CITY OF COURTENAY

TENDER T20-11

Greenwood Trunk Sewers

Master Municipal Construction Documents (2009 Edition)
Unit Price Contract

Issued: February 27, 2020

Tender Closing Date: April 2nd, 2020, 2:00PM Local Time

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The complete **Contract Documents** consist of the following parts:

1. The Master Municipal Construction Documents (Tender Package) consisting of the following parts (included in this tender package):

   - Invitation to Tender
   - Instructions to Tenderers, Part I
   - Form of Tender
     Appendix 1 – Schedule of Quantities and Prices
     Appendix 2 – Preliminary Construction Schedule
     Appendix 3 – Experience of Superintendent
     Appendix 4 – Comparable Work Experience
     Appendix 5 – Subcontractors
     Appendix 6 – Tenderers Current Projects Underway
     Appendix 7 – Prime Contractor Designation Agreement
   - Draft Agreement
     Schedule 1 – Schedule of Contract Documents
     Schedule 2 – List of Contract Detail Drawings
   - Supplementary General Conditions
   - Supplementary Specifications
   - City of Courtenay Standard Construction Supplementary Specifications
   - Reference Documents
     - Greenwood Trunk Sewer Geotechnical Investigation
     - Greenwood Trunk Sewer Settlement Analysis and Liquefaction Triggering Assessment
     - Environmental Overview City of Courtenay Greenwood Trunk Main

2. The balance of the Master Municipal Construction Documents, Platinum, latest edition including revisions. These documents are available in the “MMCD – General Conditions, Specifications and Standard Detail Drawings” (**not distributed in the tender package**):

   - Instructions to Tenderers, Part II
   - General Conditions
   - Technical Specifications
   - Standard Detail Drawings

Invitation to Tender

Tender T20-11
Greenwood Trunk Sewers

The City of Courtenay invites Tenders for T20-11, Greenwood Trunk Sewers. The work will include the following:

Installation of a new sanitary sewer trunk main connecting the City of Courtenay System from existing and future development in East Courtenay, to the existing CVRD trunk main at Anderton Road. Work to include:

- Installation of a gravity trunk sewer main, including tie-in to existing CVRD trunk main;
- Installation of a force-main, complete with air valves and pigging chambers;
- Installation of a sanitary lift station;
- Drainage work including swales and culverts;
- Access road construction and restoration; and
- Various site works.

Tender documents are available for downloading from BC Bid at www.bcbid.gov.bc.ca and the City's website www.courtenay.ca/bids.

Sealed tenders submitted must be accompanied by the specified Bid Bond and will be received at the location stated below, **on or before 2:00 p.m., April 2nd, 2020.**

City of Courtenay – City Hall
830 Cliffe Avenue
Courtenay, B.C. V9N 2J7

Tenders will be opened in public. Tender results will be forwarded to all participants by email unless otherwise requested.

Tenderers are required to periodically check the BC Bid website or City of Courtenay website for any updated Addenda issued before the Closing Date.

Any changes to the Tender documentation or clarifications will be issued by means of written Addenda and posted on the BC Bid and City of Courtenay websites and will form part of the Tender.

The City does not retain a bidder's list or bidder's registry. Tenderers are encouraged to register as plan takers and view the Tender documents and drawings by contacting the Vancouver Island Construction Association: website: www.vicabc.com.

Should there be any discrepancy in the information provided the City's original file copy will prevail.

All enquiries are to be submitted in writing by email, **no later than 3 days prior to the Tender Closing Time** and quoting the Tender Name and Number to:

Email: purchasing@courtenay.ca

Tenders shall remain open for a period of 120 days following the Tender Closing Date. The City is currently undergoing an Alternate Approval Borrowing Process and do not expect approval to proceed until at least late May, 2020.

Bernd Guderjahn, SCMP
Manager of Purchasing, City of Courtenay

INSTRUCTIONS TO TENDERERS
PART I

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Instructions to Tenderers - Part I

(FOR USE WHEN UNIT PRICES FORM THE BASIS OF PAYMENT - TO BE USED ONLY WITH THE GENERAL CONDITIONS AND OTHER STANDARD DOCUMENTS OF THE UNIT PRICE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS.)

(TO BE READ WITH "INSTRUCTIONS TO TENDERERS - PART II" CONTAINED IN THE EDITION OF THE PUBLICATION "MASTER MUNICIPAL CONSTRUCTION DOCUMENTS" SPECIFIED IN ARTICLE 2.2 BELOW)

Owner: CITY OF COURTENAY

Contract: Greenwood Trunk Sewers

Reference No. TENDER T20-11

1 Introduction

1.1 These *Instructions to Tenders Part I* apply to and govern the preparation of tenders for this *Contract*. The *Contract* is generally for the following work:

Work will generally include:

- Installation of gravity trunk sewer main, including tie-in to existing CVRD trunk main,
- Installation of forcemain, complete with air valves and pigging chambers,
- Installation of sanitary lift station,
- Drainage work including swales and culvers,
- Access road construction and restoration, and
- Various site works.

