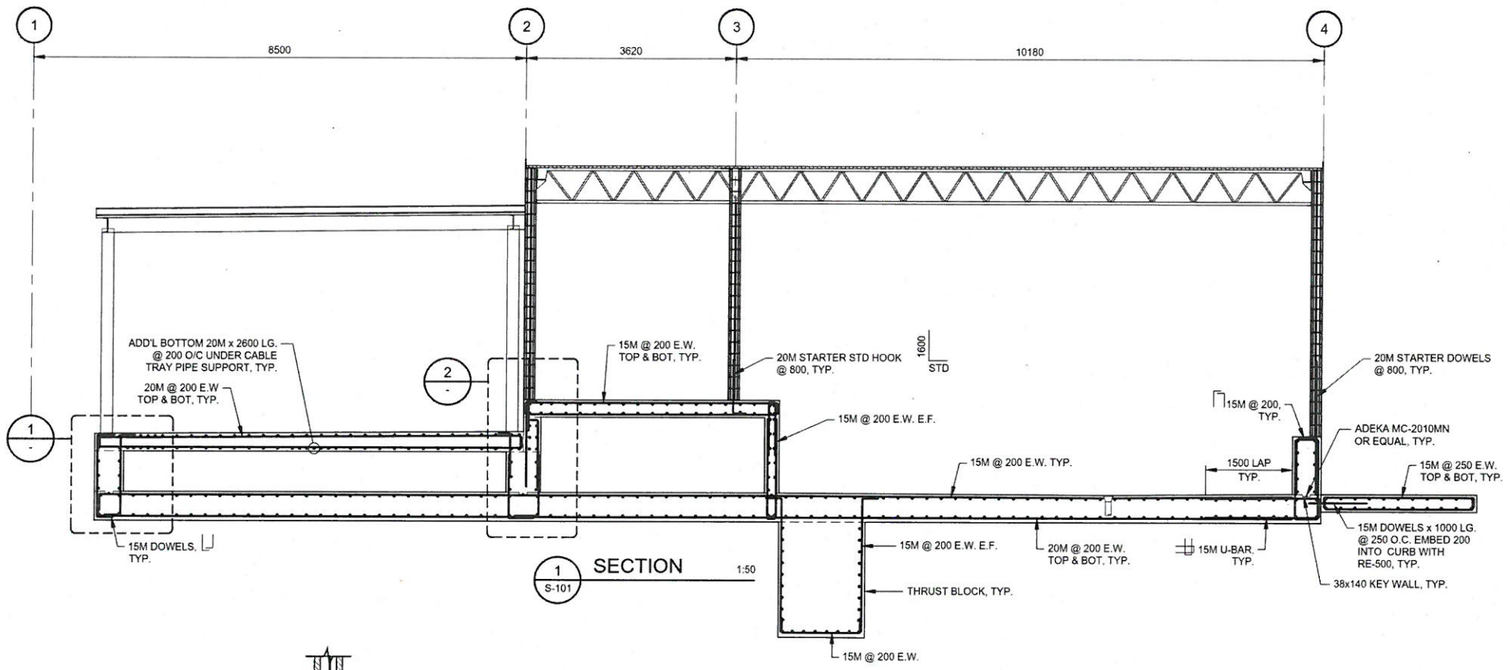
UV BUILDING
SECTIONS

DRAWING	REVISION	SHEET
2972-00-S-301	0	43 / 111

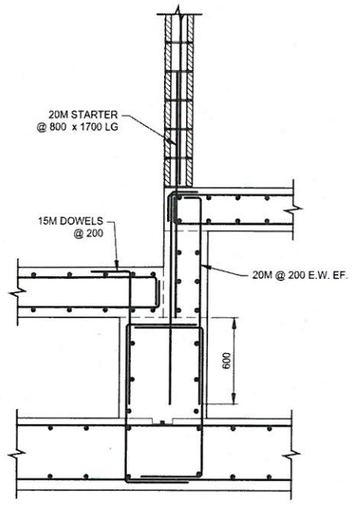
IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

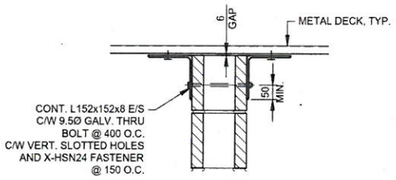


1 / S-101 SECTION 1:50

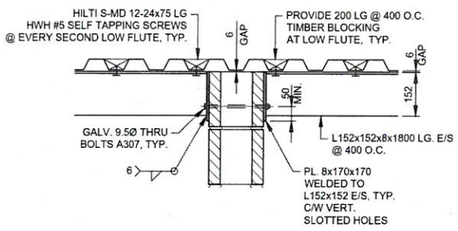
1 / - DETAIL 1:20



2 / - DETAIL 1:20



3 / - DETAIL 1:10
CMU WALL PERPENDICULAR TO DECK



4 / - DETAIL 1:10
CMU WALL PARALLEL TO DECK

P:\20172972\00_Wet\Wtr_Trtmnt_Upg\Working_Dwgs\300_Structural\2972-00-s-302.dwg
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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

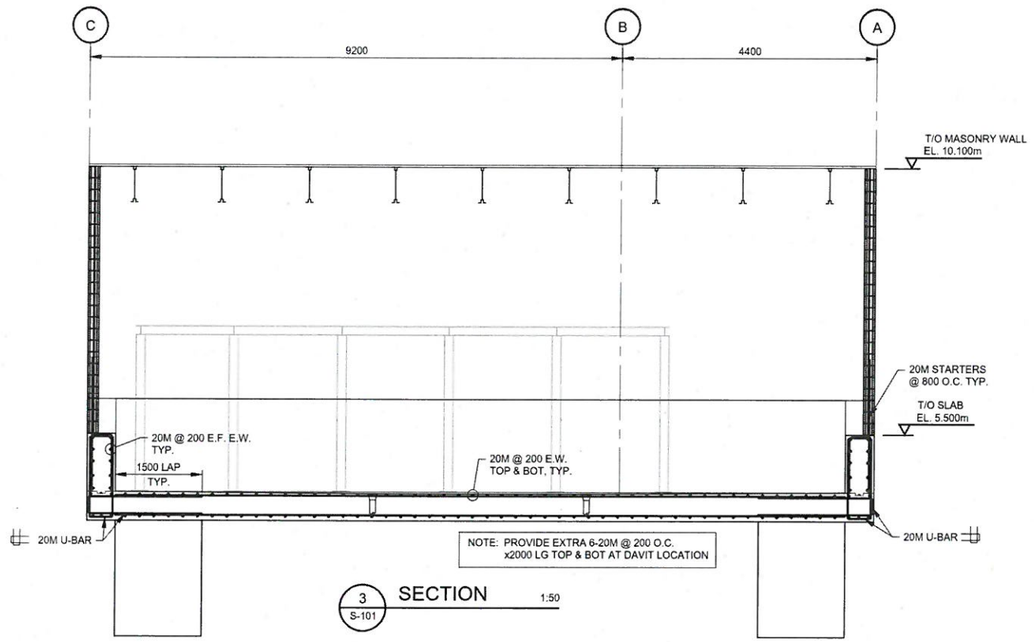
THE CITY OF Port Alberni

STRUCTURAL
UV BUILDING
REINFORCEMENT SECTIONS SHEET 1

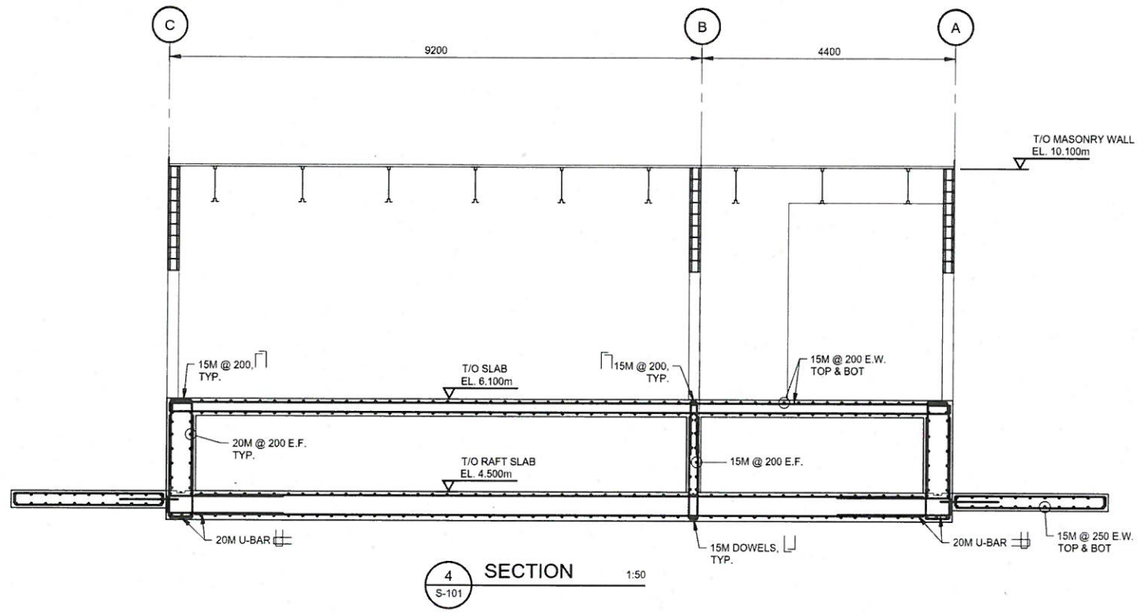
DRAWING	REVISION	SHEET
2972-00-S-302	0	44 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

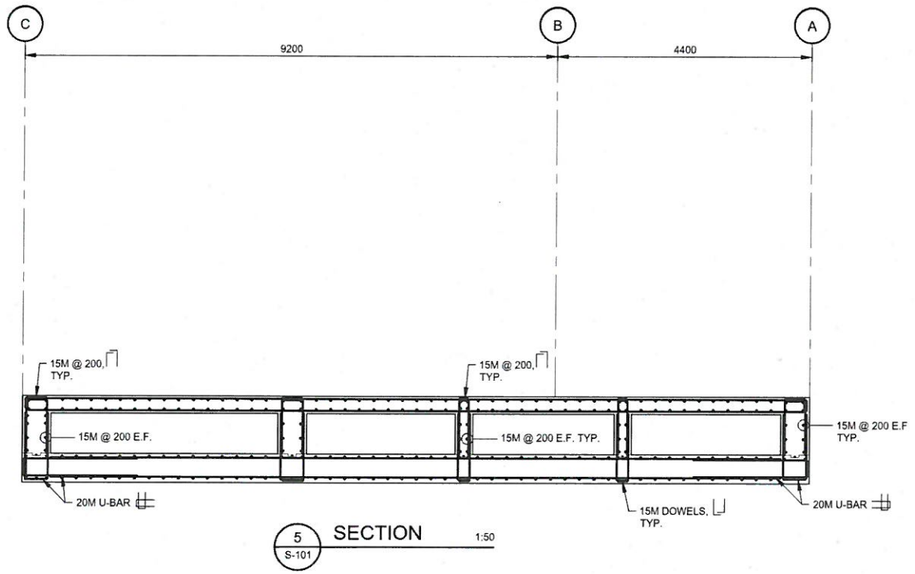
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



3 S-101 SECTION 1:50



4 S-101 SECTION 1:50



5 S-101 SECTION 1:50

P:\20172972\00_WstWtr_Trtmnt_Upg\Working_Dwgs\300_Structural\2972-00-s-303.dwg
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WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

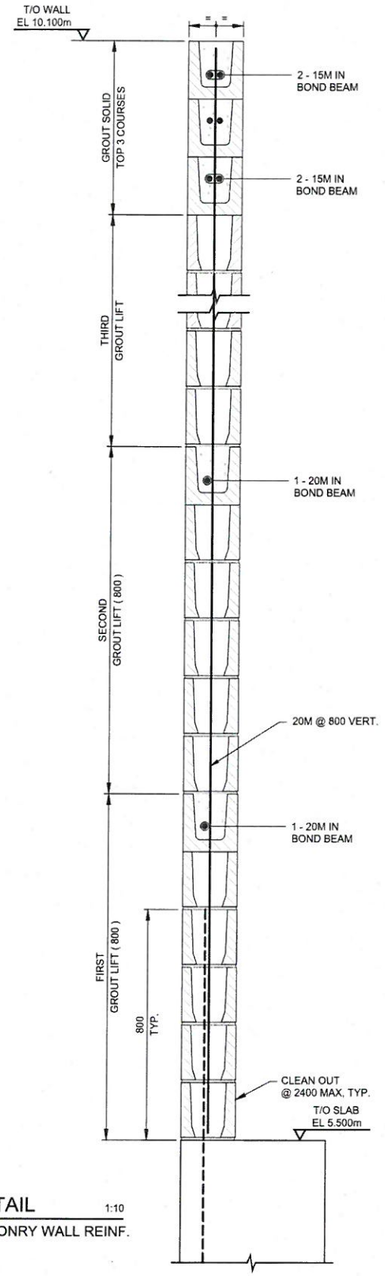
THE CITY OF Port Alberni

STRUCTURAL
UV BUILDING
REINFORCEMENT SECTIONS SHEET 2

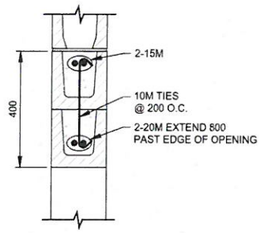
DRAWING	REVISION	SHEET
2972-00-S-303	0	45 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

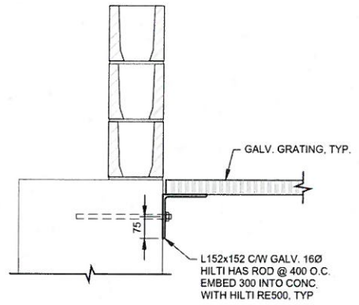
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



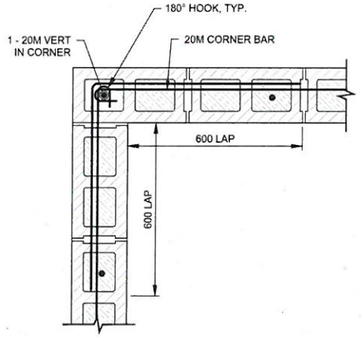
1 DETAIL 1:10
MASONRY WALL REINF.
TYP



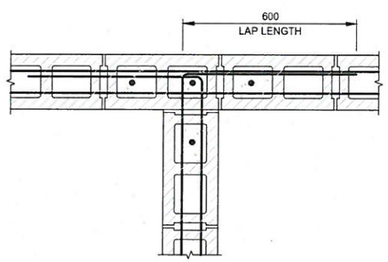
2 DETAIL 1:10
BOND BEAM @ ROLL UP DOOR



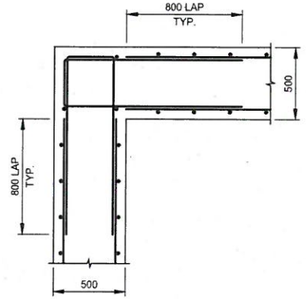
5 DETAIL 1:10
EXTERIOR GRATING AT CURB



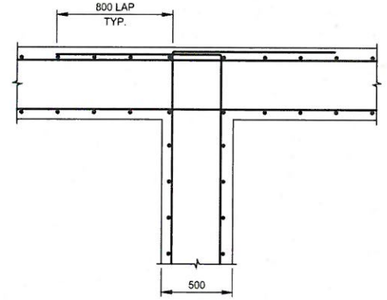
3 DETAIL 1:10
MASONRY CORNER
TYP.



4 DETAIL 1:10
MASONRY T-JUNCTION
TYP.



6 DETAIL 1:10
CONCRETE CORNER
TYP.



7 DETAIL 1:10
CONCRETE T-JUNCTION
TYP.

P:\20172972\00_Wet\Wr_Trtmnt_Lllpg\Working_Dwgs\300_Structural\2972-00-s-304.dwg
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CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
UV BUILDING
REINFORCEMENT SECTIONS SHEET 3

DRAWING	REVISION	SHEET
2972-00-S-304	0	46 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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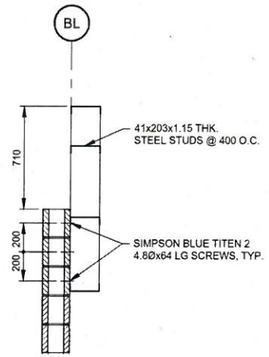
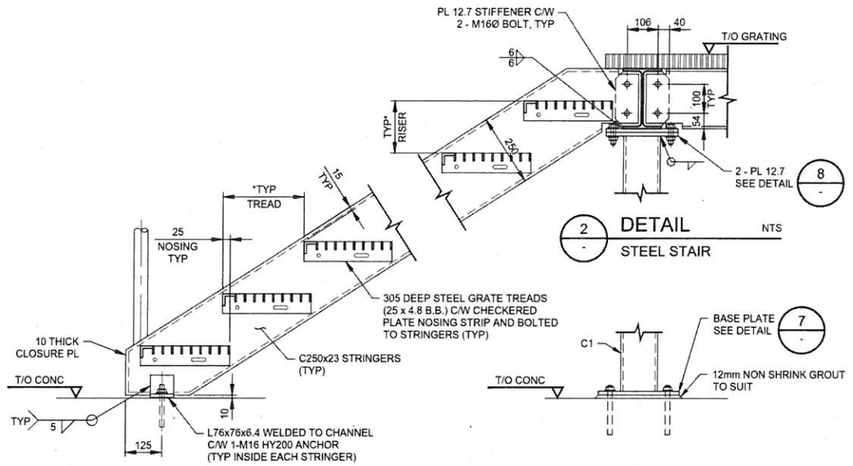


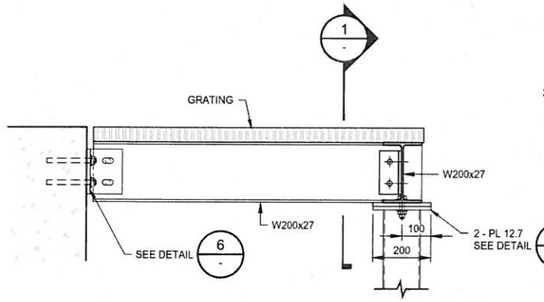
9 - DETAIL 1:20
PARAPET



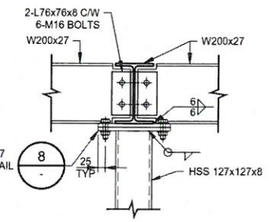
2 - DETAIL NTS
STEEL STAIR

1 - DETAIL NTS
STEEL STAIR

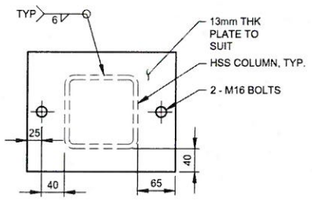
3 - DETAIL NTS
COLUMN BASE CONN
TYP



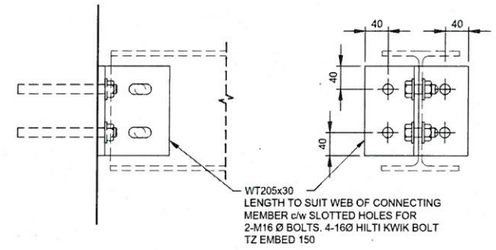
4 - DETAIL 1:10
PLATFORM



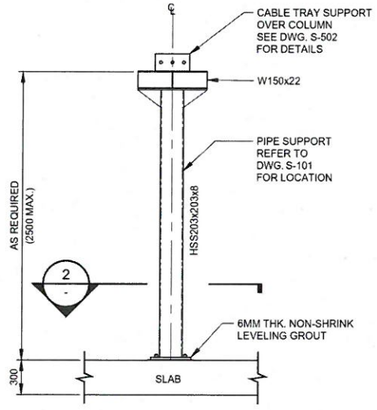
1 - SECTION 1:10



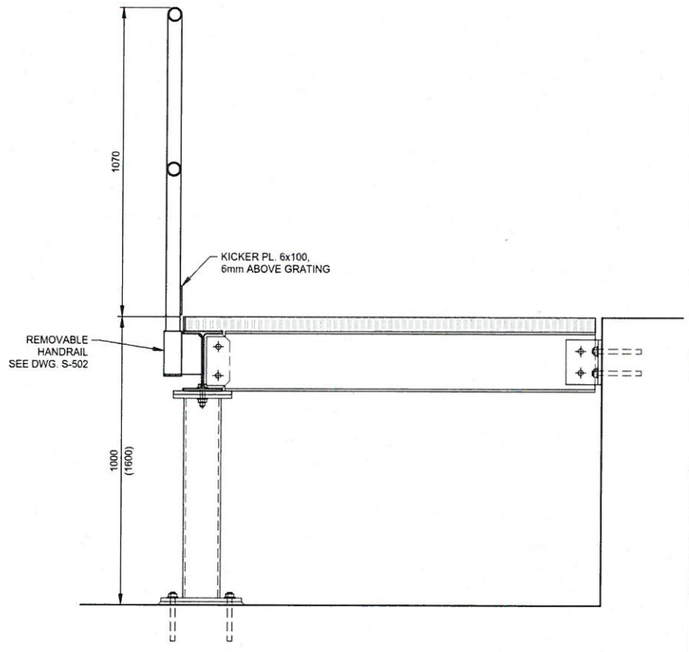
8 - DETAIL NTS
TYP. TOP PLATE
HSS 127 / HSS 203 COLUMN



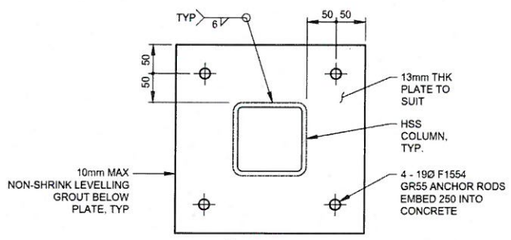
6 - DETAIL NTS
TYPICAL CONNECTION
AT CONCRETE INTERFACE



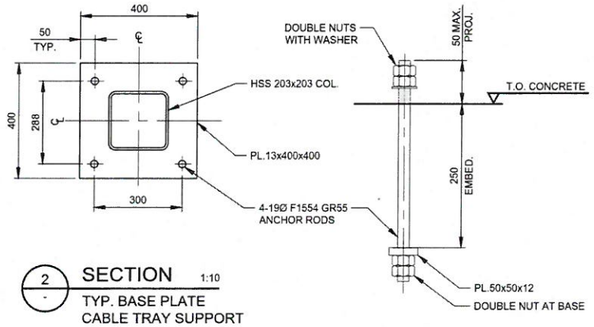
9 - DETAIL 1:25
PIPE SUPPORT



5 - DETAIL 1:10



7 - DETAIL NTS
TYP. BASE PLATE
HSS 127 / HSS 203 COLUMN



2 - SECTION 1:10
TYP. BASE PLATE
CABLE TRAY SUPPORT

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CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

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DETAILS SHEET 1

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2972-00-S-501	0	47 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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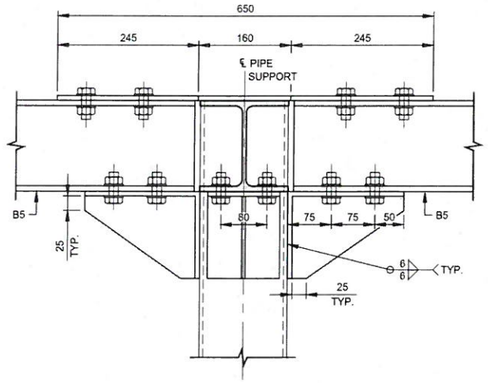
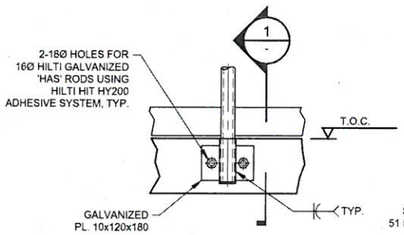
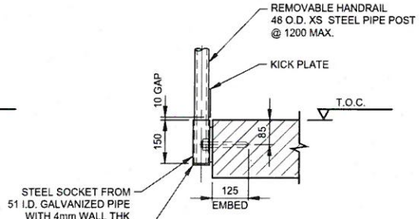


3 SECTION 1:5

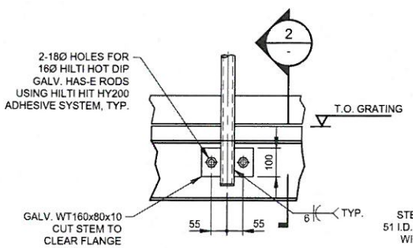


ELEVATION



1 SECTION

11 DETAIL N.T.S.
REMOVABLE GUARDRAIL CONCRETE CONNECTION



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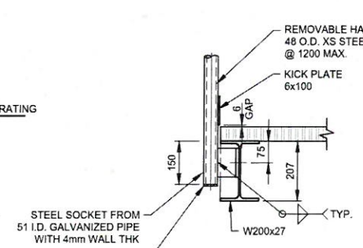
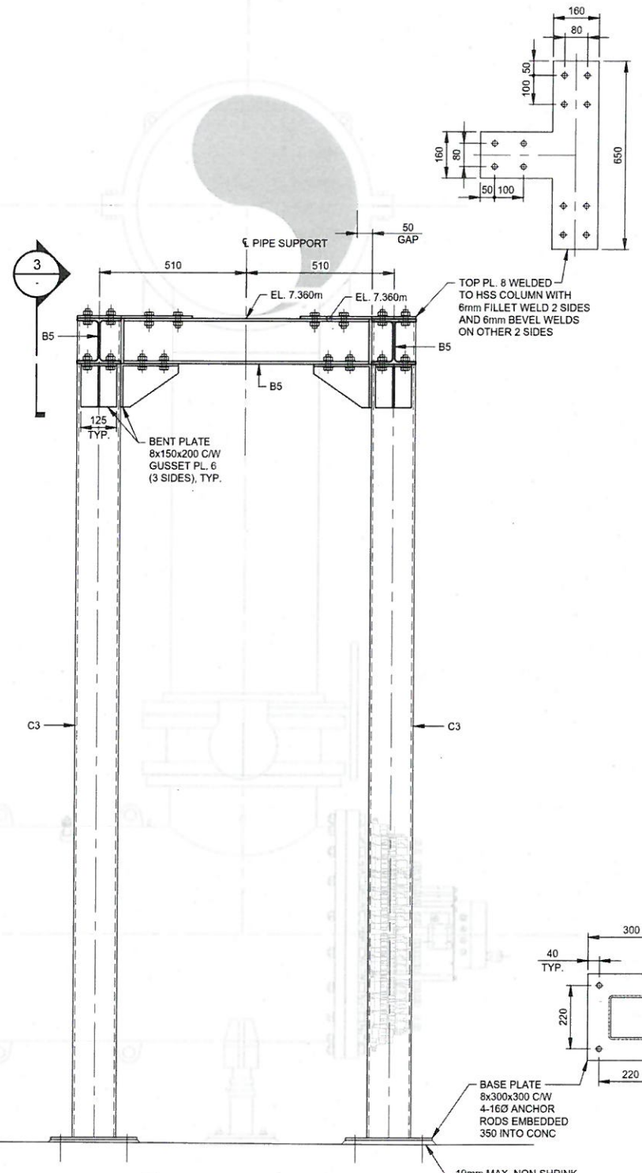
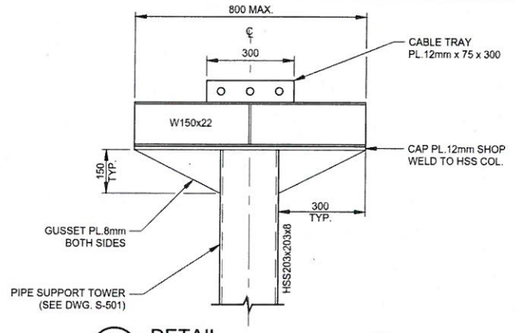


2 SECTION

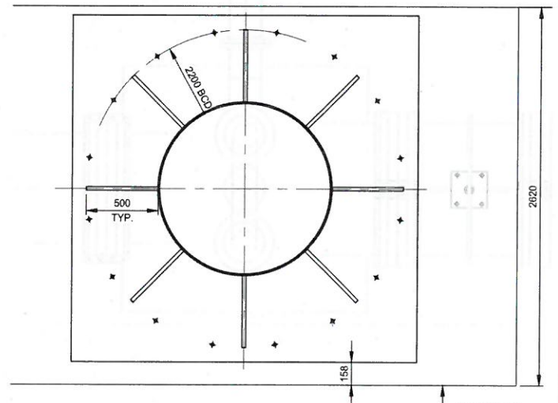
12 DETAIL N.T.S
FIXED GUARDRAIL W200 CONNECTION



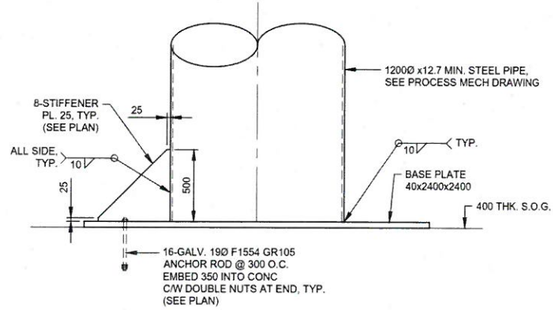
4 S-102 SECTION 1:10
STEEL PIPE SUPPORT



13 DETAIL 1:10
PIPE SUPPORT OVER COLUMN



PLAN



ELEVATION

14 S-101 DETAIL 1:10
STANDPIPE

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DATE: 2018-06-28, Jhum Dualan

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. K. D. WOO
34152
JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	D. WOO	H. DUALAN JR	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
UV BUILDING
DETAILS SHEET 2

DRAWING	REVISION	SHEET
2972-00-S-502	0	48 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

GENERAL NOTES:

1. THE GENERAL NOTES AND STRUCTURAL STANDARD DETAILS ARE GENERAL AND APPLY TO THE ENTIRE PROJECT EXCEPT WHERE THERE ARE SPECIFIC INDICATIONS TO THE CONTRARY.
2. READ THIS SET OF DRAWINGS IN CONJUNCTION WITH OTHER CONTRACT DOCUMENTS AND SPECIFICATIONS RELATING TO STRUCTURAL ENGINEERING AND OTHER DISCIPLINES. THESE DRAWINGS AND SPECIFICATIONS SHALL BE CONSIDERED AN INTEGRAL PART OF THE CONTRACT DOCUMENTS, NEITHER THE DRAWINGS NOR THE SPECIFICATIONS SHALL BE USED ALONE. CONTRACTOR SHALL REPORT OF ANY DISCREPANCIES IMMEDIATELY FOR CLARIFICATION TO THE ENGINEER. IN THE EVENT OF A DISCREPANCY BETWEEN THE VARIOUS DOCUMENTS, THE MORE STRINGENT PROVISIONS SHALL APPLY.
3. DESIGN AND CONTRUCTION TO BE IN ACCORDANCE WITH THE LATEST EDITION CODES, STANDARDS, RULES AND REGULATIONS (AND LOCAL AUTHORITIES HAVING JURISDICTION). THE LATEST EDITION CODE TO GOVERN EXCEPT WHERE OTHER APPLICABLE CODES OR THE FOLLOWING NOTES ARE MORE RESTRICTIVE.
4. DO NOT CONSTRUCT FROM THESE DRAWINGS UNLESS THEY ARE MARKED "ISSUED FOR CONSTRUCTION" IN THE REVISION COLUMN.
5. STRUCTURAL DIMENSIONS CONTROLLED BY OR RELATED TO ARCHITECTURAL, CIVIL, PROCESS MECHANICAL, BUILDING MECHANICAL, ELECTRICAL OR LANDSCAPING TO BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. CONTRACTOR SHALL REPORT OF ANY DISCREPANCIES AND CONFLICTS IMMEDIATELY FOR CLARIFICATION TO THE ENGINEER.
6. NO SLEEVES, DUCTS, PIPES OR OTHER OPENINGS SHALL PASS THROUGH STRUCTURAL MEMBERS EXCEPT WHERE DETAILED ON THE DRAWINGS. DO NOT CUT OR DRILL OPENINGS OR GROUPS OF OPENINGS THROUGH STRUCTURAL MEMBERS WITHOUT WRITTEN PERMISSION BY THE ENGINEER. CONTRACTOR TO PROVIDE APPROPRIATE ATTACHMENTS AND CONNECTIONS FOR MECHANICAL, ELECTRICAL, AND OTHER SERVICES WITHOUT CUTTING OR DRILLING.
7. FOR CONDITIONS NOT EXPLICITLY SHOWN, CONTRACTOR SHALL REQUEST FOR CLARIFICATION FROM THE ENGINEER.
8. BEFORE CONCRETING, ENSURE THAT ALL EMBEDDED ITEMS, SUCH AS ANCHOR BOLTS, SLEEVES AND WATER STOPS ARE IN POSITION AND SECURELY FASTENED IN PLACE TO THE SATISFACTION OF THE ENGINEER.

CONSTRUCTION:

1. THESE DRAWINGS SHOW THE REQUIREMENTS FOR PERMANENT AND COMPLETED STRUCTURE ONLY. CONTRACTOR IS RESPONSIBLE FOR DESIGNING AND PROVIDING ALL TEMPORARY WORKS INCLUDING BUT NOT LIMITED TO BRACING, FALSEWORK, SHORING, AND TEMPORARY SUPPORTS. TEMPORARY WORKS MUST BE CAPABLE OF TRANSFERRING ALL IMPOSED CONSTRUCTION AND DEAD LOADS WITHOUT EXCEEDING SPECIFIED DESIGN LOADS TO THE STRUCTURE. TEMPORARY WORKS TO BE DESIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROJECT PROVINCE/TERRITORY IN ACCORDANCE WITH WCB STANDARDS AND LOCAL RULES AND REGULATIONS.
2. THE CONTRACTOR WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY.
3. BUILDING CONTROL LINES, REFERENCE LINES, GRID LINES AND TEMPORARY BENCH MARKS TO BE CLEARLY IDENTIFIED AND MAINTAINED DURING THE ENTIRE CONSTRUCTION PERIOD.
4. ACCURACY OF THE SITE SURVEY AND LAYOUT IS THE RESPONSIBILITY OF THE CONTRACTOR. REMEDIAL ACTIONS RESULTING FROM INACCURACIES, ERRORS AND OMISSIONS WILL BE AT THE CONTRACTOR'S OWN EXPENSE.
5. ALL DIMENSIONS, ELEVATIONS AND SLOPES SHALL BE CHECKED AND VERIFIED WITH THE DRAWINGS AND EXISTING SITE CONDITIONS PRIOR TO CONSTRUCTION AND FABRICATION. DO NOT SCALE DRAWINGS.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFICATION OF ALL UNDERGROUND AND SUB-GRADE SERVICES PRIOR TO COMMENCING SITE WORK.
7. CONTRACTOR TO SUBMIT TO THE ENGINEER IN WRITING ALL PROPOSED ALTERNATE PRODUCTS, STRUCTURAL DETAILS, AND STRUCTURAL SYSTEMS, INCLUDING TECHNICAL SPECIFICATIONS, CALCULATIONS AND DATA SHEETS FOR REVIEW AND APPROVAL PRIOR TO COMMENCING WITH WORK. ALTERNATE PRODUCTS MUST HAVE DESIGN PROPERTIES EQUIVALENT TO OR GREATER THAN THOSE SPECIFIED ON THE DRAWINGS AND SPECIFICATIONS.

EXCAVATION & BACKFILL:

2. REFER TO GEOTECHNICAL REPORT PREPARED BY WSP CANADA INC., FILE # 171-04753-00, FOR DESCRIPTION OF EXISTING SOIL CONDITIONS AND SITE PREPARATION REQUIREMENTS.
3. ENSURE THE BOTTOM OF EXCAVATION IS UNDISTURBED SOIL, LEVEL AND FREE OF ALL LOOSE, SOFT OR ORGANIC MATTER AND IS PROTECTED AND KEPT DRY DURING EXCAVATION AND DURING CONCRETE PLACEMENT. THOROUGHLY COMPACT THE BASE OF THE EXCAVATION PRIOR TO FOUNDATION CONSTRUCTION IN ORDER TO DENSIFY THE SOIL LOOSENED BY THE EXCAVATION EQUIPMENT.
4. ENSURE THAT THE SOIL BELOW A FOUNDATION IS NOT ALLOWED TO FREEZE, EITHER DURING OR AFTER CONSTRUCTION. UNDER NO CIRCUMSTANCES SHALL CONCRETE BE PLACED ON FROZEN SOIL.
5. USE HAND-OPERATED COMPACTION EQUIPMENT WITHIN 1m OF WALLS AND FOOTINGS.
6. BACKFILL AGAINST GRADE BEAMS AND FOUNDATIONS AS SPECIFIED AFTER CONCRETE HAS ACHIEVED 20 MPa STRENGTH, AND AFTER APPROVAL FROM THE ENGINEER.
7. NOTIFY ENGINEER BEFORE COMMENCING WITH EXCAVATION. SOIL CONDITIONS SHALL BE APPROVED BY ENGINEER DURING EXCAVATION AND PRIOR TO CONSTRUCTION OF FORMWORK OR REINFORCEMENT FOR FOUNDATIONS.
8. TEST LAYER COMPACTION AS SPECIFIED, FREQUENCY AS FOLLOWS:
   - AT LEAST FOUR (4) RANDOM LOCATIONS FROM SAME LAYER, FOR AT LEAST THREE (3) LAYERS EQUALLY SPACED THROUGH DEPTH.
8. THE GEOTECHNICAL ENGINEER SHALL BE NOTIFIED A MINIMUM OF 24 HRS. BEFORE COMMENCEMENT OF EXCAVATION. SOIL CONDITIONS SHALL BE INSPECTED BY THE GEOTECHNICAL ENGINEER DURING EXCAVATION AND PRIOR TO CONSTRUCTION OF FORMWORK FOR FOUNDATIONS.

CONCRETE:

1. PERFORM CONCRETING WORK TO CAN/CSA A23.1.
2. TEST CONCRETE IN ACCORDANCE WITH CAN/CSA A23.2.
3. CONCRETE MIXES SHALL BE PROPORTIONED IN ACCORDANCE WITH CAN/CSA A23.2 TO MEET THE FOLLOWING REQUIREMENTS:

LOCATION	28 DAY COMP. STRENGTH (MPa) MIN	CEMENT TYPE	AIR %	SLUMP mm	NOMINAL COARSE SIZE AGG. mm	EXP. COND.
BLDG RAFT SLAB	30	GU	4-7	60-100	20	F-2
CONC CHANNELS AND DIVIDING STRUCTURE	35	GU	4-7	60-100	20	A-1

- WATER/CEMENT RATIO FOR EXPOSURE CLASSES AS PER CAN/CSA A23.1
- MAX W/C = 0.45 F-2, 0.40 FOR A-1
- WHERE SPECIFIED STRENGTH EXCEEDS THOSE IMPLIED BY EXPOSURE CLASS, SPECIFIED STRENGTH GOVERNS.
- ALL CONCRETE TO BE NORMAL WEIGHT 2400 kg/m³
- MIX DESIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW
- SUPPLEMENTAL FLYASH TO A MAXIMUM OF 20% MAY BE PERMITTED AT THE DISCRETION OF THE ENGINEER.
- SEE SPECIFICATIONS FOR OTHER TYPES OF CONCRETE REQUIREMENTS

4. STRENGTH OF CONCRETE TO BE DETERMINED BY FIELD-CURED CYLINDERS. ALTERNATE METHODS, IF ACCEPTABLE TO THE ENGINEER, MAY BE USED.
5. LOCATIONS & DETAILS OF CONSTRUCTION JOINTS NOT SHOWN ON DRAWINGS ARE TO BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION.
6. BEFORE CONCRETE PLACEMENT, ENSURE THAT ALL EMBEDDED ITEMS SUCH AS ANCHOR BOLTS, SLEEVES, AND WATER STOPS ARE IN POSITION AND SECURELY FASTENED IN PLACE TO THE SATISFACTION OF THE ENGINEER.
7. ANCHOR BOLTS AND DOWELS SHALL BE PLACED BEFORE CONCRETE IS POURED. TEMPLATES SHALL BE USED TO ENSURE CORRECT PLACEMENT OF ANCHOR BOLTS AND DOWELS. DOWELS TO MATCH VERTICAL BARS IN SIZE AND SPACING.
8. BEFORE PLACING CONCRETE, ENSURE THAT THE REINFORCING STEEL AND FORMS ARE CLEAN, FREE OF LOOSE SCALE, DIRT AND OTHER FOREIGN MATERIALS WHICH WOULD REDUCE THE BOND BETWEEN THE REINFORCING STEEL AND THE CONCRETE.
9. ALL EXPOSED CONCRETE CORNERS TO HAVE 20x20 CHAMFER.
10. SUBMIT TO THE ENGINEER FOR REVIEW AND APPROVAL NO LATER THAN THREE WEEKS PRIOR TO CONSTRUCTION:
    - REBAR SHOP DRAWINGS, METRIC
    - CONCRETE MIX DESIGN
    - DETAIL AND LOCATION OF CONSTRUCTION JOINTS

REINFORCED MASONRY:

1. ALL MATERIALS AND CONSTRUCTION METHODS SHALL BE IN ACCORDANCE WITH THE BRITISH COLUMBIA BUILDING CODE, LATEST EDITION AND THE FOLLOWING STANDARDS: CAN/CSA-S304.1 "MASONRY DESIGN FOR BUILDINGS", CAN/CSA-A370 "CONNECTORS FOR MASONRY" AND CAN/CSA-A371 "MASONRY CONSTRUCTION FOR BUILDINGS."
2. CONCRETE BLOCK UNITS SHALL BE STANDARD 190 METRIC UNITS CONFORMING TO THE REQUIREMENTS OF CAN/CSA-A165.1, CLASSIFICATION H/20/M
3. USE ONLY TYPE S MORTAR CONFORMING TO CSA A179.
4. REINFORCING FOR STANDARD 190 UNITS SHALL BE AS SHOWN ON DRAWINGS. JOINT REINFORCING TO BE NO. 9 GAUGE WIRE LADDER-TYPE @ 400 O/C.
5. CELLS TO BE GROUTED ARE TO BE KEPT CLEAN. CELLS SHALL BE GROUTED AT 1200mm LIFTS.
6. GROUT CELLS CONTAINING REINFORCEMENT, BOLTS OR EMBEDDED ITEMS. VIBRATE TO CONSOLIDATE AND COMPLETELY FILL CELLS.
7. MASONRY FILL SHALL BE 25 MPA @ 28 DAYS, SLUMP 250mm (+/- 30mm), 10mm MAX. AGGREGATE SIZE.
8. CONCRETE MASONRY UNITS SHALL BE LAID AS RUNNING BOND CONFIGURATION. INTERSECTING WALLS SHALL HAVE ALTERNATE INTERLOCKING COURSING.
9. ALL EXPOSED OR CONCEALED MORTAR JOINTS TO BE TOOLED CONCAVE.
10. ENGINEER TO INSPECT REINFORCING PRIOR TO CASTING GROUT FILL.

FIELD REVIEW AND TESTING:

1. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE WORK AND ENSURING CONFORMANCE TO DRAWINGS AND CONTRACT DOCUMENTS PRIOR TO THE FIELD REVIEW OF THE ENGINEER.
2. THE CONTRACTOR SHALL GIVE REASONABLE ADVANCE NOTICE OF WHEN THE STRUCTURAL WORK IS GENERALLY COMPLETED AND READY FOR REVIEW. THE STRUCTURAL WORK CANNOT BE CONCEALED BY FINISHES OR OTHER MEANS WITHOUT PRIOR PERMISSION BY THE ENGINEER. THE CONTRACTOR SHALL NOTIFY THE ENGINEER AT LEAST 48 HOURS IN ADVANCE FOR THE FOLLOWING FIELD REVIEWS:
    - CONCRETE REINFORCEMENT BEFORE EACH CONCRETE POUR
    - STRUCTURAL STEEL FRAMING BEFORE CONCEALMENT
    - STEEL DECKING BEFORE CONCEALMENT
3. THE STRUCTURAL WORK MUST BE SUBSTANTIALLY COMPLETE AT THE TIME OF FIELD REVIEW. ANY WORK FOUND INCOMPLETE OR DEFICIENT AT THE TIME OF FIELD REVIEW MAY REQUIRE ADDITIONAL FIELD REVIEWS BY THE ENGINEER OR ADDITIONAL MATERIAL TESTING AT THE EXPENSE OF THE CONTRACTOR.
4. THE FIELD REVIEW IS CONDUCTED FOR THE SOLE PURPOSE OF ENSURING GENERAL CONFORMANCE TO THE DRAWINGS AND CONTRACT DOCUMENTS. THE REVIEW IS CONDUCTED AT ANY STAGE AT THE DISCRETION OF THE ENGINEER AND DOES NOT GUARANTEE THE WORK OF THE CONTRACTOR.

STRUCTURAL STEEL AND FABRICATIONS:

1. FABRICATE AND ERECT STRUCTURAL STEEL TO CSA CAN-S16.1. SUBMIT SHOP DRAWINGS SHOWING ALL DETAILS AND MATERIAL SPECIFICATIONS FOR REVIEW PRIOR TO FABRICATION.
2. PROVIDE STRUCTURAL STEEL TO CSA G40.21 WITH THE FOLLOWING GRADES:

WIDE FLANGE BEAMS AND COLUMNS:	350 W
CHANNELS AND ANGLES:	300 W
HSS SECTIONS (CLASS C):	350 W
STRUCTURAL BARS AND PLATES:	300 W
MISCELLANEOUS STEEL:	300 W

3. PROVIDE ERECTION BOLTS TO ASTM A325, MINIMUM 19mm DIAMETER. DESIGN BOLTED CONNECTIONS TO ASTM A325. TIGHTEN BOLTS BY THE "TURN OF NUT" METHOD TO BOLT TENSIONS SPECIFIED IN CSA S16.1. ANCHOR RODS TO ASTM A307 (UNLESS NOTED OTHERWISE).
4. WELD TO CSA W59 BY FABRICATORS CERTIFIED TO CSA W47.1 DIV.1 OR DIV. 2.1.1. WELDING OF REINFORCING SHALL CONFORM TO CSA W186.
5. MINIMUM WELDS FOR CONNECTIONS SHALL BE 6mm FILLET WELD AND WHERE EXPOSED IN FINISHED BUILDING, WELD SHALL BE GROUND SMOOTH.
6. NO BURNING OF HOLES SHALL BE ALLOWED IN STRUCTURAL STEEL.
7. ALL STEEL STUD TO CONFORM TO CAN/CSA-S136, 228 MPa MIN.
8. GALVANIZED STEEL TO BE HOT DIP GALVANIZED TO CSA-G-164.
9. NON-GALVANIZED STEEL TO BE PAINTED WITH A SUITABLE PAINT SYSTEM APPROVED BY ARCHITECT.
10. STEEL FABRICATOR SHALL DESIGN ALL STEEL-TO-STEEL CONNECTIONS INDICATED ON THE DRAWINGS. ALL CONNECTIONS SHALL BE SHOP WELDED AND FIELD BOLTED UNLESS NOTED OTHERWISE. DESIGN BOLTED CONNECTIONS ASSUMING THE BOLT THREADS INTERCEPT THE SHEAR PLANE. CONNECTIONS SHALL BE DESIGNED TO TRANSFER FORCES THROUGH THE CENTERLINE OF MEMBERS WITHOUT IMPOSING ROTATIONAL LOADS.
11. DESIGN CONNECTIONS FOR THE HIGHER OF THE FORCES AS INDICATED ON THE DRAWINGS OR FOR FACTORED END SHEAR OF A MINIMUM OF 60% OF THE TOTAL BEAM LOAD CAPACITY AS LISTED IN THE BEAM LOAD TABLES OF THE CISC HANDBOOK.
12. SUBMIT TO THE ENGINEER FOR REVIEW AND APPROVAL:
    - SHOP DRAWINGS AND CALCULATIONS SIGNED AND SEALED BY SUPPORTING REGISTERED PROFESSIONAL FOR THE CONNECTION DESIGN OF STEEL-TO-STEEL CONNECTIONS.
    - FIELD REVIEW REPORT FROM SUPPORTING REGISTERED PROFESSIONAL
    - SCHEDULES S-B AND S-C FROM SUPPORTING REGISTERED PROFESSIONAL

REINFORCEMENT:

1. REINFORCING STEEL: NEW DEFORMED BARS TO CSA G30.18, "BILLET" STEEL BARS FOR CONCRETE REINFORCEMENT, WITH MIN. YIELD STRENGTH OF 400WMPa. WELDED WIRE FABRIC TO CONFORM TO CSA G30.5 WITH MIN. YIELD STRENGTH OF 450MPa. PLACE REBAR TO CSA/CAN A23.1. REINFORCEMENT REQUIREMENTS ARE SHOWN ON DETAIL DRAWINGS. WHERE DETAILS OF BAR SIZING AND SPACING ARE NOT SHOWN, ALLOW FOR MINIMUM REINFORCEMENT IN ACCORDANCE WITH CSA/CAN A23.1
2. PROVIDE CLEAR CONCRETE COVER OVER REBAR AS FOLLOWS U.N.O.:

   CONCRETE PLACED DIRECTLY ON GROUND
   75mm

   FORMED SURFACES EXPOSED TO WEATHER & SEWAGE
   - WALLS AND SLABS
     50mm

   TOP SLAB REINF. & BEAM STIRRUPS IN BUILDING
   60mm IN CHANNELS, 50mm ELSEWHERE

   BOTTOM SLAB REINFORCING IN BUILDING
   60mm IN CHANNELS, 50mm ELSEWHERE

   FORMED SURFACES EXPOSED TO EARTH
   50mm

3. REBAR SPLICE LENGTHS (UNLESS NOTED OTHERWISE):
   LENGTHS SHOWN ARE IN mm

REBARS		10M	15M	20M	25M	30M	35M
WALLS	HORIZONTAL	500	650	800	1300	1700	2000
	VERTICAL	400	400	650	1000	1300	1500
SLABS	TOP	500	700	900	1400	1700	2000
	BOTTOM	400	600	750	1100	1300	1500

4. LAP WIRE MESH REINFORCING 200mm AND MINIMUM 2 LONGITUDINAL MESH BARS.
5. UNLESS OTHERWISE NOTED, EDGE OF ALL SLABS SHALL HAVE 2-15M CONT. LAPPED 600mm
6. UNLESS NOTED OTHERWISE, ALL OPENINGS IN SLAB SHALL HAVE 2-15M BARS PARALLEL TO ALL EDGES EXTENDING BEYOND CORNERS 600mm
7. ALL REINFORCEMENT REQUIRED TO BE WELDED SHALL BE GRADE 400W (WELDABLE)
8. PLACE ADDITIONAL REINFORCEMENT AT ALL OPENINGS FOR PIPING, MECHANICAL AND ELECTRICAL EQUIPMENT, DOORS AND OTHER OPENINGS UNLESS NOTED OTHERWISE.
9. PLACE REINFORCING BARS SYMMETRICALLY OVER SUPPORTS AND SYMMETRICALLY IN SPANS UNLESS NOTED OTHERWISE.
10. UNLESS NOTED OTHERWISE, SLAB REINFORCING SHALL NOT BE CUT AT OPENINGS. SPREAD REINFORCING AROUND OPENINGS.
11. PROVIDE SUFFICIENT CHAIRS AND SUPPORT BARS TO MAINTAIN SPECIFIED CONCRETE COVER AND TO SECURE REINFORCING STEEL IN PLACE DURING CONCRETE PLACEMENT.
12. RESERVE MINIMUM OF 1% TOTAL VOLUME OF REINFORCEMENT TO BE USED AS DIRECTED BY THE ENGINEER FOR FIELD ADJUSTMENT.
13. REINFORCEMENT REQUIREMENTS ARE SHOWN ON DETAIL DRAWINGS. WHERE DETAILS OF BAR SIZING AND SPACING ARE NOT SHOWN, ALLOW FOR A MINIMUM 0.5% REINFORCING IN EACH DIRECTION, EACH FACE.