1.2 Direct all inquiries regarding the *Contract*, to:

Contact: Bernd Guderjahn, SCMP
City of Courtenay
Manager of Purchasing
Address: 830 Cliffe Avenue,
Courtenay, B.C. V9N 2J7

Email: purchasing@courtenay.ca

2 Tender Documents

2.1 The tender documents which a tenderer should review to prepare a tender consist of all of the *Contract Documents* listed in Schedule 1 entitled "Schedule of Contract Documents". Schedule 1 is attached to the Agreement which is included as part of the tender package. The *Contract Documents* include the drawings listed in Schedule 2 to the Agreement, entitled "List of *Contract Drawings*".

2.2 A portion of the *Contract Documents* are included by reference. Copies of these documents have not been included with the tender package. These documents are the Instructions to Tenderers - Part II, General Conditions, Specifications and Standard Detail Drawings contained in the publication entitled "Master Municipal Construction Documents - General Conditions, Specifications and Standard Detail Drawings". Refer to Schedule 1 to the Agreement or, if not specified in Schedule 1, then the applicable edition shall be the most recent edition as of the date of the *Tender Closing Date.* All sections of this publication are by reference included in the *Contract Documents*.

2.3 Any additional information made available to tenderers prior to the Tender Closing Time by the Owner or representative of the Owner, such as geotechnical reports or as-built plans, which is not expressly included in Schedule 1 or Schedule 2 to the Agreement, is not included in the *Contract Documents*. Such additional information is made available only for the assistance of tenderers who must make their own judgement about its reliability, accuracy, completeness and relevance to the *Contract*, and neither the Owner nor any representative of the Owner gives any guarantee or representation that the additional information is reliable, accurate, complete or relevant.

3 Submission of Tenders

3.1 Tenders must be submitted in a sealed envelope, marked on the outside with the above *Contract* Title and Reference No., and must be received on or before:

Tender Closing Time: 2:00 p.m. local time

Tender Closing Date: Thursday, April 2nd, 2020

***Delivered to*:** Manager of Purchasing
City of Courtenay
c/o Purchasing Division
830 Cliffe Avenue,
Courtenay, B.C. V9N 2J7

3.2 Late tenders will not be accepted or considered, and will be returned unopened.

3.3 Tender Submission

a. Tenders **must** be submitted on the tender forms included in these tender documents. The addition to or changing of any words in these tender forms by the Tenderer or

the failure to comply with and complete all items may be cause for rejection without consideration of the tender submission.

b. The tender submission **must** include acknowledgement of receipt of all issued addenda.

c. The tender submission **must** include the specified financial security, in the form of a Bid Security as required in Section 5.2 of the Instructions to Tenderers Part II.

d. The Form of Tender **must** bear the signature of a legal signing authority of the Tenderer.

e. Other than the acknowledgement of receipt of addenda, or request for withdrawal or revision, documents submitted as part of a tender **will not be considered** if received by any of the Owner's facsimile machines or by email.

f. Except as expressly and specifically permitted in these Instructions to Tenderers, no Tenderers shall have any claim for any compensation of any kind whatsoever, as a result of participating in the tender, and by submitting a bid, each Tenderer shall be deemed to have agreed that is has no claim.

4 Additional Instructions to Tenderers

4.1 The Owner is subject to the provisions of the Freedom of Information and Protection of Privacy Act. As a result, while Section 21 of the Act does offer some protection for third party business interests, the Owner cannot guarantee that any information provided to the Owner can be held in confidence. All tenders, after closing time and date become the property of the City of Courtenay.

4.2 The Owner shall not be liable for a Tenderer's cost of submitting a tender.

4.3 No Mandatory Site Meeting will be held for this project. A non-mandatory pre-tender meeting is scheduled as follows:

Meeting Place: Beaver Meadows Farm Gate on Anderton Road

Meeting Date: March 12, 2020

Meeting Start Time: 10:00 am

4.4 Acceptance of any Tender may be subject to budgetary considerations and/or City of Courtenay Council approval, and/or the approval of jurisdictions having authority.

4.5 It should be noted that the majority of this work is to be constructed within a Statutory Right of Way within private property. Work on the Owner's property shall be carried out subject to City of Courtenay Bylaw No. 2804 – Prevention of Public Nuisances, unless other arrangements are made between the Owner and the Tenderer, and agreed to in writing.