NON-STRUCTURAL ELEMENTS:

1. DESIGN OF NON-STRUCTURAL AND SECONDARY STRUCTURAL ELEMENTS IS NOT THE RESPONSIBILITY OF THE ENGINEER-OF-RECORD. SUCH COMPONENTS OF THE PROJECT SHALL BE DESIGNED, DETAILED, SPECIFIED AND REVIEWED IN THE FIELD BY A SUPPORTING REGISTERED PROFESSIONAL. EXAMPLES OF NON-STRUCTURAL COMPONENTS INCLUDE, BUT ARE NOT LIMITED TO:
   - HANDRAILS, GUARDRAILS AND RAILINGS, STAIR AND PLATFORM
   - CURTAIN WALL SYSTEMS, SKYLIGHTS AND GLAZING
   - INTERIOR AND EXTERIOR STEEL STUD WALLS
   - ROOFING SYSTEMS AND WALL CLADDING SYSTEMS
   - ANCHORAGE, SUPPORTS AND BRACINGS OF ELECTRICAL, PROCESS MECHANICAL AND BUILDING MECHANICAL SYSTEMS AND OTHER EQUIPMENT FOR BOTH GRAVITY AND LATERAL LOADS
   - ATTACHED AND FREE-STANDING SIGNAGE STRUCTURES
2. STRUCTURAL DESIGN OF NON-STRUCTURAL AND SECONDARY STRUCTURAL ELEMENTS IS TO BE PERFORMED BY SUPPORTING REGISTERED PROFESSIONAL RETAINED BY THE CONTRACTOR AND/OR SUPPLIER IN ACCORDANCE TO PART 4 OF THE BUILDING CODE.
3. IN ADDITION TO CONSTRUCTION TOLERANCE, NON-STRUCTURAL AND SECONDARY STRUCTURAL ELEMENTS ARE TO BE DESIGNED FOR VERTICAL DEFLECTIONS AND HORIZONTAL DEFLECTIONS OF THE PRIMARY STRUCTURE.
4. NON-STRUCTURAL AND SECONDARY STRUCTURAL ELEMENTS ARE TO BE DESIGNED TO MINIMIZE TORSIONAL LOADING TO THE PRIMARY STRUCTURAL ELEMENTS.
5. SUBMIT TO THE ENGINEER FOR REVIEW AND APPROVAL:
   - SHOP DRAWING AND CALCULATIONS SIGNED AND SEALED BY SUPPORTING REGISTERED PROFESSIONAL SHOWING THE ELEMENT, DESIGN LOADS, LOADS IMPOSED ON THE PRIMARY STRUCTURE, AND METHOD OF ATTACHMENT TO PRIMARY STRUCTURE
   - FIELD REVIEW REPORT FROM SUPPORTING REGISTERED PROFESSIONAL TO THE RESPECTIVE ELECTRICAL, BUILDING MECHANICAL, PROCESS MECHANICAL ENGINEER-OF-RECORD
   - SCHEDULES S-B AND S-C FROM SUPPORTING REGISTERED PROFESSIONAL TO THE RESPECTIVE ELECTRICAL, BUILDING MECHANICAL, PROCESS MECHANICAL ENGINEER-OF-RECORD.

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
SCREEN BUILDING
GENERAL NOTES SHEET 1

DRAWING	REVISION	SHEET
2972-00-S-011	0	49 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

POST-INSTALLED ANCHORS

1) EXCEPT WHERE INDICATED ON THE DRAWINGS, POST-INSTALLED ANCHORS SHALL CONSIST OF THE FOLLOWING ANCHOR TYPES AS PROVIDED BY HILTI, INC. CONTACT HILTI AT (800) 679-8000 FOR PRODUCT RELATED QUESTIONS.

a) ANCHORAGE TO CONCRETE

i) ADHESIVE ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI HIT-HY 200 SAFE SET SYSTEM WITH THE HILTI HIT-Z ROD
(2) HILTI HIT-HY 200 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH HAS-E THREADED ROD
(3) HILTI HIT-RE 500v3 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH HAS-E THREADED ROD
(4) HILTI HIT-RE 500v3 SAFE SET SYSTEM WITH HILTI ROUGHENING TOOL (HIT RT) WITH HAS-E THREADED ROD PER ICC ESR-3814 FOR DIAMOND CORED HOLES

ii) MEDIUM DUTY MECHANICAL ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI KWIK HUS EZ AND KWIK HUS EZ-I SCREW ANCHORS PER ICC ESR-3027
(2) HILTI KWIK BOLT-TZ EXPANSION ANCHORS PER ICC ESR-1917
(3) HILTI KWIK BOLT 3 EXPANSION ANCHORS (UNCRACKED CONCRETE ONLY) PER ICC ESR-2302

iii) HEAVY DUTY MECHANICAL ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI HDA UNDERCUT ANCHORS PER ICC ESR 1546
(2) HILTI HSL-3 EXPANSION ANCHORS PER ICC ESR 1545

b) REBAR DOWELING INTO CONCRETE

i) ADHESIVE ANCHORS FOR CRACKED AND UNCRACKED CONCRETE USE:
(1) HILTI HIT-HY 200 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH CONTINUOUSLY DEFORMED REBAR PER ICC ESR-3187
(2) HILTI HIT-HY 500v3 SAFE SET SYSTEM (TE-CD OR TE-YD, HILTI HOLLOW DRILL BIT AND VC 20/40 VACUUM SYSTEM) WITH CONTINUOUSLY DEFORMED REBAR PER ICC ESR-3814
(3) HILTI HIT-RE 500v3 SAFE SET SYSTEM WITH HILTI ROUGHENING TOOL (HIT RT) WITH CONTINUOUSLY DEFORMED REBAR PER ICC ESR-3814 IN DIAMOND CORED HOLES

c) ANCHORAGE TO SOLID GROUTED MASONRY

i) ADHESIVE ANCHORS USE:
(1) HILTI HIT-HY 200 SAFE SET SYSTEM.
(2) STEEL ANCHOR ELEMENT SHALL BE HILTI HAS-E CONTINUOUSLY THREADED ROD OR CONTINUOUSLY DEFORMED STEEL REBAR

ii) MECHANICAL ANCHORS USE:
(1) HILTI KWIK BOLT-3 EXPANSION ANCHORS PER ICC ESR 1385

d) ANCHORAGE TO HOLLOW / MULTI-WYTHE MASONRY

i) ADHESIVE ANCHORS USE:
(1) HILTI HIT-HY 70 MASONRY ADHESIVE ANCHORING SYSTEM PER ICC ESR-3342.
(2) STEEL ANCHOR ELEMENT SHALL BE HILTI HAS-E CONTINUOUSLY THREADED ROD OR CONTINUOUSLY DEFORMED STEEL REBAR
(3) THE APPROPRIATE SIZE SCREEN TUBE SHALL BE USED PER ADHESIVE MANUFACTURER'S RECOMMENDATION

2) ANCHOR CAPACITY USED IN DESIGN SHALL BE BASED ON THE TECHNICAL DATA PUBLISHED BY HILTI OR SUCH OTHER METHOD AS APPROVED BY THE STRUCTURAL ENGINEER OF RECORD. SUBSTITUTION REQUESTS FOR ALTERNATE PRODUCTS MUST BE APPROVED IN WRITING BY THE STRUCTURAL ENGINEER OF RECORD PRIOR TO USE. CONTRACTOR SHALL PROVIDE CALCULATIONS DEMONSTRATING THAT THE SUBSTITUTED PRODUCT IS CAPABLE OF ACHIEVING THE PERFORMANCE VALUES OF THE SPECIFIED PRODUCT. SUBSTITUTIONS WILL BE EVALUATED BY THEIR HAVING AN ICC ESR SHOWING COMPLIANCE WITH THE RELEVANT BUILDING CODE FOR SEISMIC USES, LOAD RESISTANCE, INSTALLATION CATEGORY, AND AVAILABILITY OF COMPREHENSIVE INSTALLATION INSTRUCTIONS. ADHESIVE ANCHOR EVALUATION WILL ALSO CONSIDER CREEP, IN-SERVICE TEMPERATURE AND INSTALLATION TEMPERATURE.

3) INSTALL ANCHORS PER THE MANUFACTURER INSTRUCTIONS, AS INCLUDED IN THE ANCHOR PACKAGING.

4) OVERHEAD ADHESIVE ANCHORS MUST BE INSTALLED USING THE HILTI PROFI SYSTEM.

5) THE CONTRACTOR SHALL ARRANGE AN ANCHOR MANUFACTURER'S REPRESENTATIVE TO PROVIDE ONSITE INSTALLATION TRAINING FOR ALL OF THEIR ANCHORING PRODUCTS SPECIFIED. THE STRUCTURAL ENGINEER OF RECORD MUST RECEIVE DOCUMENTED CONFIRMATION THAT ALL OF THE CONTRACTOR'S PERSONNEL WHO INSTALL ANCHORS ARE TRAINED PRIOR TO THE COMMENCEMENT OF INSTALLING ANCHORS.

6) ANCHOR CAPACITY IS DEPENDANT UPON SPACING BETWEEN ADJACENT ANCHORS AND PROXIMITY OF ANCHORS TO EDGE OF CONCRETE. INSTALL ANCHORS IN ACCORDANCE WITH SPACING AND EDGE CLEARANCES INDICATED ON THE DRAWINGS.

7) EXISTING REINFORCING BARS IN THE CONCRETE STRUCTURE MAY CONFLICT WITH SPECIFIC ANCHOR LOCATIONS. UNLESS NOTED ON THE DRAWINGS THAT THE BARS CAN BE CUT, THE CONTRACTOR SHALL REVIEW THE EXISTING STRUCTURAL DRAWINGS AND SHALL UNDERTAKE TO LOCATE THE POSITION OF THE REINFORCING BARS AT THE LOCATIONS OF THE CONCRETE ANCHORS, BY HILTI FERROSCAN, GPR, X-RAY, CHIPPING OR OTHER MEANS.

8) PROOF LOADING PROGRAM

a) WHEN SUBSTITUTING EMBEDDED ANCHORAGE SYSTEM OR WHERE REQUIRED BY ENGINEER, A PROGRAM FOR ON-SITE PROOF LOADING, THAT IS, PROOF LOADING PROGRAM, TO BE CONDUCTED AS PART OF THE INSPECTION PROGRAM AT THE COST OF CONTRACTOR EXPENSE. THE PROOF LOADING PROGRAM SHALL CONFORM TO THE FOLLOWING MINIMUM REQUIREMENTS AS PER ACI 308
i) FREQUENCY OF PROOF LOADING BASED ON ANCHOR TYPE, DIAMETER, AND EMBEDMENT.
ii) PROOF LOADS BY ANCHOR TYPE, DIAMETER, EMBEDMENT, AND LOCATION
iii) ACCEPTABLE DISPLACEMENT AT PROOF LOAD.
iv) REMEDIAL ACTION IN THE EVENT OF FAILURE TO ACHIEVE PROOF LOAD OR EXCESSIVE DISPLACEMENT.
b) UNO, PROOF LOADS SHALL BE APPLIED AS CONFINED TENSION TEST (4.7.3.2). PROOF LOAD LEVELS SHALL NOT EXCEED THE LESSER OF 67% OF THE LOAD CORRESPONDING TO THE NOMINAL BOND STRENGTH AS CALCULATED FROM THE CHARACTERISTIC BOND STRESS FOR UNCRACKED CONCRETE MODIFIED FOR EDGE EFFECTS AND CONCRETE PROPERTIES OR 80% OF THE MINIMUM SPECIFIED ANCHOR ELEMENT YIELD STRENGTH. MAINTAIN THE PROOF LOAD AT THE REQUIRED LOAD LEVEL FOR A MINIMUM OF 10 SECONDS.

SHOP DRAWINGS AND SPECIALTY ENGINEER:

1. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE SHOP DRAWINGS AND ENSURING CONFORMANCE TO DRAWINGS AND CONTRACT DOCUMENTS PRIOR TO THE SHOP DRAWING REVIEW OF THE ENGINEER. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING ALL SUB-TRADES, SUBCONTRACTORS, SUPPLIERS AND SUPPORTING REGISTERED PROFESSIONALS.

2. SUBCONTRACTORS AND SUPPLIERS SHALL SUBMIT SHOP DRAWINGS TO THE ENGINEER AND CONTRACTOR FOR REVIEW PRIOR TO FABRICATION. SHOP DRAWINGS ARE TO BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROJECT PROVINCE/TERRITORY WHO WILL BE THE SUPPORTING REGISTERED PROFESSIONAL (SRP) RESPONSIBLE FOR THE DESIGN AND FIELD REVIEW OF THE PARTICULAR COMPONENT OR SYSTEM.

3. WHERE REQUIRED IN THE FOLLOWING SECTIONS, THE SUPPORTING REGISTERED PROFESSIONAL (SRP) SHALL CONDUCT FIELD REVIEWS DURING CONSTRUCTION AT THE DISCRETION OF THE SRP AND SUBMIT A WRITTEN FIELD REVIEW REPORT TO THE ENGINEER. THE SRP SHALL SUBMIT SEALED LETTERS OF ASSURANCE B AND C-B OR SCHEDULES S-B AND S-C FOR ASSURANCE OF DESIGN AND FIELD REVIEW OF THE PARTICULAR COMPONENT OR SYSTEM.

4. THE SHOP DRAWING REVIEW IS CONDUCTED FOR THE SOLE PURPOSE OF ENSURING GENERAL CONFORMANCE TO THE DESIGN CONCEPT. THE SHOP DRAWING REVIEW DOES NOT GUARANTEE THE SUBCONTRACTOR OR SUPPLIER'S DESIGN, DETAILS, QUANTITIES, DIMENSIONS, METHOD OF CONSTRUCTION, AND SAFETY MEASURES. THE CONTRACTOR IS RESPONSIBLE FOR ANY ERRORS/AND OR OMISSIONS IN THE SHOP DRAWINGS AND MEETING THE REQUIREMENTS OF THE CONSTRUCTION AND CONTRACT DOCUMENTS.

5. THE SHOP DRAWINGS SHALL INDICATE THE METHOD AND MEANS OF ATTACHMENT TO THE PRIMARY STRUCTURAL SYSTEM AS WELL AS THE DESIGN LOADS AND CRITERIA USED AS THE BASIS OF DESIGN OF THE PARTICULAR COMPONENT OR SYSTEM.

DESIGN DATA:

1. FOOTING FOUNDATIONS BEARING PRESSURE 70 kPa (ULS) ON NATIVE SILT

2. DESIGN LIVE LOADS (SERVICE):

STAIRWAYS AND PLATFORM	4.8 kPa
BUILDING FLOOR	4.8 kPa

3. SEISMIC LOADING:

SITE CLASS	D
IMPORTANCE FACTOR	Ie = 1.5
Sa (0.2)	0.76
Sa (0.5)	0.56
Sa (1.0)	0.30
Sa (2.0)	0.16
MODIFICATION FACTORS (SEISMIC)	Rd = 2.0

4. SNOW LOADING:

IMPORTANCE FACTOR	Is = 1.25
GROUND SNOW LOAD	Ss = 3.0 kPa
RAIN LOAD	Sr = 0.4 kPa

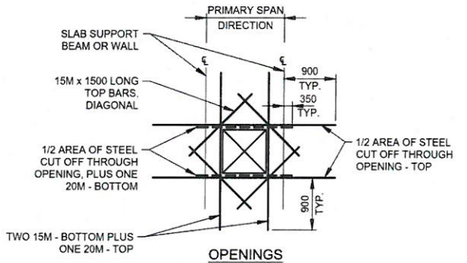
5. WIND LOADING:

IMPORTANCE FACTOR	Iw = 1.25
WIND 1/10	q = 0.25 kPa
WIND 1/50	q = 0.32 kPa

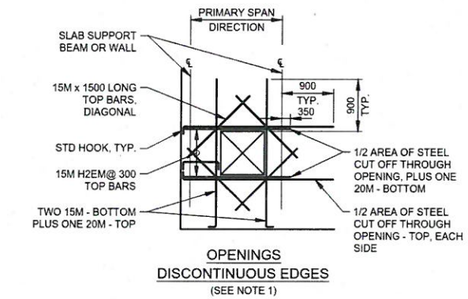
6. SUPERIMPOSED CONTROL BUILDING ROOF DEAD LOAD 1.5 kPa

DESIGN CODES STANDARDS REGULATIONS:

- BRITISH COLUMBIA BUILDING CODE 2012



OPENINGS
CONTINUOUS EDGES
(SEE NOTE 1)



OPENINGS
DISCONTINUOUS EDGES
(SEE NOTE 1)

NOTES:

1. THIS DESIGN STANDARD APPLIES TO ADDITIONAL REINFORCING AROUND OPENINGS SMALLER THAN 1500 PERPENDICULAR TO THE SPAN DIRECTION, INCLUDING CIRCULAR OPENINGS LESS THAN 1500 DIAMETER. FOR ADDITIONAL REINFORCING AROUND LARGER OPENINGS SEE THE DRAWINGS.

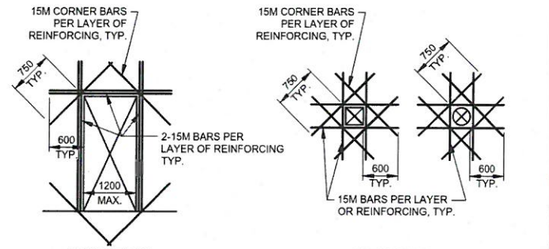
A. THIS STANDARD DETAIL APPLIES TO OPENINGS LARGER THAN 300 BUT LESS THAN 1500 PERPENDICULAR TO THE SPAN DIRECTION. CIRCULAR OPENINGS 300 TO 1500 IN DIAMETER REQUIRE SIMILAR REINFORCING.

B. OPENINGS LESS THAN 300 PERPENDICULAR TO THE SPAN DIRECTION AND LESS THAN 600 PARALLEL TO THE SPAN, SHALL NOT REQUIRE ADDITIONAL REINFORCING. ANY BARS CONFLICTING WITH THE OPENING SHALL BE DEFLECTED AROUND THE OPENING.

C. OPENINGS LESS THAN 300 PERPENDICULAR TO THE SPAN DIRECTION AND GREATER THAN 600 PARALLEL TO THE SPAN, REQUIRE BOTH DIAGONAL AND PERPENDICULAR TO SPAN ADDITIONAL REINFORCING AS SHOWN ON THIS STANDARD DETAIL.

2. LIMITATIONS: THIS STANDARD IS NOT APPLICABLE FOR SLABS SUBJECT TO DYNAMIC OR HEAVY EQUIPMENT (AND/OR MACHINERY) LOADING.

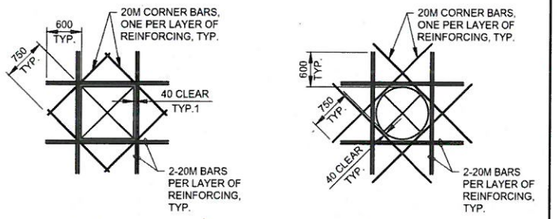
1 - DETAIL
ADDITIONAL REINFORCEMENT AROUND OPENING IN CONCRETE SLAB



ELEVATION
ADDITIONAL REINFORCEMENT AT DOORWAYS

ELEVATION
AT WALL OPENINGS UP TO 300 MAXIMUM

2 - DETAIL
ADDITIONAL REINFORCEMENT AROUND OPENING IN CONCRETE WALL



ELEVATION
ADDITIONAL REINFORCEMENT AT WALL OPENINGS 300 TO 1200 MAXIMUM

ELEVATION
ADDITIONAL REINFORCEMENT AT CIRCULAR OPENINGS 300Ø TO 1200Ø MAXIMUM

NOTES:

1. THE NUMBER OF REINFORCING BARS CUT AT AN OPENING SHALL BE KEPT TO A MINIMUM. DEFLECT AS MANY BARS AROUND OPENING AS POSSIBLE.
2. REINFORCING BARS SHALL HAVE A MINIMUM 40mm CONCRETE COVER.
3. WHERE REINFORCING ON A DRAWING DIFFERS FROM THIS DESIGN STANDARD, THE DRAWING SHALL GOVERN.

3 - DETAIL
ADDITIONAL REINFORCEMENT AROUND OPENING IN CONCRETE WALL , U.N.O.

ONLY FOR : 32MPa CONCRETE , NORMAL WEIGHT
400MPa REINFORCING BAR

BAR SIZE	TOP BARS (mm)		OTHER BARS (mm)	
	CLASS A	CLASS B	CLASS A	CLASS B
10M	390	500	300	390
15M	550	710	420	550
20M	670	870	520	670
25M	1080	1400	830	1080
30M	1280	1660	990	1280
35M	1530	1990	1180	1530

NOTES:
1. TOP BARS ARE:
a) ALL BARS IN CONCRETE WITH MORE THAN 300mm CONCRETE BELOW.
b) ALL HORIZONTAL BARS IN WALLS.
2. PROVIDE CLASS B LAP UNLESS NOTED OTHERWISE.
LAP SPLICE LENGTHS SHOWN IN THE TABLE ARE BASED ON HEAVIER
3. CONFINED BARS.
4. TABLE APPLIES UNLESS SHOWN OTHERWISE.
5. DEVELOPMENT LENGTHS ARE EQUAL TO CLASS A LAP SPLICES.

4 - DETAIL
REINFORCING BAR TENSION LAP SPLICE TABLE

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34152

JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
SCREEN BUILDING
GENERAL NOTES SHEET 2

DRAWING	REVISION	SHEET
2972-00-S-012	0	50 / 111

IF NOT 50 mm ADJUST SCALES
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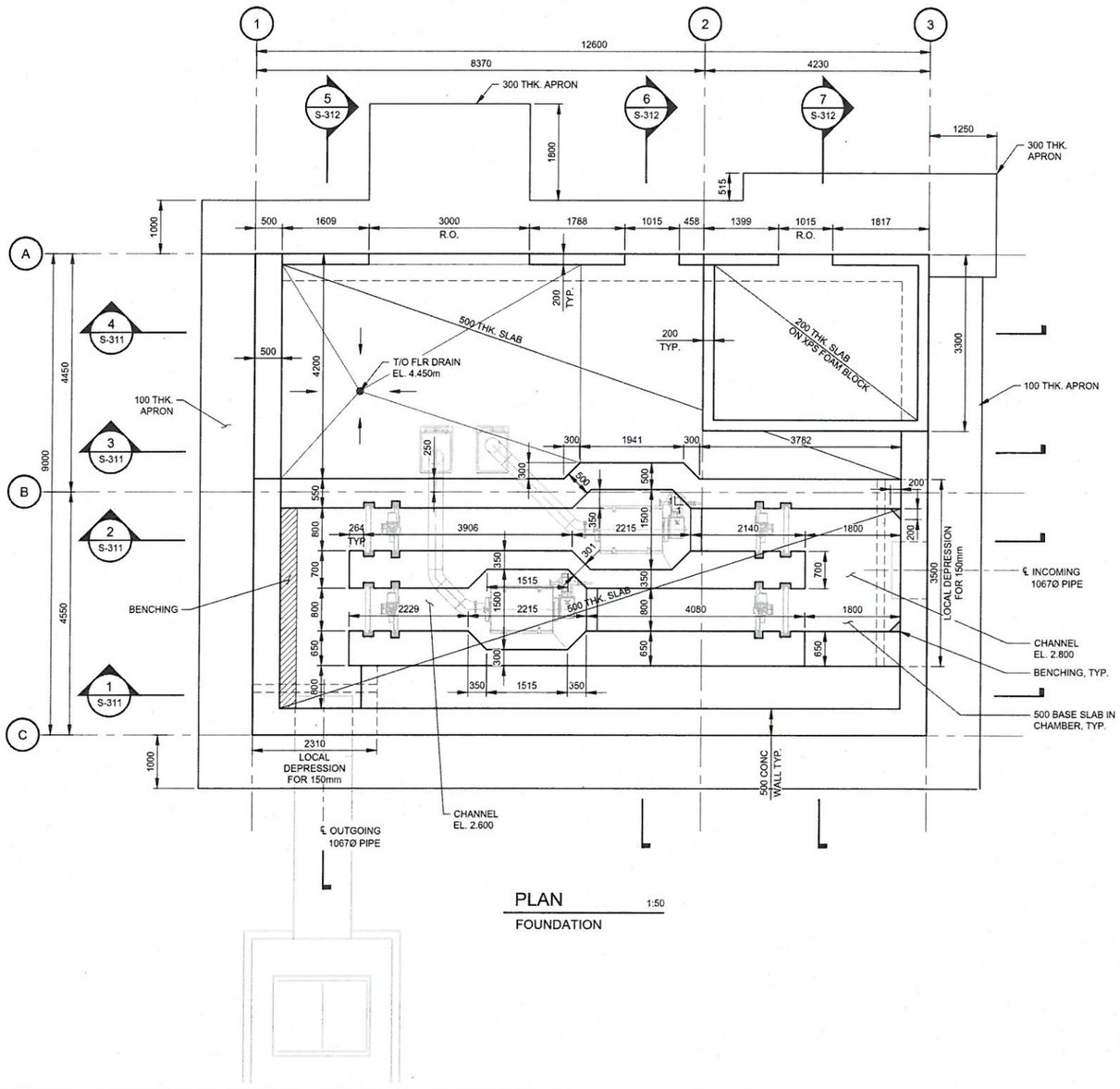

PLAN 1:50
FOUNDATION

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THE CITY OF Port Alberni

STRUCTURAL
SCREEN BUILDING
FOUNDATION PLAN

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2972-00-S-111	0	51 / 111

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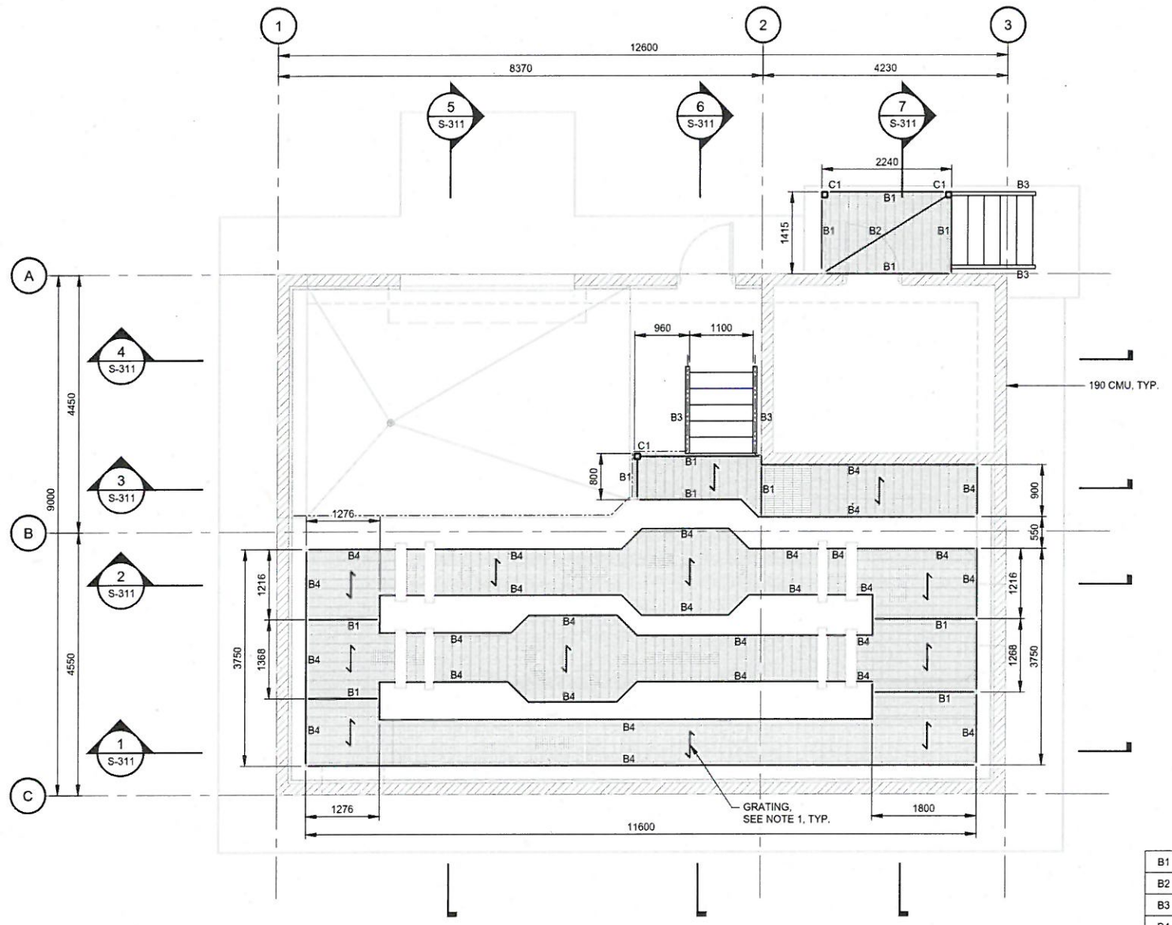

PLAN 1:50
PLATFORM LAYOUT

B1	W200x27
B2	L102x102x6.4
B3	C250x23
B4	L152x152x8
C1	HSS 127x127x8

NOTES:

1. FRP MOLDED HLC GRATING 50x25x50 C/W REMOVABLE CLIP. TYP.
2. ALL STEEL TO BE GALVANIZED.
3. STEEL FABRICATOR TO DESIGN STEEL PLATFORM CONNECTIONS. DESIGN FOR FACTORED SHEAR OF 10kN AND FACTORED AXIAL COMPRESSION OF 15kN.

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STRUCTURAL
SCREEN BUILDING
PLATFORM LAYOUT PLAN

DRAWING	REVISION	SHEET
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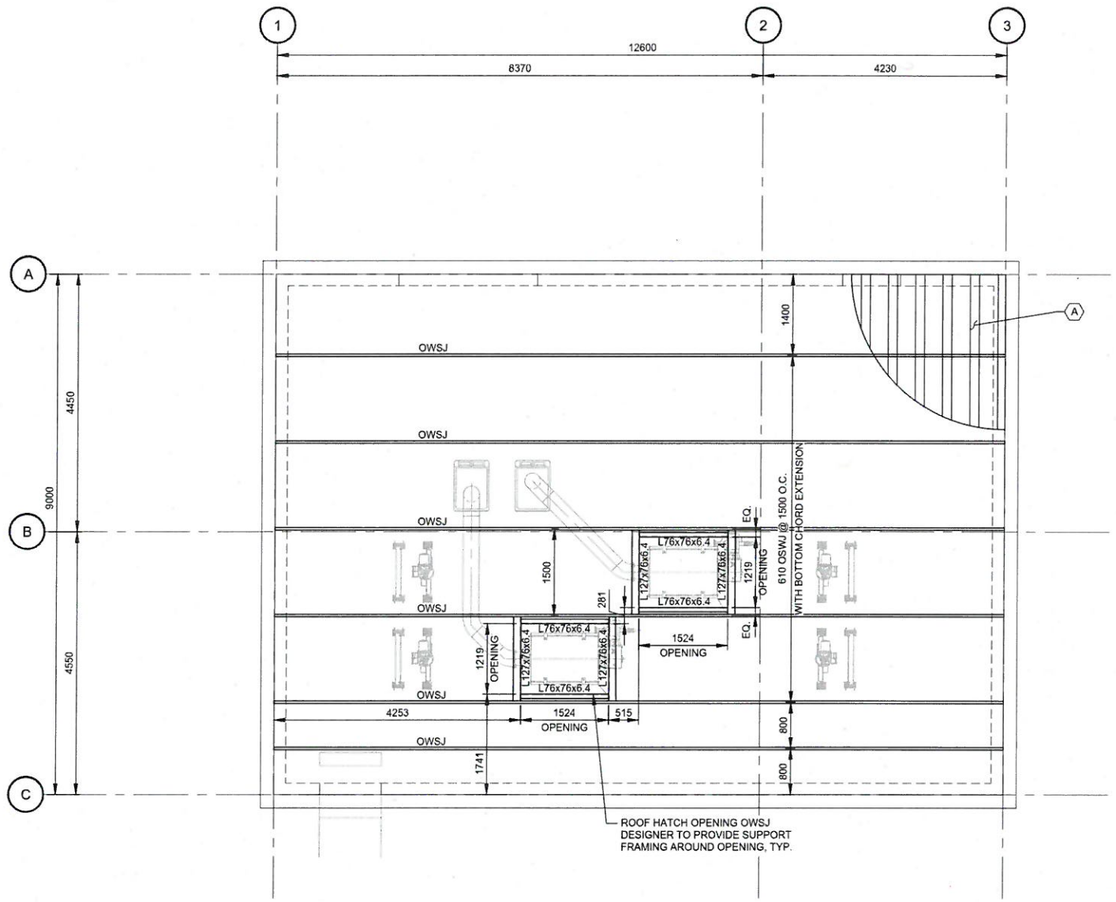
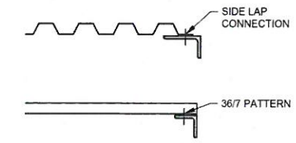
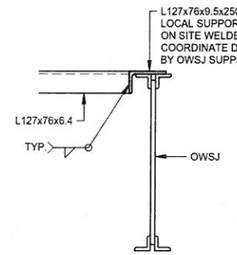


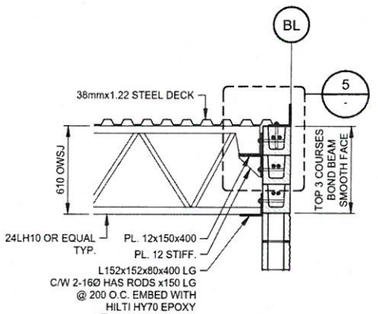
PLAN 1:50
ROOF LAYOUT PLAN



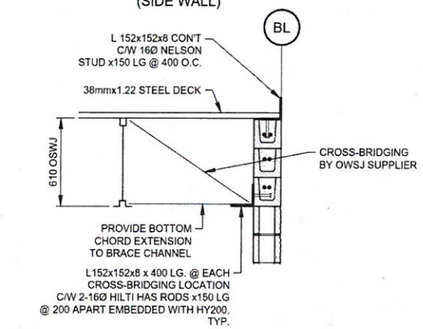
3 - DETAIL 1:10
DECK OPENING



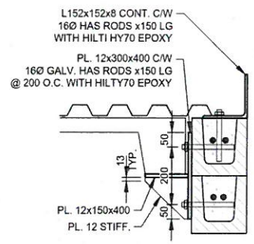
4 - DETAIL 1:10
OPENING AT JOIST



1 - DETAIL 1:20
ROOF AND PARAPET
(SIDE WALL)



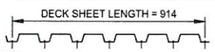
2 - DETAIL 1:20
ROOF AND PARAPET
(END WALL)



5 - DETAIL 1:10

ROOF DECK FASTENING PATTERNS

ZONE	DECK THICKNESS (GAUGE)	FRAME FASTENER	FASTENING PATTERNS	SIDELAP FASTENER SPACING	MIN. FACTORED DECK SHEAR CAPACITY REQ'D
(A)	18	X-ENP-19 OR X-HSN-24	36/7 (914/7)	150mm	15 kN/m



NOTES:

1. SEE GENERAL NOTES ON DWG. S-011
2. STEEL ROOF DECK: CANAM P3615 38 DP. PROFILE OR EQUIVALENT
3. FINISH: Z275 COATING, GRADE 230 MIN.
4. SHEET SPAN: 2 SPAN CONTINUOUS
5. FRAME CONNECTION: HILTI POWDER ACTUATED DRIVE PINS FRAME < 6 THK. HILTI X-ENP-19
6. SIDELAP CONNECTION: HILTI S-SLC 01 M HWH @ 150 O.C.
7. PERIMETER FASTENING:
   - PERPENDICULAR TO FLUTE: HILTI DRIVE PINS AT 36/7 FASTENING PATTERN
   - PARALLEL FLUTE: HILTI DRIVE PINS @ 150 O.C.
   - DRAG/TIE STRUT: HILTI DRIVE PINS @ 150 O.C.
8. SHEET END LAPS: MINIMUM 150 LAP HILTI S-MD 12-24X1-5/8 M HWH5 RACING TIP-5 (RT5) 36/7 FASTENING PATTERN
9. OPENINGS: OPENINGS < 1000x1000 FRAME WITH L51x51x6.4
10. DECK SUPPLIER TO CONFIRM ON P.ENG SEALED SHOP DWGS THAT DECKING SUPPLIED MEETS SPECIFIED GRAVITY LOADS AND THE MIN. FACTORED DECK SHEAR CAPACITIES ABOVE.
11. STEEL DECK DIAPHRAGM HAS BEEN DESIGNED WITH RdRo=1.3
12. MIN. FACTORED DECK SHEAR CAPACITY TO BE NO LESS THAN 15 kN/m U.N.O.
13. DECKING CONTRACTOR SHALL ARRANGE FOR A HILTI REPRESENTATIVE TO VISIT THE SITE AND PROVIDE APPLICABLE TRAINING TO ALL INSTALLERS.
14. INSTALLATION OF ROOF DECK TO BE REVIEWED ON SITE BY A QUALIFIED INSPECTOR RETAINED BY THE DECK CONTRACTOR.
15. OWSJ SUPPLIER TO SUBMIT P.ENG SEALED SHOP DRAWINGS FOR REVIEW PRIOR TO FABRICATION.

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WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
SCREEN BUILDING
ROOF LAYOUT PLAN

DRAWING	REVISION	SHEET
2972-00-S-113	0	53 / 111

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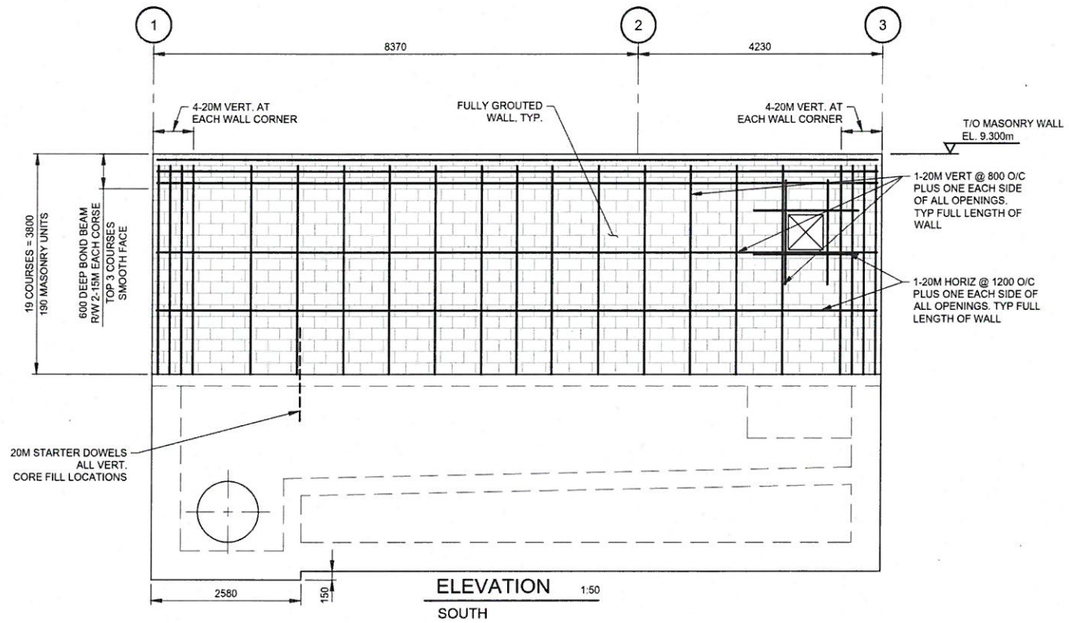
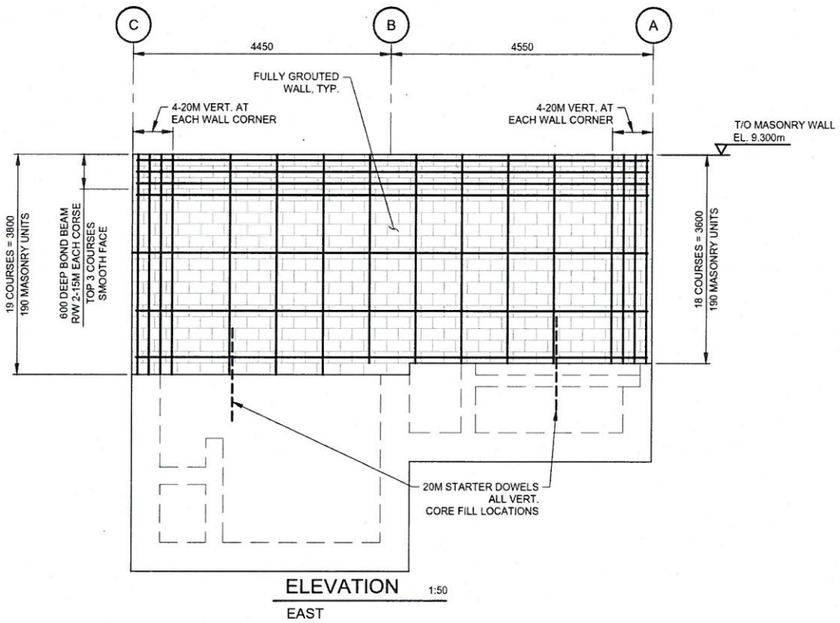
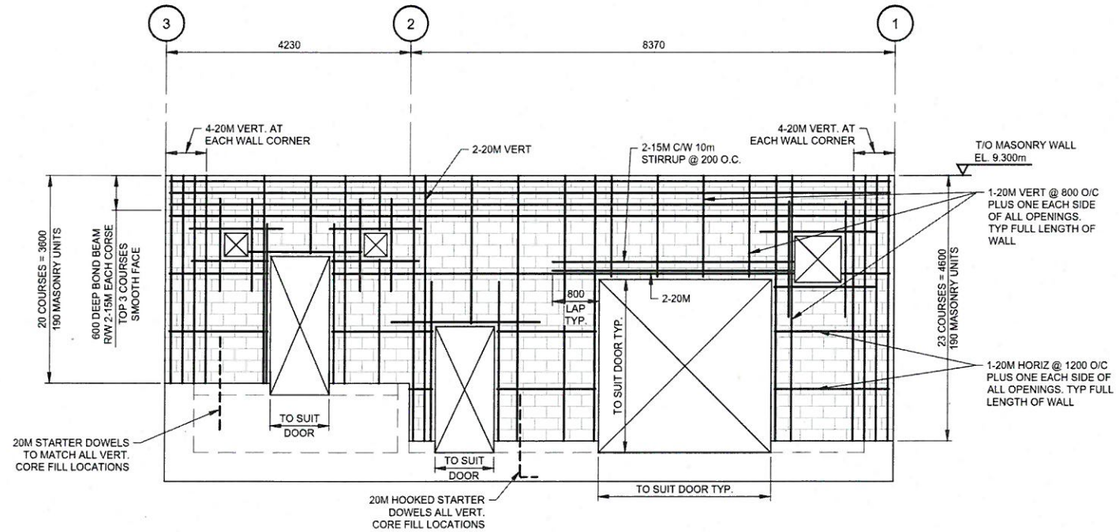


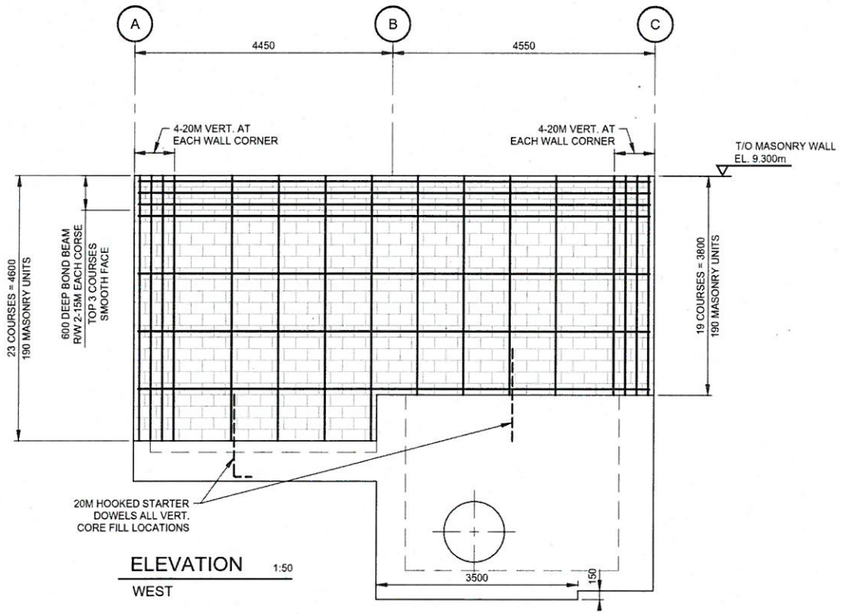
ELEVATION 1:50
SOUTH



ELEVATION 1:50
EAST



ELEVATION 1:50
NORTH



ELEVATION 1:50
WEST

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WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
SCREEN BUILDING
MASONRY WALL ELEVATIONS

DRAWING	REVISION	SHEET
2972-00-S-211	0	54 / 111

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50 mm

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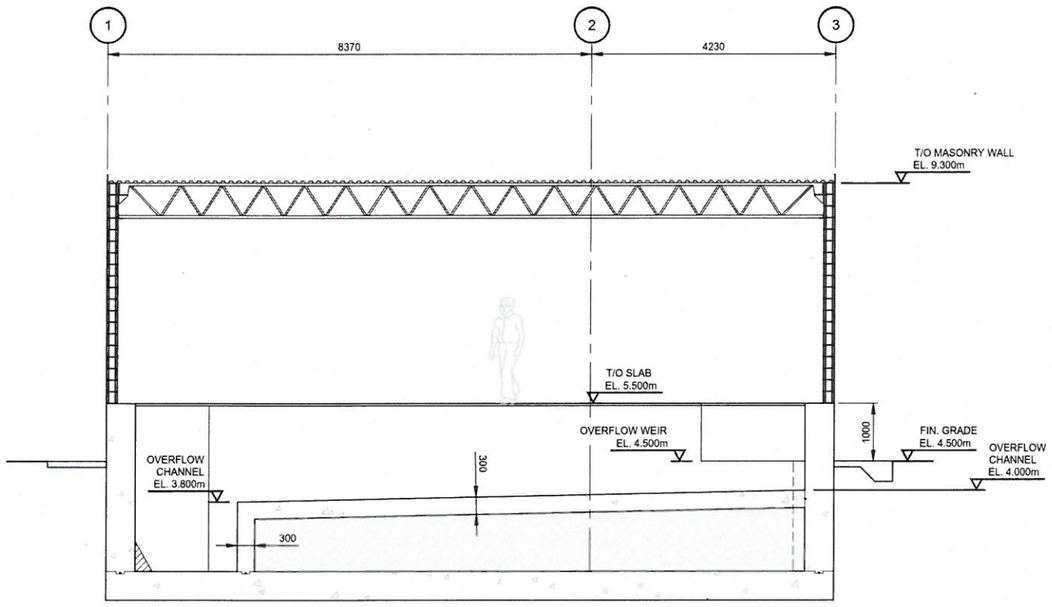
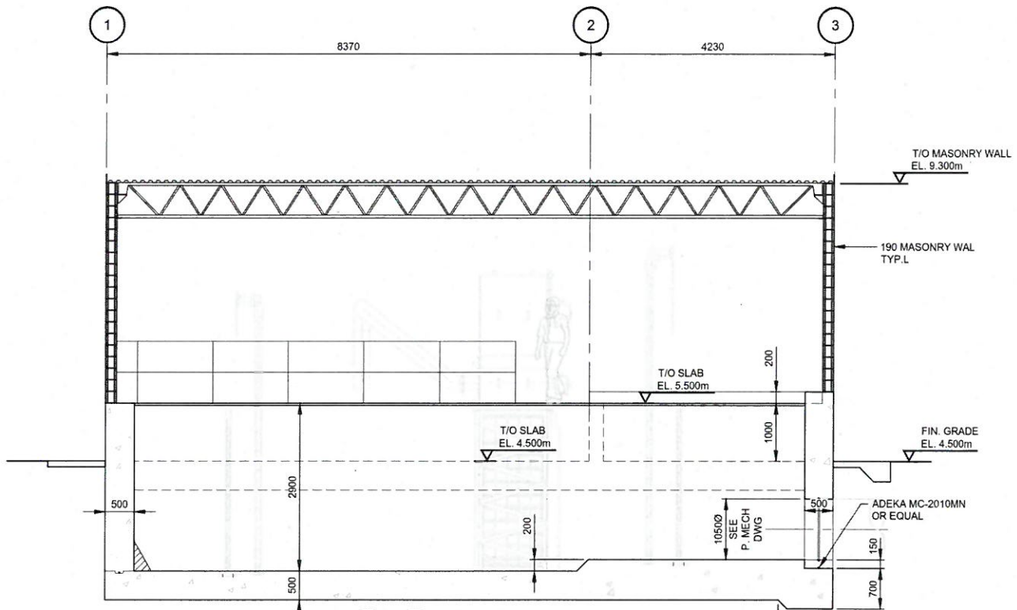
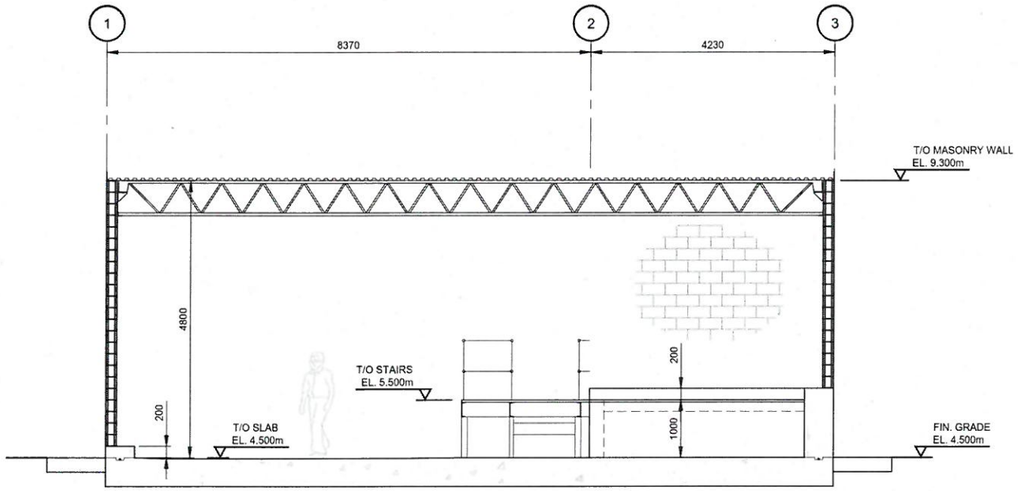


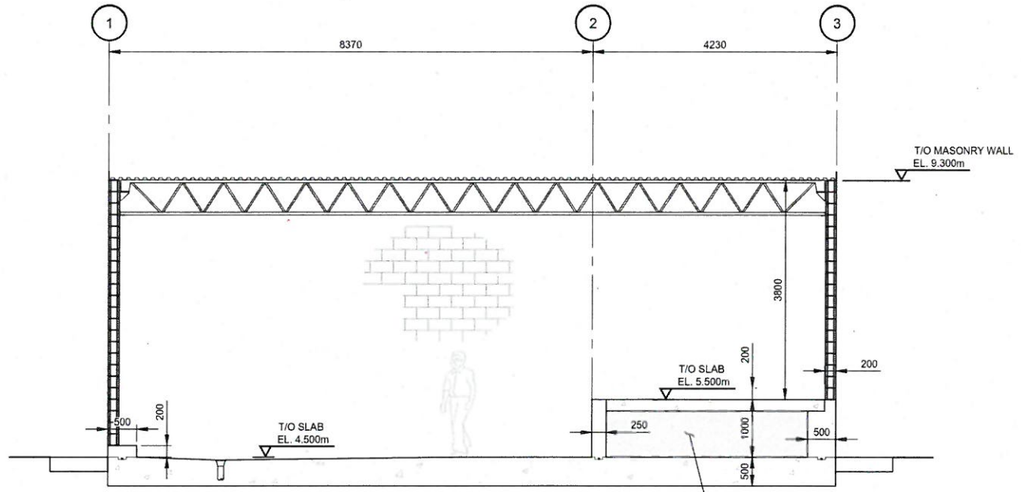
1 S-112 / 1 S-111 SECTION 1:50



2 S-112 / 2 S-111 SECTION 1:50



3 S-112 / 3 S-111 SECTION 1:50



4 S-112 / 4 S-111 SECTION 1:50

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CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

STRUCTURAL
SCREEN BUILDING
SECTIONS SHEET 1

DRAWING	REVISION	SHEET
2972-00-S-311	0	55 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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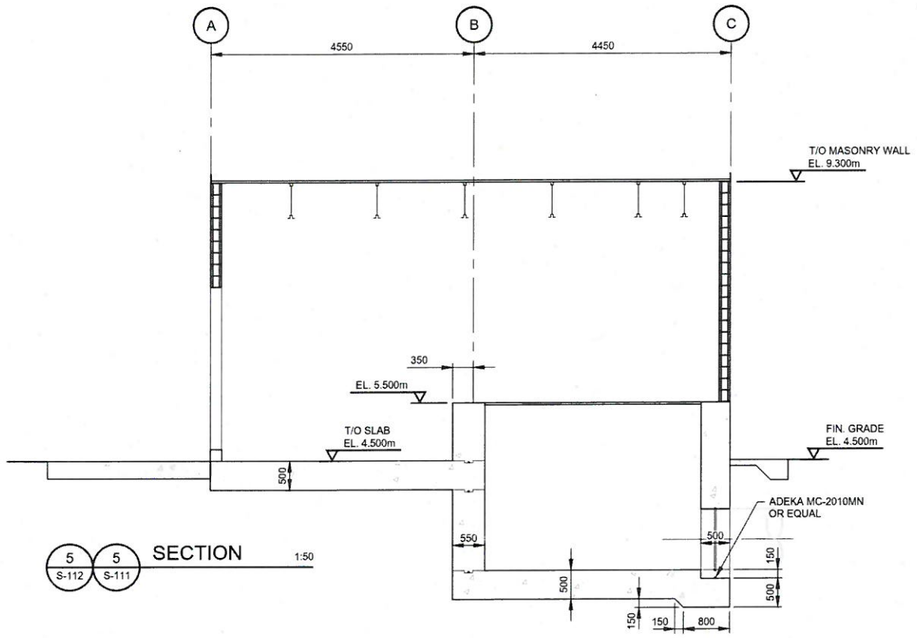
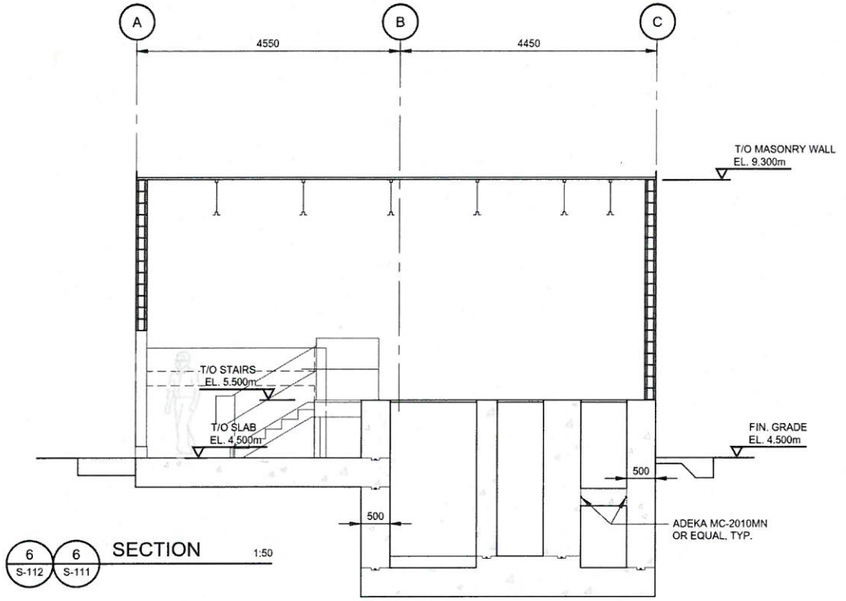
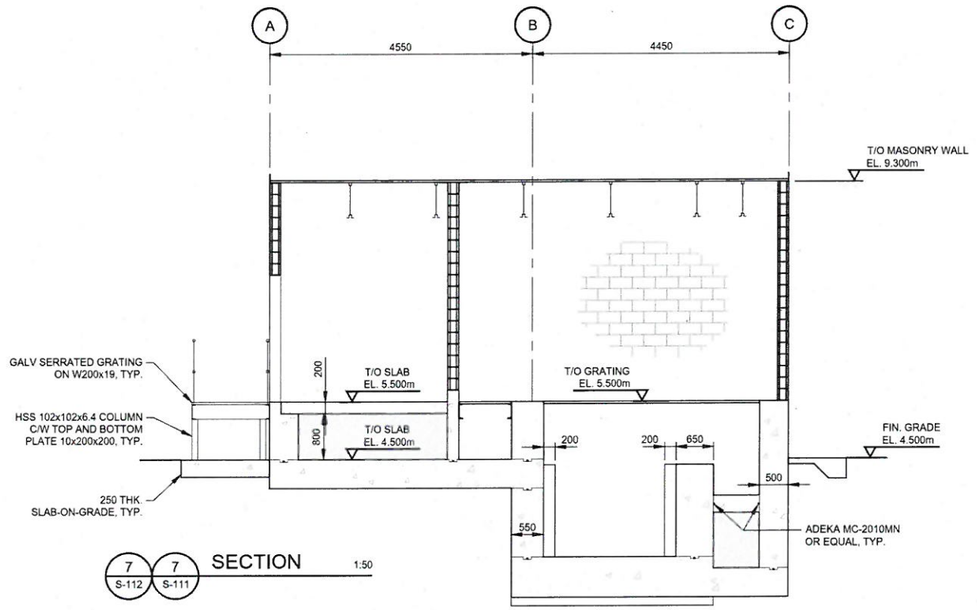


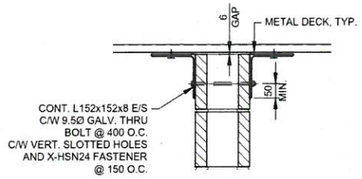
5 / S-112 — 5 / S-111 SECTION 1:50



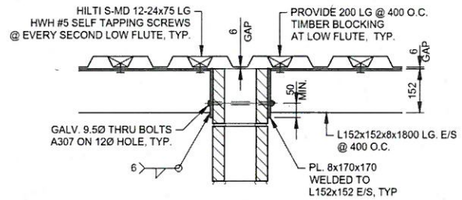
6 / S-112 — 6 / S-111 SECTION 1:50



7 / S-112 — 7 / S-111 SECTION 1:50



1 / - DETAIL 1:10
CMU WALL PERPENDICULAR TO DECK



2 / - DETAIL 1:10
CMU WALL PARALLEL TO DECK

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SECTIONS SHEET 2

DRAWING	REVISION	SHEET
2972-00-S-312	0	56 / 111

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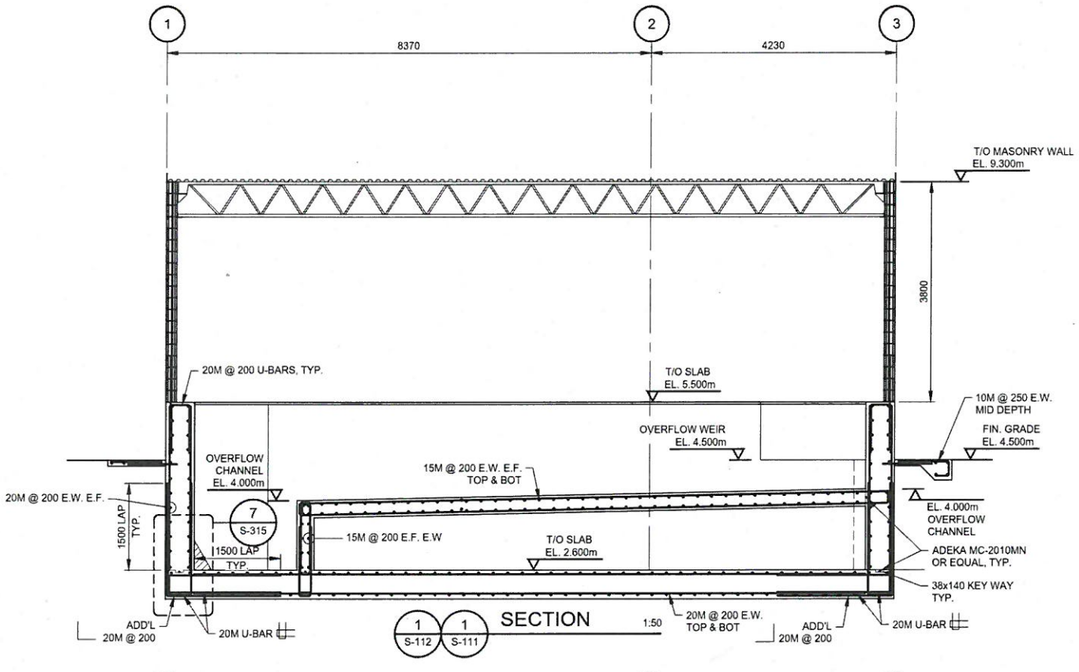
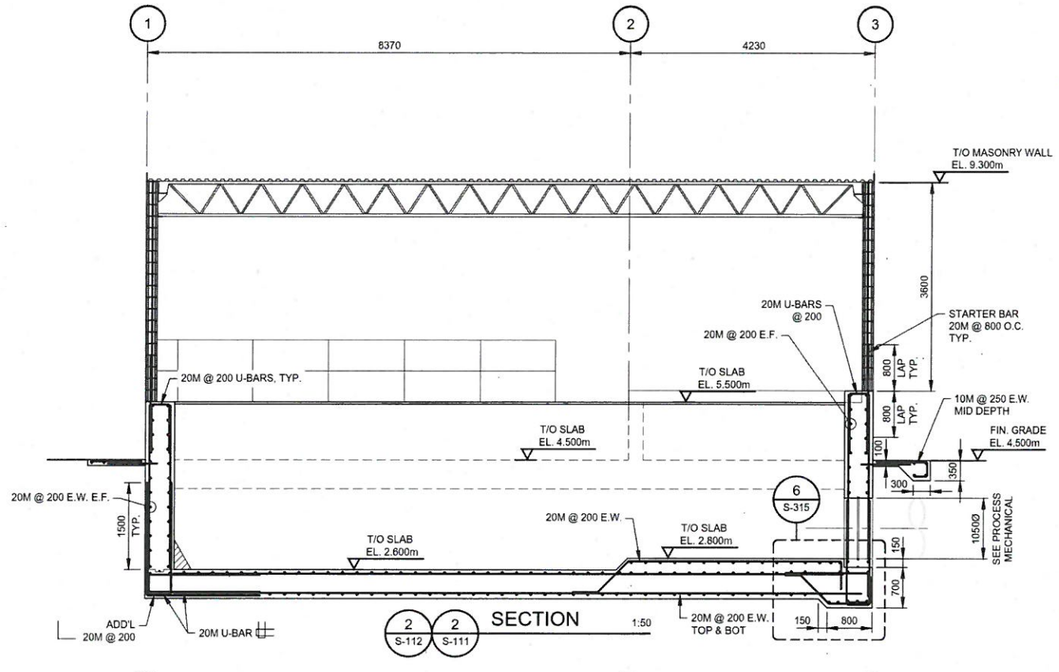
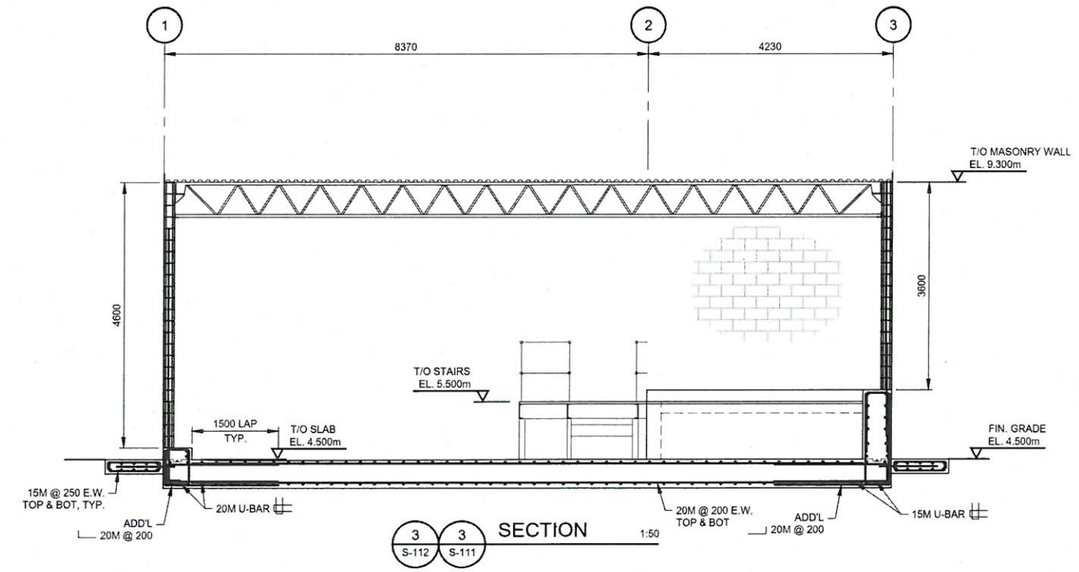
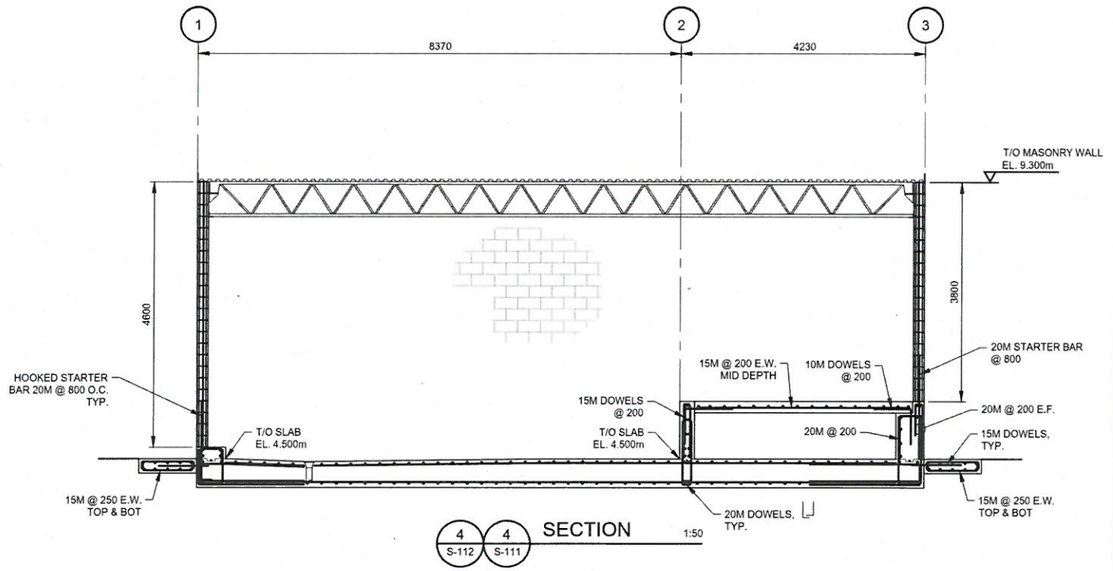
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE









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REINFORCEMENT SECTION SHEET 1

DRAWING	REVISION	SHEET
2972-00-S-313	0	57 / 111

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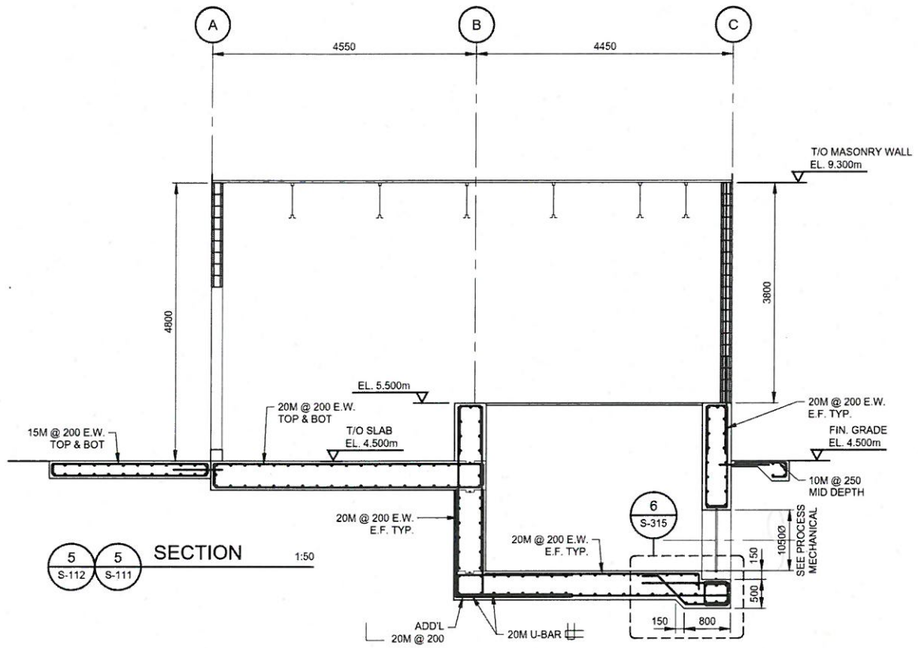

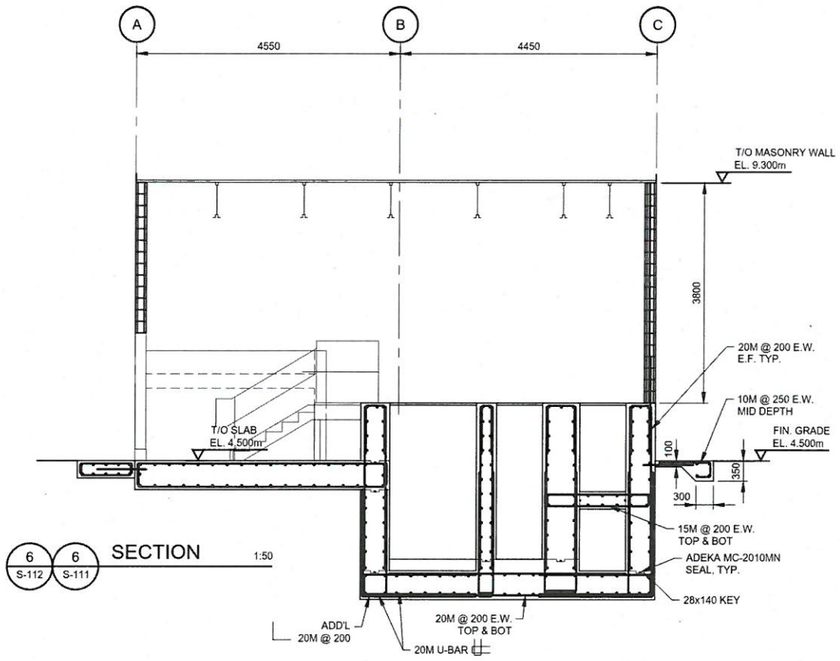

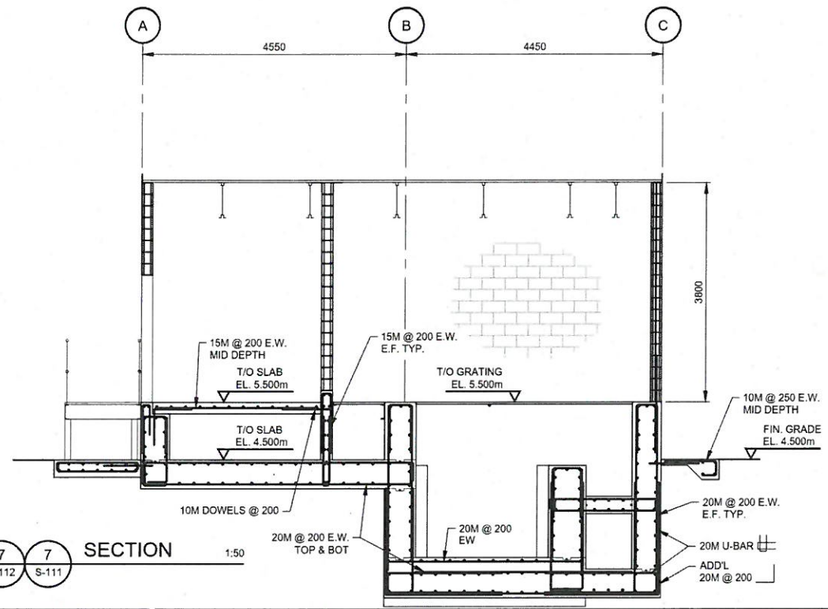

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REINFORCEMENT SECTION SHEET 2

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2972-00-S-314	0	58 / 111

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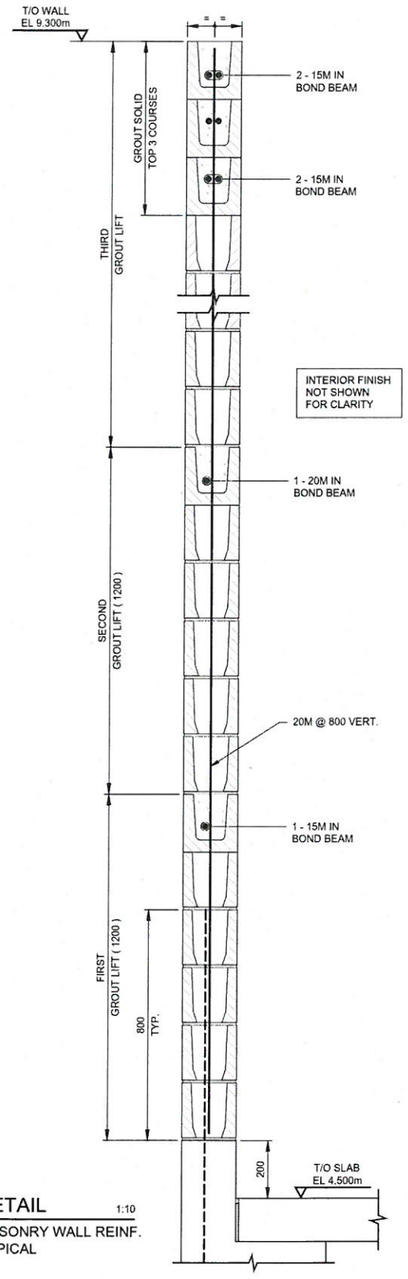
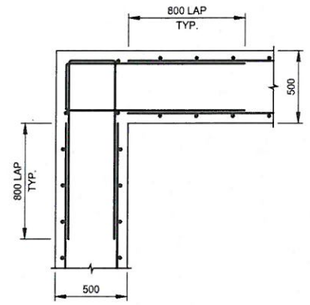
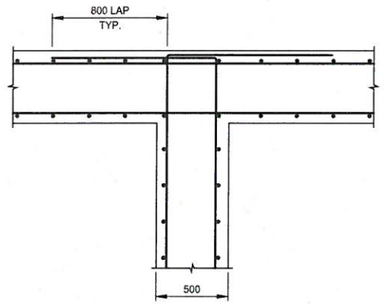


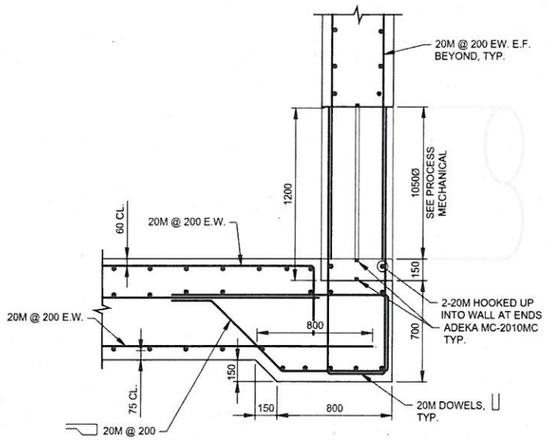
1 - DETAIL 1:10
MASONRY WALL REINF.
TYPICAL



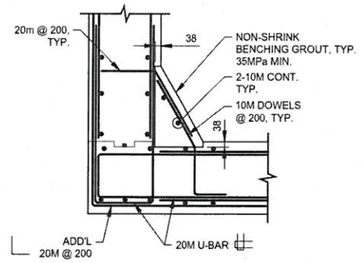
5 - DETAIL 1:10
CONCRETE CORNER
TYP.



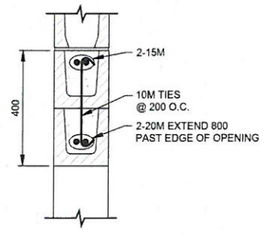
6 - DETAIL 1:10
CONCRETE T-JUNCTION
TYP.



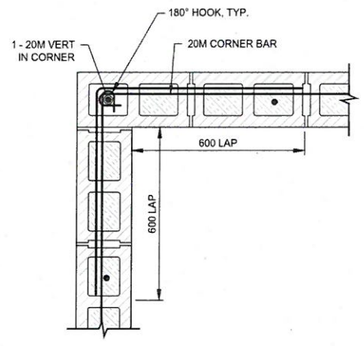
7 - DETAIL 1:20
TYPICAL REINFORCEMENT
AT PIPE PENETRATION



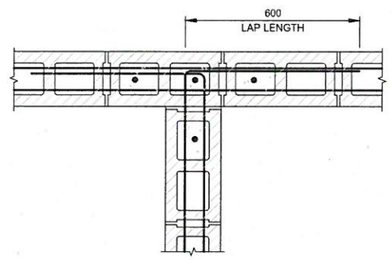
8 - DETAIL 1:20
TYPICAL BENCHING
REINFORCEMENT



2 - DETAIL 1:10
BOND BEAM @ ROLL UP DOOR



3 - DETAIL 1:10
MASONRY CORNER DETAIL
TYP



4 - DETAIL 1:10
MASONRY INTERSECTION
TYP.

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WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

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REINFORCEMENT SECTION SHEET 3

DRAWING	REVISION	SHEET
2972-00-S-315	0	59 / 111

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50 mm

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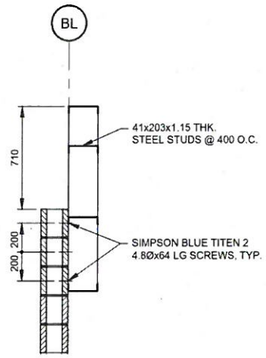
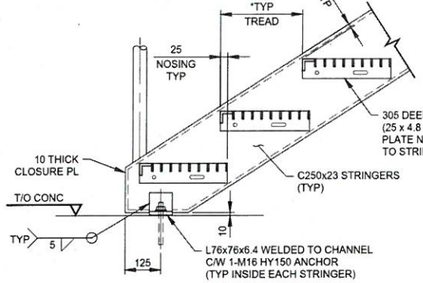
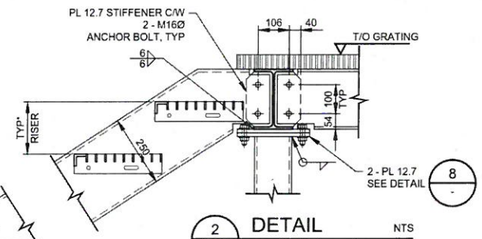


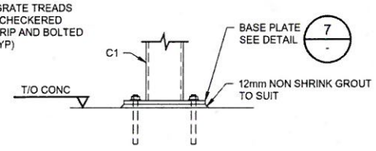
9 DETAIL 1:20
PARAPET



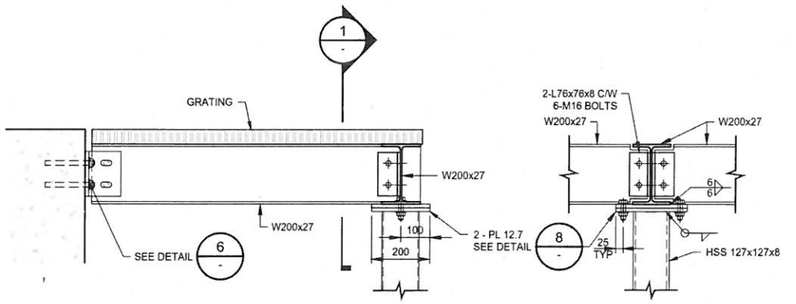
1 DETAIL NTS
STEEL STAIR



2 DETAIL NTS
STEEL STAIR

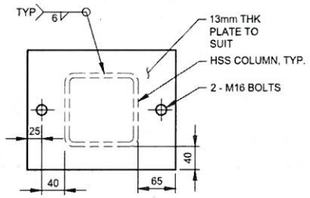


3 DETAIL NTS
COLUMN BASE CONN
TYP

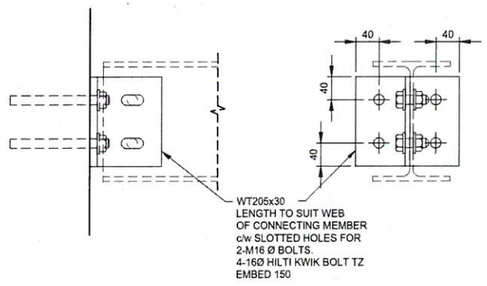


4 DETAIL 1:10
PLATFORM

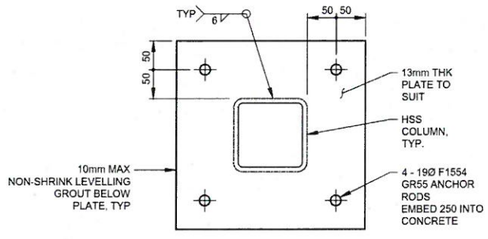
1 SECTION 1:10



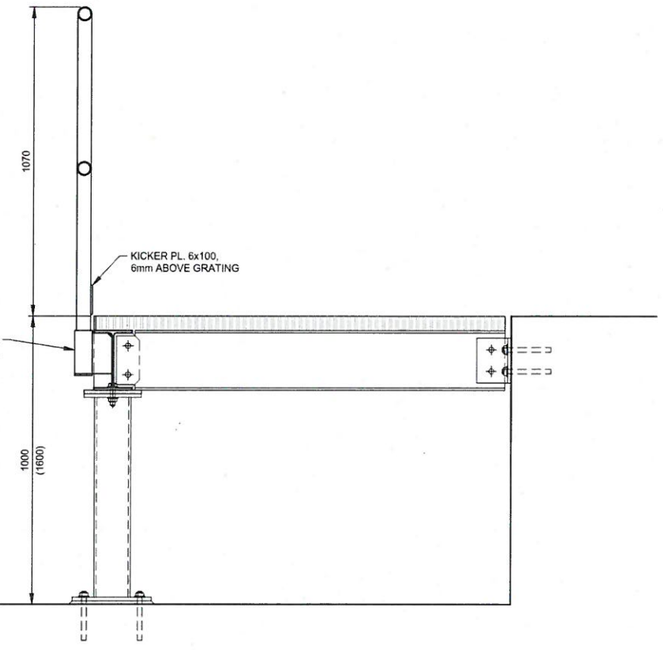
8 DETAIL NTS
TYP. TOP PLATE
HSS 127 / HSS 203 COLUMN



6 DETAIL NTS
TYPICAL CONNECTION
AT CONCRETE INTERFACE



7 DETAIL NTS
TYP. BASE PLATE
HSS 127 / HSS 203 COLUMN



5 DETAIL 1:10

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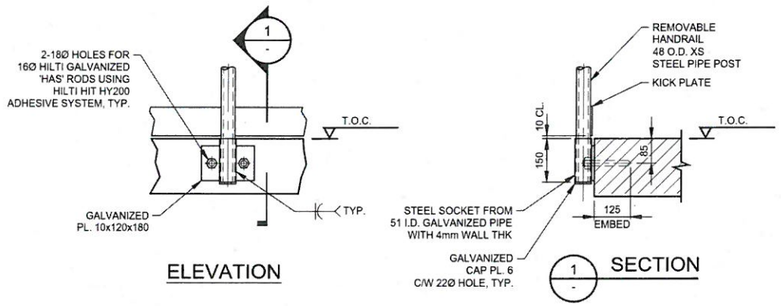
DETAILS SHEET 1

DRAWING	REVISION	SHEET
2972-00-S-511	0	60 / 111

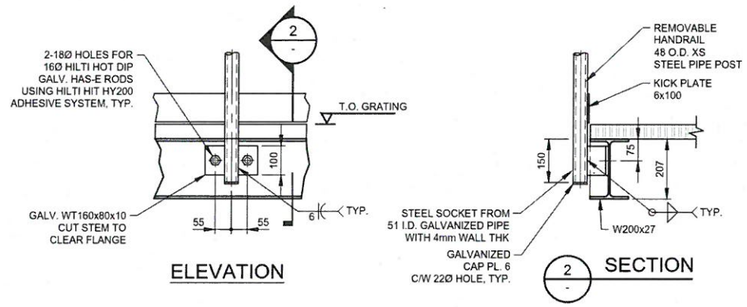


1 - ELEVATION

1 - SECTION

11 - DETAIL N.T.S.

REMOVABLE GUARDRAIL
CONCRETE CONNECTION



2 - ELEVATION

2 - SECTION

12 - DETAIL N.T.S

FIXED GUARDRAIL
W200 CONNECTION

P:\20172972\00_WellWe_Trident_Ltd\Working_Dwgs\300_Structural\2972-00-s-512.dwg
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IF NOT 50 mm ADJUST SCALES — 50 mm

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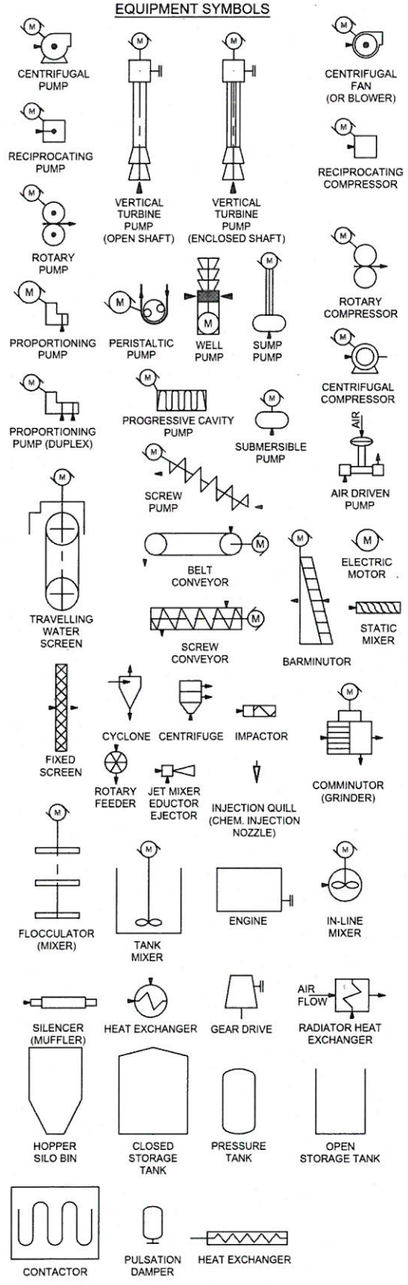
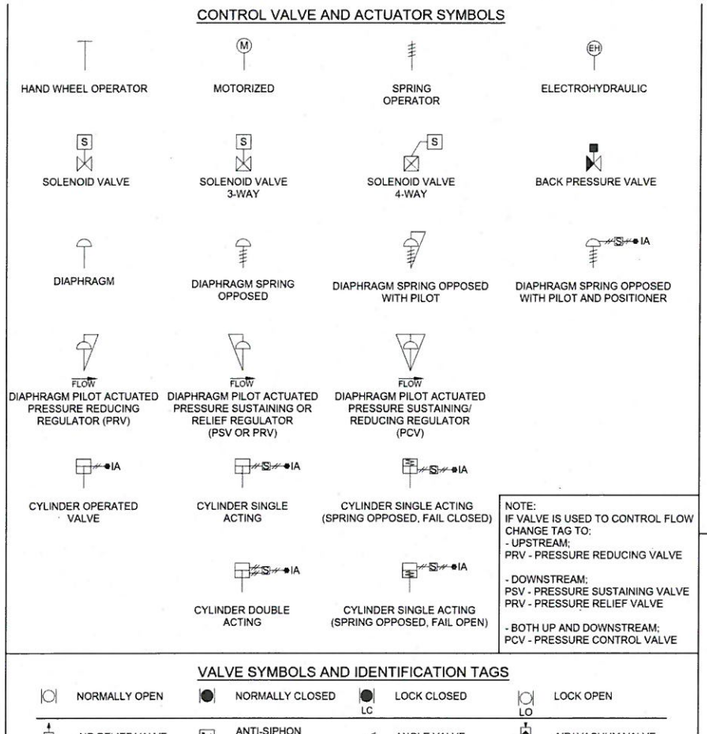
EQUIPMENT SYMBOLS



CONTROL VALVE AND ACTUATOR SYMBOLS



NOTE:
IF VALVE IS USED TO CONTROL FLOW CHANGE TAG TO:
- UPSTREAM;
PRV - PRESSURE REDUCING VALVE

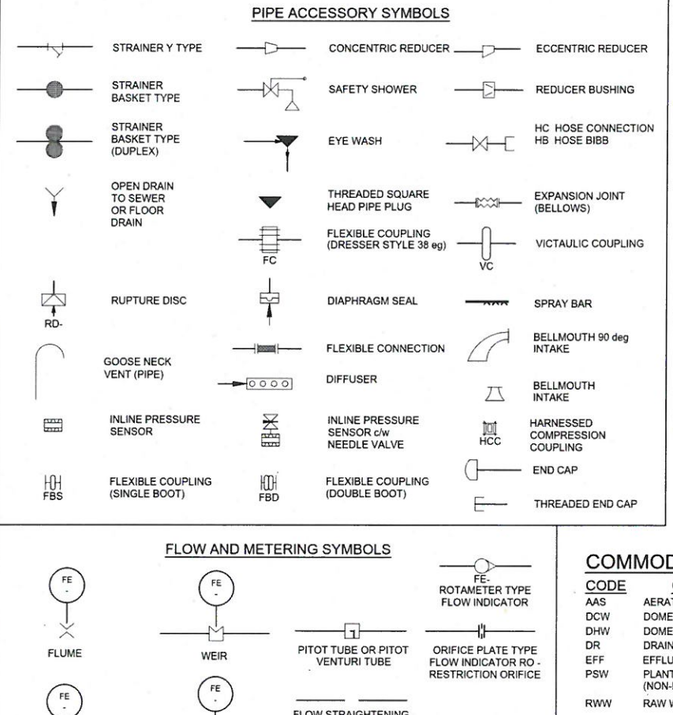
- DOWNSTREAM;
PSV - PRESSURE SUSTAINING VALVE
PRV - PRESSURE RELIEF VALVE

- BOTH UP AND DOWNSTREAM;
PCV - PRESSURE CONTROL VALVE

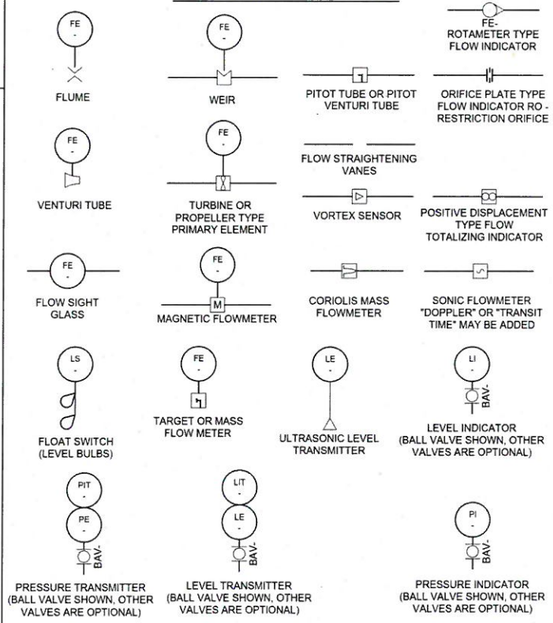
VALVE SYMBOLS AND IDENTIFICATION TAGS

NORMALLY OPEN	NORMALLY CLOSED	LOCK CLOSED (LC)	LOCK OPEN (LO)
AIR RELIEF VALVE (ARV)	ANTI-SIPHON VALVE (ASV-)	ANGLE VALVE (AV-)	AIR/ VACUUM VALVE (AVV-)
BALL VALVE (BAV-)	BLOCK & BLEED VALVE (BBV-)		BACKFLOW PREVENTOR (REDUCED PRESSURE PRINCIPLE) (BFP-)
BACKFLOW PREVENTOR (ANTI-SIPHON) (BFP-)	BLAST GATE VALVE (BGV-)	BACK PRESSURE VALVE (BPV-)	BUTTERFLY VALVE (BUV-)
	COMBINATION AIR RELIEF & AIR/ VACUUM VALVE (CAV-)	CHECK VALVE (CHV-)	CAR SEAL OPEN (CSO-)
DIAPHRAGM VALVE (DIV-)	FLAME ARRESTOR (FA-)	FLAP GATE (FGV-)	FOOT VALVE (CHECK) (FV-)
GATE VALVE (GAV-)	GLOBE VALVE (GLV-)	KNIFE GATE VALVE (KGV-)	MUD VALVE (MUV-)
NEEDLE VALVE (NEV-)	POST INDICATOR VALVE (PIV-)	PLUG VALVE (PLV-)	PRESSURE RELIEF VALVE (PRV-)
PINCH VALVE (PV-)	THREE WAY VALVE (PV3-)	ROTARY VALVE (ROV-)	SPECTACLE BLIND (SB-)
SLUICE GATE (SG-)	SLIDE GATE (SGV-)	STOP LOGS (SL-)	THERMAL VALVE (TV-)
VACUUM BREAKER (VB-)	VACUUM RELIEF VALVE (VRV-)	THREE WAY GATE VALVE (3GAV-)	EQUALIZING VALVE ON MAIN VALVE BODY
DRAIN VALVE ON MAIN VALVE BODY			

PIPE ACCESSORY SYMBOLS



FLOW AND METERING SYMBOLS



LINE IDENTIFICATION

300 - PW - A1 - A - D

- 300 — LINE SIZE (IN MILLIMETRES)
- PW — PIPE MATERIAL CODE
- A1 — COMMODITY
- A — EXTERNAL PIPE COATING / INTERNAL PIPE LINING
- D — CODE LETTERS USED DEPENDS ON COATING REQUIRED

EQUIPMENT IDENTIFICATION

PWP - 401 (A,B etc)

- PWP — EQUIPMENT SYMBOL
- 401 — AREA NUMBER
- 01 — SEQUENCE NUMBER (IN NUMERICAL ORDER STARTING WITH 01 (ONE) FOR EACH DIFFERENT PIECE OF EQUIPMENT)
- A,B etc — DUPLICATION IDENTIFIER (OPTIONAL USAGE)

VALVE IDENTIFICATION

GAV - 401

- GAV — VALVE SYMBOL
- 401 — AREA NUMBER
- 01 — SEQUENCE NUMBER (IN NUMERICAL ORDER STARTING WITH 01 (ONE) FOR EACH DIFFERENT PIECE OF EQUIPMENT)

PID TAGGING

LIT - 701

- LIT — INSTRUMENT SYMBOL
- 701 — AREA NUMBER
- 01 — SEQUENCE NUMBER (IN NUMERICAL ORDER STARTING WITH 01 (ONE) FOR EACH DIFFERENT PIECE OF EQUIPMENT)

COMMODITY CODES

CODE	COMMODITY
AAS	AERATION AIR SUPPLY
DCW	DOMESTIC COLD WATER
DHW	DOMESTIC HOT WATER
DR	DRAIN
EFF	EFFLUENT
PSW	PLANT SERVICE WATER (NON-DRINKABLE WATER)
RWW	RAW WASTE WATER

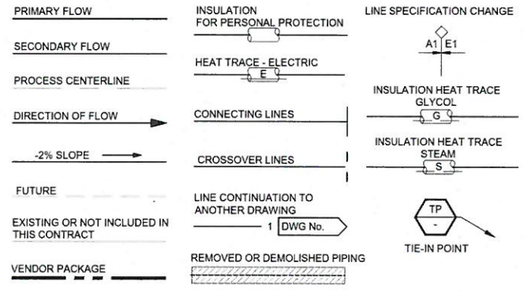
PIPE TREATMENT CODES

CODE	DESCRIPTION
A	CEMENT MORTAR LINING
B	INTERNAL HOT APPLIED COAL TAR LINING
C	INTERNAL EPOXY LINING
D	YELLOW JACKET COATED
E	EXTERNAL HOT APPLIED COAL TAR COATING
F	EXTERNAL EPOXY COATED
G	INSULATED
H	FLEXIBLE ELASTOMERIC INSULATION
I	INSULATION C/W JACKET (HIGH TEMPERATURE)

PIPE MATERIAL CODES

CODE	MATERIAL AND FLANGE RATING
A1	STEEL PIPE 900mm Dia AND SMALLER 150 POUND FLANGE RATING
D1	CONCRETE PIPE - PRESSURE PIPE
D2	CONCRETE PIPE - REINFORCED
D3	CONCRETE PIPE - NON REINFORCED
E1	PVC PIPE (PRESSURE PIPE)
E2	PVC PIPE - GRAVITY SERVICE
E3	POLYETHYLENE PIPE
E4	CPVC PIPE (PRESSURE PIPE)
E5	PLASTIC FLEXIBLE TUBING
E6	RUBBER HOSE
E7	PVDF PIPE (PRESSURE PIPE)
G1	COPPER PIPE - TYPE K
G2	COPPER PIPE - TYPE L
H1	STAINLESS STEEL PIPE
H2	STAINLESS STEEL TUBING
H3	STEEL TUBING
P1	PLASTIC DWV, COPPER DWV, CAST IRON DWV PLUMBING SERVICE

LINE SYMBOLS



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H. MASUDA # 44056 PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA
June 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	H. MASUDA	S.LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - LEGEND & SYMBOLS
SHEET 1 OF 2

DRAWING	REVISION	SHEET
2972-00-D-001A	0	62 / 111

IF NOT 50 mm ADJUST SCALES
50 mm
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

MISCELLANEOUS

- AAH - ANALYZING ALARM - HIGH SET POINT
- AE - ANALYZING ELEMENT (REFER TO LEGEND)
- AIT - ANALYZING INDICATING TRANSMITTER
- AP - ANALYSIS POINT
- AT - ANALYZING TRANSMITTER
- CI - CONDUCTIVITY INDICATOR
- CR - CONDUCTIVITY RECORDER
- CSH - CONDUCTIVITY SWITCH - HIGH SET POINT
- CSL - CONDUCTIVITY SWITCH - LOW SET POINT
- GD - GAS DETECTOR
- GS - EVENT SWITCH
- HC - HAND CONTROLLER (MANUAL LOADING STATION)
- HIC - HAND INDICATING CONTROLLER (MANUAL LOADING STATION WITH OUTPUT GAUGE)
- HJS - MANUAL SELECTOR SWITCH
- HS - HAND SWITCH
- JS - LOSS OF POWER SWITCH
- KC - TIME SEQUENCING PROGRAMMER
- KS - TIMER OR COUNTER
- MOV - MOTORIZED OPERATING VALVE (OPEN/CLOSE)
- SC - SPEED CONTROL (SCR DRIVE)
- VAH - ALARM - HIGH SET POINT
- VS - VIBRATION SWITCH
- VSH - VIBRATION SWITCH HIGH
- VSL - VIBRATION SWITCH LOW
- WAH - WEIGHT ALARM - HIGH
- WAL - WEIGHT ALARM - LOW
- WIT - WEIGHT INDICATING TRANSMITTER
- WR - WEIGHT RECORDER
- XS - MOTOR START/CONTROL
- XSC - MOTOR CLOSE COMMAND

MISCELLANEOUS

- XSO - MOTOR OPEN COMMAND
- YAH - TORQUE ALARM - HIGH SET POINT
- YAHH - TORQUE ALARM VERY HIGH
- YS - TORQUE SWITCH
- ZC - VALVE POSITION CONTROLLER
- ZS - LIMIT SWITCH
- ZT - VALVE POSITION TRANSMITTER

PRESSURE

- PAH - PRESSURE ALARM - HIGH
- PAHH - PRESSURE ALARM - VERY HIGH
- PAL - PRESSURE ALARM - LOW
- PALL - PRESSURE ALARM - VERY LOW
- PC - PRESSURE CONTROLLER
- PCV - PRESSURE CONTROL VALVE (REFER TO LEGEND)
- PDI - PRESSURE DIFFERENTIAL INDICATOR
- PDSH - PRESSURE DIFFERENTIAL SWITCH - HIGH
- PDSL - PRESSURE DIFFERENTIAL SWITCH - LOW
- PDT - PRESSURE DIFFERENTIAL TRANSMITTER
- PI - PRESSURE INDICATOR
- PIC - PRESSURE INDICATING CONTROLLER
- PIT - PRESSURE INDICATING TRANSMITTER
- PP - PRESSURE TEST POINT
- PR - PRESSURE RECORDER
- PRC - PRESSURE RECORDING CONTROLLER
- PS - PRESSURE SWITCH
- PSE - PRESSURE RUPTURE DISK
- PSH - PRESSURE SWITCH - HIGH SET POINT
- PSL - PRESSURE SWITCH - LOW SET POINT
- PT - PRESSURE TRANSMITTER
- PY - PRESSURE SIGNAL CONVERTER (CURRENT INPUT / PNEUMATIC OUTPUT)

- LINE FILTER
- PRE FILTER
- REFRIGERATED DRYER
- DESICCANT DRYER
- AUTOMATIC DRAIN (FLOAT TYPE)
- WATER COOLER
- COMBINATION REGULATOR LINE FILTER
- COMBINATION LINE FILTER REGULATOR, LUBRICATOR

FLOW

- FAH - HIGH - FLOW ALARM
- FAL - LOW - FLOW ALARM
- FC I/P - FLOW SIGNAL CONVERTER (CURRENT INPUT / PNEUMATIC OUTPUT)
- FC √ - FLOW SQUARE ROOT EXTRACTOR
- FCV - FLOW CONTROL VALVE
- FE - FLOW ELEMENT (PRIMARY ELEMENT WITHOUT TRANSMITTER)
- FG - FLOW SIGHT GLASS
- FI - FLOW INDICATOR
- FIC - FLOW INDICATING CONTROLLER
- FIT - FLOW INDICATING TRANSMITTER
- FO - FLOW RESTRICTION ORIFICE
- FQ - FLOW SIGNAL INTEGRATOR
- FQI - FLOW TOTALIZING INDICATOR
- FQS - FLOW TOTALIZER SWITCH (PREDETERMINING COUNTER)
- FR - FLOW RECORDER
- FRC - FLOW RECORDING CONTROLLER
- FS - FLOW SWITCH
- FSH - FLOW SWITCH - HIGH SET POINT
- FSL - FLOW SWITCH - LOW SET POINT
- FT - FLOW TRANSMITTER
- FX - FLOW STRAIGHTENING VANES
- FX Σ - FLOW SIGNAL SUMMATION
- FY - FLOW SOLENOID VALVE

- LOCALLY MOUNTED INSTRUMENT
- PANEL MOUNTED INSTRUMENT
- BACK OF PANEL MOUNTED INSTRUMENT
- PILOT LIGHT
- SIGNAL INTERLOCK LOGIC
- CP - CONTROL PANEL

LEVEL

- LAH - LEVEL ALARM - HIGH
- LAHH - LEVEL ALARM - VERY HIGH
- LAL - LEVEL ALARM - LOW
- LALL - LEVEL ALARM - VERY LOW
- LC I/P - LEVEL SIGNAL CONVERTER (CURRENT INPUT / PNEUMATIC OUTPUT)
- LC - LEVEL CONTROLLER
- LCV - LEVEL CONTROL VALVE
- LE - LEVEL ELEMENT
- LG - LEVEL GAUGE GLASS
- LI - LEVEL INDICATOR
- LIC - LEVEL INDICATING CONTROLLER
- LIS - LEVEL INDICATING SWITCH
- LIT - LEVEL INDICATING TRANSMITTER
- LR - LEVEL RECORDER
- LS - LEVEL SWITCH
- LSH - LEVEL SWITCH - HIGH SET POINT
- LSL - LEVEL SWITCH - LOW SET POINT
- LT - LEVEL TRANSMITTER
- LX 10kΩ - LEVEL POTENTIOMETER 10,000 OHMS RESISTANCE
- LY - LEVEL - LOW SELECT RELAY
- LY - LEVEL - HIGH SELECT RELAY

ANALYZING ELEMENT / ALARM LEGEND

AMM(FREE)	FREE AMMONIA
CL(FREE)	FREE CHLORINE
CL(MONO)	MONOCHLORAMINES
CL(TOTAL)	TOTAL CHLORINE
CON	CONDUCTIVITY
DO	DISSOLVED OXYGEN
I/P	CURRENT TO PNEUMATIC
ORP	OXIDATION-REDUCTION POTENTIAL
PC	PARTICLE COUNTER
pH	POTENTIAL HYDROGEN
TSS	TOTAL SUSPENDED SOLIDS
TUR	TURBIDITY

PLC EQUIPMENT OPERATIONS STATUS LEGEND

HSI	HAND SWITCH POSITION INDICATION
SC	SPEED CONTROL
SI	SPEED INDICATION
XI	RUN
XA	TRIP / UNDEFINED ALARM
XS	START/STOP
ZI	VALVE POSITION INDICATION
ZC	VALVE POSITION CONTROL

PRESSURE CONTROL VALVE LEGEND

RD	REDUCING
RF	RATE OF FLOW
RL	RELIEVING
SA	SURGE ANTICIPATING
SU	SUSTAINING
VR	VACUUM RELIEF

PROGRAMMABLE LOGIC CONTROL TAG IDENTIFICATION FOR PUMPS

XXX-XXXX
- XXX ## - PLC EQUIPMENT OPERATIONS STATUS TAG
- SEQUENCE NUMBER
- EQUIPMENT TAG

PLC TAG NUMBER
EXAMPLE XI-RWP-3401

TEMPERATURE

- TAH - TEMPERATURE ALARM - HIGH SET POINT
- TAL - TEMPERATURE ALARM - LOW SET POINT
- TCR - TEMPERATURE RECORDING CONTROLLER
- TCV - TEMPERATURE CONTROL VALVE
- TE - TEMPERATURE ELEMENT (PRIMARY ELEMENT WITHOUT TRANSMITTER)
- TI - TEMPERATURE INDICATOR
- TIC - TEMPERATURE INDICATING CONTROLLER
- TJI - MULTIPOINT TEMPERATURE INDICATOR (SCANNING TEMPERATURE INDICATOR)
- TJR - MULTIPOINT TEMPERATURE RECORDER (SCANNING TEMPERATURE RECORDER)
- TP - TEMPERATURE TEST POINT
- TR - TEMPERATURE RECORDER
- TS - TEMPERATURE SWITCH
- TSH - TEMPERATURE SWITCH - HIGH SET POINT
- TSL - TEMPERATURE SWITCH - LOW SET POINT
- TT - TEMPERATURE TRANSMITTER
- TW - THERMOWELL (WITHOUT THERMOCOUPLE)
- TZ - TEMPERATURE FINAL CONTROL ELEMENT (DAMPER OPERATOR FOR LOUVERS)

	PRIMARY LOCATION ***NORMALLY ACCESSIBLE TO OPERATOR	FIELD MOUNTED	AUXILIARY LOCATION ***NORMALLY ACCESSIBLE TO OPERATOR
DISCRETE INSTRUMENTS	1. * IP1**	2.	3.
SHARED DISPLAY SHARED CONTROL	4.	5.	6.
COMPUTER FUNCTION	7.	8.	9.
PROGRAMMABLE LOGIC CONTROL	10.	11.	12.

* SYMBOL SIZE MAY VARY ACCORDING TO THE USER'S NEEDS AND THE TYPE OF DOCUMENT. A SUGGESTED SQUARE AND CIRCLE SIZE FOR LARGER DIAGRAMS IS SHOWN ABOVE. CONSISTENCY IS RECOMMENDED.
** ABBREVIATION OF THE USER'S CHOICE SUCH AS IP! (INSTRUMENT PANEL #1), IC2 (INSTRUMENT CONSOLE #2), CC3 (COMPUTER CONSOLE #3), ECT., MAY BE USED WHEN IT IS NECESSARY TO SPECIFY INSTRUMENT OR FUNCTION LOCATION.
*** NORMALLY INACCESSIBLE OR BEHIND-THE-PANEL DEVICES OR FUNCTIONS MAY BE DEPICTED BY USING THE SAME SYMBOLS BUT WITH DASHED HORIZONTAL BARS, I.E.

- CONNECTION TO PROCESS, MECHANICAL LINK, OR INSTRUMENT SUPPLY
- THE FOLLOWING ABBREVIATIONS DENOTE TYPES OF POWER SUPPLY
- AIR SUPPLY (PLANT AIR, HEADER SUPPLY REGULATED eg ADJUSTED TO 552 kPa)
- FILTERED AIR SUPPLY (REGULATED eg ADJUSTED TO 138 kPa)
- ES - ELECTRIC SUPPLY
- GS - GAS SUPPLY
- SS - STEAM SUPPLY
- WS - WATER SUPPLY
- 1 PSI = 6.894 kPa
- UNDEFINED SIGNAL
- PNEUMATIC SIGNAL **
- OR - ELECTRICAL CONTROL SIGNAL
- DEVICENET
- ETHERNET
- FIELDBUS (FF)
- MODBUS
- PROFIBUS
- HYDRAULIC SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- ELECTROMAGNETIC OR SONIC SIGNAL *** (GUIDED)
- ELECTROMAGNETIC OR SONIC SIGNAL *** (NOT GUIDED)
- INTERNAL SYSTEM LINK (SOFTWARE OR DATA LINK)
- MECHANICAL LINK

OPTIONAL BINARY (ON-OFF) SYMBOLS
- PNEUMATIC BINARY SIGNAL
- OR - ELECTRIC BINARY SIGNAL

NOTE: 'OR' MEANS USER'S CHOICE. CONSISTENCY IS RECOMMENDED. THE FOLLOWING ABBREVIATIONS ARE SUGGESTED TO DENOTE THE TYPES OF POWER SUPPLY. THESE DESIGNATIONS MAY ALSO BE APPLIED TO PURGE FLUID SUPPLIES.

AS - AIR SUPPLY
OPTIONS: IA - INSTRUMENT AIR; PA - PLANT AIR
ES - ELECTRICAL SUPPLY
GS - GAS SUPPLY
HS - HYDRAULIC SUPPLY
NS - NITROGEN SUPPLY
SS - STEAM SUPPLY
WS - WATER SUPPLY

* THE SUPPLY LEVEL MAY BE ADDED TO THE INSTRUMENT SUPPLY LINE, E.G., AS-100, A 100-PSIG AIR SUPPLY; ES-24DC, A 24 VOLT DIRECT CURRENT POWER SUPPLY.
** THE PNEUMATIC SIGNAL SYMBOL APPLIES TO A SIGNAL USING ANY GAS AS THE MEDIUM. IF A GAS OTHER THAN AIR IS USED, THE GAS MAY BE IDENTIFIED BY A NOTE ON THE SIGNAL SYMBOL OR OTHERWISE.
*** ELECTROMAGNETIC PHENOMENA INCLUDE HEAT, RADIO WAVES, NUCLEAR RADIATION, AND LIGHT.

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H. MASUDA # 44056 BRITISH COLUMBIA ENGINEER
June 28/18

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0	2018JUN27	H. MASUDA	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - LEGEND & SYMBOLS
SHEET 2 OF 2

DRAWING	REVISION	SHEET
2972-00-D-001B	0	63 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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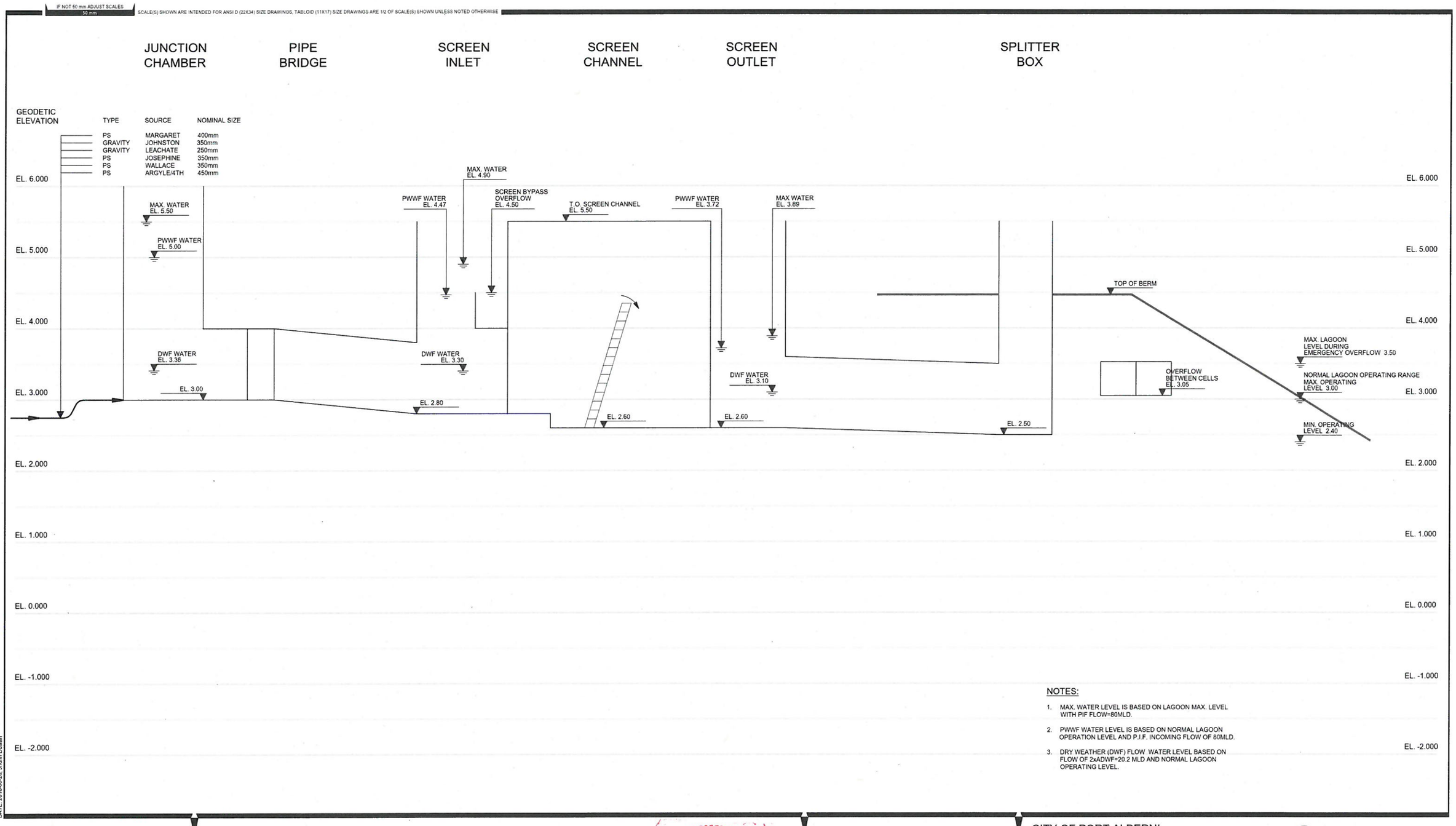

NOTES:

1. MAX. WATER LEVEL IS BASED ON LAGOON MAX. LEVEL WITH PIF FLOW=80MLD.
2. PWWF WATER LEVEL IS BASED ON NORMAL LAGOON OPERATION LEVEL AND P.I.F. INCOMING FLOW OF 80MLD.
3. DRY WEATHER (DWF) FLOW WATER LEVEL BASED ON FLOW OF 2xADWF=20.2 MLD AND NORMAL LAGOON OPERATING LEVEL.

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PROVINCE OF BRITISH COLUMBIA
C. G. BRUMPTON
30001
June 28, 2018

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PROCESS MECHANICAL
HYDRAULIC PROFILE SHEET 1

DRAWING	REVISION	SHEET
2972-00-D-002	0	65 / 111

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50 mm

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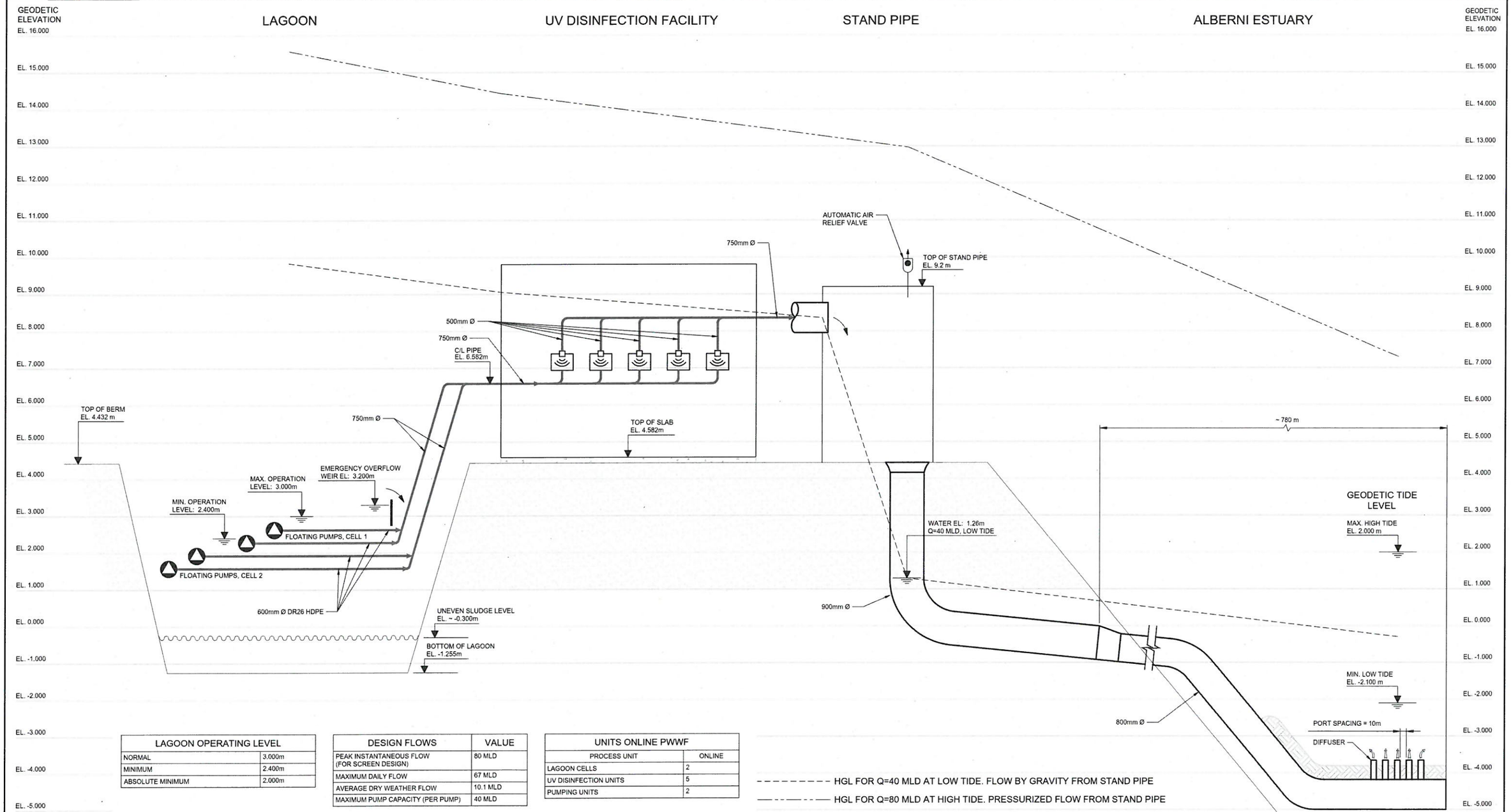

LAGOON OPERATING LEVEL	
NORMAL	3.000m
MINIMUM	2.400m
ABSOLUTE MINIMUM	2.000m

DESIGN FLOWS	VALUE
PEAK INSTANTANEOUS FLOW (FOR SCREEN DESIGN)	80 MLD
MAXIMUM DAILY FLOW	67 MLD
AVERAGE DRY WEATHER FLOW	10.1 MLD
MAXIMUM PUMP CAPACITY (PER PUMP)	40 MLD

UNITS ONLINE PWWF	
PROCESS UNIT	ONLINE
LAGOON CELLS	2
UV DISINFECTION UNITS	5
PUMPING UNITS	2

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

PROCESS MECHANICAL
HYDRAULIC PROFILE SHEET 2

DRAWING	REVISION	SHEET
2972-00-D-003	0	64 / 111

IF NOT 50 mm ADJUST SCALES — 50 mm

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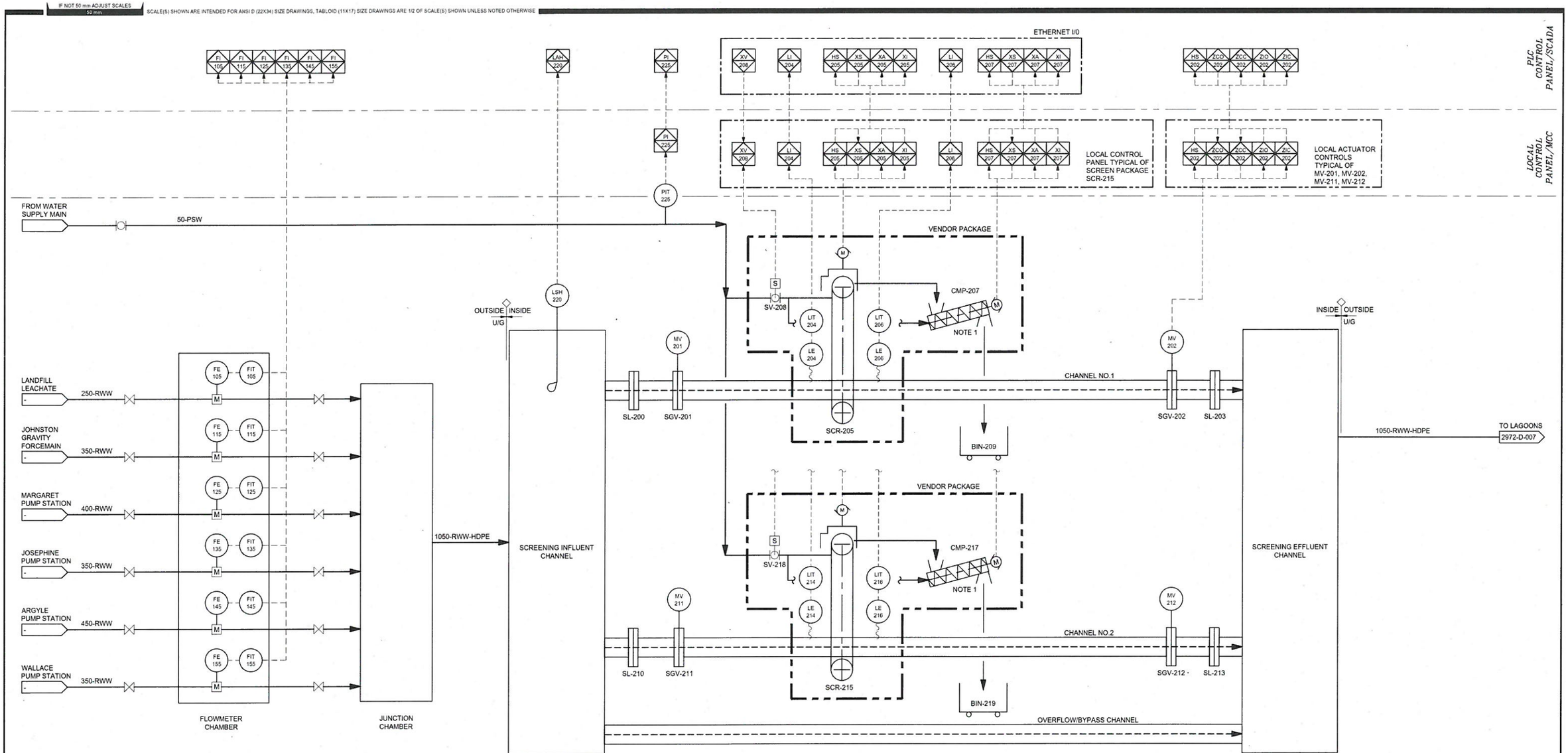

NOTES:

1. WASHER/COMPACTORS ARE INTEGRAL WITH SCREENS.

EQUIPMENT DATA

SCREEN		COMPACTOR		BIN	
NAME:	SCR-205, 215	NAME:	CMP-207, 217	NAME:	BIN-209, 219
TYPE:	CENTERFLOW	MOTOR:	2.2 kW (3 HP)	CAPACITY:	2.7 m³
MOTOR:	0.75 kW (1 HP)				
CAPACITY:	80 ML/d				
MATL:	304 SS				
OPENING SIZE:	6 mm				

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: N.T.S.

THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - SCREENING

DRAWING	REVISION	SHEET
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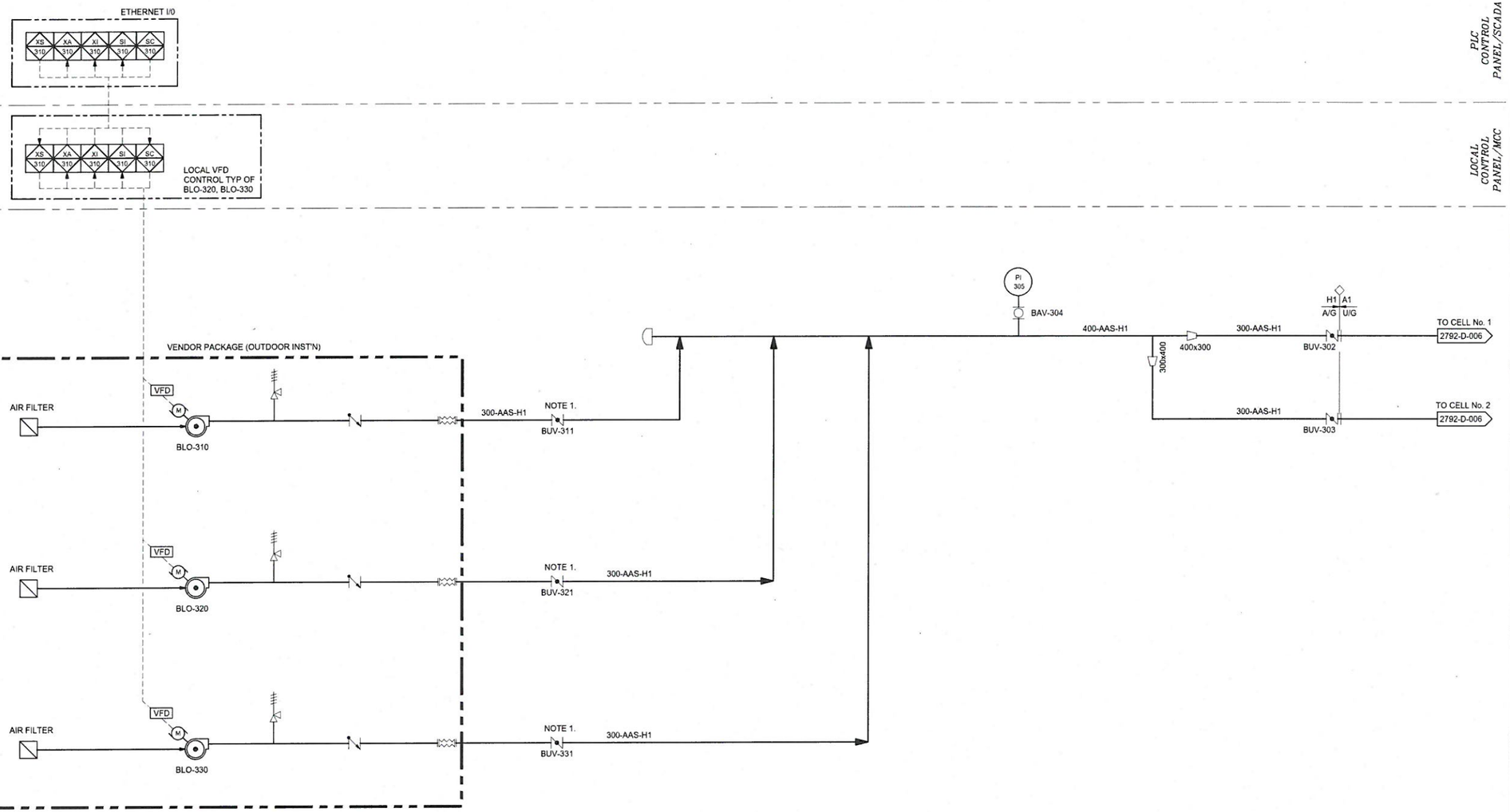
PLC CONTROL PANEL/SCADA

LOCAL CONTROL PANEL/MCC



EQUIPMENT DATA

NOTES:

1. BLOWER VENDOR SUPPLIED.

BLOWERS

NAME:	BLO-310, 320, 330
TYPE:	HIGH SPEED TURBO
SIZE:	300mm DISCHARGE FLG.
MOTOR:	179 kW
CAPACITY:	7120 Sm^3/hr (4200 SCFM)
NOTES:	VFD

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44056
June 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	C. BRUMPTON	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - BLOWERS

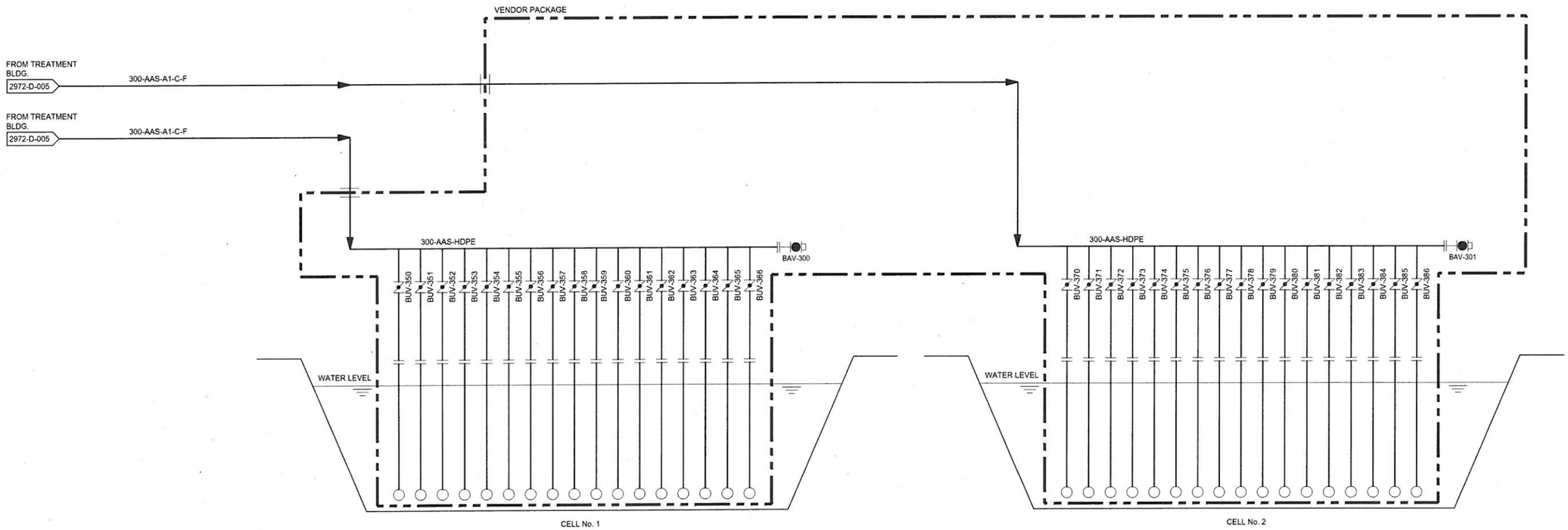
DRAWING	REVISION	SHEET
2972-00-D-005	0	67 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

PLC CONTROL PANEL/SCADA

LOCAL CONTROL PANEL/MCC



EQUIPMENT DATA

P:\20172972\00_WetWtr_Trtmnt_Upg\Working_Dwgs\400_Process_Mech\2972-00-d-006.dwg
DATE: 2015-06-28, Jhum Duttin

Associated Engineering
Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
Ph: 604 293 1411 Fax: 604 291 6163
www.ae.ca

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA H. MASUDA # 44056

June 28/15

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2015JUN27	C. BRUMPTON	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - AERATION SYSTEM

DRAWING	REVISION	SHEET
2972-00-D-006	0	68 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

PLC CONTROL PANEL/SCADA

LOCAL CONTROL PANEL/MCC

ETHERNET I/O

MCC VFD

TREATMENT BUILDING

LIT 405

LIT 425

FROM SCREEN BLDG. 2972-D-004

1050-RWW-HDPE

VENDOR PACKAGE

600x750

600-EFF-HDPE

A/G U/G

VENDOR A/G | G.C. U/G

750-EFF-HDPE

TO TREATMENT BLDG. 2972-D-009

TO TREATMENT BLDG. 2972-D-010

LE 405

LE 425

CHV-411

KGV-412

CHV-421

KGV-422

CHV-431

KGV-432

CHV-441

KGV-442

WATER LEVEL

PMP-410 PUMP 1-A

PMP-420 PUMP 1-B

PMP-430 PUMP 2-A

PMP-440 PUMP 2-B

CELL No. 1

CELL No. 2

EQUIPMENT DATA

PUMPS

NAME:	PMP-410, 420, 430, 440
TYPE:	AXIAL, FLOAT MOUNTED
SIZE:	TBD BY VENDOR
MOTOR:	112 kW (150 HP)
CAPACITY:	40 MLD
NOTES:	-

P:\20172972\00_WWtrt_Trtmnt_Upgr\Working_Dwgs\400_Process_Mech\2972-00-d-007.dwg
DATE: 2018-06-28, Jhum Dudani

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA H. MASUDA # 44056

June 28/18.

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - EFFLUENT PUMPS I OF 2

DRAWING	REVISION	SHEET
2972-00-D-007	0	69 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

PLC CONTROL PANEL/SCADA

LOCAL CONTROL PANEL/MCC

AI 500

DO ZCO 511 | DO ZCC 511 | DI ZIO 511 | DI ZIC 511 | DI XA 511 | DI HS 511

DO ZCO 521 | DO ZCC 521 | DI ZIO 521 | DI ZIC 521 | DI XA 521 | DI HS 521

ETHERNET I/0

EN 520 | XI 520 | XA 520

TYPICAL OF CP-510

FROM LAGOON CELL 1 PUMP 1&2

2972-D-007

HDPE A1 A/G U/G

750-EFF-A1-C-F

FC

VENDOR PACKAGE

AIT 500 UVT

AE 500

TO DRAIN

H1 A1 A/G U/G

KGV-503

MV 511

500-EFF-H1

VENDOR PACKAGE

CP-510

UV-510 REACTOR-1

BUV-512

500-EFF-H1

500x750

750-EFF-H1

TO UV-520,530,540 2972-D-010

TO/FROM UV-520,530,540 2972-D-010

VENDOR PACKAGE

CP-520

MV 521

500-EFF-H1

UV-520 REACTOR-2

BUV-522

500-EFF-H1

UV REACTORS

NAME:	UV-510, 520
SIZE:	500mm F.LG.
CAPACITY:	40,000 m3/d
POWER:	18.4 kW

EQUIPMENT DATA

P:\20172972\00_WstWtr_Trtmt_Upg\Working_Dwgs\400_Process_Mech\2972-00-d-009.dwg
DATE: 2018-06-28, Jhum Dublin

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PROFESSIONAL ENGINEER
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44056
BRITISH COLUMBIA

June 28/18.

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WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - UV SHEET 1 OF 2

DRAWING	REVISION	SHEET
2972-00-D-009	0	70 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

PLC CONTROL PANEL/SCADA

LOCAL CONTROL PANEL/MCC

ETHERNET I/O

TYPICAL OF CP-530, CP-540

FROM UV-500,510
2972-D-009
750-EFF-H1

FROM LAGOON CELL1 PUMP 1 & 2
2972-D-009
750-EFF-H1

VENDOR PACKAGE
CP-530

UV-530 REACTOR-3

MV 531

500-EFF-H1

BUV-532

VENDOR PACKAGE
CP-540

UV-540 REACTOR-4

MV 541

BUV-542

VENDOR PACKAGE
CP-550

UV-550 REACTOR-5

MV 551

BUV-552

SAMPLE POINT

BUV-504

200-EFF-H1

FC

AVV-501

AVV-500

PLV-503

PLV-502

150-EFF-A1-C-F/G
NOTE 1

T-300

FT 535

900-EFF-HDPE

FC

900x800

TO OUTFALL

VENDOR PACKAGE
AIT 525
AE 525
UVT
TO DRAIN

KGV-501

FROM LAGOON CELL 2 PUMP 3&4
2972-D-007
750-EFF-HDPE

HDPE

750-EFF-A1-C-F

FC

NOTES:

1. ELECTRICAL HEAT TRACE LINE, VALVES AND AVVS.

UV REACTOR

NAME:	UV-530, 540, 550
SIZE:	500mm FLG.
CAPACITY:	40,000 m3/d
POWER:	18.4 kW

STANDPIPE

NAME:	T-300
DIAMETER:	1.2 m
HEIGHT:	4.6 m

EQUIPMENT DATA

P:\20172972\00_WetWtr_Trtmnt_Upg\Working_Dwgs\400_Process_Mech\2972-00-d-010.dwg
DATE: 2018-06-28, Jhurn Dustin

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Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
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PROFESSIONAL ENGINEER
H. MASUDA
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BRITISH COLUMBIA

June 28/18.

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WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

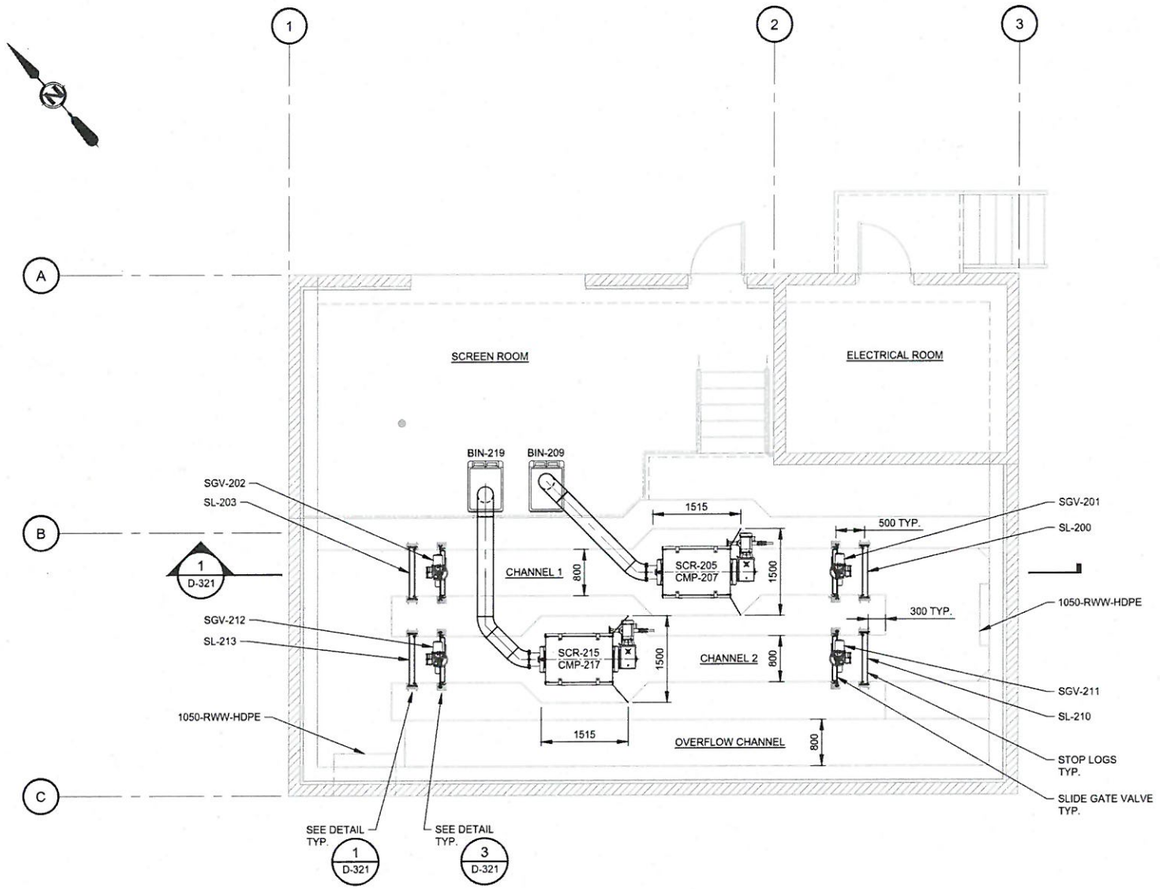
THE CITY OF Port Alberni

PROCESS MECHANICAL
P&ID - UV SHEET 2 OF 2

DRAWING	REVISION	SHEET
2972-00-D-010	0	71 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:50

P:\20172972\00_WstWtr_Trtmt_Upg\Working_Dwgs\400_Process_Mech\2972-00-d-121.dwg
DATE: 2018-06-28, Jhunn Dualan

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Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
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www.ae.ca

BEST MANAGED COMPANIES

PROFESSIONAL ENGINEER
H. MASUDA
44056
BRITISH COLUMBIA
ENGINEER

due 28/18.

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0	2018JUN27	H. MASUDA	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

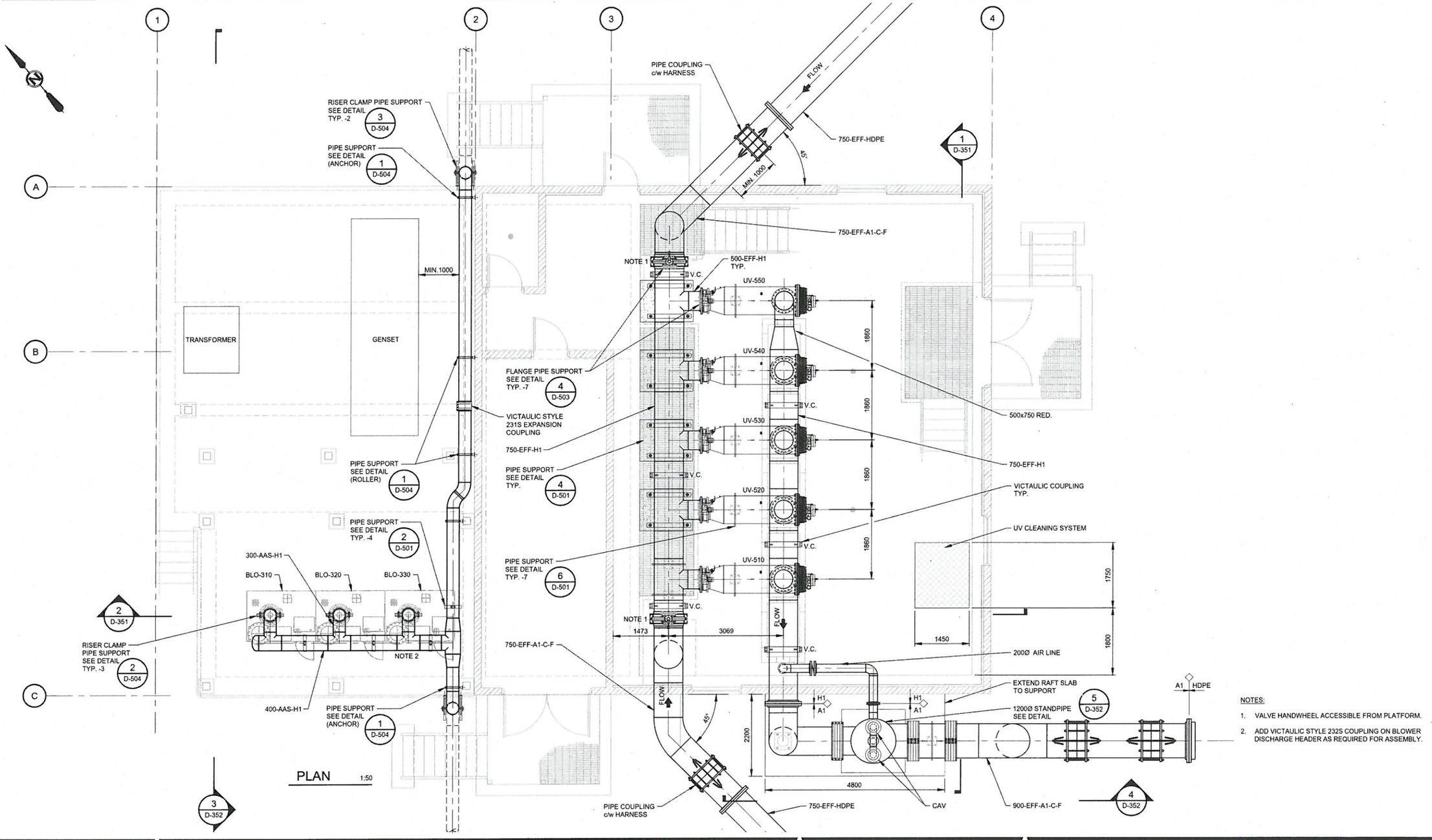
THE CITY OF Port Alberni

PROCESS MECHANICAL
SCREEN BUILDING
PLAN

DRAWING	REVISION	SHEET
2972-00-D-121	0	74 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



NOTES:

1. VALVE HANDWHEEL ACCESSIBLE FROM PLATFORM.
2. ADD VICTAULIC STYLE 232S COUPLING ON BLOWER DISCHARGE HEADER AS REQUIRED FOR ASSEMBLY.

P:\20172972\00_Wet\Pr_Trtmnt_Upg\Working_Dwgs\400_Process_Mech\2972-00-d-151.dwg
DATE: 2018-06-28, Jhurn Dualan

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Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. G. BRUMPTON
30001
June 28, 2018

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

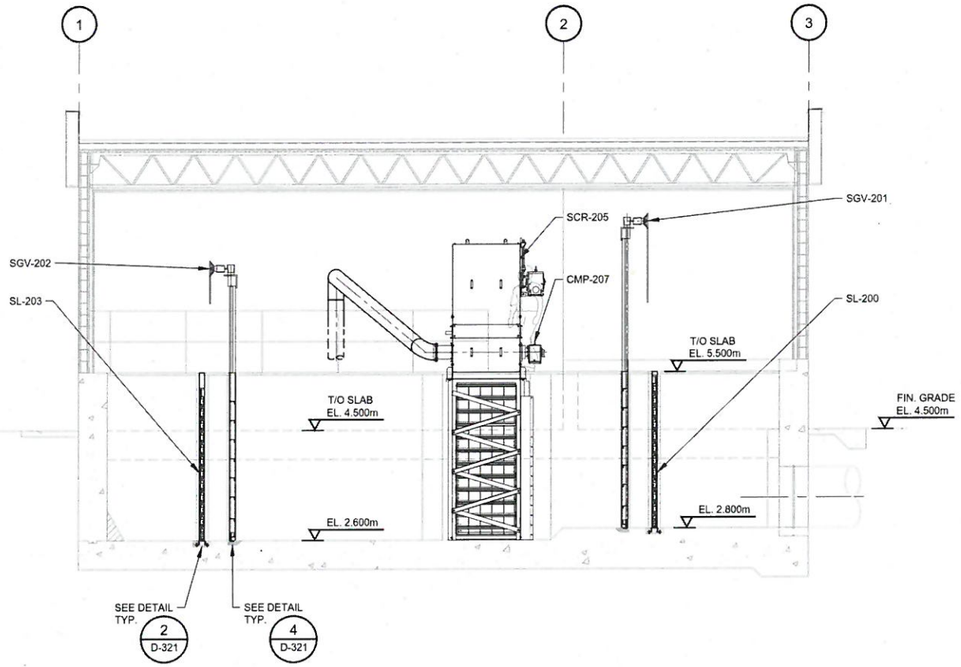
20172972-00

SCALE: AS SHOWN

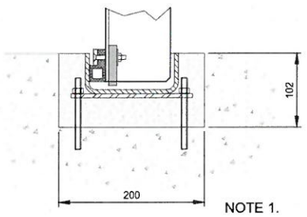
THE CITY OF Port Alberni

PROCESS MECHANICAL TREATMENT BUILDING PLAN

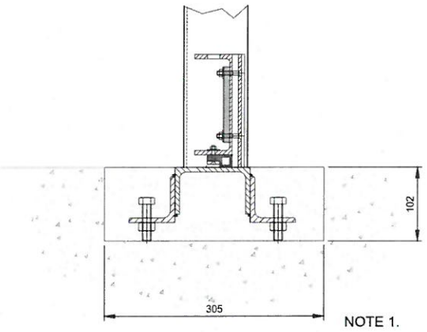
DRAWING	REVISION	SHEET
2972-00-D-151	0	75 / 111



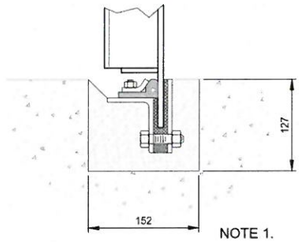
1 D-121 SECTION 1:50



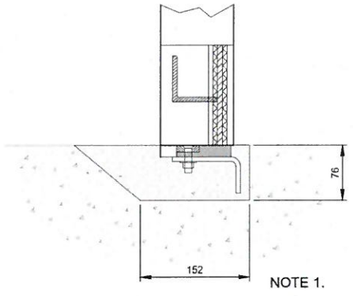
1 D-121 DETAIL NTS
STOP LOGS - SIDE



2 D-121 DETAIL NTS
STOP LOGS - BASE



3 D-321 DETAIL NTS
SLIDE GATE - SIDE



4 D-321 DETAIL NTS
SLIDE GATE - BASE

NOTES:
1. GENERAL CONTRACTOR TO VERIFY BLOCKOUT DIMENSION w/ MANUFACTURER.

Associated Engineering
Suite 300 - 4940 Canada Way, Burnaby, British Columbia. V5G 4M5
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www.ae.ca

PROFESSIONAL ENGINEER
H. MASUDA
44056
BRITISH COLUMBIA
June 28/18.

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	H. MASUDA	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

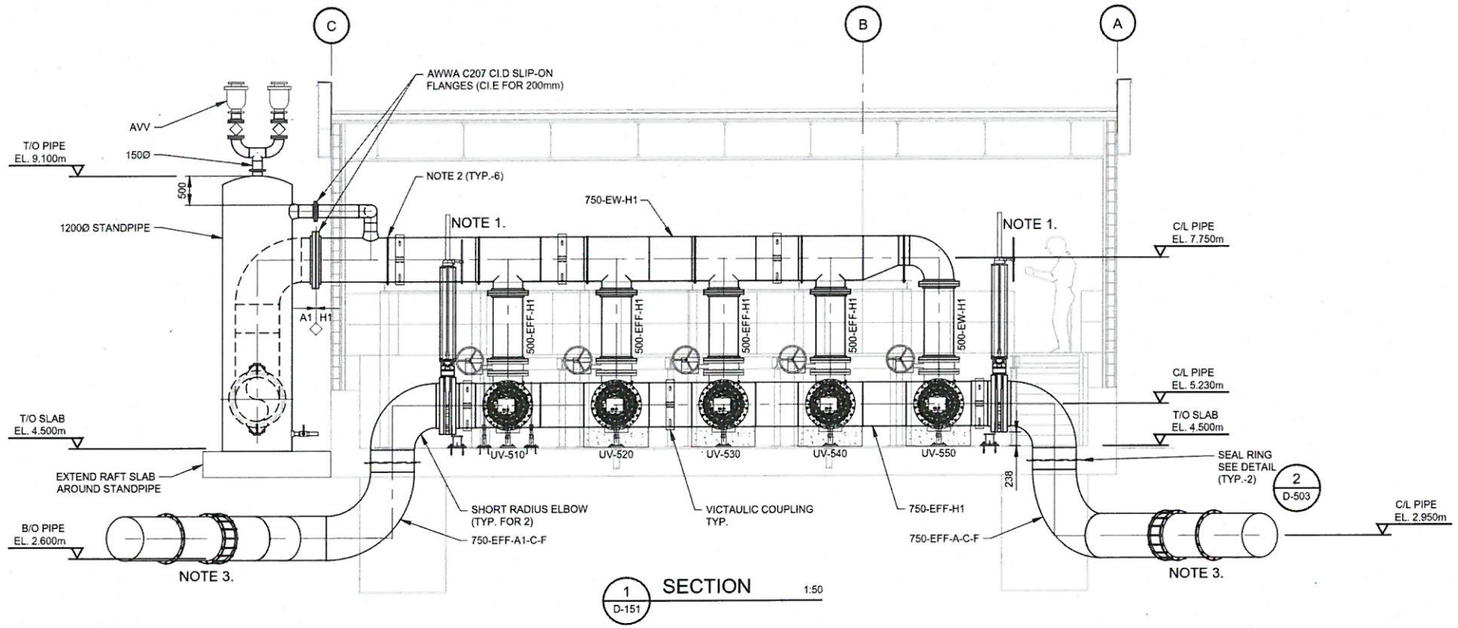
THE CITY OF Port Alberni

PROCESS MECHANICAL
SCREEN BUILDING
SECTION SHEET 1

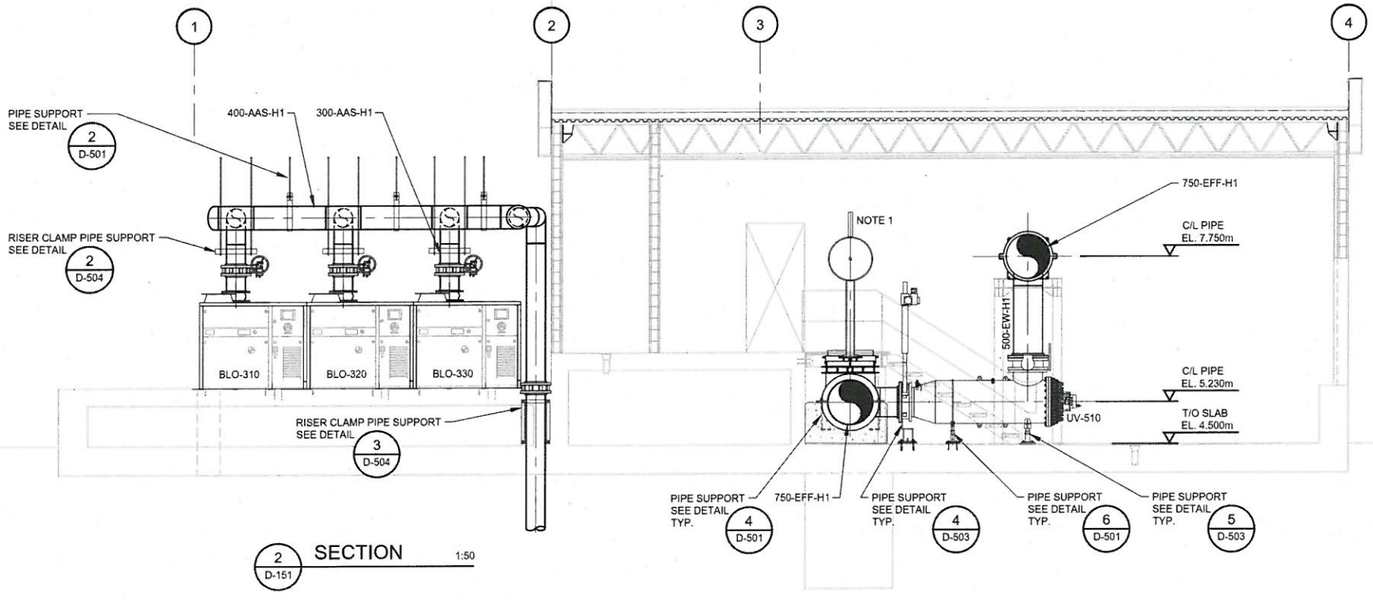
DRAWING	REVISION	SHEET
2972-00-D-321	0	77 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 D-151 SECTION 1:50



2 D-151 SECTION 1:50

NOTES:

1. VALVE HANDWHEEL ACCESSIBLE FROM PLATFORM.
2. U-BOLT, MYATT FIG. 414 OR AS APPROVED. ATTACHED AT COLUMN LOCATIONS.
3. FOR BURIED PIPE, REFER TO CIVIL DETAILS & SPECS FORLAYMENT & BEDDING REQUIREMENTS.

P:\20172972\00_WstWtr_Trtmnt_Upg\Working_Dwgs\400_Process_Mech\2972-00-d-351 352.dwg
DATE: 2018-06-28, Jhum Dutain

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PROFESSIONAL ENGINEER
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June 28, 2018

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

PROCESS MECHANICAL
TREATMENT BUILDING
SECTION SHEET 1

DRAWING	REVISION	SHEET
2972-00-D-351	0	78 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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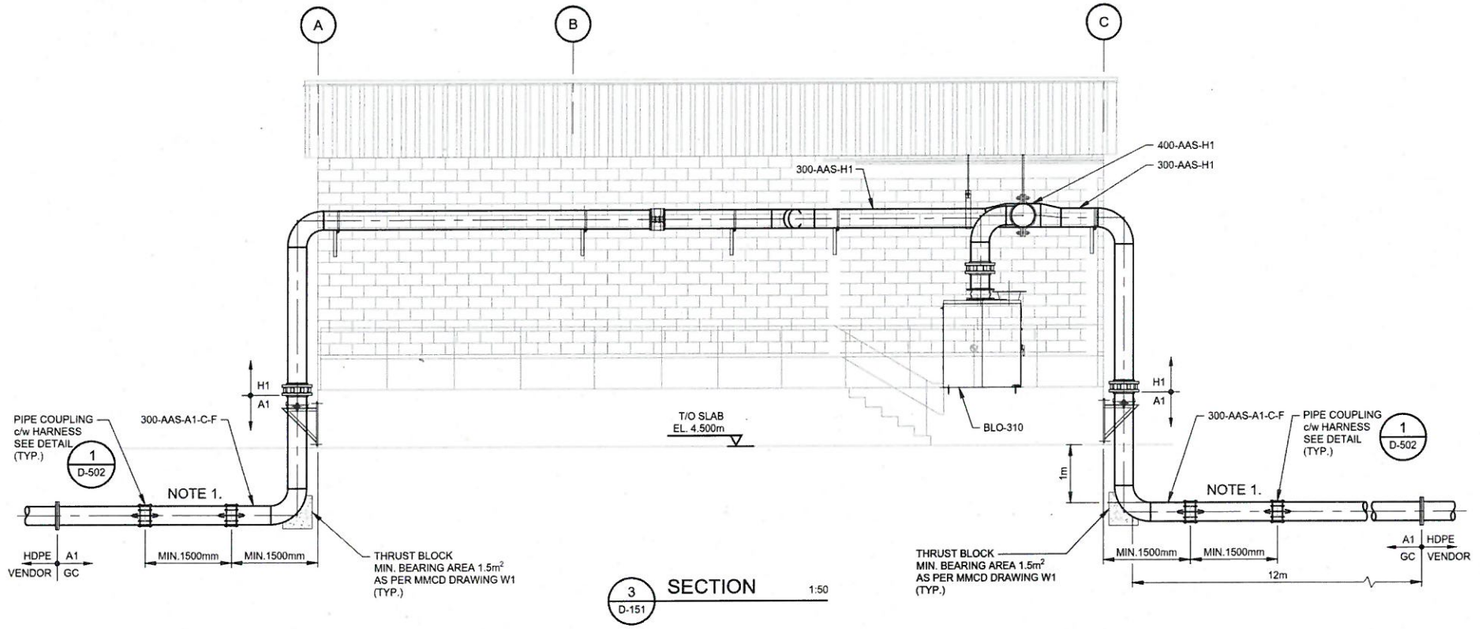
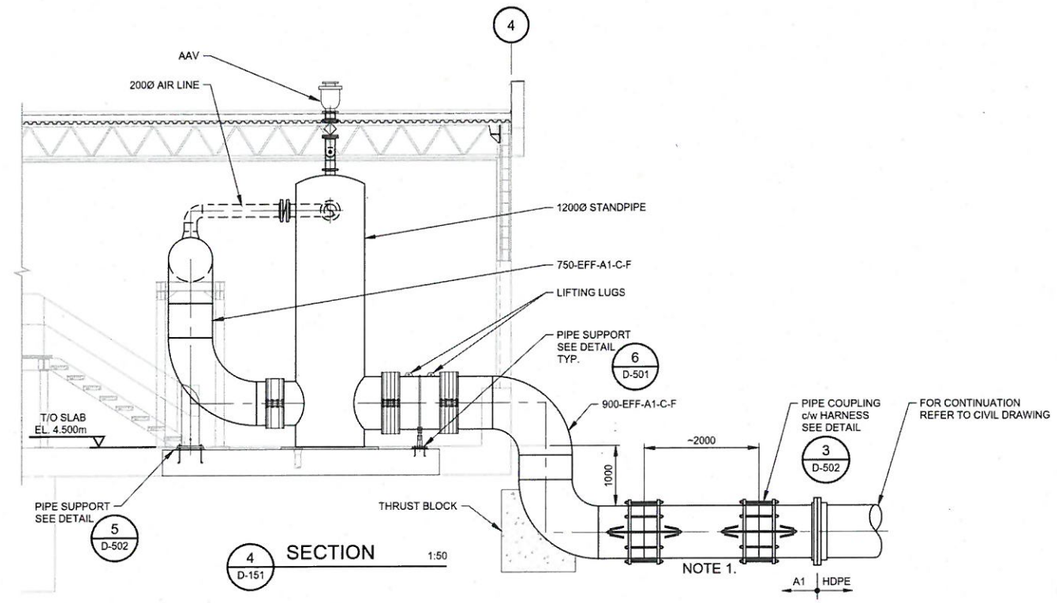
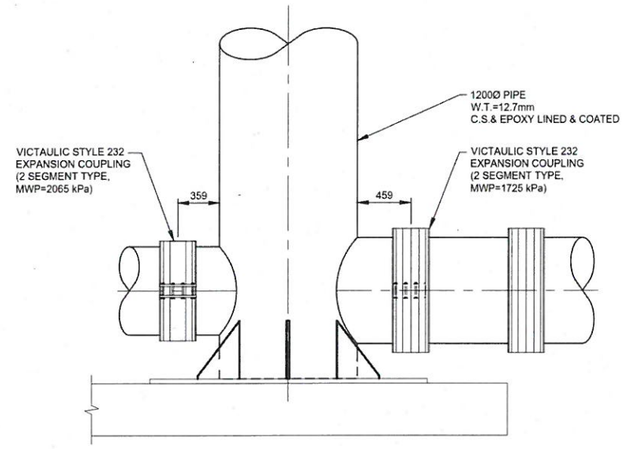


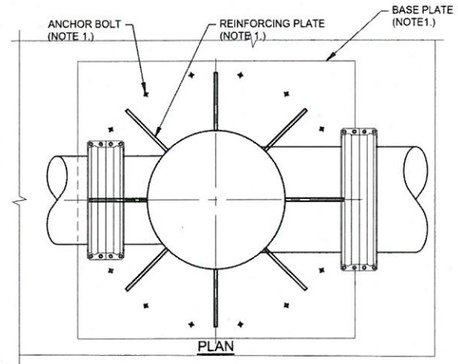
3 D-151 SECTION 1:50



4 D-151 SECTION 1:50



ELEVATION



PLAN

5 D-151 DETAIL 1:25

NOTE:

1. FOR STEEL BASE AND ANCHOR DETAILS REFER TO DRAWING S-502.

NOTE:

1. FOR BURIED PIPE, REFER TO CIVIL DETAILS & SPECS FOR LAYMENT & BEDDING REQUIREMENTS.

P:\20172972\00_Wstwtr_Trtmnt_Upgr\Working_Dwgs\400_Process_Mech\2972-00-d-351 352.dwg
DATE: 2018-06-28, Rumi Dualin

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PROFESSIONAL ENGINEER
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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

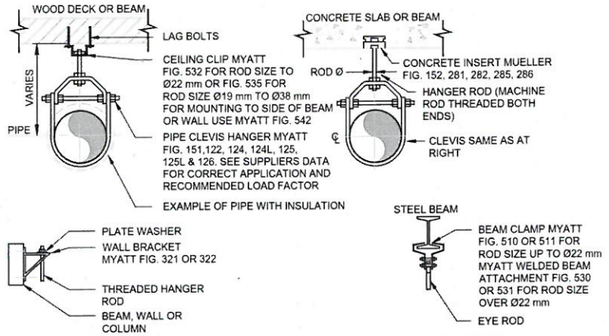
THE CITY OF Port Alberni

PROCESS MECHANICAL
TREATMENT BUILDING
SECTION SHEET 2

DRAWING	REVISION	SHEET
2972-00-D-352	0	79 / 111

IF NOT 50 mm ADJUST SCALES — 50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



OPTIONAL METHODS OF UPPER HANGER ROD ATTACHMENTS

DEPICTING DIFFERENT CEILING STRUCTURES

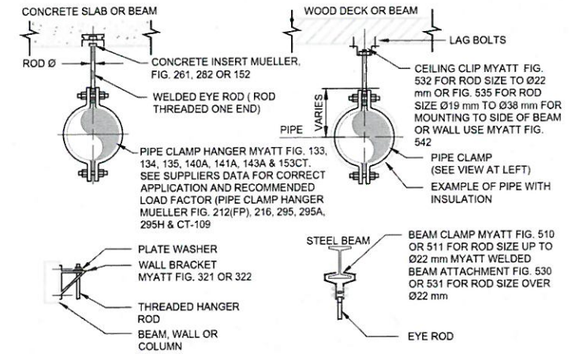
PIPE SIZE	10	15	20	25	30	40	50	65	80	100	150	200	250	300	350	400	450	500	600
CLEVIS No.	ROD Ø																		
MYATT 122	10	10	10	10	10	10	10	13	13	13									
MYATT 124			10	10	10	10	10	13	13	16	19	19	22	22	25	25	28	32	32
MYATT 125									19	22	25	25	28	32					
MYATT 126										19	19	22	22	25	25	32	32	32	38
MYATT 151		10	10	10	10	10	10	13	13	13	19	19	22						

NOTES:

FOR ANY OTHER TYPE OF INSTALLATION, PLEASE REFER TO MANUFACTURE'S SPECIFICATIONS
ALL PARTS MUST BE FROM SAME MANUFACTURER
MANUFACTURED COMPONENTS MAY BE ORDERED FROM MYATT, MUELLER OR AS APPROVED S.L. IS THE SAFE TOTAL UNIFORMLY DISTRIBUTED LOAD IN KILOGRAMS WITH A MAXIMUM DEFLECTION OF 6 mm
FABRICATED COMPONENTS SHOP PRIME WITH 2 COATS RED OXIDE PRIMER OR GALVANIZED AS PER SPECS.

1 - DETAIL — NTS

PIPE HANGER - STANDARD CLEVIS HANGER



OPTIONAL METHODS OF UPPER HANGER ROD ATTACHMENTS

DEPICTING DIFFERENT CEILING STRUCTURES

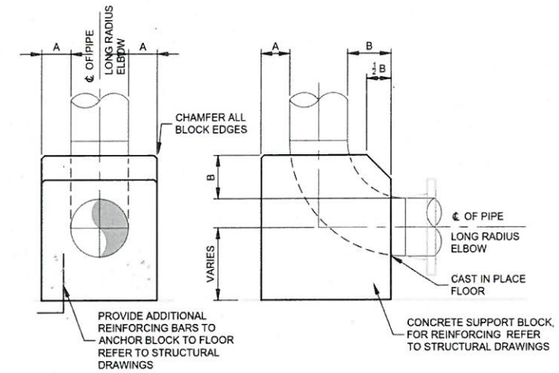
PIPE SIZE	10	15	20	25	30	40	50	65	80	100	150	200	250	300	350	400	450	500	600
CLEVIS No.	ROD Ø																		
MYATT 122	10	10	10	10	10	10	10	13	13	13									
MYATT 124			10	10	10	10	10	13	13	16	19	19	22	22	25	25	28	32	32
MYATT 125									19	22	25	25	28	32					
MYATT 126										19	19	22	22	25	25	32	32	32	38
MYATT 151		10	10	10	10	10	10	13	13	13	19	19	22						

NOTES:

FOR ANY OTHER TYPE OF INSTALLATION, PLEASE REFER TO MANUFACTURE'S SPECIFICATIONS
ALL PARTS MUST BE FROM SAME MANUFACTURER
MANUFACTURED COMPONENTS MAY BE ORDERED FROM MYATT, MUELLER OR AS APPROVED
S.L. IS THE SAFE TOTAL UNIFORMLY DISTRIBUTED LOAD IN KILOGRAMS WITH A MAXIMUM DEFLECTION OF 6 mm
FABRICATED COMPONENTS SHOP PRIME WITH 2 COATS RED OXIDE PRIMER OR GALVANIZED AS PER SPECS.

2 - DETAIL — NTS

PIPING HANGER - STANDARD PIPE CLAMP HANGER

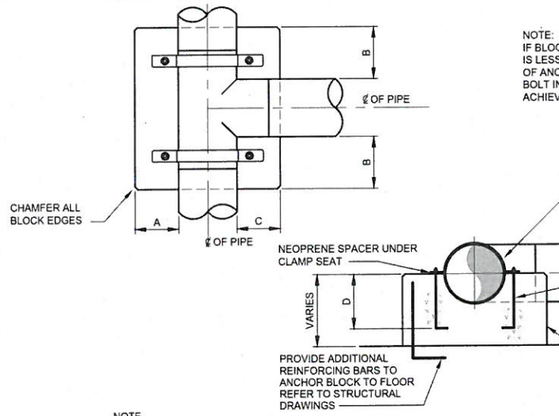


NOTE
THESE BLOCK DIMENSIONS ARE FOR LONG RADIUS ELBOWS ONLY
FOR OTHER TYPE OF ELBOWS ADJUST DIMENSIONS ACCORDINGLY

PIPE SIZE	50 & 65	80 & 100	125 & 150	200 & 250	300 TO 400	450 TO 600	750 & 900	1050 & LARGER
A	50	75	100	150	200	250	300	CUSTOM DESIGN FOR EACH APPLICATION
B	1/2 PIPE DIAMETER	1/2 PIPE DIAMETER	1/2 PIPE DIAMETER	1/2 PIPE DIAMETER	1/2 PIPE DIAMETER	1/2 PIPE DIAMETER	1/2 PIPE DIAMETER	

3 - DETAIL — NTS

CAST IN PLACE CONCRETE ANCHOR BLOCK FOR VERTICAL ELBOW (FIG 7)

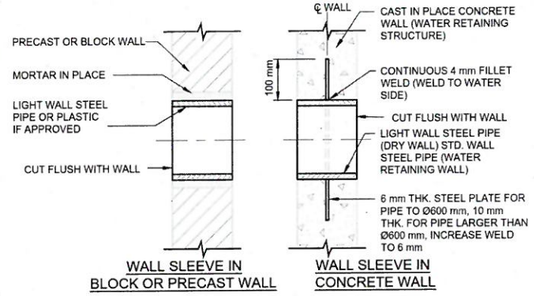


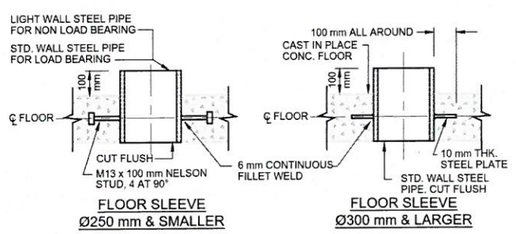
NOTE
THESE BLOCK DIMENSIONS ARE FOR STANDARD STEEL TEES ONLY FOR OTHER TYPE OF TEES ADJUST DIMENSIONS ACCORDINGLY ANCHOR BOLTS MAY BE REPLACED WITH HILTI HSL OR HIT HY 150 OR AS APPROVED

PIPE SIZE	50 & 65	80 & 100	125 & 150	200 & 250	300 TO 400	450 TO 600	750 & 900	1050 & LARGER
A	75	100	150	200	250	300	400	DESIGN CUSTOM FOR EACH APPLICATION
B	50	75	100	150	200	200	300	
C	50	50	75	100	100	150	200	
BOLT Ø x D	M8 x 90 (MIN)	M12 x 110 (MIN)	M16 x 130 (MIN)	M19 x 170 (MIN)	M22 x 210 (MIN)	M25 x 210 (MIN)	M38 x 305 (MIN)	

4 - DETAIL — NTS

CONCRETE SUPPORT BLOCK WITH STRAP HORIZONTAL TEE



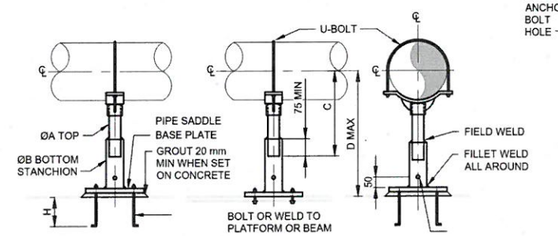


NOTES:

- SLEEVE TO BE NEXT PIPE DIAMETER LARGER THAN OUTSIDE DIAMETER OF PIPE PASSING THROUGH, OR AS SPECIFIED ON THE DRAWINGS.
- THE STEEL RETAINING PLATE MAY BE ROUND, SQUARE OR OCTAGON.
- SHOP PRIME EXPOSED SURFACE WITH 2 COATS RED OXIDE PRIMER.
- SLEEVES IN A WET ENVIRONMENT TO BE EPOXY LINED AND COATED.

5 - DETAIL — NTS

PIPE PENETRATIONS - PIPE SLEEVE DETAIL



NOTES:
STANCHION MATERIAL SCH. 40 PIPE, OR AS PER SPECIFICATIONS.
BASE PLATE - CARBON STEEL
SHOP PRIME - 2 COATS RED OXIDE PRIMER OR GALVANIZED AS PER SPECIFICATIONS
TOUCH UP FIELD WELDS WITH PRIMER OR GALVICON
PIPE STANCHION SADDLE - MAY BE MYATT FIG. 306/306S OR MUELLER (ANVIL) FIG. 259/265

PIPE SIZE	100	125	150	200	250	300	350	400	450	500	600	750	900	-
A	80	80	80	80	80	80	80	80	90	90	100	100	100	-
B	100	100	100	100	100	100	100	100	150	150	150	150	150	-
C MIN	240	255	270	310	350	370	380	425	485	510	590	670	745	-
C MAX	350	370	390	425	460	485	515	540	600	625	705	785	860	-
D MAX	1200	1200	1200	1200	1200	1200	1200	1200	1850	1850	1850	1850	1850	-
THICK x E SQUARE	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	10 mm x 250	-
F SQUARE	200	200	200	200	200	200	200	200	200	200	200	200	200	-
G DIA. x No. HOLES	20 DIAMETER x 4													
BOLT DIA. x H	M16x100 GALVANIZED OR AS APPROVED EXIST. CONCRETE USE M16 HSL HILTI													

6 - DETAIL — NTS

PIPE SUPPORT - PIPE STANCHION WITH SADDLE (ADJUSTABLE)

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DATE: 2018-06-28, Jhunn Dudan

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PROFESSIONAL ENGINEER — H. MASUDA # 44056 — BRITISH COLUMBIA

June 28/18.

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	H. MASUDA	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

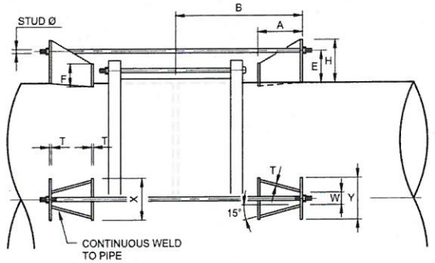
THE CITY OF Port Alberni

PROCESS MECHANICAL DETAILS SHEET 1

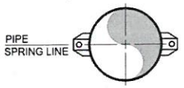
DRAWING	REVISION	SHEET
2972-00-D-501	0	80 / 111

IF NOT 50 mm ADJUST SCALES — 50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PIPE Ø300 & SMALLER



HARNESS LOCATION FOR 2 TIE BOLTS

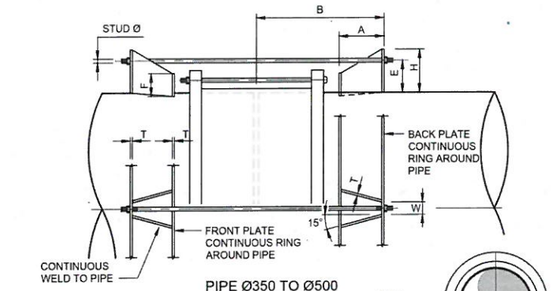
DIMENSIONS BASED ON MANUFACTURED COUPLINGS USING 178 mm LONG MIDDLE RING
DESIGN PRESSURE 1724 kPA (250 PSI) MAX. PLACE JOINT HARNESS TIE BOLTS ON PIPE AS SHOWN FOR STAINLESS STEEL PIPE - FABRICATE LUG PLATES FROM SAME MATERIAL AS PIPE

FOR CARBON STEEL PIPE - FABRICATE LUG PLATES FROM CARBON STEEL PIPE ASTM A283, GRADE B, OR ASTM A285, GRADE C OR EQUAL STUD DIAMETER DETERMINED ASSUMING 52000 PSI ALLOWABLE STRESS BOLTS AND NUTS TO BE STAINLESS STEEL

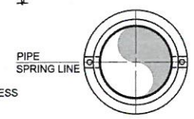
NOTE:
HARNESS CHART INFORMATION BASED ON MAX. PRESSURE AND LARGEST BOLT SIZE FOR THAT PARTICULAR PIPE SIZE, FOR OTHER BOLT SIZES REFER TO AWWA M-11 TABLES 13-4,13-5, 13-5A AND HARNESS LUG DETAIL FIGURE 13-20

NOMINAL PIPE SIZE MILLIMETRES	CPLG OD (MAX)	MAX STUD DIA	MAX HOLE DIA	LUG DIMENSIONS (MILLIMETRES)									TIE BOLT
				A	W	T	H	E	F	Y	X	B	
150	266	16	19	127	35	10	98	76	51	127	127	300	2
200	316	16	19	127	35	10	98	76	51	127	127	305	2
250	386	19	22	127	38	10	108	79	51	127	127	310	2
300	428	22	25	140	41	13	108	79	51	127	127	310	2

1 — DETAIL — NTS
PIPE HARNESS - AWWA TYPE P HARNESS LUG



PIPE Ø350 TO Ø500



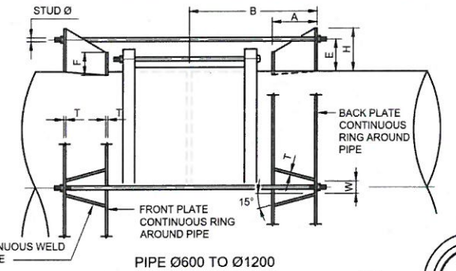
HARNESS LOCATION FOR 2 TIE BOLTS

DIMENSIONS BASED ON DRESSER STYLE 38 OR ROBAR STYLE 1506 COUPLING USING 178 mm LONG MIDDLE RING
DESIGN PRESSURE 1724 kPa (250 PSI) MAX. PLACE JOINT HARNESS TIE BOLTS ON PIPE AS SHOWN FOR STAINLESS STEEL PIPE - FABRICATE LUG PLATES FROM SAME MATERIAL AS PIPE
FOR CARBON STEEL PIPE - FABRICATE LUG PLATES FROM CARBON STEEL PIPE ASTM A283, GRADE B, OR ASTM A285, GRADE C OR EQUAL STUD DIAMETER DETERMINED ASSUMING 52000 PSI ALLOWABLE STRESS BOLTS AND NUTS TO BE STAINLESS STEEL

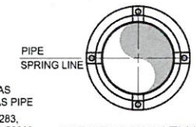
NOTE:
HARNESS CHART INFORMATION BASED ON MAX. PRESSURE AND LARGEST BOLT SIZE FOR THAT PARTICULAR PIPE SIZE, FOR OTHER BOLT SIZES REFER TO AWWA M-11 TABLES 13-4,13-5, 13-5A AND HARNESS LUG DETAIL FIGURE 13-20

NOMINAL PIPE SIZE MILLIMETRES	CPLG OD (MAX)	MAX STUD DIA	MAX HOLE DIA	LUG DIMENSIONS (MILLIMETRES)									TIE BOLT
				A	W	T	H	E	F	Y	X	B	
350	460	22	25	127	41	13	108	79	51	RING	RING	315	2
400	519	28	32	178	48	13	121	92	64	RING	RING	365	2
500	624	32	35	190	51	16	127	95	64	RING	RING	375	2

2 — DETAIL — NTS
PIPE HARNESS - AWWA TYPE RR HARNESS LUG



PIPE Ø600 TO Ø1200



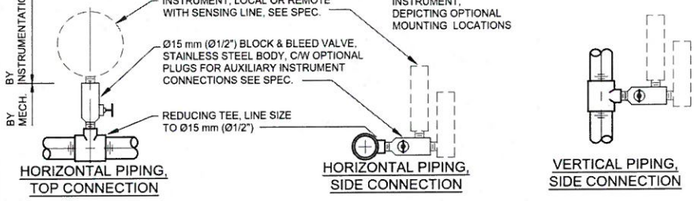
HARNESS LOCATION FOR 4 TIE BOLTS

DIMENSIONS BASED ON DRESSER STYLE 38 OR ROBAR STYLE 1506 COUPLING USING 178 mm LONG MIDDLE RING
DESIGN PRESSURE 1724 kPa (250 PSI) MAX. PLACE JOINT HARNESS TIE BOLTS ON PIPE AS SHOWN FOR STAINLESS STEEL PIPE - FABRICATE LUG PLATES FROM SAME MATERIAL AS PIPE
FOR CARBON STEEL PIPE - FABRICATE LUG PLATES FROM CARBON STEEL PIPE ASTM A283, GRADE B, OR ASTM A285, GRADE C OR EQUAL STUD DIAMETER DETERMINED ASSUMING 52000 PSI ALLOWABLE STRESS BOLTS AND NUTS TO BE STAINLESS STEEL

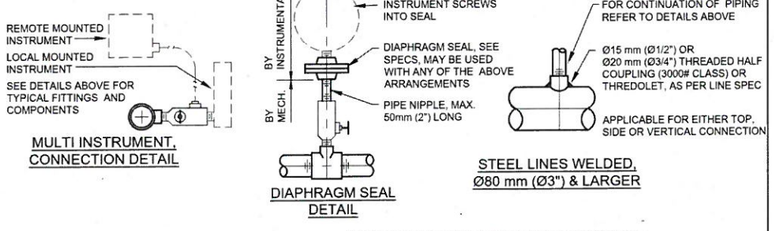
NOTE:
HARNESS CHART INFORMATION BASED ON MAX. PRESSURE AND LARGEST BOLT SIZE FOR THAT PARTICULAR PIPE SIZE, FOR OTHER BOLT SIZES REFER TO AWWA M-11 TABLES 13-4,13-5, 13-5A AND HARNESS LUG DETAIL FIGURE 13-20

NOMINAL PIPE SIZE MILLIMETRES	CPLG OD (MAX)	MAX STUD DIA	MAX HOLE DIA	LUG DIMENSIONS (MILLIMETRES)									TIE BOLT
				A	W	T	H	E	F	Y	X	B	
600	736	29	32	178	48	13	121	92	64	RING	RING	367	4
750	914	35	38	222	54	16	136	95	64	RING	RING	449	4
900	1067	41	44	273	60	19	143	98	64	RING	RING	500	4
1050	1220	38	41	254	57	19	140	98	64	RING	RING	500	4
1200	1372	41	44	273	60	19	143	98	64	RING	RING	500	4
1350 AND LARGER REFER TO AWWA M-11 TABLE 13-4 AND 13-5													

3 — DETAIL — NTS
PIPE HARNESS - AWWA TYPE RR HARNESS LUG

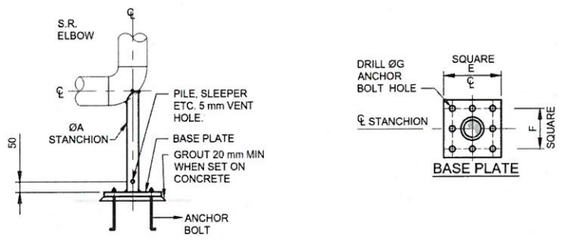


STEEL LINES SCREWED, Ø65 mm (Ø2 1/2") AND SMALLER



VALVE TYPE AND PIPING MATERIAL IN ACCORDANCE WITH SPECS. INSTRUMENT CONNECTIONS Ø15 mm UNLESS SPECIFIED OTHER- WISE, SEE SPEC DIV. 13, IF SO, INCREASE PIPING TO SUIT HORIZONTAL PIPING. SIDE CONNECTION IS THE PREFERRED CONNECTION FOR GAUGES.

4 — DETAIL — NTS
INSTRUMENT CONNECTION TO PIPE - INSTRUMENT PIPING DETAIL



NOTES: STANCHION MATERIAL STD. WT PIPE, OR AS PER SPECIFICATIONS.
BASE PLATE - CARBON STEEL
SHOP PRIME - 2 COATS RED OXIDE PRIMER OR GALVANIZED AS PER SPECIFICATIONS
TOUCH UP FIELD WELDS WITH PRIMER OR GALVICON
STANCHIONS - MAY BE (ANVIL) FIG. 63, TYPE B.

PIPE SIZE	750
A	500
THICK x E SQUARE	12.7 mm x 800
F SQUARE	670
G DIAM. x No. HOLES	25 DIAMETER x 8
BOLT DIAM. x H	M20x150(MIN) GALVANIZED BOLT CAST IN PLACE OR AS APPROVED

5 — DETAIL — NTS
PIPE SUPPORT - PIPE STANCHION

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DATE: 2018-06-26, Jhunt Dustan

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PROFESSIONAL ENGINEER — H. MASUDA # 44056 — BRITISH COLUMBIA
June 28/18.

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	H. MASUDA	B. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

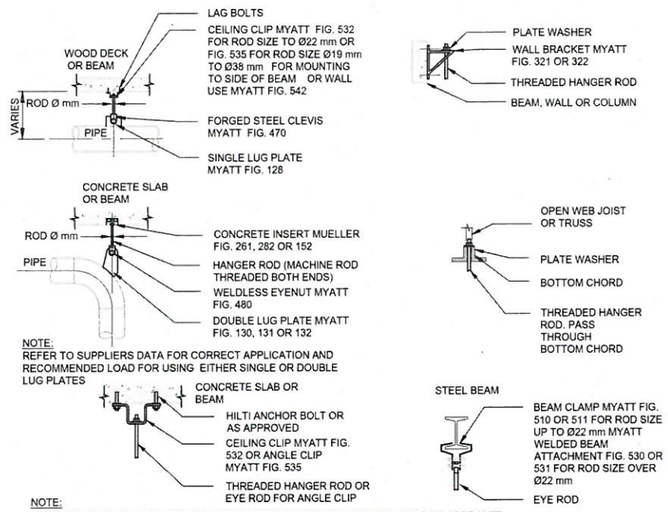
THE CITY OF Port Alberni

PROCESS MECHANICAL
DETAILS SHEET 2

DRAWING	REVISION	SHEET
2972-00-D-502	0	81 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

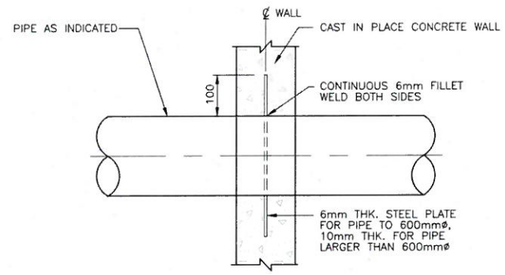


NOTE:
MANUFACTURED COMPONENTS MAY BE ORDERED FROM MYATT, MUELLER OR AS APPROVED

S.L. IS THE SAFE TOTAL UNIFORMLY DISTRIBUTED LOAD IN KILOGRAMS WITH A MAXIMUM DEFLECTION OF 6 mm

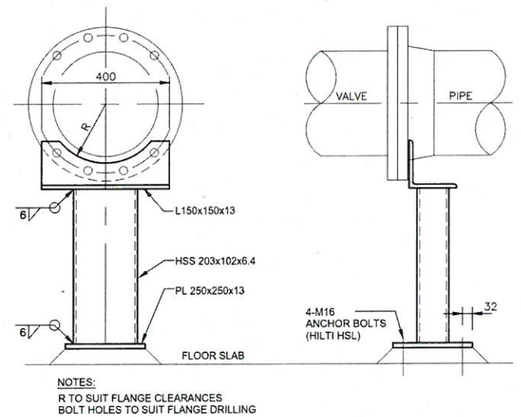
FABRICATED COMPONENTS SHOP PRIME WITH 2 COATS RED OXIDE PRIMER OR GALVANIZED AS PER SPECS.

1 / - DETAIL — NTS
PIPE HANGER - STANDARD HANGER COMPONENTS



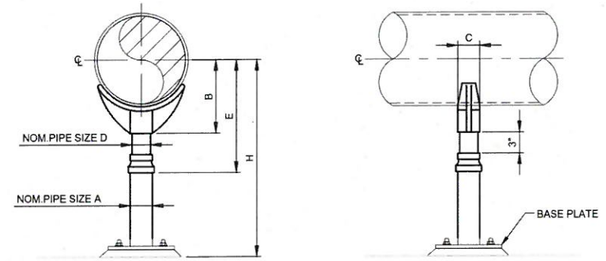
NOTES:
1. MISCELLANEOUS STEEL TO BE GALVANIZED.

2 / D-351 DETAIL — NTS
SEAL RING DETAIL



NOTES:
R TO SUIT FLANGE CLEARANCES
BOLT HOLES TO SUIT FLANGE DRILLING

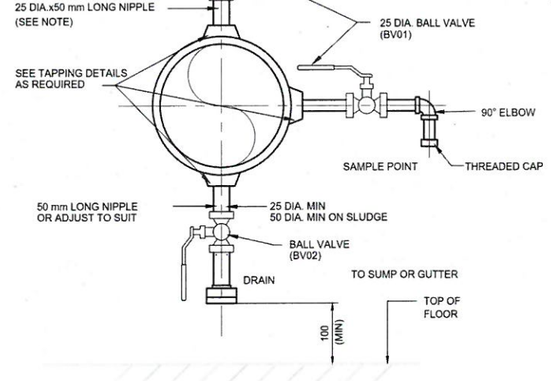
4 / - DETAIL — NTS
FLANGE PIPE SUPPORT



NOTES:
MATERIAL: CAST IRON SADDLE, LOCKNUT NIPPLE AND SPECIAL CAST IRON REDUCER, ASSEMBLED.
INSTALLATION: ADJUSTMENT OBTAINED BY TURNING THE LOCKNUT NIPPLE. THE LOWER END OF THE NIPPLE IS STAKED, UPSETTING THE THREADS TO PREVENT SEPARATION OF NIPPLE AND COUPLING DURING ADJUSTMENT.

FIG. 264: LOADS (LBS); WEIGHT (LBS); DIMENSIONS (IN)									
PIPE SIZE	WEIGHT		A	B	C	E		WIDTH C	MAX LOAD
	COMPLETE	SADDLE ONLY				MIN	MAX		
30	170	150.0	6	21 5/16	4	27	31 1/2	6 3/4	7300

5 / - DETAIL — NTS
PIPE SUPPORT - ADJUST PIPE SADDLE



NOTES:
1. WHEN SERVICE PIPE IS MORE THAN 1800 mm ABOVE FLOOR, DRAIN (AIR RELEASE) SHALL BE PIPED DOWN NEAREST WALL WITH A VALVE 1200 mm ABOVE FINISHED FLOOR.

6 / - DETAIL — NTS
AIR RELEASE, SAMPLE POINTS AND DRAIN CONNECTION

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DATE: 2018-06-28, Jhurm Dullan

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H. MASUDA # 44056 — PROFESSIONAL ENGINEER — BRITISH COLUMBIA
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WASTEWATER LAGOON EXPANSION UPGRADES

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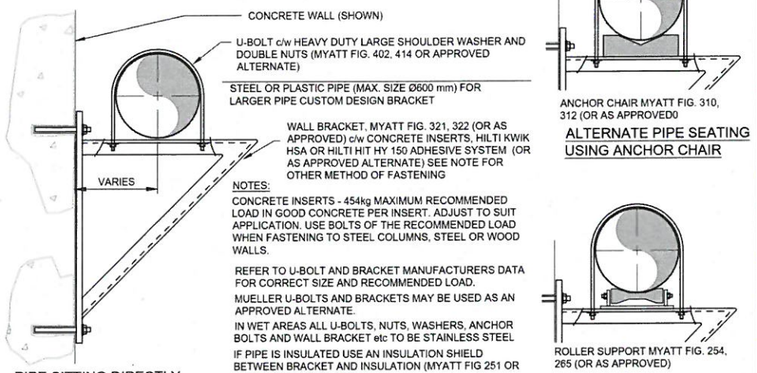
SCALE: AS SHOWN

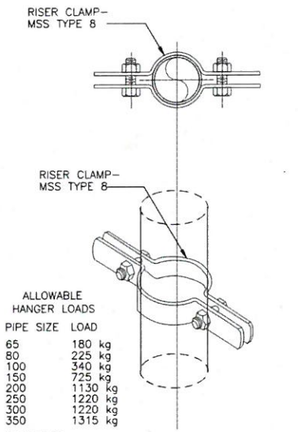
THE CITY OF Port Alberni

PROCESS MECHANICAL DETAILS SHEET 3

DRAWING	REVISION	SHEET
2972-00-D-503	0	82 / 111



1 - DETAIL NTS
PIPE SUPPORT - (SINGLE PIPE) WALL BRACKET

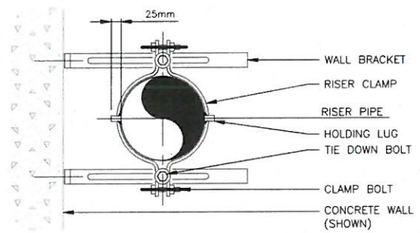


ALLOWABLE HANGER LOADS

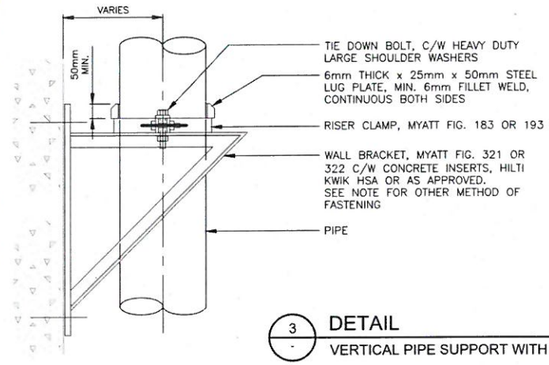
PIPE SIZE	LOAD
65	180 kg
80	225 kg
100	340 kg
150	725 kg
200	1130 kg
250	1220 kg
300	1220 kg
350	1315 kg

NOTES:
1. ASSOCIATED HANGERS MUST BE CAREFULLY LOCATED TO ASSURE THAT RISER PIPE HANGER DOES NOT EXCEED THE DESIGN LOAD CAPACITY.
2. FOR VERTICAL PIPE ONLY.

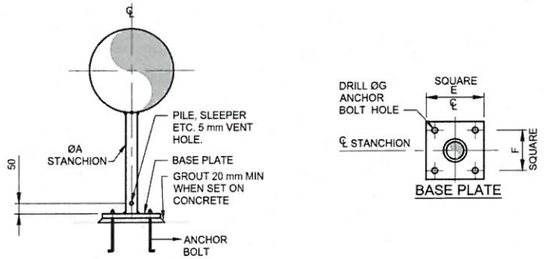
2 - DETAIL NTS
RISER CLAMP PIPE HANGER



NOTES:
1. CONCRETE INSERTS – 454kg MAXIMUM RECOMMENDED LOAD IN GOOD CONCRETE PER INSERT. ADJUST TO SUIT APPLICATION USE BOLTS OF THE RECOMMENDED LOAD WHEN FASTENING TO STEEL COLUMNS, STEEL OR WOOD WALLS.
2. REFER TO CLAMP AND BRACKET MANUFACTURERS DATA FOR CORRECT SIZE AND RECOMMENDED LOAD.
3. LUG PLATES MAY BE REPLACED BY TACK WELDING (EQUAL STRENGTH) CLAMP TO PIPE, IF APPROVED BY ENGINEER.
4. MUELLER CLAMPS AND BRACKETS MAY BE USED AS AN APPROVED ALTERNATE.



3 - DETAIL NTS
VERTICAL PIPE SUPPORT WITH PIPE BRACKET



NOTES: STANCHION MATERIAL STD. WT PIPE, OR AS PER SPECIFICATIONS.
BASE PLATE - CARBON STEEL
SHOP PRIME - 2 COATS RED OXIDE PRIMER OR GALVANIZED AS PER SPECIFICATIONS
TOUCH UP FIELD WELDS WITH PRIMER OR GALVICON
STANCHIONS - MAY BE (ANVIL) FIG. 63, TYPE C.

PIPE SIZE	900
A	400
THICK x E SQUARE	12.7 mm x 600
F SQUARE	500
G DIAM. x No. HOLES	25 DIAMETER x 4
BOLT DIAM. x H	M20x150(MIN) GALVANIZED BOLT CAST IN PLACE OR AS APPROVED

4 - DETAIL NTS
PIPE SUPPORT - PIPE STANCHION

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www.ae.ca

PROFESSIONAL ENGINEER
H. MASUDA
44056
BRITISH COLUMBIA

dme 28/18.

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	H. MASUDA	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

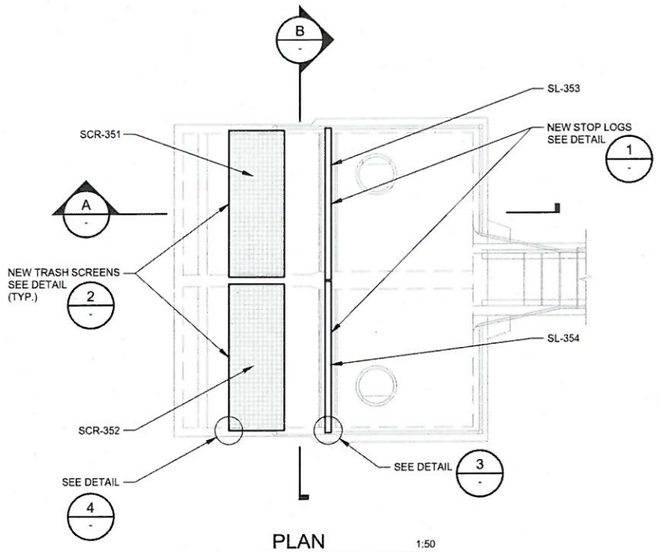
THE CITY OF Port Alberni

PROCESS MECHANICAL
DETAILS SHEET 4

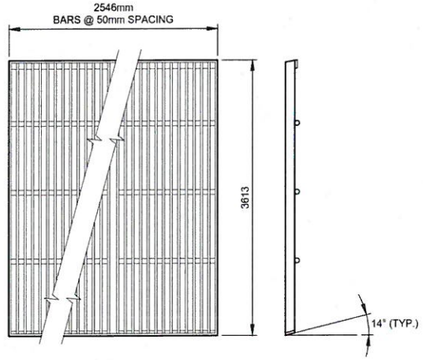
DRAWING	REVISION	SHEET
2972-00-D-504	0	83 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

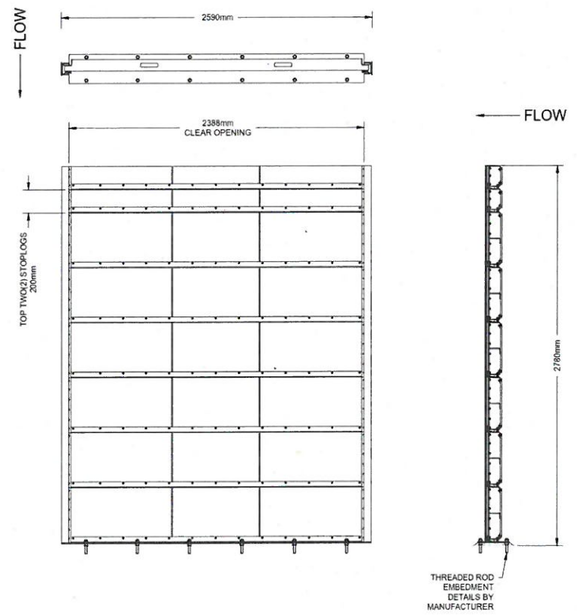
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



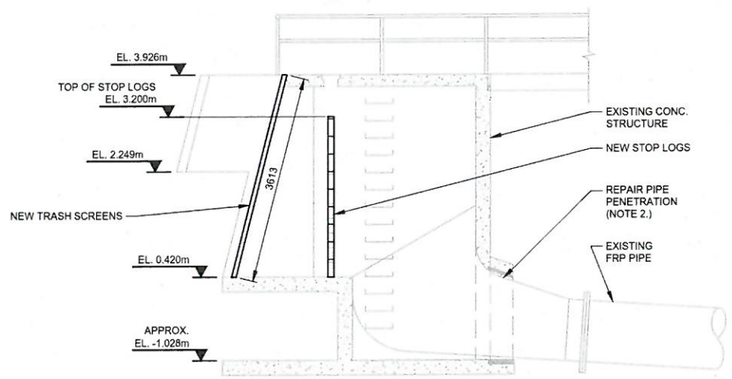
PLAN 1:50



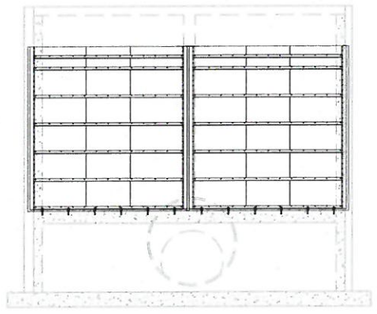
2 - DETAIL NTS
TRASH SCREENS (2 REQ'D)



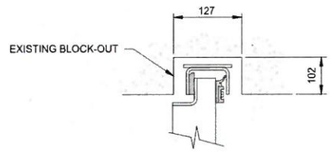
1 - DETAIL NTS
STOP LOGS



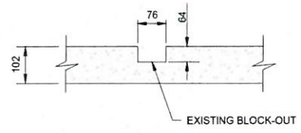
A - SECTION 1:50



B - SECTION 1:50



3 - DETAIL NTS
STOP LOGS BLOCK-OUT



4 - DETAIL NTS
TRASH SCREEN BLOCK-OUT

NOTES:

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS.
2. REPAIR WATER LEAK BETWEEN FRP PIPE AND CONCRETE STUCTURAL WITH POLYURETHANE RESIN OR APPROVED EQUAL.

P:\20172972\00_WetWtr_Trtmnt_Upg\Working_Dwgs\400_Process_Mech\2972-00-d-561.dwg
DATE: 2018-06-28, Jhurm Duilan

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BEST MANAGED COMPANIES

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA
H. MASUDA
44056
June 28/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	H. MASUDA	S. LUI	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

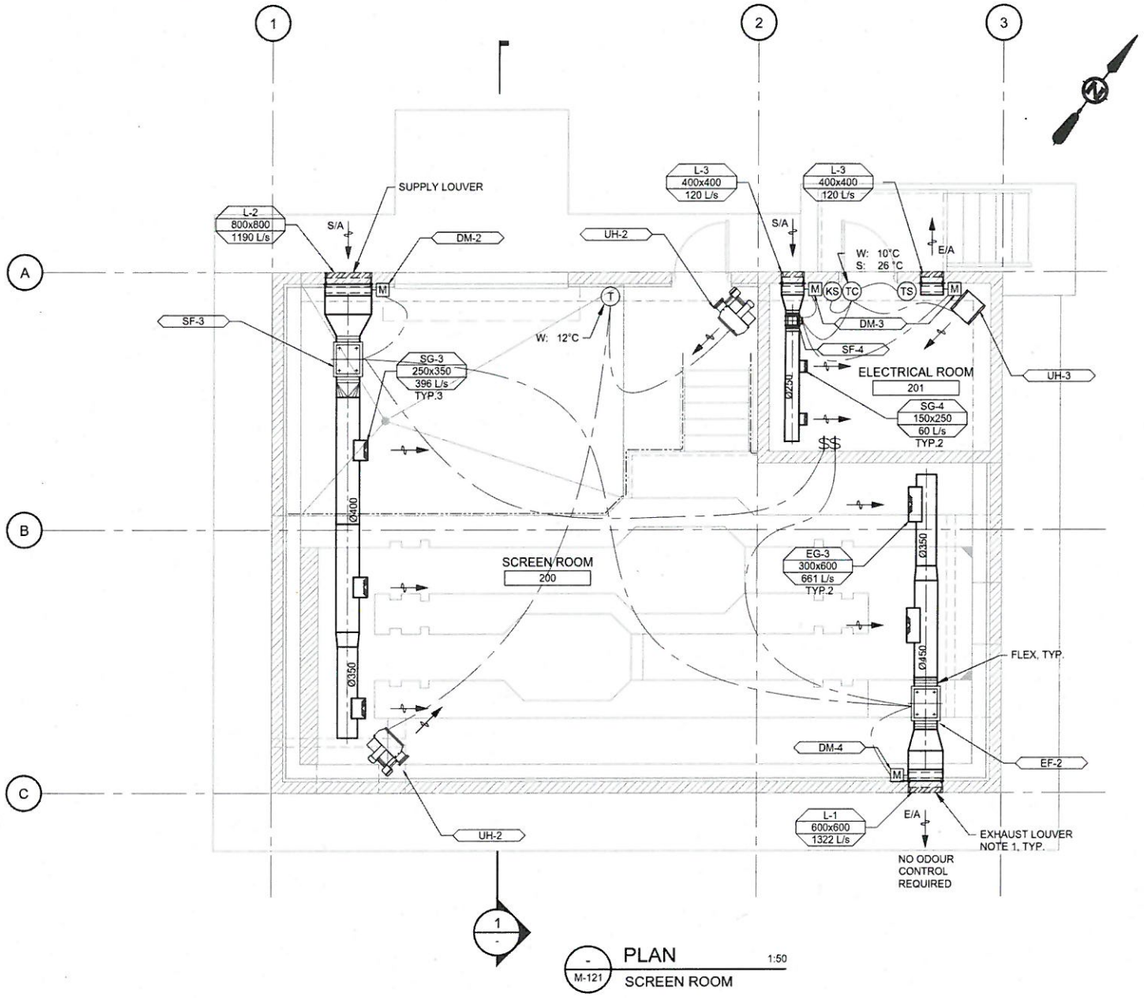
THE CITY OF Port Alberni

PROCESS MECHANICAL
EMERGENCY OVERFLOW STRUCTURE
STOP LOGS GA AND DETAILS

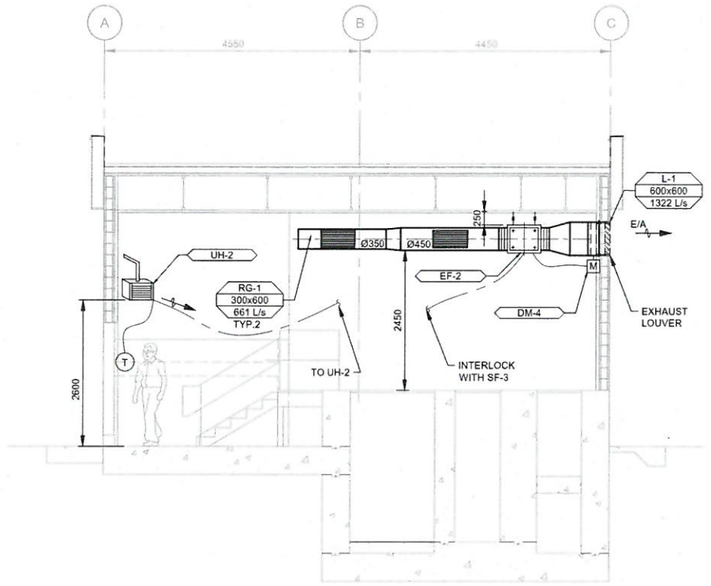
DRAWING	REVISION	SHEET
2972-00-D-561	0	84 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 / - / M-121 PLAN 1:50
SCREEN ROOM



1 / M-121 SECTION 1:50
SCREEN ROOM

NOTES:
1. REFER TO STRUCTURAL DRAWINGS FOR EXACT LOCATIONS OF THE LOUVERS.
2. REFER TO SPECIFICATIONS FOR DUCT AND PLENUM INSULATION REQUIREMENTS.
3. FOR ABBREVIATIONS REFER TO M-151DRAWING.

P:\20172972\00_WetWx_Trtmnt_Upg\Working_Dwgs\500_Building_Mech\2972-00-m-121.dwg
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
S. DEE JR
25684
JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	S. DEE	S. PETROV	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: 1:50

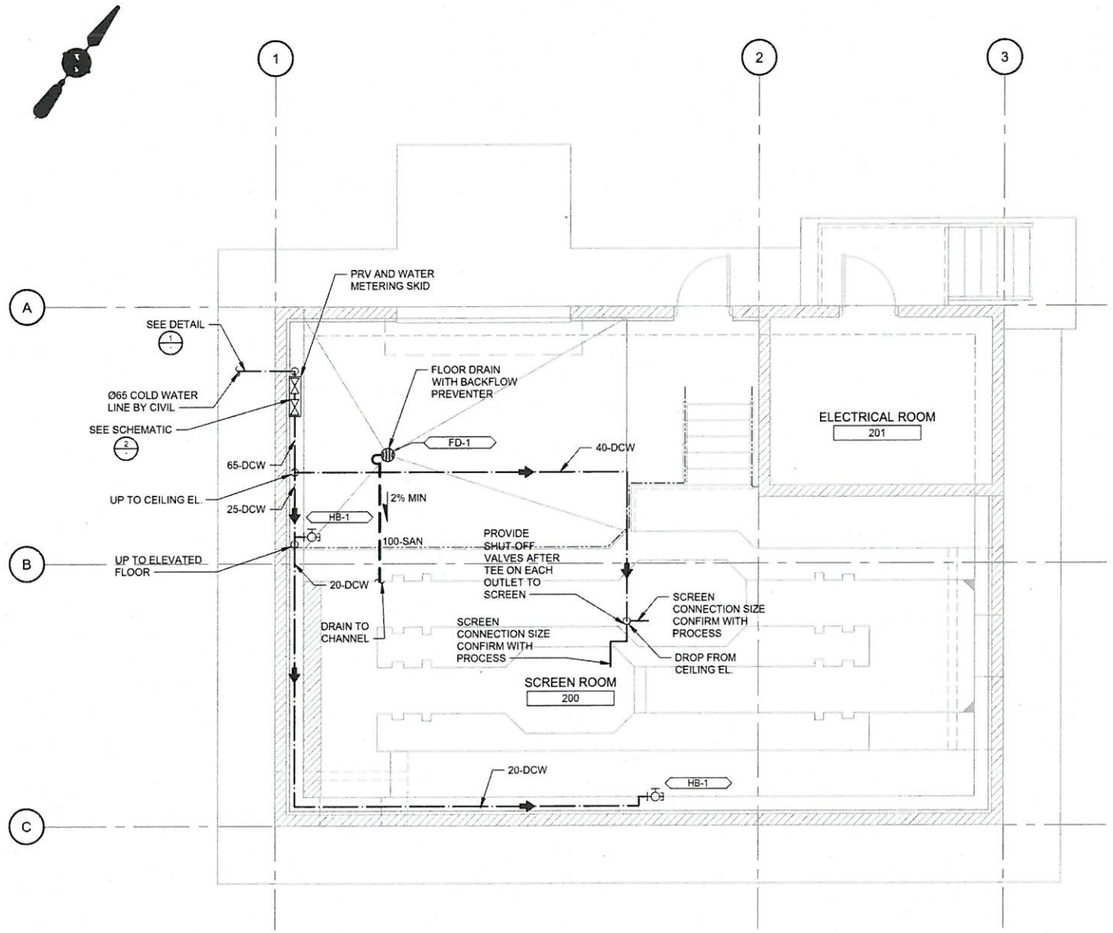
THE CITY OF Port Alberni

BUILDING MECHANICAL
SCREEN BUILDING
HVAC SYSTEM PLAN AND SECTION

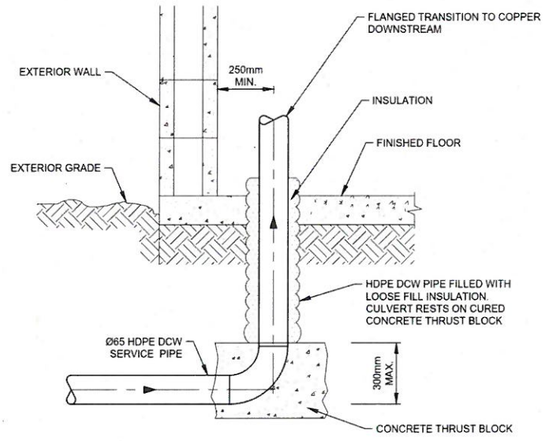
DRAWING	REVISION	SHEET
2972-00-M-121	0	85 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

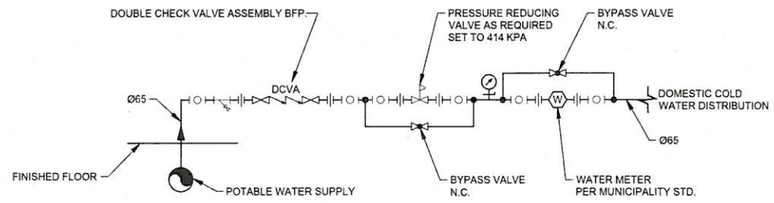
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 / - PLAN 1:50
SCREEN BUILDING



1 / - DETAIL NTS
UNDERGROUND WATER SERVICE ENTRY



2 / - SCHEMATIC NTS
DOMESTIC WATER METER

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JUN 28 2018

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

BUILDING MECHANICAL
SCREEN BUILDING
PLUMBING PLAN

DRAWING	REVISION	SHEET
2972-00-M-122	0	86 / 111

IF NOT 50 mm ADJUST SCALES
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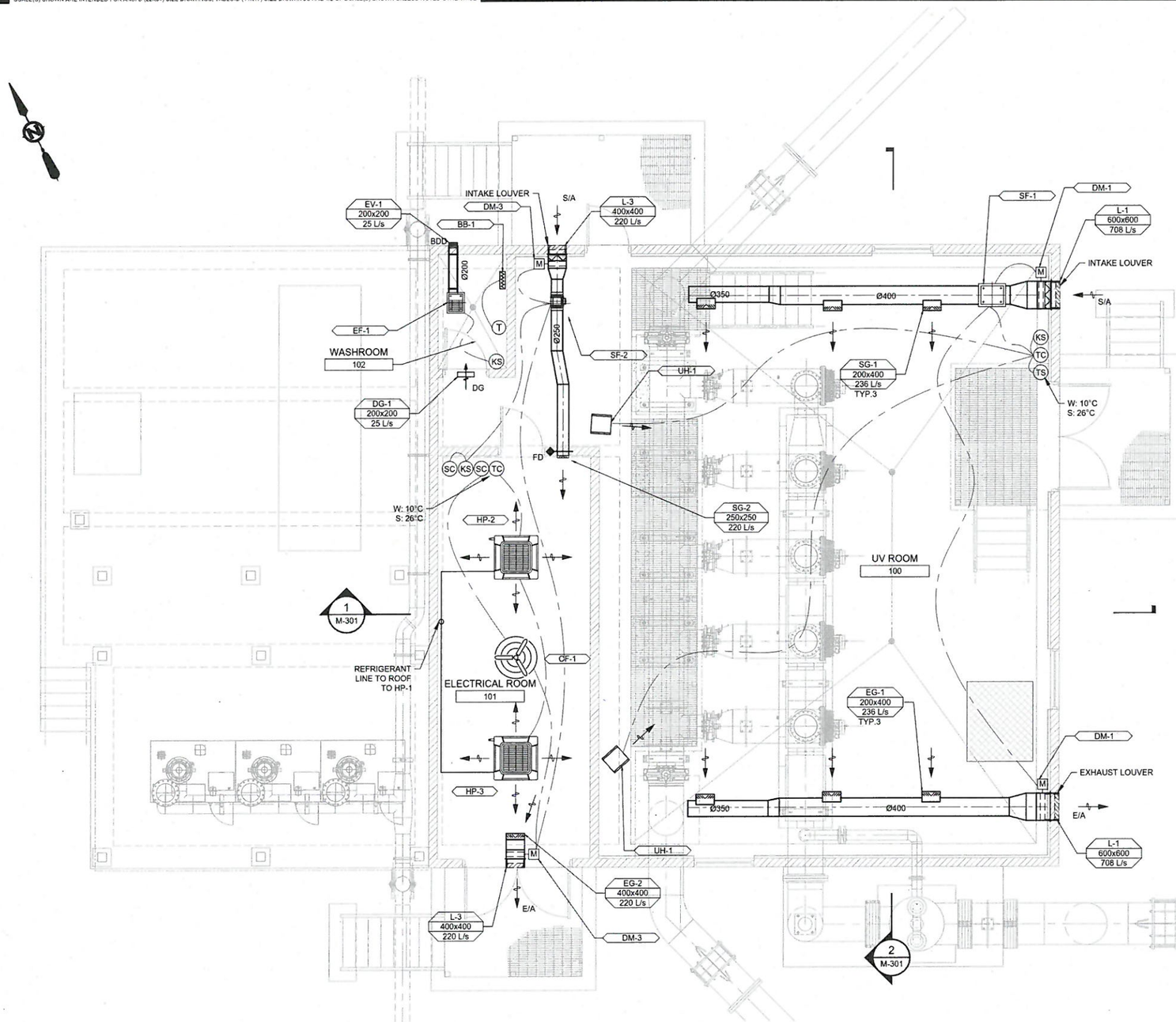

HVAC SYMBOL SCHEDULE

SYMBOL	DESCRIPTION
CF	CEILING FAN
BB	BASEBOARD ELECTRIC HEATER
DG	DOOR GRILLE
DM	DAMPER MOTOR
DS	DOOR SWITCH
EF	EXHAUST FAN
EG	EXHAUST GRILLE
FD	FIRE DAMPER
HP	HEAT PUMP
KS	TIMER SWITCH
L	LOUVRE
SG	SUPPLY GRILLE
SF	SUPPLY FAN
T	THERMOSTAT
TC	TEMPERATURE CONTROLLER
TS	TEMPERATURE SENSOR
UH	ELECTRIC UNIT HEATER
WHA	WATER HAMMER ARRESTER
$	WALL SWITCH

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
S. DEE JR
25884
JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	S. DEE	S. PETROV	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: 1:50

THE CITY OF Port Alberni

BUILDING MECHANICAL
TREATMENT BUILDING
HVAC SYSTEM PLAN

DRAWING	REVISION	SHEET
2972-00-M-151	0	87 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

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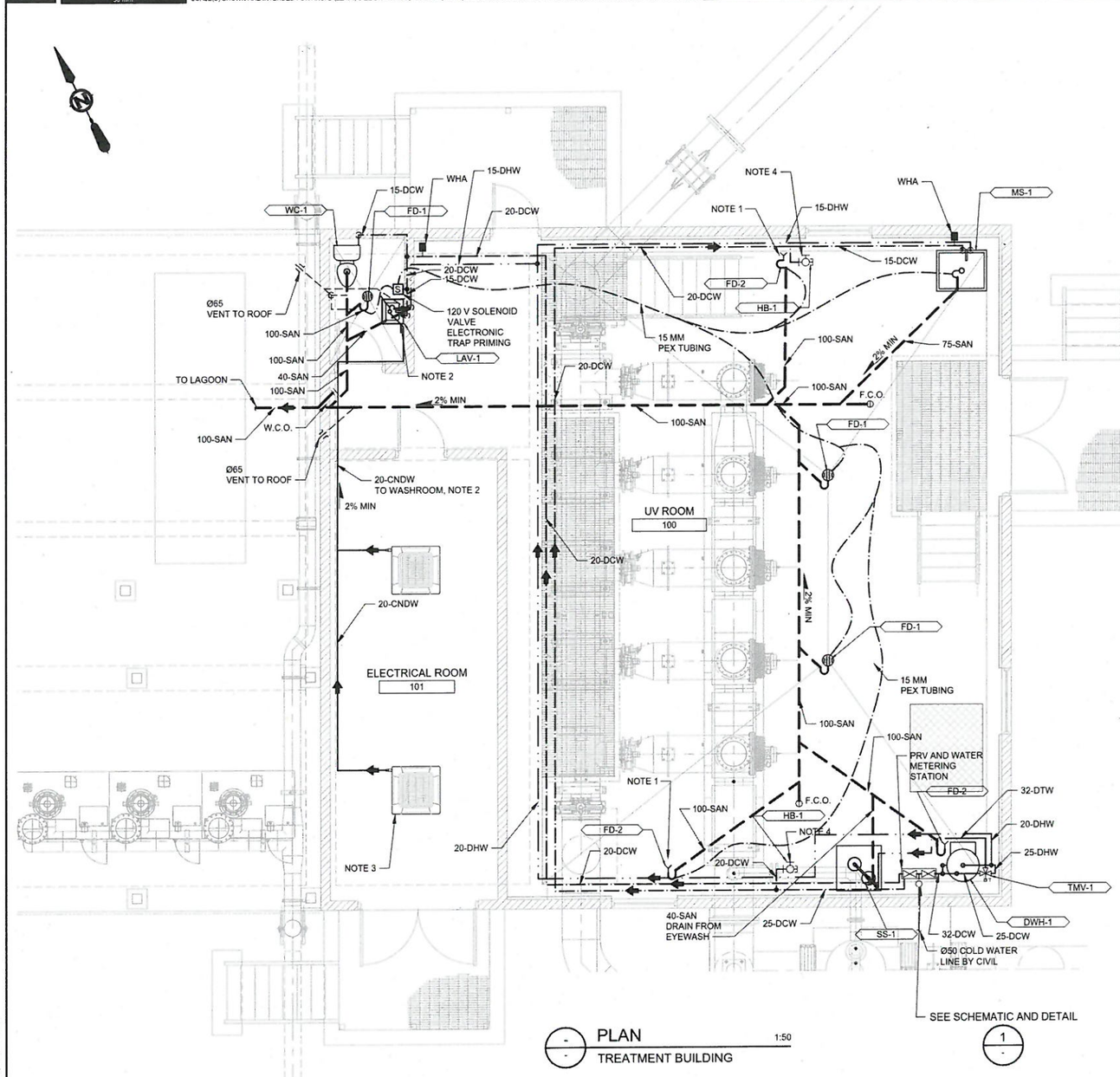
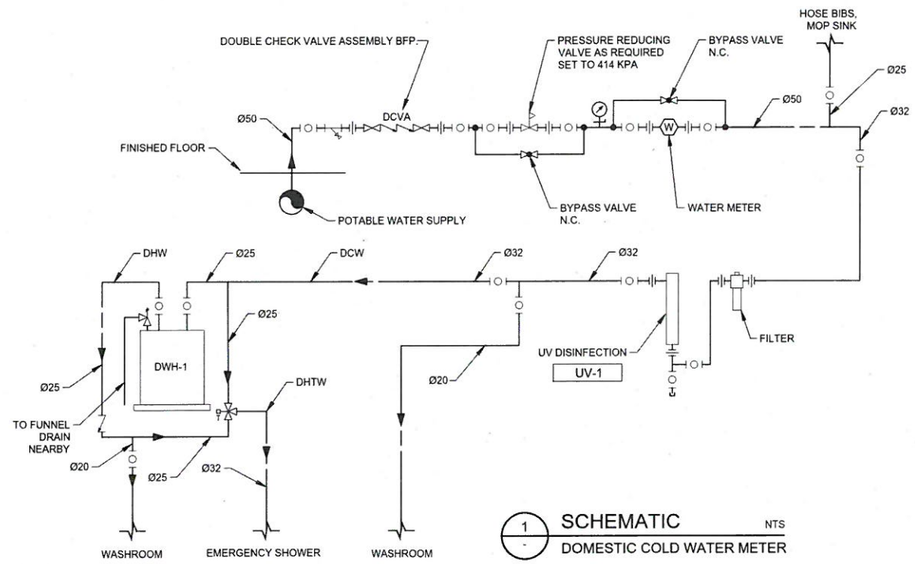
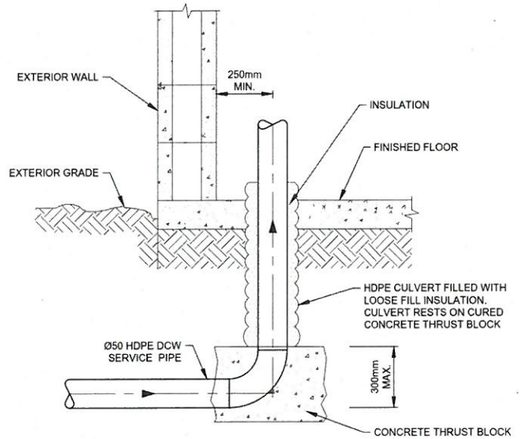


1:50 PLAN
TREATMENT BUILDING



1 - SCHEMATIC NTS
DOMESTIC COLD WATER METER



1 - DETAIL NTS
UNDERGROUND WATER
SERVICE ENTRY

NOTES:
1. COORDINATE FUNNEL DRAIN LOCATIONS WITH PROCESS.
2. CONDENSATE DRAIN TO TIE-IN UPSTREAM THE WASHROOM SINK P-TRAP.
3. CONNECT TO INTERNAL CONDENSATE PUMP DISCHARGE.
4. HOSE REELS TO BE INSTALLED NEXT TO THE HOSE BIBS.

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA S. DEE JR 25684
JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	S. DEE	S. PETROV	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

BUILDING MECHANICAL
TREATMENT BUILDING
PLUMBING PLAN

DRAWING	REVISION	SHEET
2972-00-M-152	0	88 / 111

IF NOT 50 mm ADJUST SCALES
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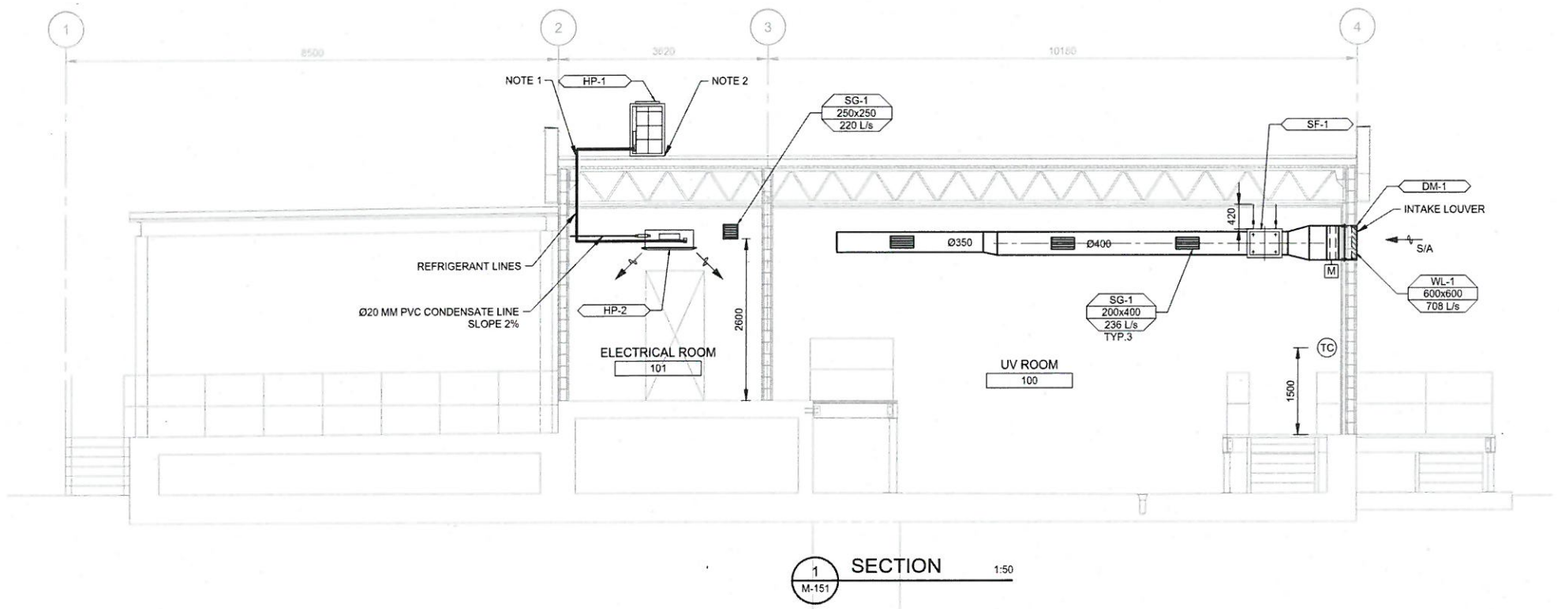
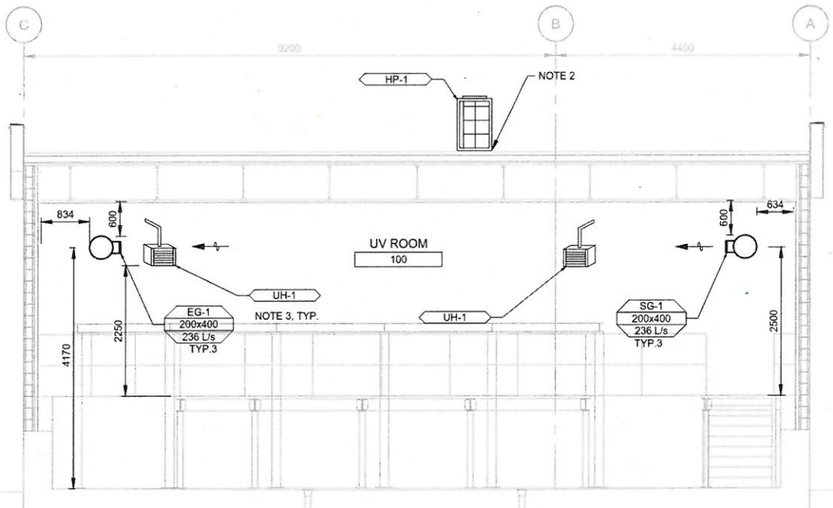


1 / M-151 SECTION 1:50



2 / M-151 SECTION 1:50

NOTES:
1. PROVIDE PVC CLADDING OVER INSULATION FOR OUTDOOR REFRIGERANT PIPING.
2. PROVIDE STEEL BASE TO MOUNT OUTDOOR HEAT PUMP UNIT AS PER MANUFACTURER REQUIREMENTS. COORDINATE WITH STEEL/STRUCTURAL CONTRACTOR/FABRICATOR.
3. FOR ABBREVIATIONS REFER TO M-151DRAWING.

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PROFESSIONAL ENGINEER
S. DEE JR
25684
BRITISH COLUMBIA
JUN 28 2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	S. DEE	S. PETROV	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: 1:50

THE CITY OF Port Alberni

BUILDING MECHANICAL
TREATMENT BUILDING
SECTIONS

DRAWING	REVISION	SHEET
2972-00-M-351	0	89 / 111

FAN SCHEDULE

TAG	MANUFACTURER	MODEL	LOCATION	SERVICE	AIR FLOW (L/s)	ESP (Pa)	FAN RPM	ARRANGEMENT	DRIVE TYPE	# OF WHEELS	DISCHARGE	MOTOR POWER (W)	V/Ph/Hz	NOTES
SF-1	LOREN-COOK	SQND-EC	UV BUILDING	OUTDOOR AIR	708	120	1725	HORIZONTAL	DIRECT	1	HORIZONTAL	0.373	120/1/60	EC MOTOR, COMPATIBLE WITH HONEYWELL T775 CONTROLLER
SF-2	SOLER-PALAU	TD-250	UV BUILDING ELECTRICAL ROOM	OUTDOOR AIR	220	110	1725	HORIZONTAL	DIRECT	1	HORIZONTAL	0.373	120/1/60	C/W WALL MOUNTED SPEED CONTROLLER
SF-3	GREENHECK	TCB-1-16-10	SCREEN ROOM	OUTDOOR AIR	1190	150	1725	HORIZONTAL	BELT	1	HORIZONTAL	0.746	208/3/60	ALL ALUMINUM AMCA CLASS-B SPARK RESISTANT CONSTRUCTION. CLASS 1, DIV.2 SUITABLE 2-SPEED MOTOR FOR CONTAMINATED AIR STREAM AND ENVIRONMENT. NEMA-3R TOGGLE SWITCH .
SF-4	SOLER-PALAU	TD-250	SCREEN BUILDING ELECTRICAL ROOM	OUTDOOR AIR	120	75	1725	HORIZONTAL	DIRECT	1	HORIZONTAL	0.373	120/1/60	C/W WALL DISCONNECT SWITCH.
EF-1	LOREN-COOK	GC-126	UV BUILDING WASHROOM	EXHAUST AIR	25	30	550	HORIZONTAL	DIRECT	1	HORIZONTAL	0.373	120/1/60	GEMINI WASHROOM EXHAUST FAN WITH INTEGRATED BACK DRAFT DAMPER
EF-2	GREENHECK	TCB-1-16-10	SCREEN ROOM	EXHAUST AIR	1322	150	1725	HORIZONTAL	BELT	1	HORIZONTAL	0.746	208/3/60	ALL ALUMINUM AMCA CLASS-B SPARK RESISTANT CONSTRUCTION. CLASS 1, DIV.2 SUITABLE 2-SPEED MOTOR FOR CONTAMINATED AIR STREAM AND ENVIRONMENT. NEMA-3R TOGGLE SWITCH .

ELECTRIC DOMESTIC WATER HEATER SCHEDULE

TAG	MANUFACTURER	MODEL	SERVICE	LOCATION	STORAGE CAPACITY (L)	ELECTRIC INPUT (kW)	RECOVERY CAPACITY (L/h)	TEMPERATURE RISE (°C)	V/Ph/Hz	NOTES
DWH-1	A.O. SMITH	DRE-120-12	HOT WATER	UV ROOM	450	12	233	45	208/3/60	REFER TO SPECIFICATIONS

PLUMBING EQUIPMENT SCHEDULE

FIXTURE TAG	TYPE	FIXTURE CONNECTIONS (in)					DESCRIPTION
		DCW	DHW	DTHW	DRAIN	VENT	
EMERGENCY SHOWER AND EYEWASH STATION, UV DISINFECTION, TRAP PRIMERS							
ESH-1	EMERGENCY SHOWER AND EYEWASH STATION	-	-	32Ø	100Ø	-	BRADLEY S19314 SERIES. COMBINATION DRENCH SHOWER AND HALO™ EYEWASH OR EYE/FACE WASH. TWO PIECE CONSTRUCTION. ERGONOMIC HAND ACTIVATION EYEWASH PADDLE.
TMV-1	THERMOSTATIC MIXING VALVE	25Ø	25Ø	32Ø	-	-	TM-800-LF, ECO-MIX ™ LEONARD VALVE. EXPOSED ASSEMBLY FOR DRENCH OR COMBINATION EMERGENCY SHOWER 3 - 56 GPM (11 - 212 L/MIN) FLOWRATE UP TO 45 PSI (3.1 BAR) SYSTEM PRESSURE DROP.
UV-1	ULTRAVIOLET WATER DISINFECTION	32Ø	-	-	-	-	RAINFRESH CANADA, MODEL R30. 30 GPM (1.89 L/S) FLOWRATE. 100 PSI (6.9 BAR) MAX PRESSURE. UV MONITOR OPTION. 304 SS MATERIAL OF THE CHAMBER. 40 WATTS LAMPS. LAMP CHANGE REMINDER OPTION. 120V/1PH/60HZ POWER SUPPLY.
ST-1	PPP ELECTRONIC TRAP PRIMING ASSEMBLY	20Ø	-	-	-	-	PTS-8, PRIME-TIME ELECTRONIC TRAP PRIMING ASSEMBLY SURFACE MOUNT. ATMOSPHERIC VACUUM BREAKER PRE-SET 24 HOUR ADJUSTABLE TIMER. MANUAL OVER RIDE SWITCH/TEST BUTTON.120v SOLENOID VALVE. 3/WIRE SINGLE POINT CONNECTION. 3/4" FNPT INLET CONNECTION. CALIBRATED MANIFOLD FOR EQUAL. 8 WATER DISTRIBUTION 5/8" OUTLETS COMPRESSION FITTINGS.
HOSE BIBBS							
HB-1	HOSE BIBB	20Ø	-	-	-	-	ACORN NEPTUNE STAINLESS STEEL CONSTRUCTION, ROUGH FINISH WITH 20mm MALE HOSE OUTLET W/ TAMPER PROOF 20mm VACUUM BREAKER
FLOOR DRAINS							
FD-1	FLOOR DRAIN	-	-	-	100Ø	-	WATTS FD-100-C-A HEAVY DUTY FLOOR DRAIN WITH STRAINER. EPOXY CAST IRON. NICKEL-BRONZE STRAINER. C/W P-TRAP.
FD-2	FLOOR DRAIN - OPEN FUNNEL	-	-	-	100Ø	-	WATTS FD-100-C-EG. HEAVY DUTY FLOOR DRAIN WITH STRAINER. EPOXY COATED CAST IRON. NICKEL-BRONZE STRAINER. NICKEL-BRONZE FUNNEL. C/W P-TRAP.
W.C.O.	WALL CLEAN-OUT	-	-	-	100Ø	-	WATTS CO-100-CR-X. HEAVY DUTY CLEAN OUT. EPOXY COATED. C/W ANCHOR FLANGE.
F.C.O.	FLOOR CLEAN-OUT	-	-	-	100Ø	-	WATTS CO-200-RFC7 . EPOXY COATED CAST IRON FLOOR CLEAN-OUT WITH ROUND ADJUSTABLE NICKEL BRONZE TOP SURFACE MEMBRANE CLAMP, REMOVABLE GAS TIGHT GASKETED BRASS CLEAN-OUT PLUG.
WATER CLOSETS AND LAVATORIES							
LAV-1	KOHLER COMMERCIAL BATHROOM SINK	15Ø	15Ø	-	40Ø	40Ø	WALL-MOUNTED OR CONCEALED CARRIER ARM MOUNTED COMMERCIAL BATHROOM SINK WITH 4" CENTERSET FAUCET HOLES AND NO OVERFLOW, ANTIMICROBAL FINISH. INCLUDES WALL HANGER. VITREOUS CHINA, K-1997-SS4N-0. FAUCET: LEAD FREE BODY WITH CERAMIC CARTRIDGES. FAUCET MODEL TO BE CHICAGO FAUCET #: 1891-ABCP.
WC-1	KOHLER CORBELLE TOILET	15Ø	-	-	100Ø	50Ø	TWO PIECE TOILET. L 29-3/8", H 31-5/16", W 16-1/2". COMFORT HEIGHT 1.28 GPF WITH SKIRTED TRAPWAY AND REVOLUTION 360 SWIRL FLUSHING TECHNOLOGY AND LEFT-HAND TRIP LEVER. STANDARD 12-INCH ROUGH-IN. SEAT TO BE INCLUDED OR PROVIDED.
SK-1	STERN WILLIAMS SINGLE FLOOR-MOUNTED STONE MOP SINK	15Ø	15Ø	-	75Ø	40Ø	CORNARO, SBC-1500 - 24x24x12". INTEGRAL DRAIN AND CAP. FAUCET: LEAD FREE BODY WITH CERAMIC CARTRIDGE. FAUCET MODEL TO BE CHICAGO FAUCET 897-RCF.

LOUVERS SCHEDULE

TAG	MANUFACTURER	MODEL	DESCRIPTION	MIN FREE AREA, (SQ.M)	FINISH
L-1	GREENHECK	ESD-435	600 X 600 DRAINABLE BLADE LOUVER	0.186	MILL
L-2	GREENHECK	ESD-435	800 X 800 DRAINABLE BLADE LOUVER	0.325	MILL
L-3	GREENHECK	ESD-435	400 X 400 DRAINABLE BLADE LOUVER	0.047	MILL
EV-1	LOREN-COOK	WCR6-ALUM	200 X 200 WALL EXHAUST VENT CAP WITH BACKDRAFT DAMPER AND SCREEN	-	MILL

DAMPERS SCHEDULE

TAG	MANUFACTURER	MODEL	DESCRIPTION	ACTUATOR	NOTES
DM-1	TAMCO	SERIES 1000	600 X 600 OPPOSED BLADE	120V / 1PH / 60Hz	TORQUE RATING TO SUIT DAMPER
DM-2	TAMCO	SERIES 1000	800 X 800 OPPOSED BLADE	120V / 1PH / 60Hz	C/W EXPLOSION PROOF ROTORK SCHISCHEK ACTUATORS TORQUE RATING TO SUIT DAMPER
DM-3	TAMCO	SERIES 1000	400 X 400 OPPOSED BLADE	120V / 1PH / 60Hz	TORQUE RATING TO SUIT DAMPER
DM-4	TAMCO	SERIES 1000	600 X 600 OPPOSED BLADE	120V / 1PH / 60Hz	C/W EXPLOSION PROOF ROTORK SCHISCHEK ACTUATORS TORQUE RATING TO SUIT DAMPER

GRILLES SCHEDULE

TAG	MANUFACTURER	MODEL	SIZE (MM)	AIRFLOW (L/S)	NOTES
SG-1	EH PRICE	620DAL	200 X 400	236	ALUMINUM, DOUBLE DEFLECTION
EG-1	EH PRICE	630DAL	200 X 400	236	ALUMINUM, DOUBLE DEFLECTION
SG-2	EH PRICE	610DAL	250 X 250	220	ALUMINUM, DOUBLE DEFLECTION
EG-2	EH PRICE	630DAL	400 X 400	220	ALUMINUM, DOUBLE DEFLECTION
SG-3	EH PRICE	620DAL	250 X 350	396	ALUMINUM, DOUBLE DEFLECTION
EG-3	EH PRICE	630DAL	300 X 600	661	ALUMINUM, DOUBLE DEFLECTION
SG-4	EH PRICE	620DAL	150 X 250	60	ALUMINUM, DOUBLE DEFLECTION
DG-1	EH PRICE	ATG1	200 X 200	25	ALUMINUM CONSTRUCTION, POWDER COATED

ELECTRIC UNIT HEATERS

TAG	MANUFACTURER	MODEL	SERIES	LOCATION	QTY	HEATING CAPACITY (kW)	TEMP RISE (°C)	MOTOR RPM	MOTOR POWER (kW)	V/Ph/Hz	NOTES
UH-1	OUELLET	OAS10038AM	OAS	UV ROOM	2	10	25	1550	0.02	208/3/60	120V CONTROL VIA TEMPERATURE CONTROLLER
UH-2	OUELLET	OHX10038	OHX	SCREEN BUILDING	2	10	22	1550	0.02	208/3/60	EXPLOSION PROOF CONSTRUCTION, ADJUSTABLE LOUVER, C/W EXPLOSION PROOF WALL THERMOSTAT, WALL MOUNTING BRACKET
UH-3	OUELLET	OAS04038AM	OAS	ELECTRICAL ROOM	1	4	14	1550	0.02	208/3/60	120V CONTROL VIA TEMPERATURE CONTROLLER

ELECTRIC BASEBOARD HEATERS

TAG	MANUFACTURER	MODEL	SERIES	LOCATION	QTY	HEATING CAPACITY (kW)	V/Ph/Hz	NOTES
BB-1	OUELLET	OFM0502	OFM	UV WASHROOM	1	0.5	120/1/60	BASEBOARD HEATER WITH MODULATING LINE VOLTAGE WALL THERMOSTAT. HEATER TO BE INTERLOCKED WITH LIGHT SWITCH FOR ON-OFF MODE.

HEAT PUMPS SCHEDULE

TAG	MANUFACTURER	MODEL	COOLING CAPACITY, (kW)	HEATING CAPACITY, (kW)	NOMINAL TONNAGE, (TON)	ELECTRICAL	WIDTH, (mm)	LENGTH, (mm)	HEIGHT, (mm)	WEIGHT, (kg)	FAN TYPE	AIRFLOW MAX. (L/s)	COP/EER	NOTES
HPU-1	FUJITSU	AOUA72RLBV	21.1	23.4	6	208 / 230, 3 PH, 60 Hz	930	765	1576	222	PROPELLER	-	3.76/12.5	OUTDOOR UNIT
HPU-2	FUJITSU	AUUB36TLAV	10.6	11.7	3	208 / 230, 1 PH, 60 Hz	950	950	298	27	TURBO	500	3.64/12.5	INDOOR CASSETTE
HPU-3	FUJITSU	AUUB36TLAV	10.6	11.7	3	208 / 230, 1 PH, 60 Hz	950	950	298	27	TURBO	500	3.64/12.5	INDOOR CASSETTE

GENERAL NOTES:
1. REFER TO SPECIFICATIONS FOR CEILING FAN DETAILS.

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

THE CITY OF Port Alberni

BUILDING MECHANICAL SCHEDULES

DRAWING	REVISION	SHEET
2972-00-M-601	0	90 / 111

IF NOT 50 mm ADJUST SCALES
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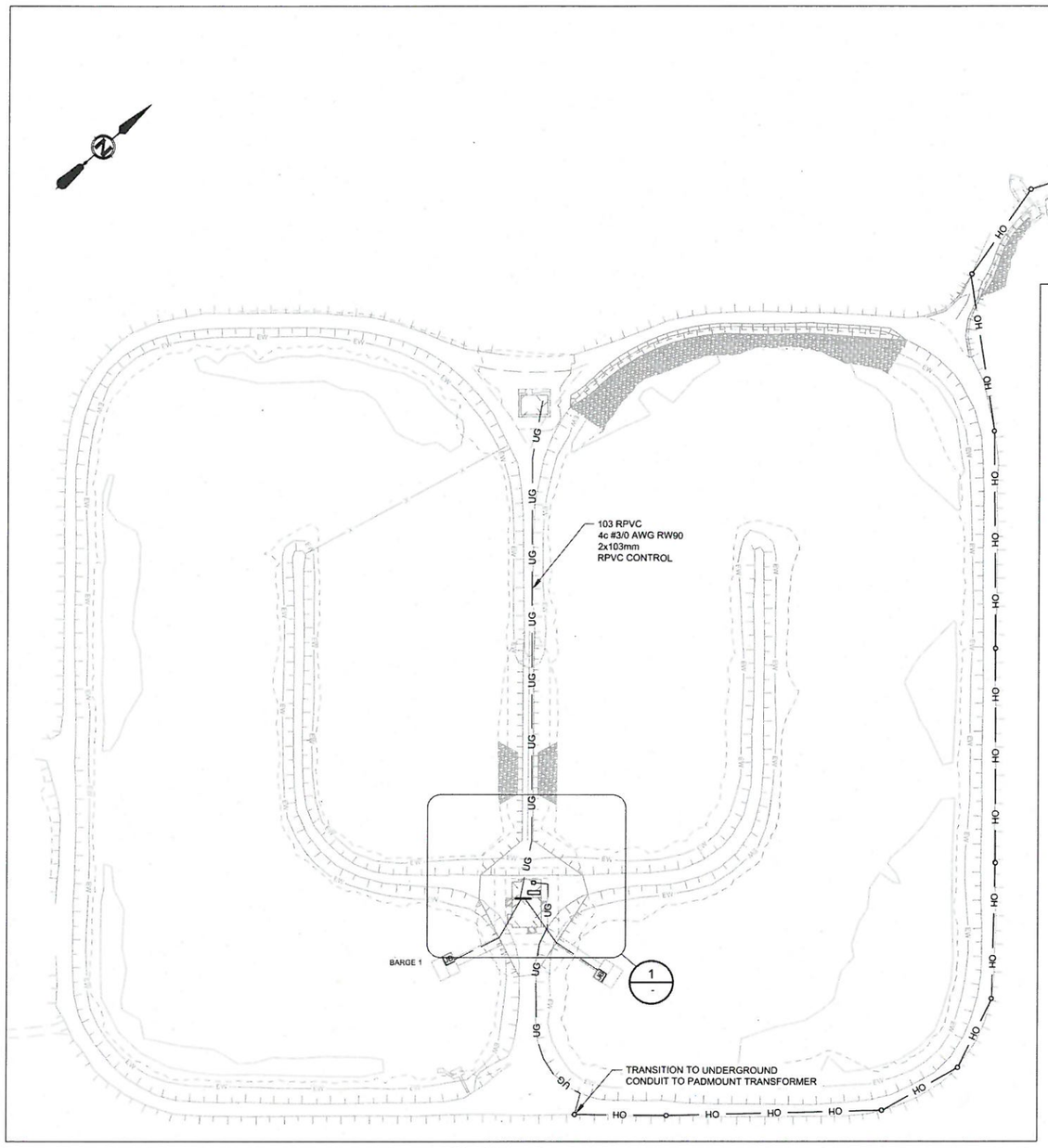
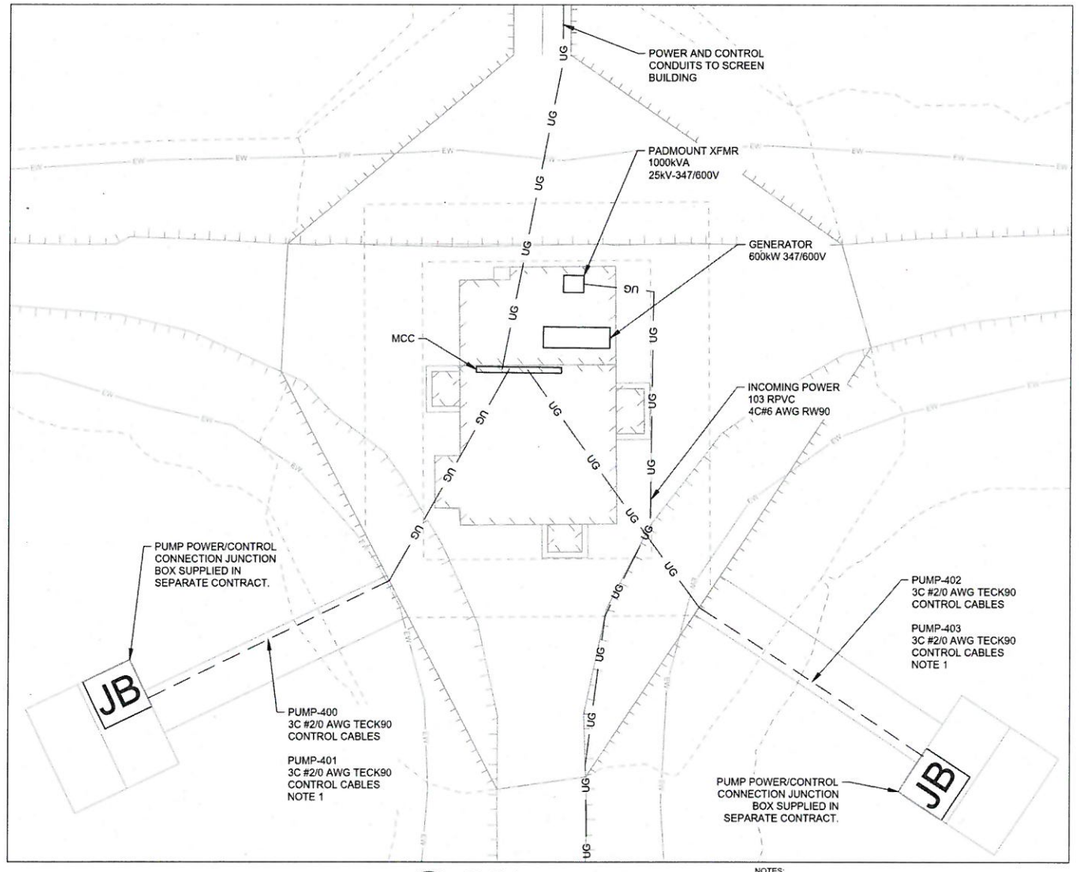
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:1250
SITE PLAN



1 PLAN 1:250
TREATMENT BUILDING SITE PLAN

NOTES:
1. CONTRACTOR TO DIRECT BURY CABLES TO EDGE OF BARGE WALKWAY AND THEN ROUTE VIA BARGE WALKWAY CABLE TRAY TO JUNCTION BOX AND CONNECT TO PUMP RAFT SUPPLIER CABLES.

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L.K. VALE
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WASTEWATER LAGOON EXPANSION UPGRADES

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THE CITY OF Port Alberni

ELECTRICAL SITE PLAN

DRAWING	REVISION	SHEET
2972-00-E-101	0	91 / 111

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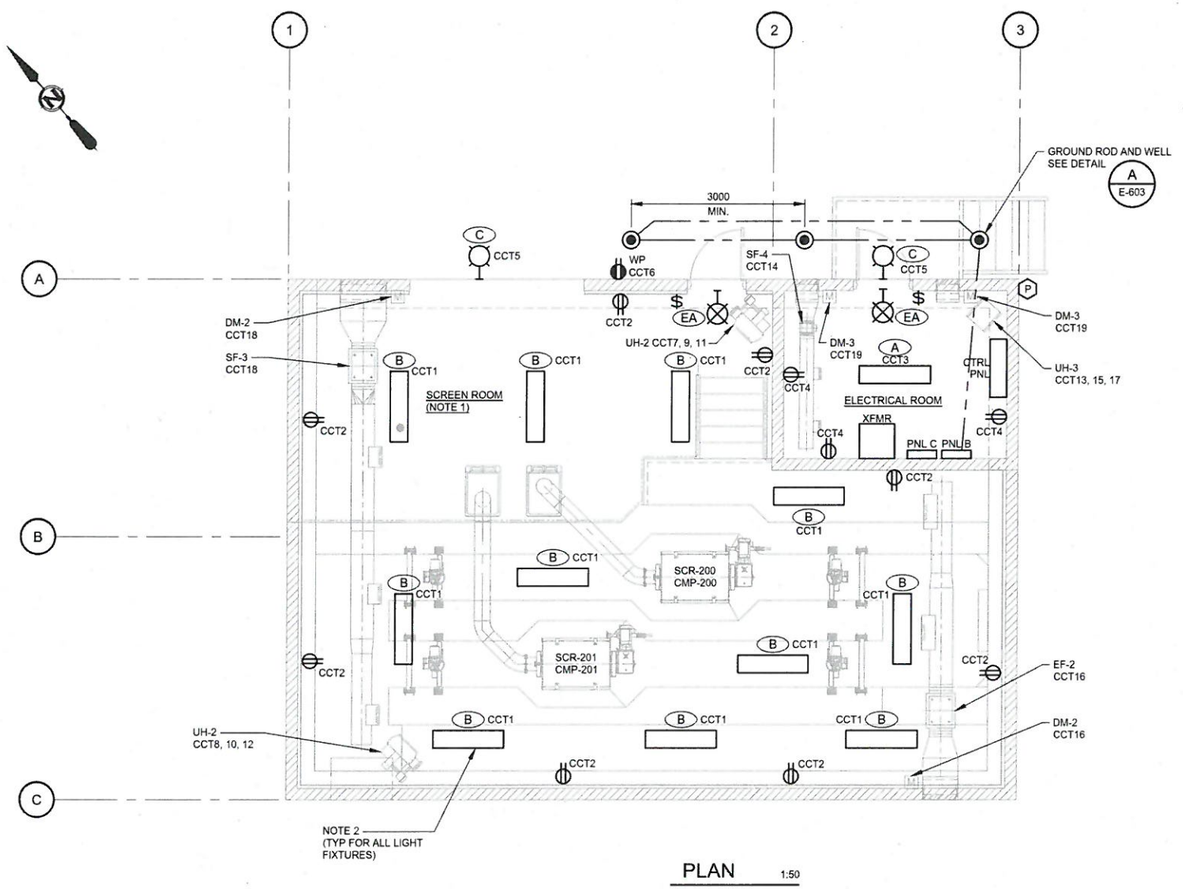

PLAN 1:50

LEGEND:

- (A) LIGHT FIXTURE TAG SEE LIGHT FIXTURE SCHEDULE
- SUSPENDED LED FIXTURE
- $ LIGHT SWITCH
- COMBO EMERGENCY EXIT RUNNING MAN SIGN AND DUAL HEAD EMERGENCY LIGHT
- WALL MOUNTED LUMINAIRE
- DUPLEX RECEPTACLE
- (P) PHOTOELECTRIC CELL

NOTES:

1. SCREEN ROOM IS A CLASS 1 ZONE 2 HAZARDOUS LOCATION AND A CATEGORY 2 CORROSIVE LOCATION. ALL EQUIPMENT INSTALLED IN SCREEN ROOM TO BE RATED FOR HAZARDOUS LOCATION INSTALLATION.
2. LIGHTING TO BE SUSPENDED JUST BELOW JOISTS.

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CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

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SCALE: AS SHOWN

THE CITY OF Port Alberni

ELECTRICAL
SCREEN BUILDING
PLAN

DRAWING	REVISION	SHEET
2972-00-E-121	0	92 / 111

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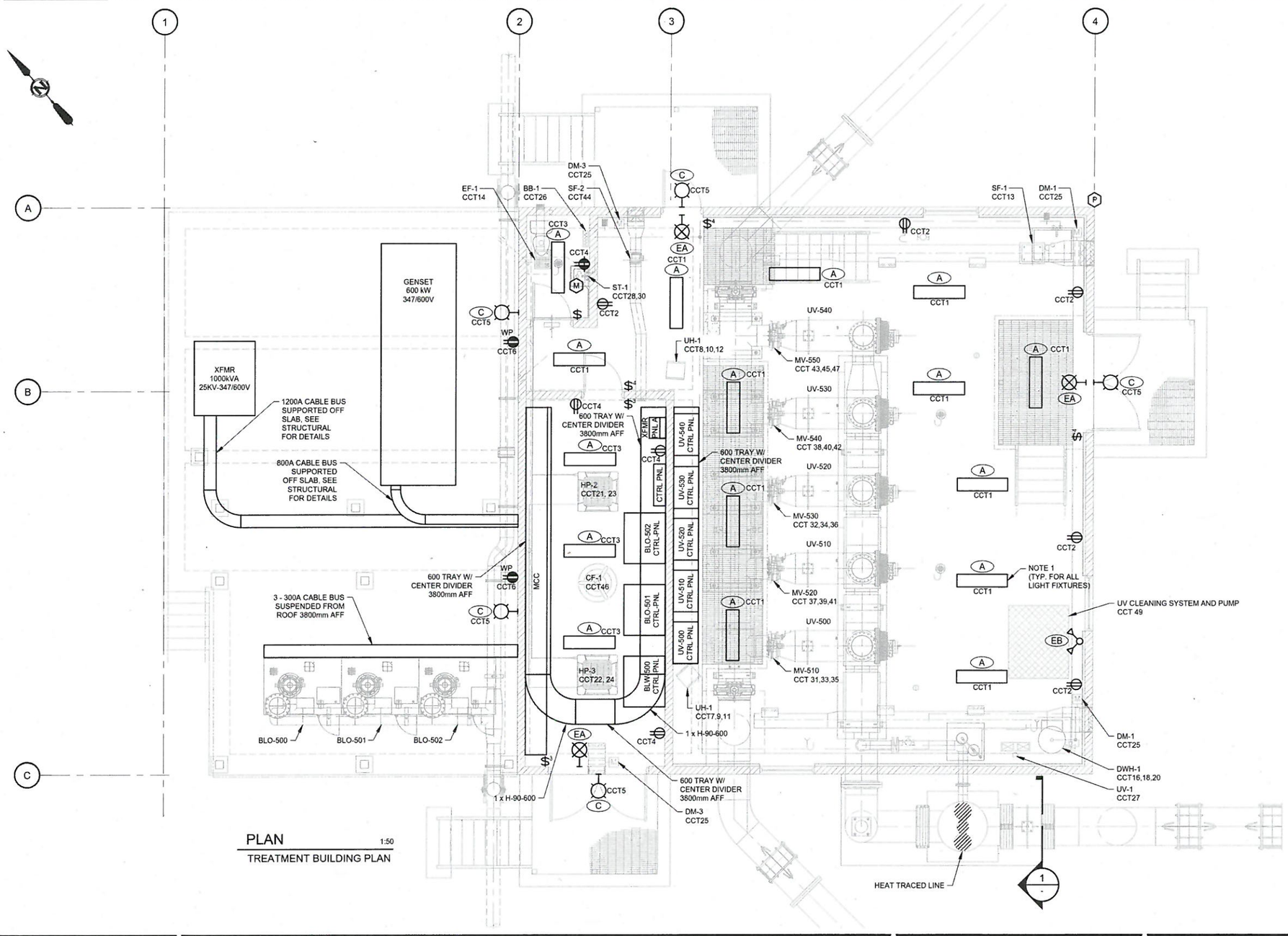
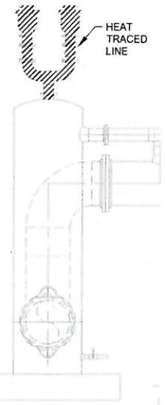


PLAN 1:50
TREATMENT BUILDING PLAN

LEGEND:

- (A) LIGHT FIXTURE TAG SEE LIGHT FIXTURE SCHEDULE
- SUSPENDED LED FIXTURE
- $ LIGHT SWITCH
- COMBO EMERGENCY EXIT RUNNING MAN SIGN AND DUAL HEAD EMERGENCY LIGHT
- WALL MOUNTED LUMINAIRE
- (M) MOTION SENSOR SWITCH
- DUPLEX RECEPTACLE
- (P) PHOTOELECTRIC CELL
- HEAT TRACED LINE
- REMOTE DUAL HEAD EMERGENCY LIGHT



1 DETAIL 1:50
PIPE HEAT TRACING

NOTES:

1. LIGHTING TO BE SUSPENDED JUST BELOW JOISTS.

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PROFESSIONAL ENGINEER
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#30
28/06/18

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

ELECTRICAL
TREATMENT BUILDING
PLAN

DRAWING	REVISION	SHEET
2972-00-E-151	0	93 / 111

IF NOT 50 mm ADJUST SCALES
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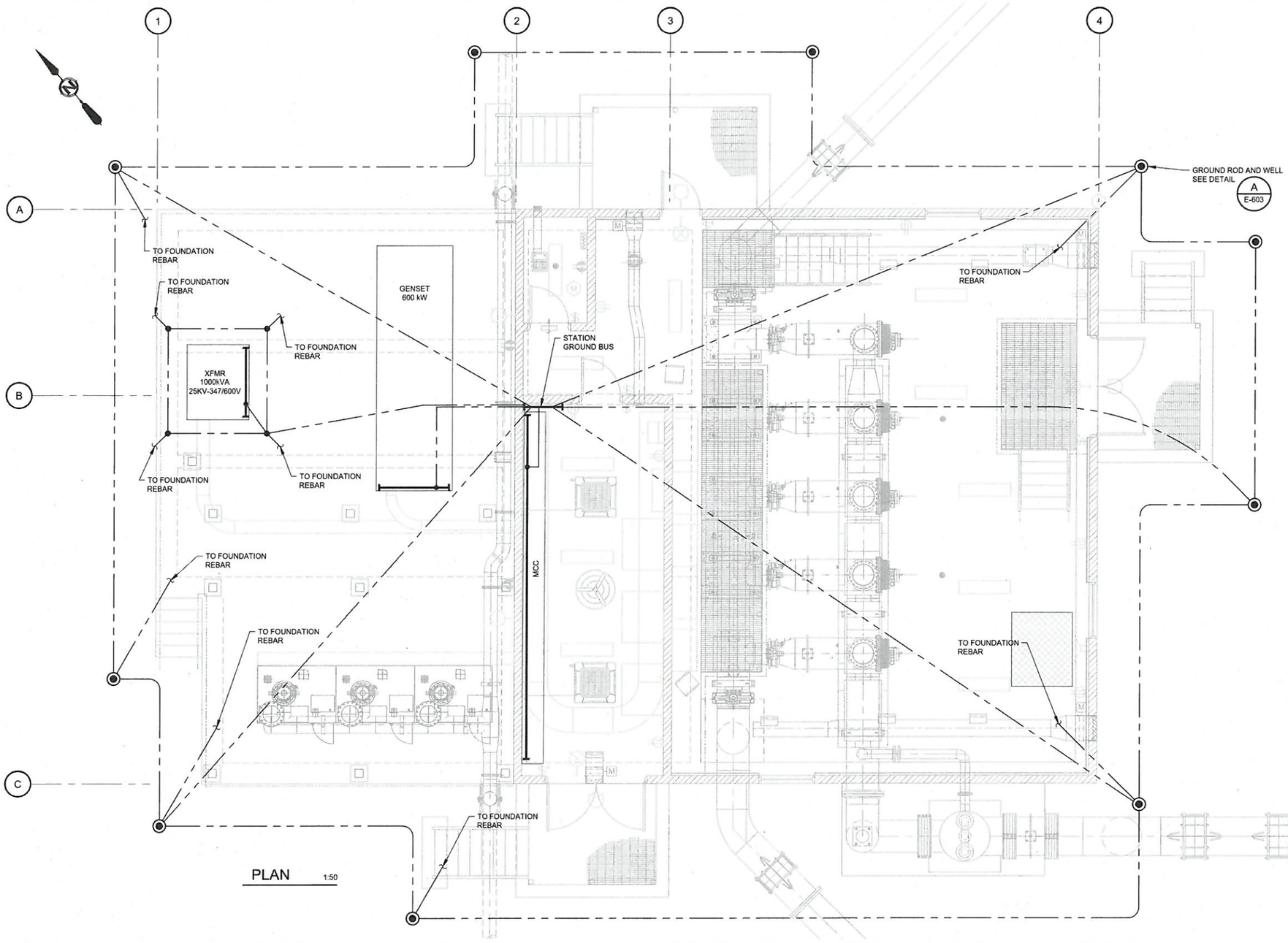
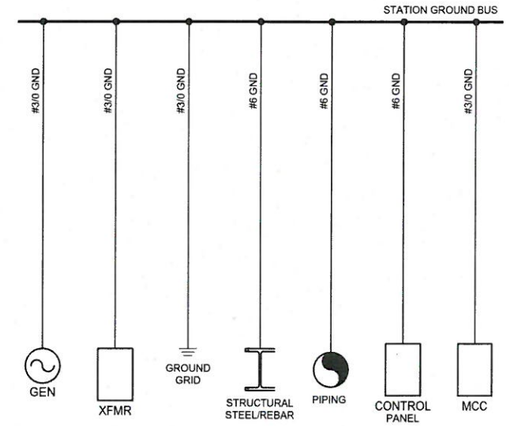


PLAN 1:50



1 - SCHEMATIC NTS
STATION GROUNDING

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

ELECTRICAL
TREATMENT BUILDING
GROUNDING PLAN

DRAWING	REVISION	SHEET
2972-00-E-152	0	94 / 111

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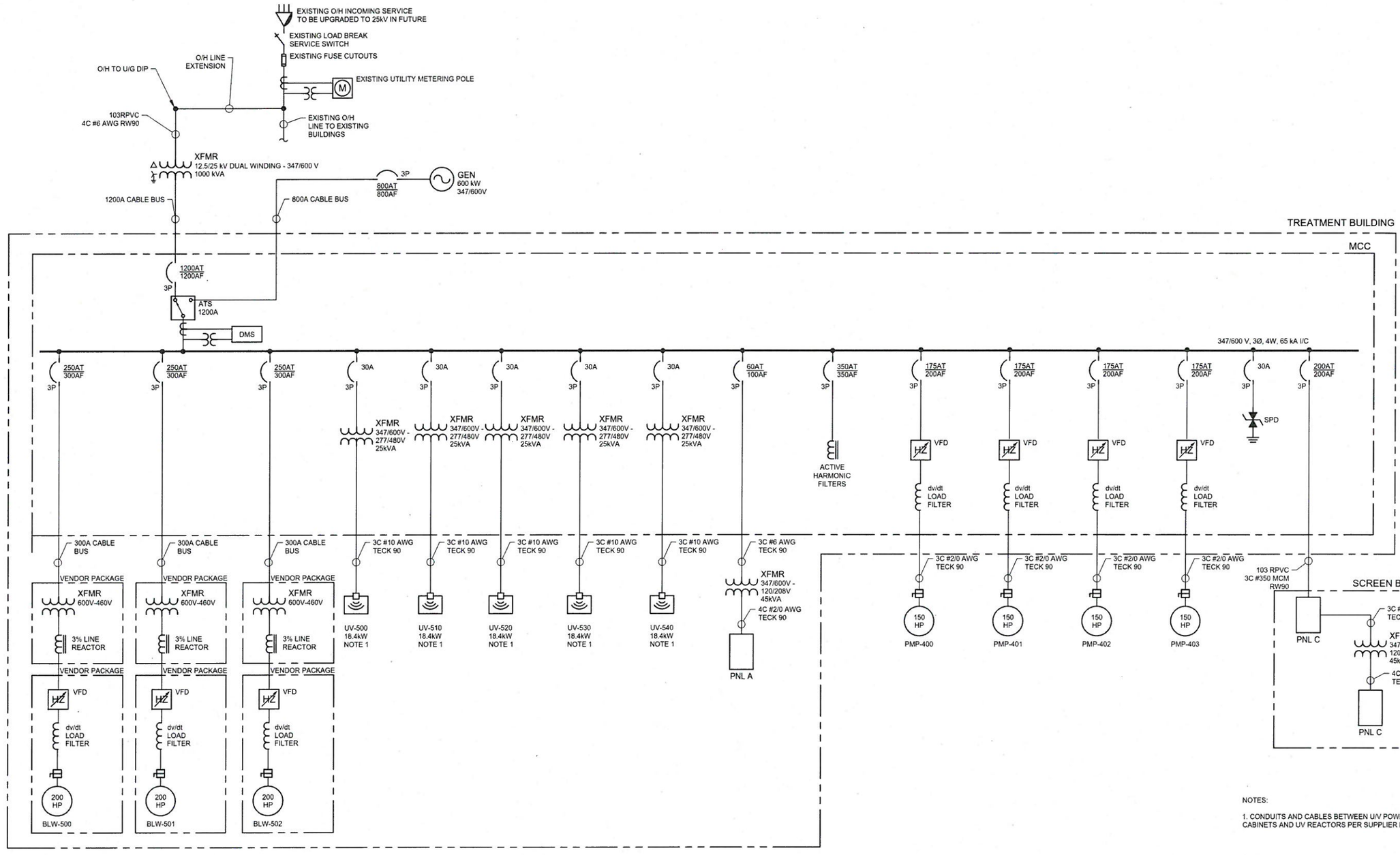

NOTES:

1. CONDUITS AND CABLES BETWEEN U/V POWER/CONTROL CABINETS AND UV REACTORS PER SUPPLIER REQUIREMENTS.

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WASTEWATER LAGOON EXPANSION UPGRADES

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THE CITY OF Port Alberni

ELECTRICAL
SINGLE LINE DIAGRAM

DRAWING	REVISION	SHEET
2972-00-E-601	0	95 / 111

IF NOT 50 mm ADJUST SCALES — 50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

PANEL A SCHEDULE

LOCATION: TREATMENT BLDG ELEC ROOM — VOLTAGE: 120/208 V — PHASE: 3 — WIRE: 4
MOUNTING: WALL — BUS RATING: 10kA
INCOMING LUGS: — MAIN BREAKER: 200A
MANUFACTURER: — FEEDER: 4C #2/0 AWG TECK90

CCT No.	DESCRIPTION	WATTAGE			BKR AMPS	BUS A	BUS B	BUS C	BKR AMPS	WATTAGE			DESCRIPTION	CCT No.
1	MAIN PROCESS LIGHTING	660			15	A			15	500			MAIN PROCESS RECEPTACLES	2
3	ELECTRICAL ROOM LIGHTING		220		15		B		15		500		ELECTRICAL ROOM RECEPTACLES	4
5	EXTERIOR LIGHTING			135	15			C	15			500	EXTERIOR RECEPTACLES	6
7	UH-1	3333			40 3P	A			40 3P	3333			UH-1	8
9			3333				B				3333			10
11				3333				C				3333		12
13	SF-1	373			15	A			15	373			EF-1	14
15	HPU-1 (ON ROOF ABOVE ELEC RM)		1800		20 3P		B		50 3P		4000		DWH-1	16
17				1800				C				4000		18
19		1800				A				4000				20
21	HPU-2		40		15 2P		B		15 2P		40		HPU-3	22
23				40				C				40		24
25	DAMPER MOTORS	373			15	A			15	500			BB-1	26
27	UV-1		84		15		B		15		40		ST-1	28
29	HEAT TRACE			300	15			C	15				SPARE	30
31	MV-510	430			15 3P	A			15 3P	430			MV-530	32
33			430				B				430			34
35				430				C				430		36
37	MV-520	430			15 3P	A			15 3P	430			MV-540	38
39			430				B				430			40
41				430				C				430		42
43	MV-550	430			15 3P	A			15	373			SF-2	44
45			430				B		15		373		CF-1	46
47				430				C						48
49	UV CLEANING PUMP	950			15	A								50
51							B							52
53								C						54
55						A								56
57							B							58
59								C						60
61						A								62
63							B							64
65								C						66
	SUBTOTALS:	8779	6767	6898						9939	9146	8733		

NOTES:
1. ALL 15A 1P AND 15A 2P CIRCUITS TO BE FED WITH 2C #12 TECK90
2. ALL 15A 3P AND 20A 3P CIRCUITS TO BE FED WITH 4C #12 TECK90
3. ALL 40A 3P CIRCUITS TO BE FED WITH 4C #8 TECK90
4. ALL 50A 3P CIRCUITS TO BE FED WITH 4C #6 TECK90

PHASE A TOTAL - 18718 W
PHASE B TOTAL - 15913 W
PHASE C TOTAL - 15631 W
PANEL LOAD TOTAL - 50262 W

LIGHTING FIXTURE SCHEDULE

FIXTURE TAG No.	EQUIPMENT INFORMATION							FINISH
	DESCRIPTION	MANUFACTURER & CATALOGUE No.	MOUNTING TYPE	MOUNTING HEIGHT	VOLTS	FIXTURE SIZE	LAMP TYPE	
A	LINEAR FIXTURE	METALUX 4SNLED-LD5-64SL-LN-UNV-L840-CD1-U OR APPROVED EQUIVALENT	SUSPENDED	BELOW JOIST	120	4'	LED	WHITE
B	VAPOR PROOF LINEAR FIXTURE	COLUMBIA HEM 4-4ML-RFA-EU LED OR APPROVED EQUIVALENT	SUSPENDED	BELOW JOIST	120	4'	LED	WHITE
C	WALL PACK	LUMARK LDWP FULL-CUT OFF OR APPROVED EQUIVALENT	WALL	2500mm AFF	120		27W LED	BLACK
EA	COMBO EMERGENCY LIGHTING AND EXIT SIGN	WALL MOUNTED LED COMBINATION PICTOGRAM EXIT SIGN AND EMERGENCY LIGHT WITH TWO HEADS IN EXTRUDED ALUMINUM HOUSING DC WIRED TO EMERGENCY LIGHT UNIT. LUMACELL #LAC SERIES 120/12VDC OR APPROVED EQUIVALENT	WALL	ABOVE DOOR	120		LED	WHITE
EB	REMOTE DUAL HEAD EMERGENCY LIGHT	WALL MOUNTED REMOTE DUAL HEAD	WALL	3500mm AFF	120		LED	WHITE

PANEL B SCHEDULE

LOCATION: SCREEN BLDG ELECTRICAL ROOM — VOLTAGE: 347/600 V — PHASE: 3 — WIRE: 4
MOUNTING: WALL — BUS RATING: 10kA
INCOMING LUGS: — MAIN BREAKER: 100A
MANUFACTURER: — FEEDER: 4C #3/0 AWG RW90

CCT No.	DESCRIPTION	WATTAGE			BKR AMPS	BUS A	BUS B	BUS C	BKR AMPS	WATTAGE			DESCRIPTION	CCT No.
1	SCR-200	125			15 3P	A			15 3P	735			CMP-200	2
3			125				B				735			4
5				125				C				735		6
7	SCR-201	125			15 3P	A			15 3P	735			CMP-201	8
9			125				B				735			10
11				125				C				735		12
13	PNL C XMFR	10000			60 3P	A			15 3P	1365			MV-211	14
15			10000				B				1365			16
17				10000				C				1365		18
19	MV-201	1365			15 3P	A			15 3P	250			MV-212	20
21			1365				B				250			22
23				1365				C				250		24
25	MV-202	250			15 3P	A								26
27			250				B							28
29				250				C						30
31						A								32
33							B							34
35								C						36
37						A								38
39							B							40
41								C						42
	SUBTOTALS:	11865	11865	11865						3085	3085	3085		

NOTES:
1. ALL 15A 3P CIRCUITS TO BE FED WITH 4C #12 AWG TECK90 CABLES.
2
3
4

PHASE A TOTAL - 14950 W
PHASE B TOTAL - 14950 W
PHASE C TOTAL - 14950 W
PANEL LOAD TOTAL - 44850 W

PANEL C SCHEDULE

LOCATION: SCREEN BLDG ELECTRICAL ROOM — VOLTAGE: 120/208 V — PHASE: 3 — WIRE: 4
MOUNTING: WALL — BUS RATING: 10kA
INCOMING LUGS: — MAIN BREAKER: 200A
MANUFACTURER: — FEEDER: 4C #2/0 AWG RW90

CCT No.	DESCRIPTION	WATTAGE			BKR AMPS	BUS A	BUS B	BUS C	BKR AMPS	WATTAGE			DESCRIPTION	CCT No.
1	MAIN PROCESS LIGHTING	510			15	A			15	500			MAIN PROCESS RECEPTACLES	2
3	ELECTRICAL ROOM LIGHTING		55		15		B		15		500		ELECTRICAL ROOM RECEPTACLES	4
5	EXTERIOR LIGHTING			55	15			C	15			500	EXTERIOR RECEPTACLES	6
7	UH-2	3333			40 3P	A			40 3P	3333			UH-2	8
9			3333				B				3333			10
11				3333				C				3333		12
13	UH-3	1333			15 3P	A			15 3P	250			SF-3	14
15			1333				B				250			16
17				1333				C				250		18
19	DAMPER MOTORS	373			15	A			15 3P	250			EF-2	20
21	SF-4		373		15		B				250			22
23								C				250		24
25						A								26
27							B							28
29								C						30
31						A								32
33							B							34
35								C						36
37						A								38
39							B							40
41								C						42
	SUBTOTALS:	5549	5094	4721						4333	4333	4333		

NOTES:
1. ALL 15A 1P CIRCUITS TO BE FED WITH 2C #12 AWG TECK90 CABLES
2. ALL 15A 3P CIRCUITS TO BE FED WITH 4C #12 AWG TECK90 CABLES
3. ALL 40A 3P CIRCUITS TO BE FED WITH 4C #8 AWG TECK90 CABLES
4

PHASE A TOTAL - 9882 W
PHASE B TOTAL - 9427 W
PHASE C TOTAL - 9054 W
PANEL LOAD TOTAL - 28363 W

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PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — L. VALE — # 45911 — EXPIRES 30
28/06/18

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

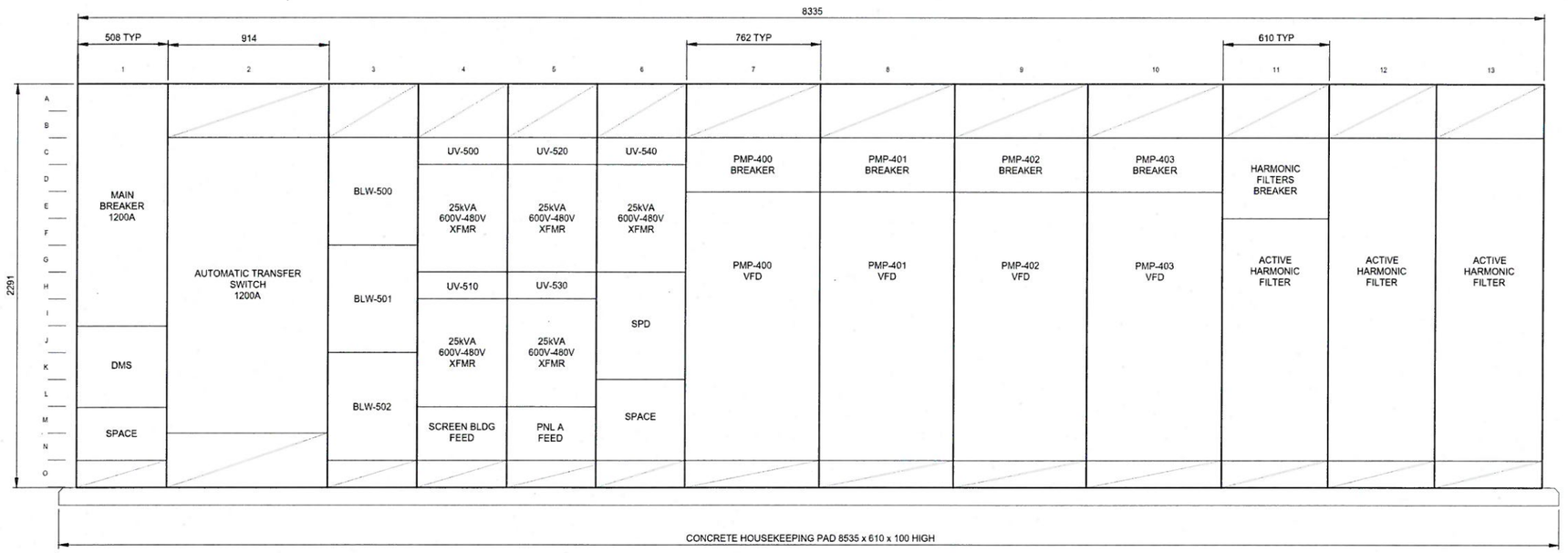
20172972-00

SCALE: AS SHOWN

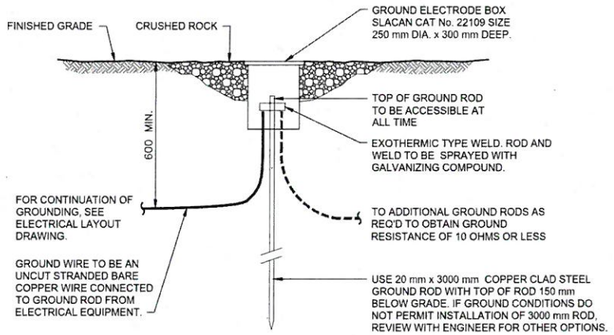
THE CITY OF Port Alberni

ELECTRICAL SCHEDULES

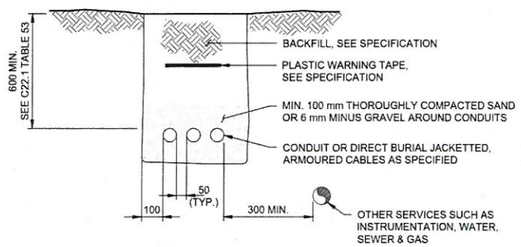
DRAWING	REVISION	SHEET
2972-00-E-602	0	96 / 111



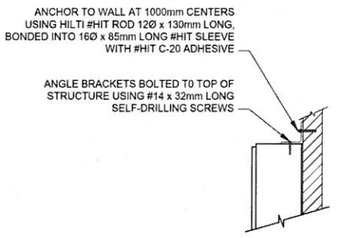
D - DETAIL NTS
TREATMENT BUILDING MCC



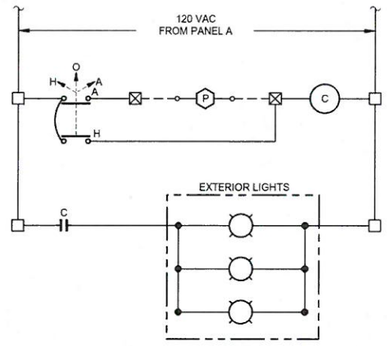
A - DETAIL N.T.S.
GROUND ROD INSTALLATION



B - DETAIL N.T.S.
TYPICAL TRENCH



C - DETAIL N.T.S.
PANEL SEISMIC RESTRAINT



SCHEMATIC N.T.S.
EXTERIOR LIGHTING CONTROL

P:\20172972000_WatWtr_Trtmt_Upgt\Working_Dwgs\600_Electrical\2972-00-e-603.dwg
DATE: 2018-06-26, Jhum Dudani

Associated Engineering
Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J.S. VALE
28/06/18

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	L VALE	L VALE	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

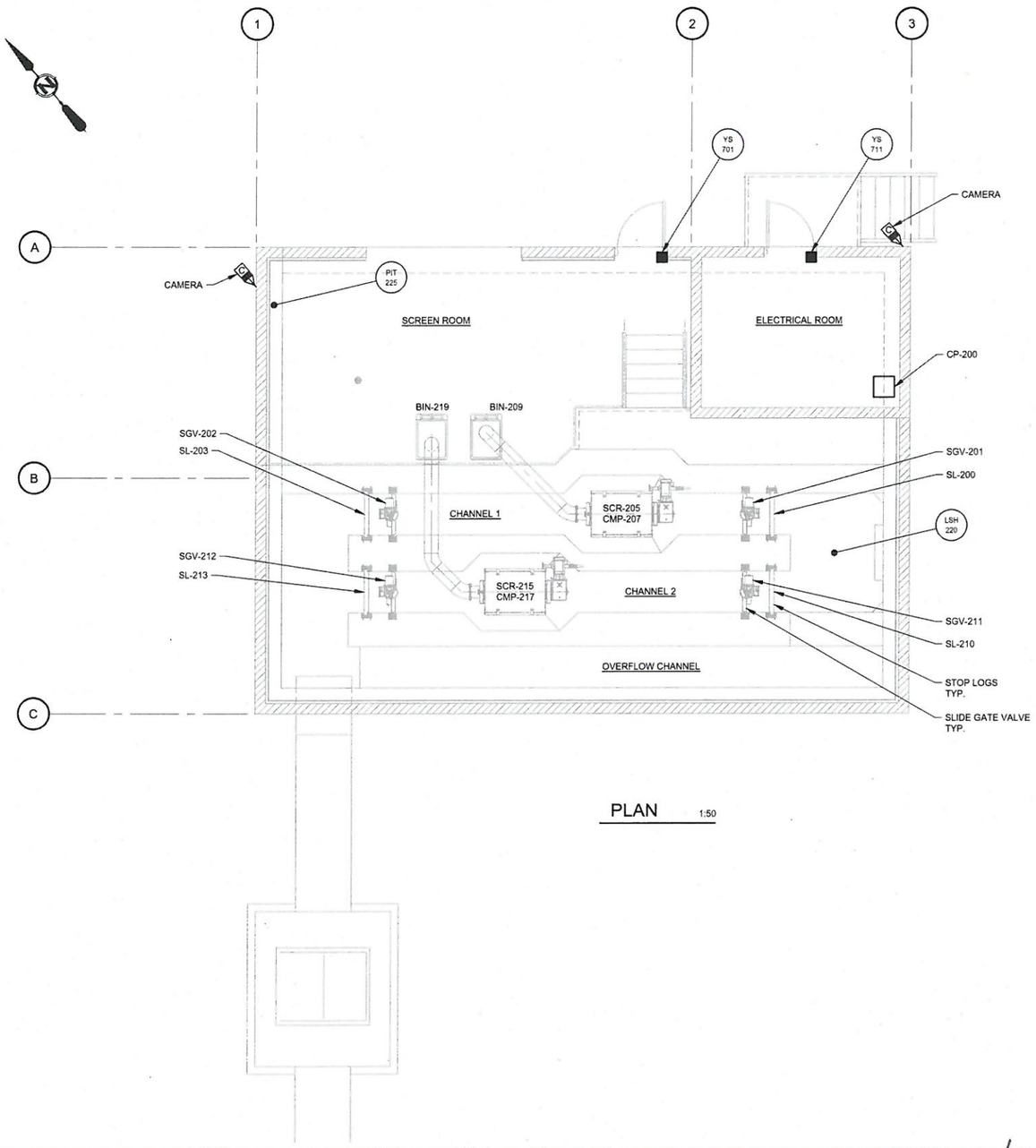
THE CITY OF Port Alberni

ELECTRICAL DETAILS

DRAWING	REVISION	SHEET
2972-00-E-603	0	97 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:50

P:\20172972\00_WstWtr_Trtmnt_Upgr\Working_Dwgs\700_Instrumentation\2972-00-I-102.dwg
DATE: 2018-06-28 Jihum Dudan

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PROFESSIONAL ENGINEER K. A. NEAVE BRITISH COLUMBIA
June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

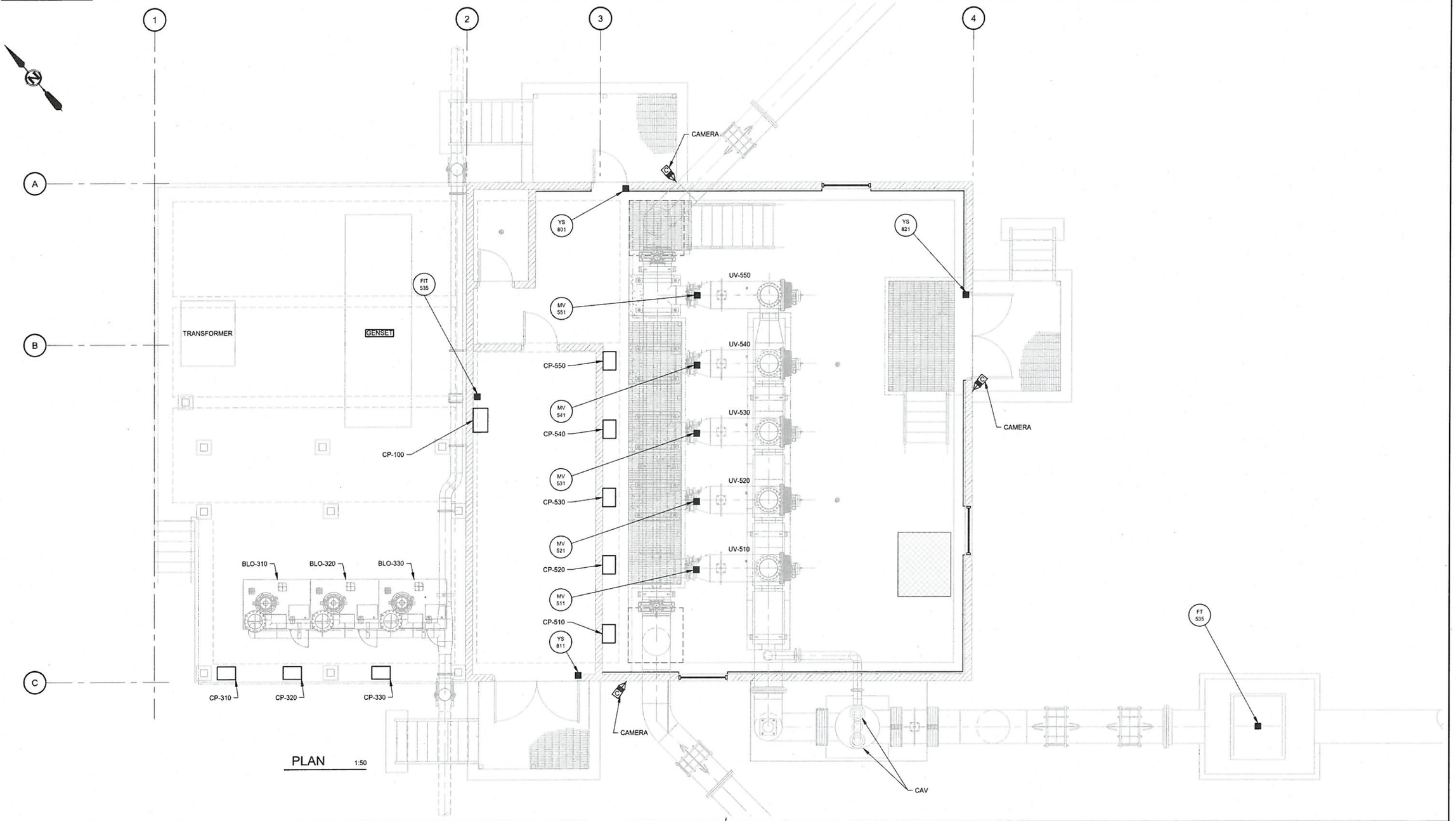
THE CITY OF Port Alberni

INSTRUMENTATION
SCREEN BUILDING
INSTRUMENTATION LAYOUT

DRAWING	REVISION	SHEET
2972-00-I-102	0	98 / 111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



PLAN 1:50

P:\20172972\00_WstWtr_Trtmnt_Upgr\Working_Dwgs\700_Instrumentation\2972-00-I-103.dwg
DATE: 2018-06-28, Rumi Dualim

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PROVINCE OF BRITISH COLUMBIA
K. A. NEAVE
June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

INSTRUMENTATION
TREATMENT BUILDING
INSTRUMENTATION LAYOUT

DRAWING	REVISION	SHEET
2972-00-I-103	0	99/111

IF NOT 50 mm ADJUST SCALES
50 mm

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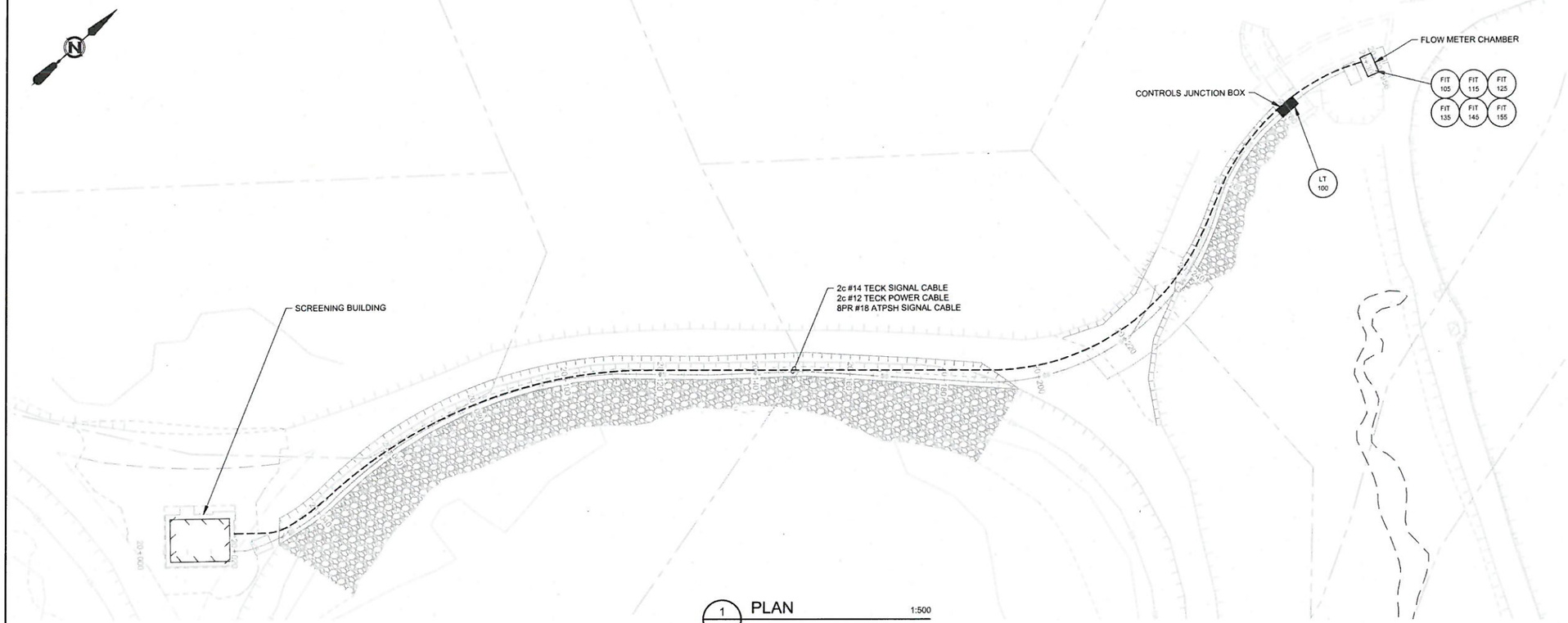
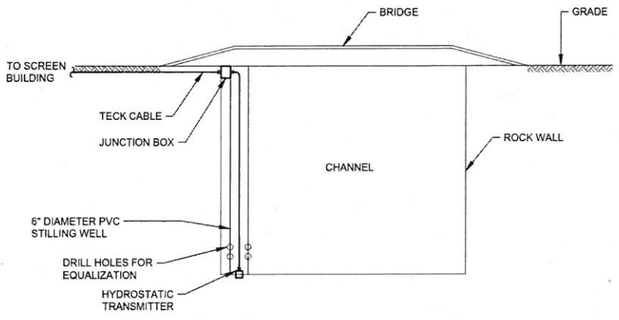
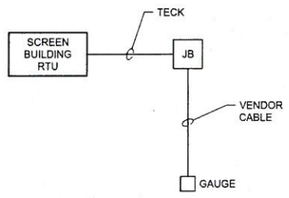


1 - PLAN 1:500



1 - DETAIL NTS
TIDAL GAUGE



1 - DIAGRAM NTS
SIMPLE LOOP

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DATE: 2018-06-28, Jhurm Duklan

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. A. NEAVE
June 28/2018

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CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

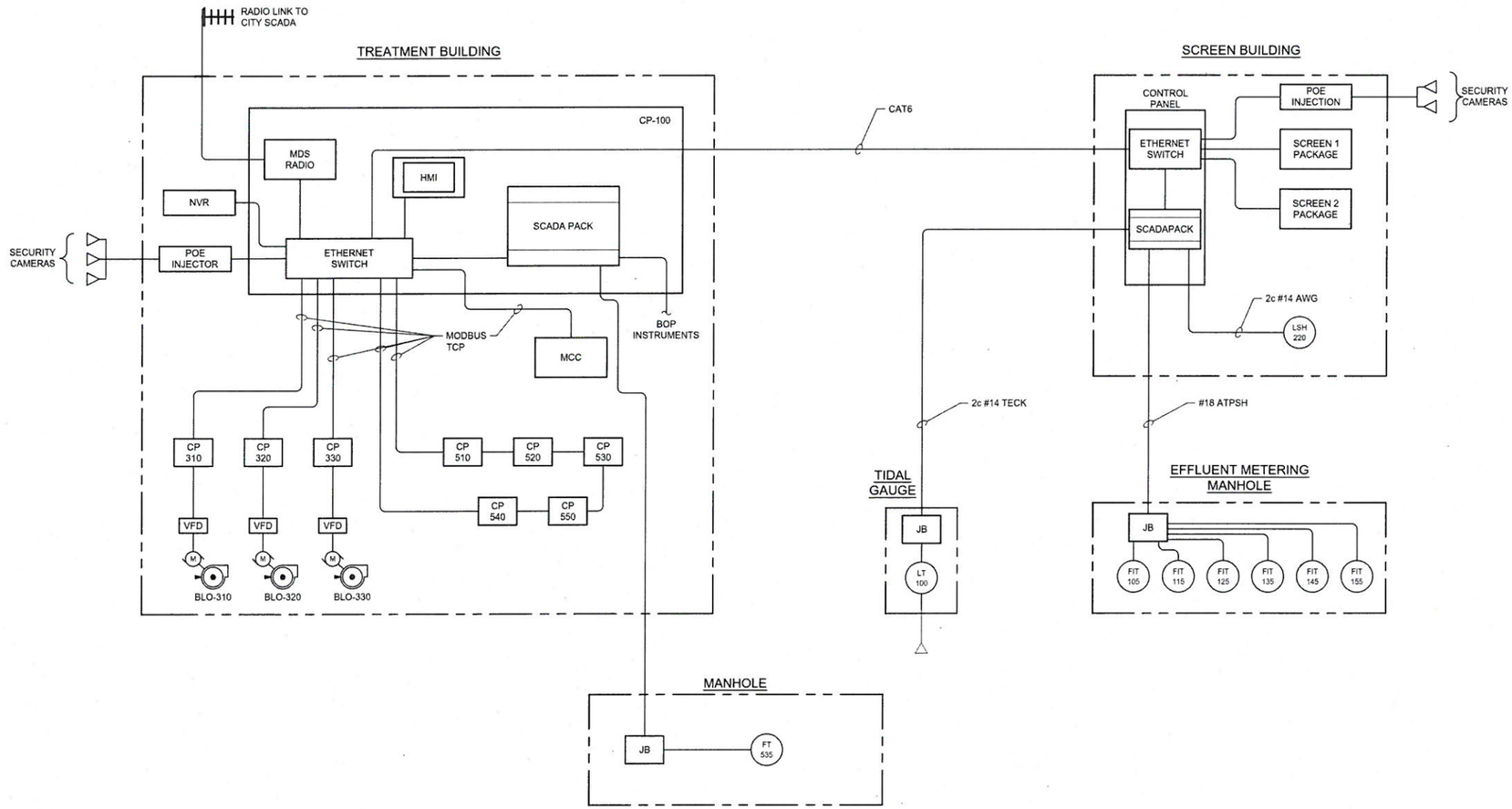
THE CITY OF Port Alberni

INSTRUMENTATION
TIDAL GAUGE
PLAN AND INTERCONNECTION

DRAWING	REVISION	SHEET
2972-00-I-104	0	100/111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



P:\20172972\00_WetWe_Trtmnt_Upg\Working_Dwgs\700_Instrumentation\2972-00-I-201.dwg
DATE: 2018-06-28, Jhunn Dudan

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. A. NEAVE
June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

THE CITY OF Port Alberni

INSTRUMENTATION COMMUNICATION BLOCK DIAGRAM

DRAWING	REVISION	SHEET
2972-00-I-201	0	101/111

IF NOT 50 mm ADJUST SCALES
50 mm

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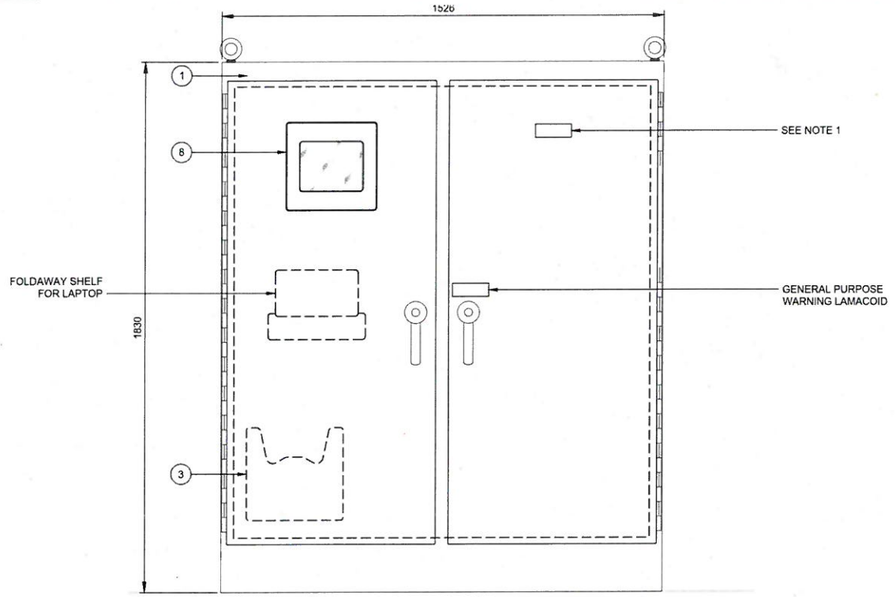
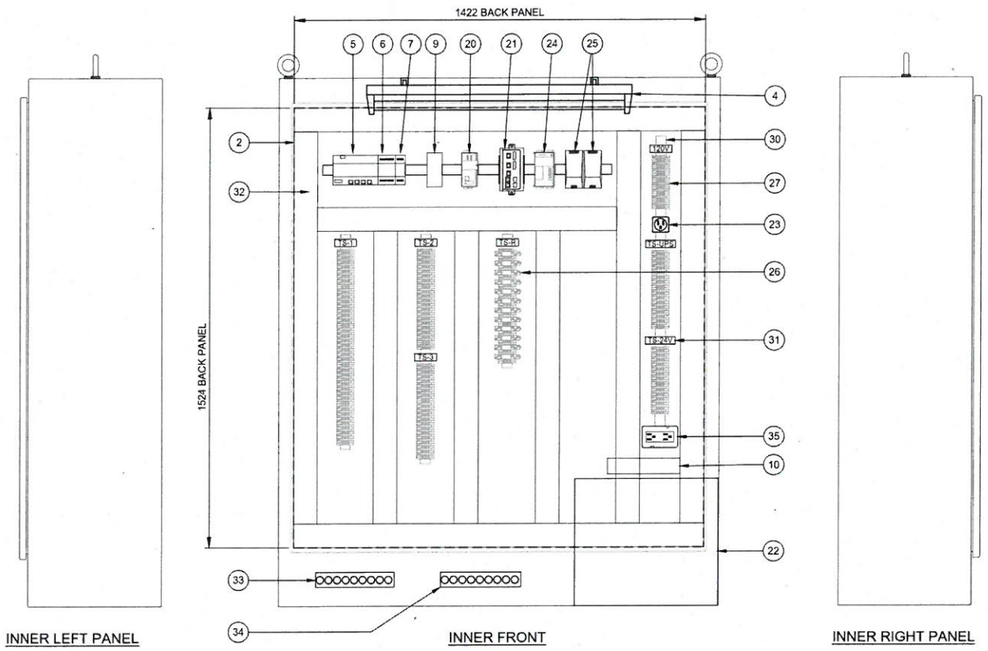


OUTER FRONT



BILL OF MATERIALS (CP-100)

ITEM	QUANTITY	PART No.	DESCRIPTION
1	1	"HOFFMAN A726018SSFSDN4"	FREE-STANDING NEMA 12X 2-DOOR ENCLOSURE WITH 3-POINT LOCKING LATCH 1830x1526x427mm, PADLOCKABLE, I
2	2	"HOFFMAN A72P60F1"	1524x1422mm BACK PANEL
3	1	"HOFFMAN ADP3"	METAL DATA POCKET 305mm X 305mm X 80mm DEEP
4	2	HOFFMAN	FLUORESCENT LIGHT WITH DOOR SWITCH AND WIRE GUARD
5	1	SCADAPACK 334	SCADAPACK 334 PLC w/MODBUS TCP
6	1	SCADAPACK 5403	SCADAPACK 5503 DIGITAL INPUT MODULE
7	1	SCADAPACK 5415	SCADAPACK 5415 DIGITAL OUTPUT MODULE
8	1	REDLION CR1000	10.4" PANEL HMI
9	1	NTRON 1000-POE4	POE INJECTOR
10	1		NETWORK VIDEO RECORDER
20	1	GE MDS ORBIT	900 mHz SPREAD SPECTRUM RADIO
21	1	SIXNET SLX-16MS-1	SIXNET MANAGED ETHERNET SWITCH
22	1	"EATON 5PX 3000 RT3U"	EATON 5PX SERIES UPS C/W WITH ETHERNET COMMUNICATION CARD
23	1	WEIDMULLER 9915480001	5-20R
24	1		24VDC REDUNDANCY DIODE UNIT
25	2	"PHOENIX CONTACT QUINT-PS/1AC/24DC/10	PHOENIX CONTACT 24VDC, 10A POWER SUPPLY
26	AS REQUIRED	OMRON G2R-2	24VDC COIL, 120V DUAL CONTACT, 10A RATING WITH BASE
27	AS REQUIRED	WDU 2.5	WEIDMULLER TERMINAL
28	AS REQUIRED	WSI 6LD SERIES	WEIDMULLER FUSED TERMINAL W/ INDICATOR
29	AS REQUIRED	WPE 2.5	WEIDMULLER GROUND TERMINAL
30	AS REQUIRED	TS35	35mm SLOTTED STEEL RAIL
31	AS REQUIRED	-	TERMINAL STRIP LABEL
32	AS REQUIRED	"PANDUIT F3X3LG6"	PANDUIT 82.6x79.2mm NARROW SLOT WIRING DUCT, C/W COVER C3LG6
33	AS REQUIRED	"SPARTAN 0063136"	101.6x508mm ISOLATED INSTRUMENT GROUND BAR C/W ISOLATING MOUNTS (RUN DEDICATED 'GREEN' WIRE TO GROUND)
34	AS REQUIRED	"SPARTAN 0063136"	ELECTRICAL GROUNDING BAR (CONNECTED TO GROUND)
35	1		DUPLEX RECEPTACLE (FOR NVR)

1 / - DETAIL 1:10
CP-100 CONTROL CABINET

P:\2017\2972\00_WkWr_Trtmnt_Upg\Working_Dwgs\700_Instrumentation\2972-00-I-601.dwg
DATE: 2018-06-28, Jhumi Dudani

Associated Engineering
Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA K. A. NEAVE
June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: AS SHOWN

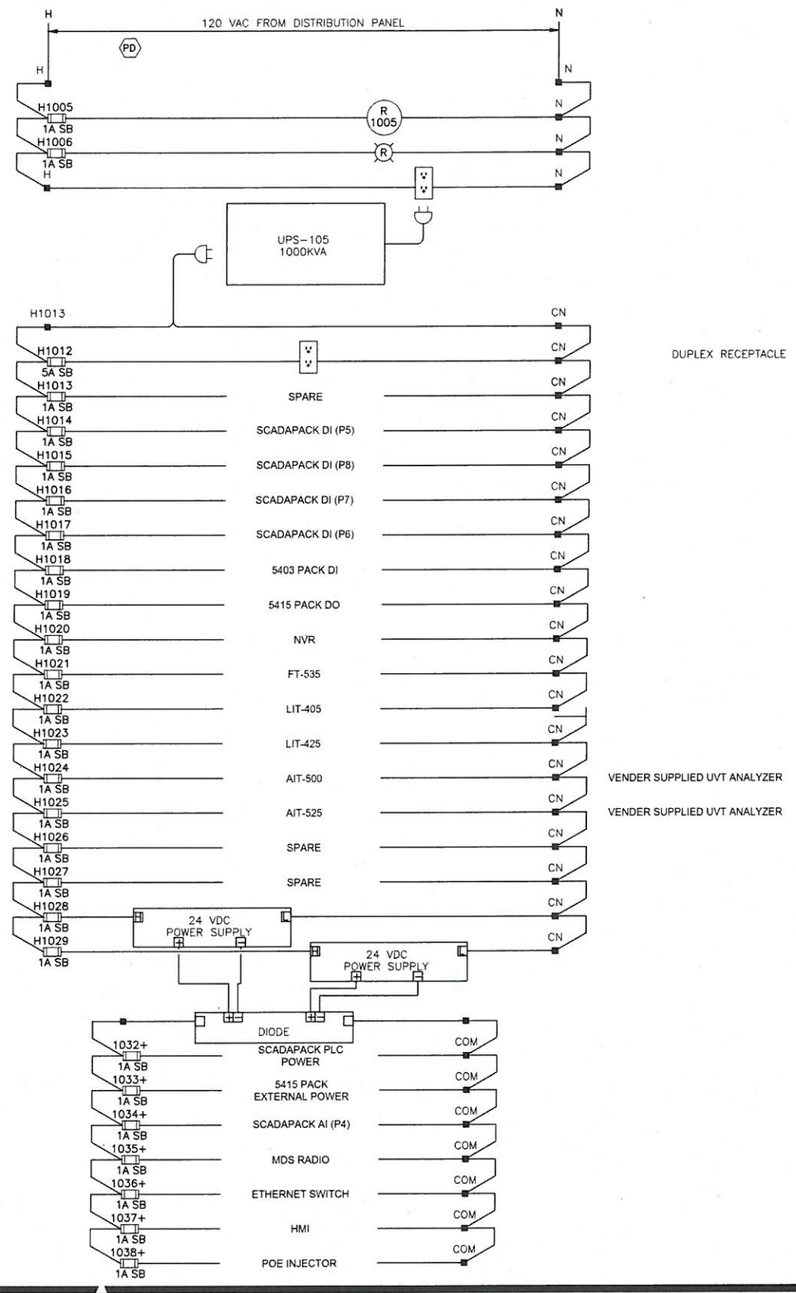
THE CITY OF Port Alberni

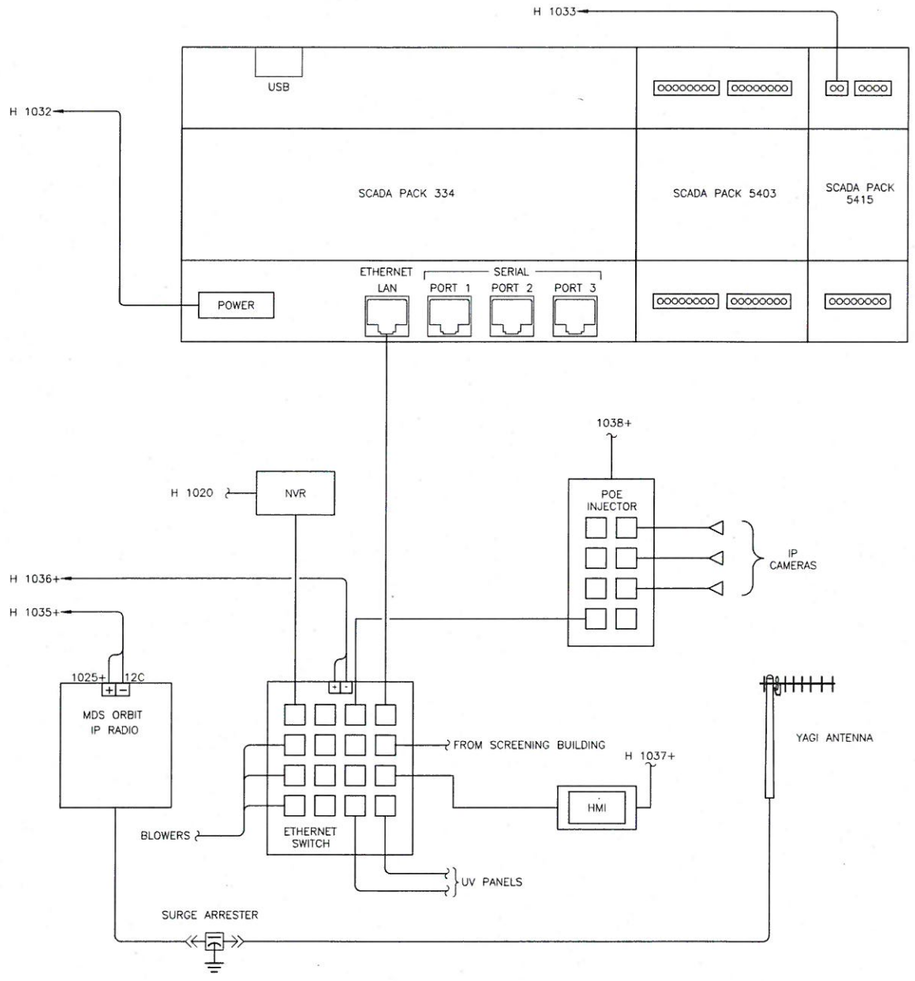
INSTRUMENTATION
CP-100 CABINET LAYOUT

DRAWING	REVISION	SHEET
2972-00-I-601	0	102/111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE





P:\20172972\00_WetWtr_Trtmnt_Upg\Working_Dwgs\700_Instrumentation\20972-00-I-602.dwg
DATE: 2018-06-28, Jhurn Duklan

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Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. A. NEAVE
June 26/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

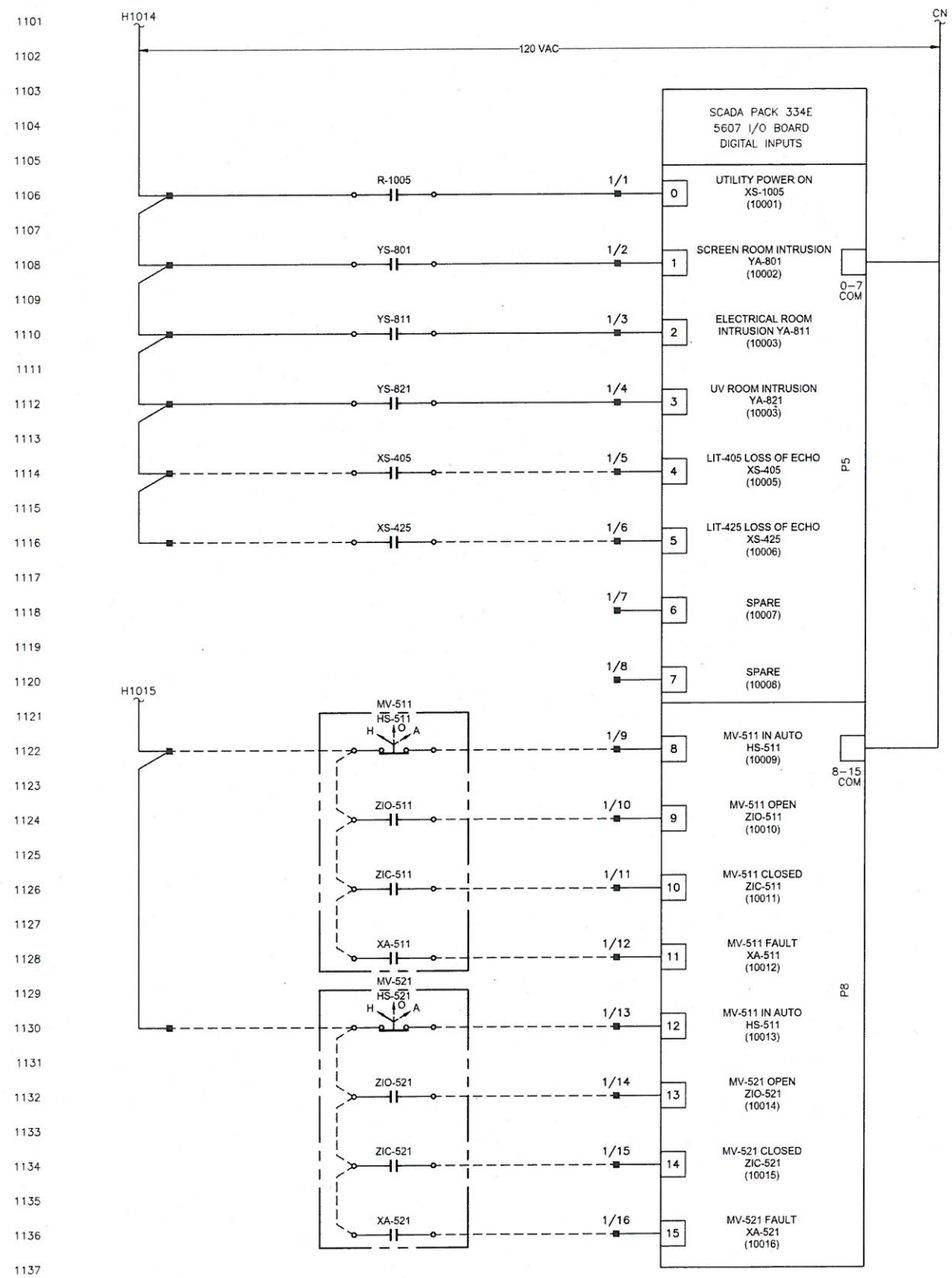
THE CITY OF Port Alberni

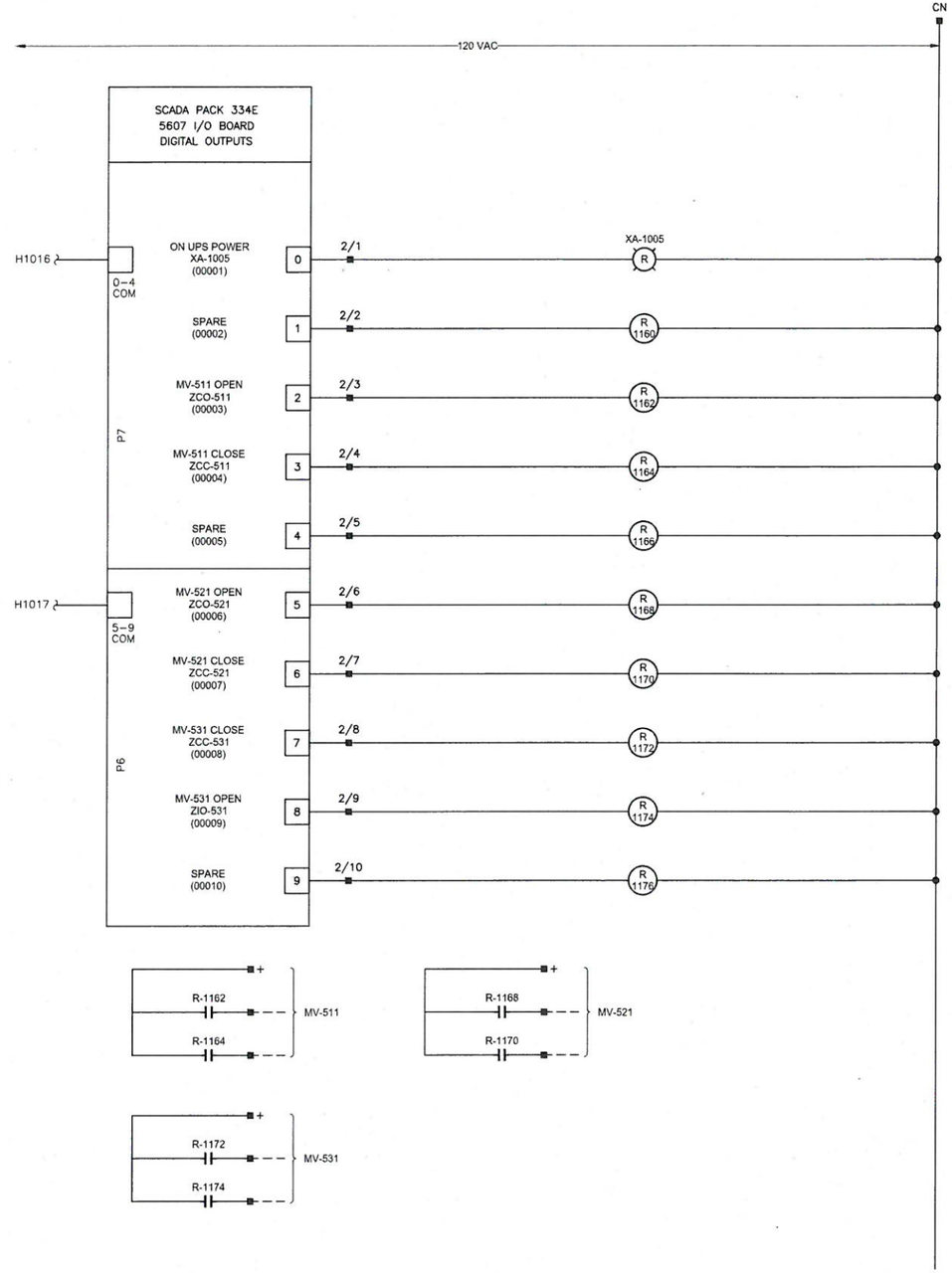
INSTRUMENTATION
CP-100 POWER DISTRIBUTION & COMMUNICATIONS TREATMENT BUILDING

DRAWING	REVISION	SHEET
2972-00-I-602	0	103/111

IF NOT 50 mm ADJUST SCALES — 50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE





P:\20172972\00_WetWtr_Trtmnt_Upg\Working_Dwgs\700_Instrumentation\2972-00-I-603.dwg
DATE: 2018-06-28, Jhum Duttim

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PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — K. A. NEAVE

June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: NTS

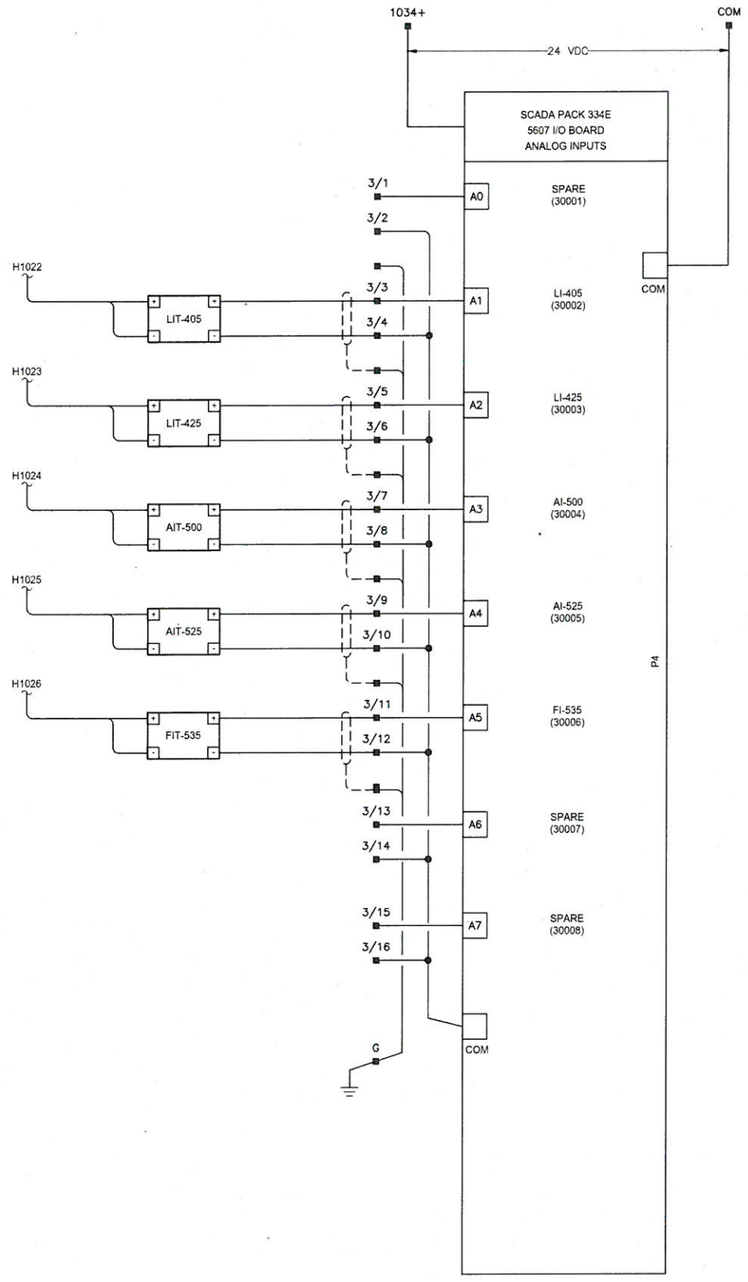
THE CITY OF Port Alberni

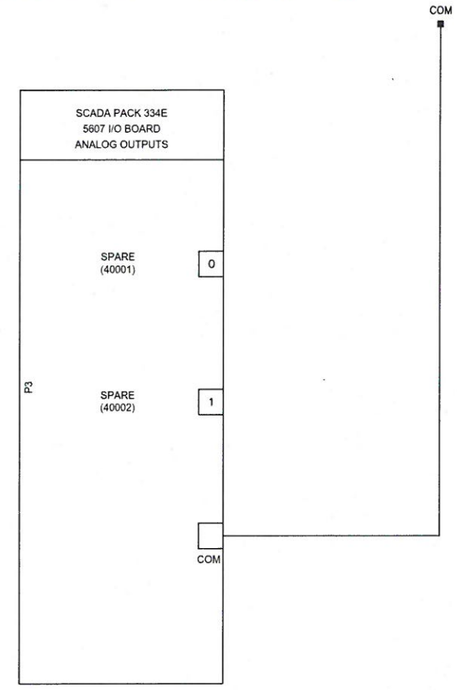
INSTRUMENTATION
CP-100 SCADAPACK ON BOARD I/0 (I OF 2)
TREATMENT BUILDING

DRAWING	REVISION	SHEET
2972-00-I-603	0	104/111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE





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DATE: 2018-06-28, Jhunn Dualan

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PROFESSIONAL ENGINEER
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R. A. NEAVE
June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

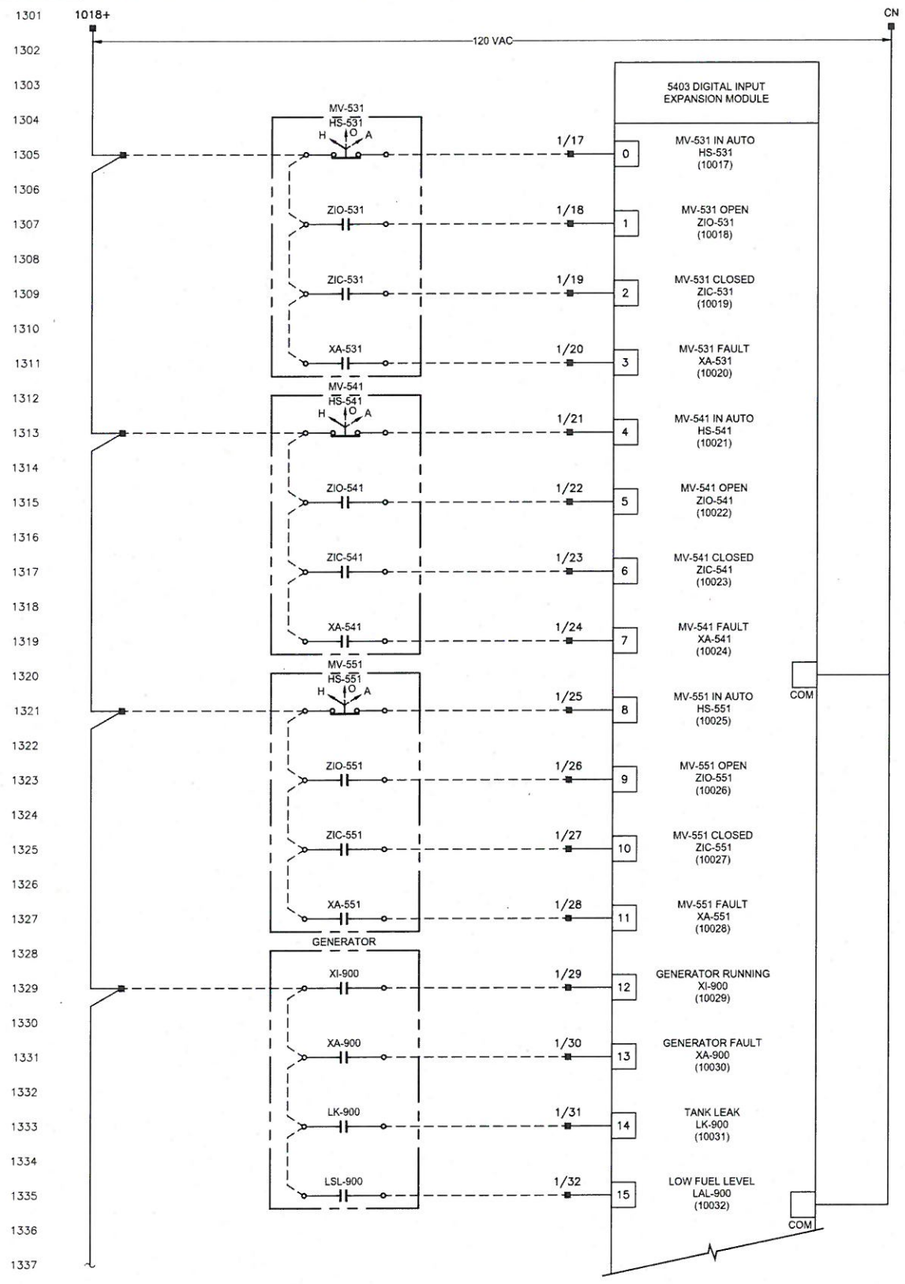
20172972-00

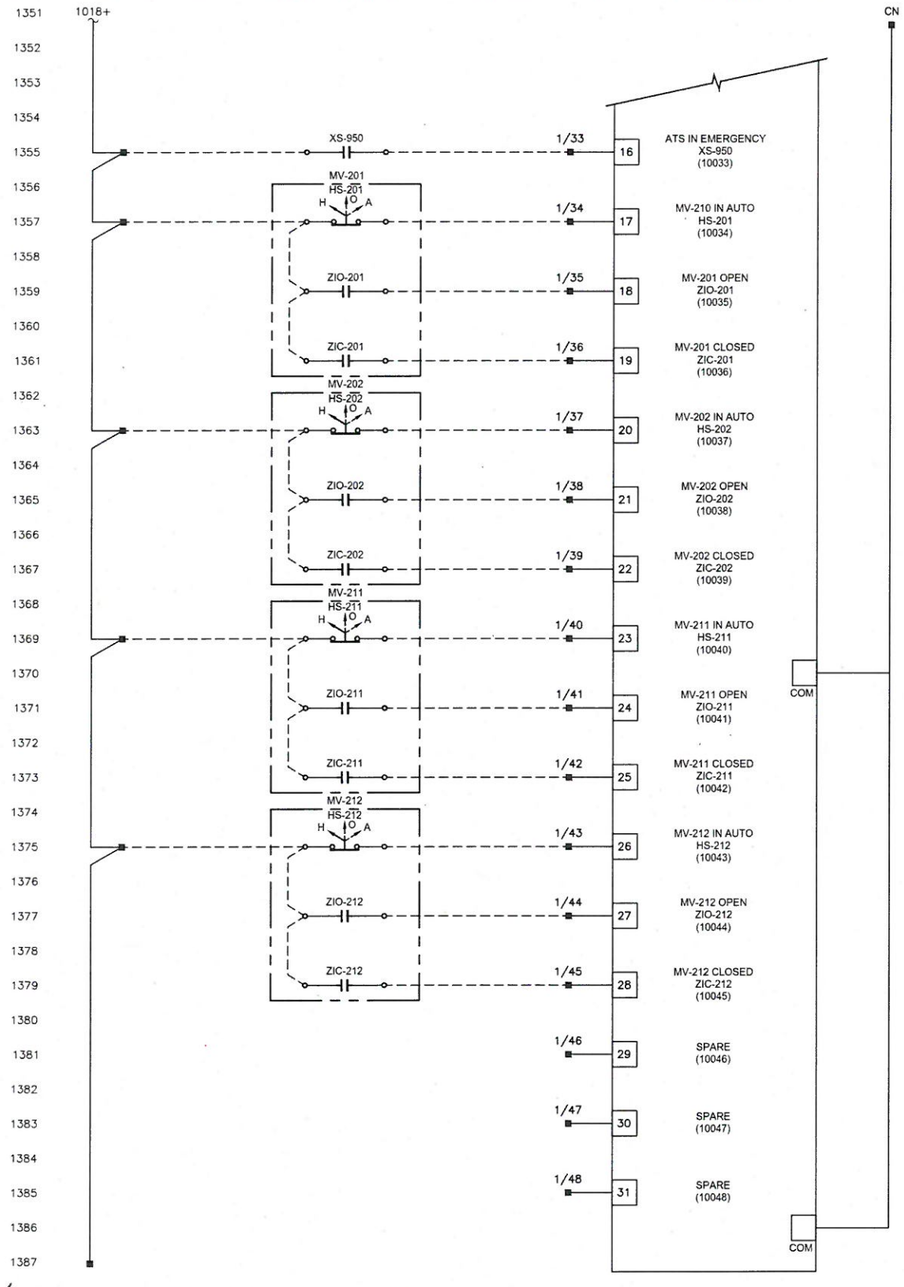
SCALE: NTS

THE CITY OF Port Alberni

INSTRUMENTATION
CP-100 SCADAPACK ON BOARD I/0 (2 OF 2)
TREATMENT BUILDING

DRAWING	REVISION	SHEET
2972-00-I-604	0	105/111





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DATE: 2018-06-28, Jhunn Dulan

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. A. NEAVE
June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

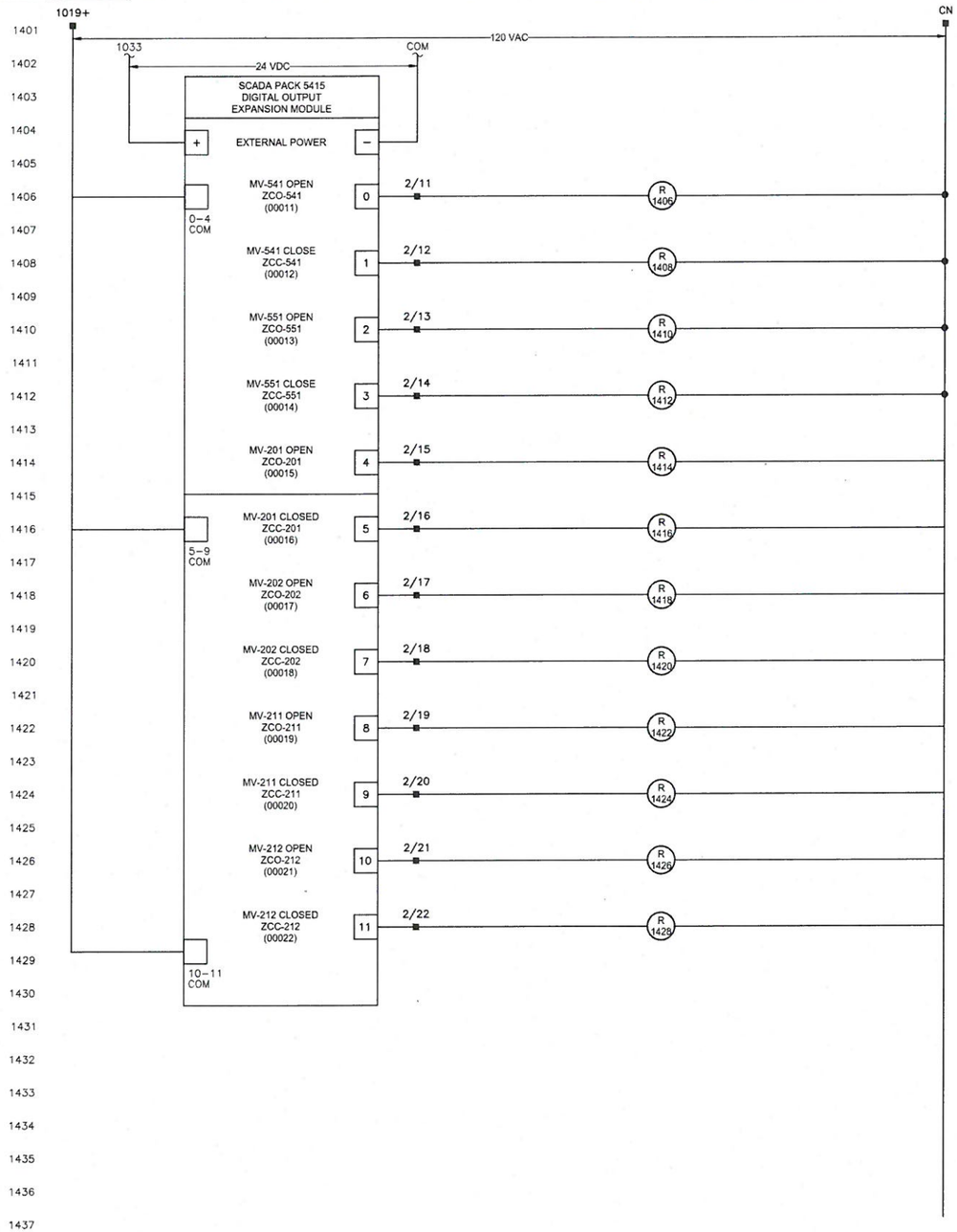
THE CITY OF Port Alberni

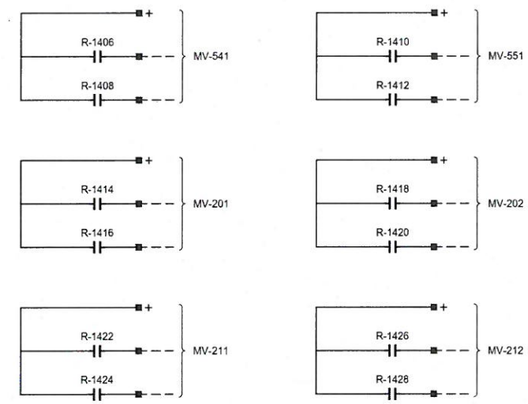
INSTRUMENTATION
CP-100 DIGITAL INPUTS 5403 EXPANSION RACK
TREATMENT BUILDING

DRAWING	REVISION	SHEET
2972-00-I-605	0	106/111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE





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DATE: 2018-06-28, Jthurm Dualan

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Suite 300 - 4940 Canada Way, Burnaby, British Columbia, V5G 4M5
Ph: 604 293 1411 Fax: 604 291 6163
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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. A. NEAVE

June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: NTS

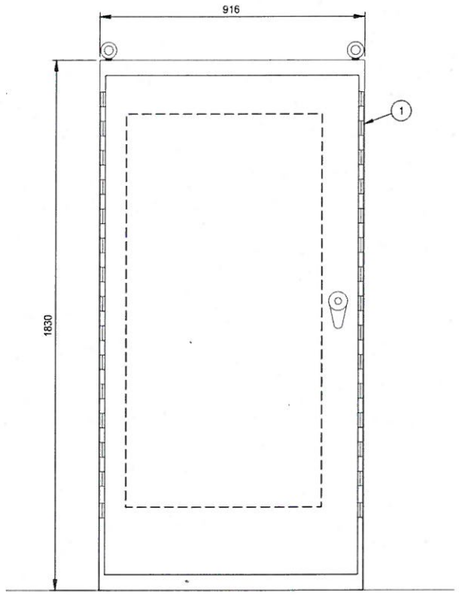
THE CITY OF Port Alberni

INSTRUMENTATION
CP-100 DIGITAL OUTPUTS 5415 EXPANSION RACK
TREATMENT BUILDING

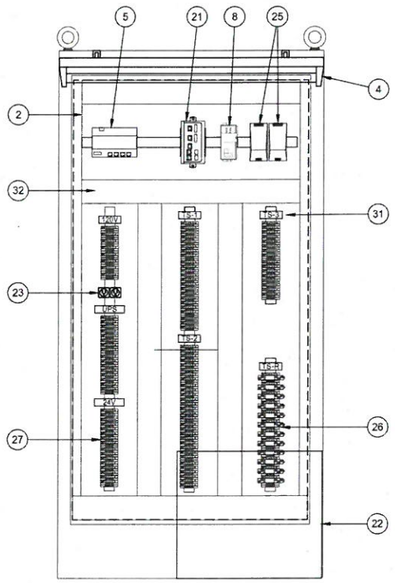
DRAWING	REVISION	SHEET
2972-00-I-606	0	107/111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



FRONT (DOOR CLOSED)



INNER FRONT

1 / - DETAIL 1:10
CP-100 CONTROL CABINET

BILL OF MATERIALS (CP-200)

ITEM	QUANTITY	PART No.	DESCRIPTION
1	1	"HOFFMAN A72361BFSG"	FREE-STANDING NEMA 12 2-DOOR ENCLOSURE
2	2	"HOFFMAN A72P60F1"	1524x1422mm BACK PANEL
	1	"HOFFMAN ADP3"	METAL DATA POCKET 305mm X 305mm X 80mm DEEP
4	2	HOFFMAN	FLUORESCENT LIGHT WITH DOOR SWITCH AND WIRE GUARD
5	1	SCADAPACK 334	SCADAPACK 334 PLC w/MODBUS TCP
8	1	NTRON 1000-POE4+	POE INJECTOR
21	1	SIXNET SLX-8MS-1	SIXNET MANAGED ETHERNET SWITCH
22	1	"EATON 5PX 1500 RT"	EATON 5PX SERIES UPS
23	1	WEIDMULLER 9915480001	5-20R
24	1		24VDC REDUNDANCY DIODE UNIT
25	2	"PHOENIX CONTACT QUINT-PS/1AC/24DC/10	PHOENIX CONTACT 24VDC, 10A POWER SUPPLY
26	AS REQUIRED	OMRON G2R-2	24VDC COIL, 120V DUAL CONTACT, 10A RATING WITH BASE
27	AS REQUIRED	WDU 2.5	WEIDMULLER TERMINAL
28	AS REQUIRED	WSI 6LD SERIES	WEIDMULLER FUSED TERMINAL W/ INDICATOR
29	AS REQUIRED	WPE 2.5	WEIDMULLER GROUND TERMINAL
30	AS REQUIRED	TS35	35mm SLOTTED STEEL RAIL
31	AS REQUIRED	-	TERMINAL STRIP LABEL
32	AS REQUIRED	"PANDUIT F3X3LG6"	PANDUIT 82.6x79.2mm NARROW SLOT WIRING DUCT, C/W COVER C3LG6
33	AS REQUIRED	"SPARTAN 0063136"	101.6x508mm ISOLATED INSTRUMENT GROUND BAR C/W ISOLATING MOUNTS (RUN DEDICATED 'GREEN' WIRE TO GROUND)
34	AS REQUIRED	"SPARTAN 0063136"	ELECTRICAL GROUNDING BAR (CONNECTED TO GROUND)

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DATE: 2018-06-28, Jhum Duklan

Associated Engineering
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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA K. A. NEAVE
June 28/2018

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2018JUN27	A. PICKETT	K. JOHNSTON	ISSUED FOR TENDER

CITY OF PORT ALBERNI

WASTEWATER LAGOON EXPANSION UPGRADES

20172972-00

SCALE: NTS

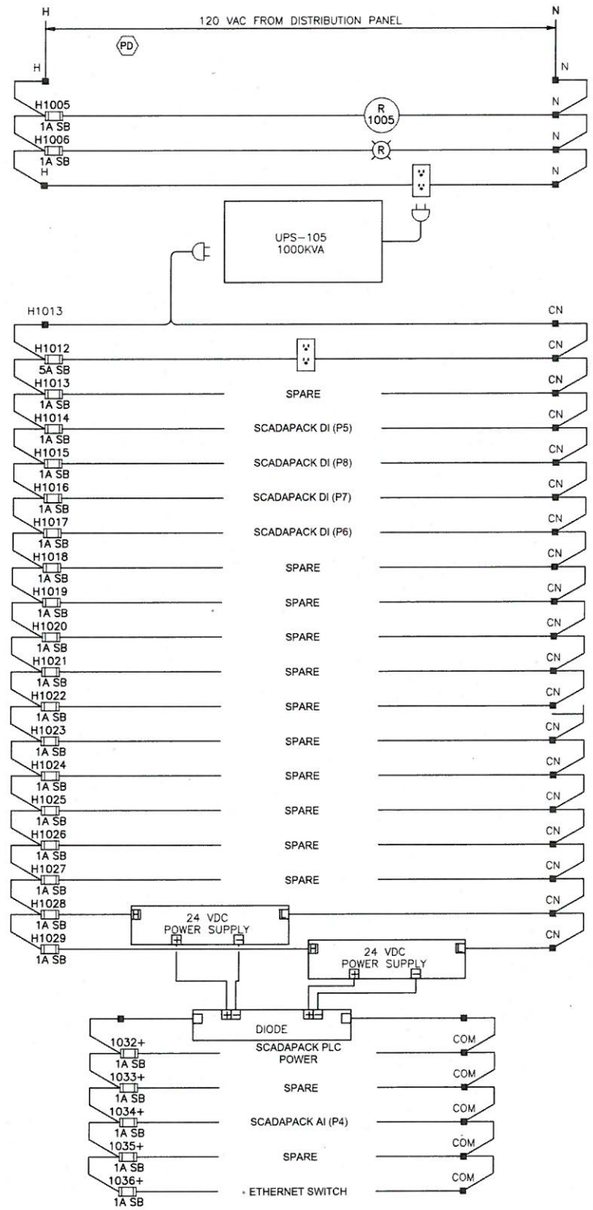
THE CITY OF Port Alberni

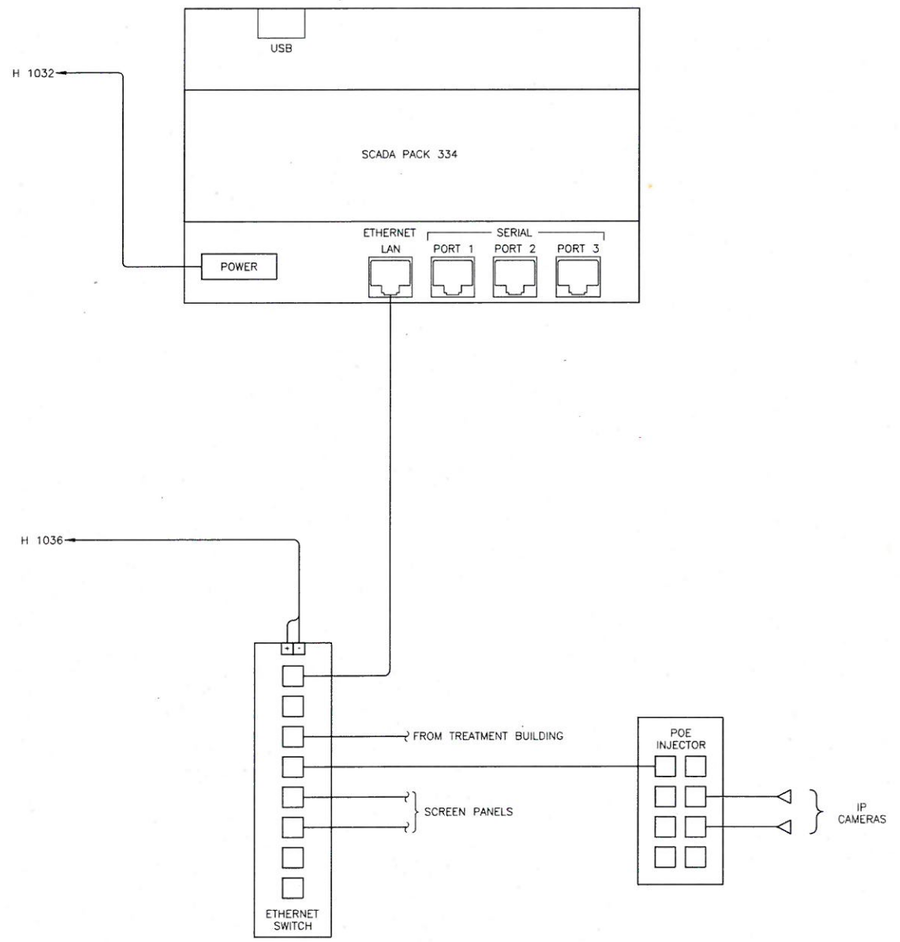
INSTRUMENTATION SCREENING BUILDING CP-200 LAYOUT

DRAWING	REVISION	SHEET
2972-00-I-611	0	108/111

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE





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BEST MANAGED COMPANIES

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K. A. NEAVE
BRITISH COLUMBIA
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CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

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SCALE: NTS

THE CITY OF Port Alberni

INSTRUMENTATION
CP-200 POWER DISTRIBUTION

DRAWING	REVISION	SHEET
2972-00-I-612	0	109/111

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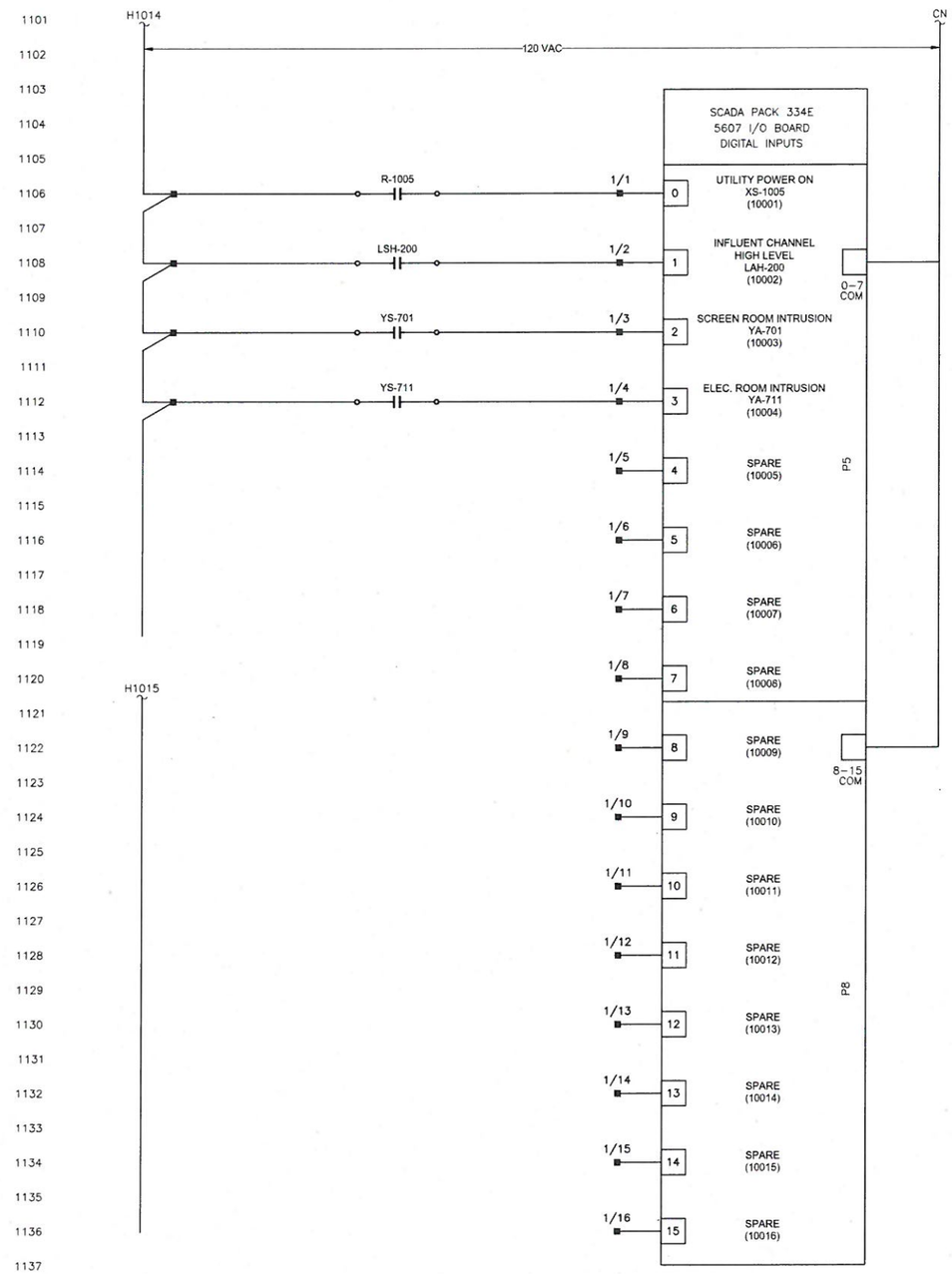

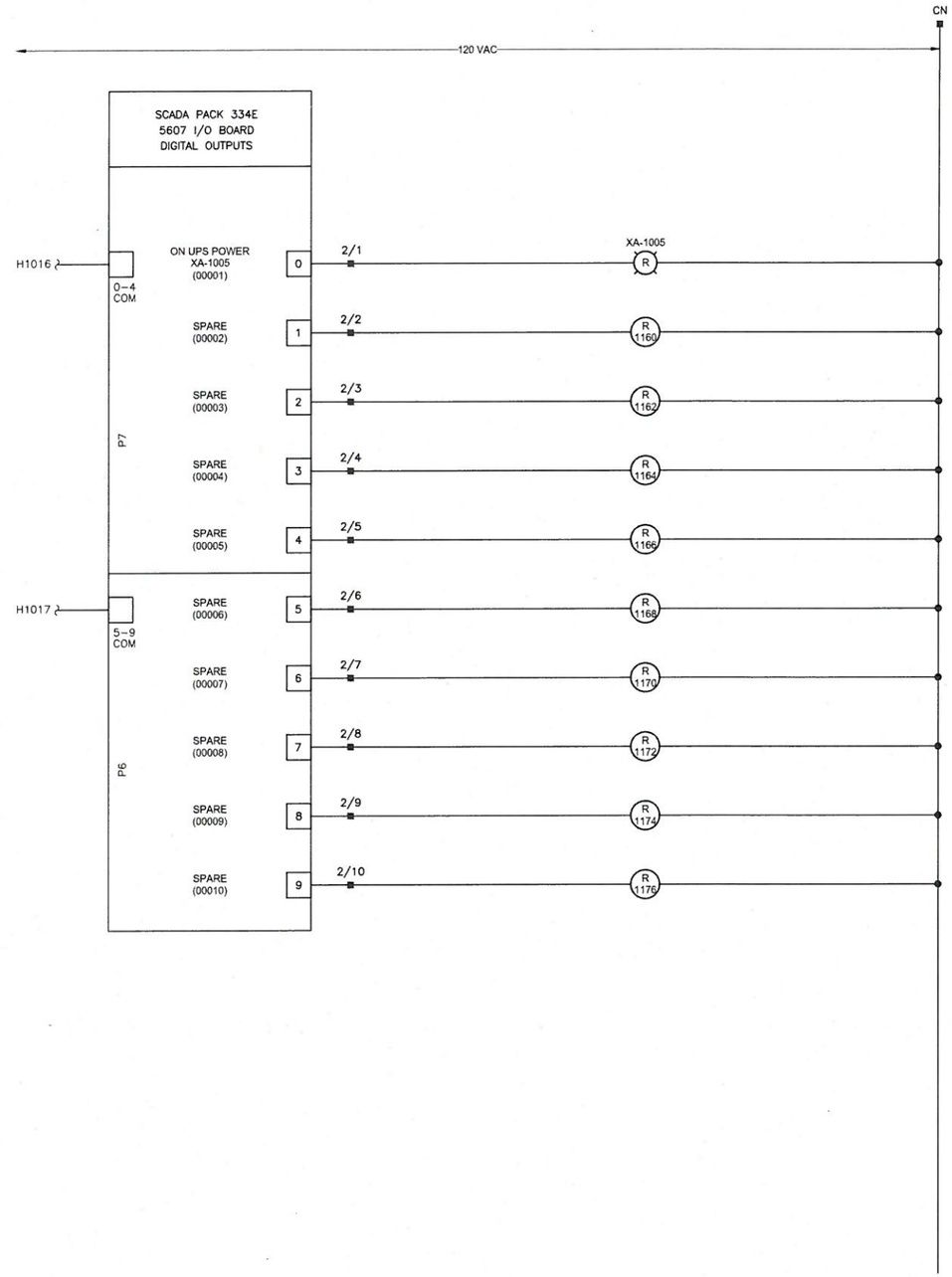

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WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: NTS

THE CITY OF Port Alberni

INSTRUMENTATION
CP-200 SCADAPACK ON BOARD I/0 (I OF 2)
SCREENING BUILDING

DRAWING	REVISION	SHEET
2972-00-I-613	0	110/111

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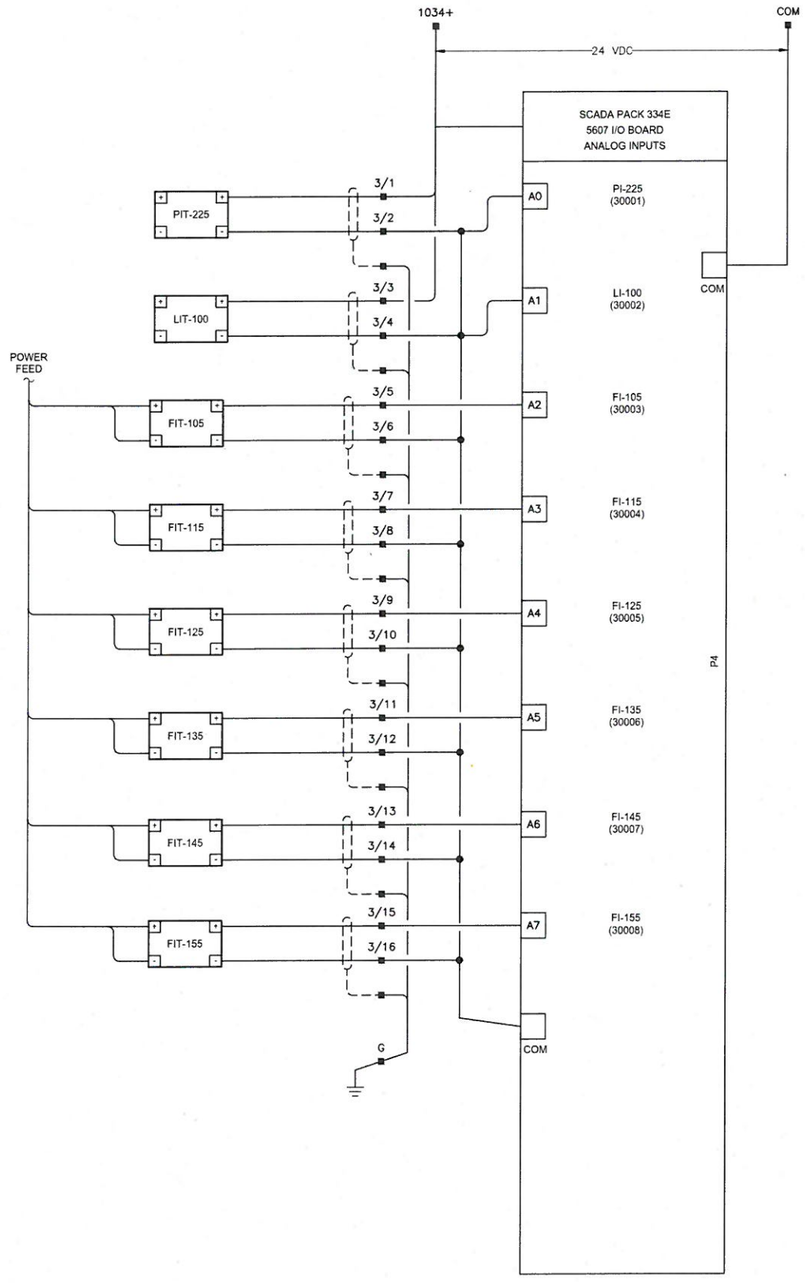

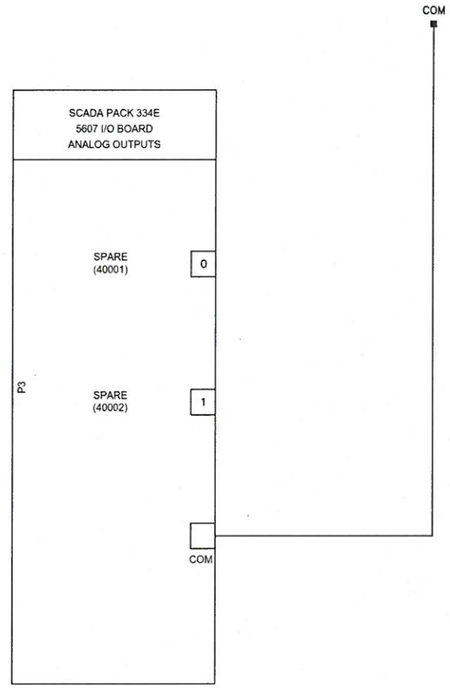

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. A. NEAVE
June 29/2018

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CITY OF PORT ALBERNI

WASTEWATER LAGOON
EXPANSION UPGRADES

20172972-00

SCALE: NTS

THE CITY OF Port Alberni

INSTRUMENTATION
CP-200 SCADAPACK ON BOARD I/0 (2 OF 2)
SCREENING BUILDING

DRAWING	REVISION	SHEET
2972-00-I-614	0	111/111