4.6 Work will take place on Beaver Meadow Farms property, which is certified as an organic farm. No backfill, embankment, or other materials of organic nature are to be brought onto site without approval from the property owner. Specific materials requiring approval shall include but not be limited to:

.1 Road gravels and backfill material,
.2 Topsoil,
.3 Erosion and sediment control materials, and
.4 Seed mixtures.

Further to the above, there are specific materials that will not be allowed on site, including hay bales, or other grown construction materials that are not certified organic in nature.

4.7 Tenderers shall include a 10% contingency allowance, as defined in GC 1.19, in the Tender Price.

4.8 Topsoil stripped from the site is not able to be removed from the property as per Agriculture Land Reserve requirements. A location southeast of the existing storage pond has been identified by the landowner as a suitable place to stockpile excess topsoil material. It can be expected that all topsoil that is not reused can be left on site in this location.

4.9 Unsuitable subgrade material has been identified in the drawings between Station 1+040 and Station 1+600. The landowner has indicated that this material can be spread on the field to the north of the proposed road. Other excess trench materials will need to be disposed of by the contractor offsite.

4.10 Tenderers to be aware that there are a number of streams, ditches, springs and environmentally sensitive areas within the project site. Additional specifications have been

provided regarding environmental and erosion and sediment control requirements.

4.11 Tenderers to be aware that there is high potential for groundwater within the site. Further information regarding groundwater and soil conditions can be found in the appended Geotechnical Report.

4.12 Tenderers to be aware of the following considerations or conditions governing work within the site:

.1 Two year weed control program,
.2 Available windows for works within drainage ditches,
.3 Vehicle and equipment access to organic farm requirements,

These items are presented in more detail throughout the specifications.

4.13 Tenderers to note that the electrical contract drawings issued as part of this tender are provided to show the general intent of electrical works that are to be completed as part of this project. Controls, instrumentation, and wiring drawings will be provided as an addendum during the tender period.

Supplemental Instructions to Tenderers

4.14 Additions and Deletions to Instructions to Tenderers Part II

Tender Requirements	5.1	Delete ITT 5.2.2
Amendment of Tenders	12.1	Change “hand, mail or fax” to “hand” and add “An amendment by email or fax will not be accepted.”
Award	15.5	Add 15.5 Basis of Contract Award & Acceptance The City reserves the right to accept or reject any or all Tenders and the lowest or any Tender may not necessarily be accepted. The City also reserves the right to cancel any Invitation to Tender at any time without recourse by the Tenderer. The City will not under any circumstance be responsible for any costs incurred by the Tenderer in preparing the Tender.

In reviewing tenders and awarding the *Contract* for this project the *Owner* may consider not only the tendered prices but the overall value that the tender presents to the *Owner* based on quality, service and price, including the *Tenderer's* experience and qualifications considered essential by the *Owner* for the satisfactory completion of this type and size of project including:

a) Bonding capability;

b) Financial capability;

c) Previous completed projects of this type and/or size;

d) Major projects now being undertaken by the *Tenderer*;

e) Key site and office personnel to be assigned by the *Tenderer* to this project.

f) Capacity to complete the *Work* on schedule.

g) The past experience of the *Owner* and/or other project owners with respect to the *Tenderer's* performance in completing projects in a timely, efficient and satisfactory manner, the *Tenderer's* methods of doing business and the *Tenderer's* ability to establish and maintain a good working relationship with the *Owner*.

The Owner reserves the right to award the Contract based on the above prerequisites and to reject without further consideration, any tender which in its opinion, does not meet the criteria it considers essential for this project.

The Tenderer by submitting a tender, agrees that it will not make a claim against the Owner, for whatever reason, relating to the tender, the tender documents, or the competitive tender process. The Tenderer, by submitting a tender, waives any claim or recovery for loss of profits or any prospective damages whatsoever if no Contract is entered into with the Tenderer.

Award of this Contract is subject to available funding approved by City Council.

FORM OF TENDER

Owner: City of Courtenay

Contract: Greenwood Trunk Sewers

Reference No. Tender T20-11

TO OWNER:

1 WE, THE UNDERSIGNED:

1.1 have received and carefully reviewed all of the *Contract Documents*, including the Instructions to Tenderers, the specified edition of the "Master Municipal Construction Documents - General Conditions, Specifications and Standard Detail Drawings" and the following Addenda:

_____
_____
_____;
(ADDENDA NUMBER AND TITLE, IF ANY)

1.2 have full knowledge of the *Place of the Work*, and the *Work* required; and

1.3 have complied with the Instructions to Tenderers; and

2 ACCORDINGLY, WE HEREBY OFFER:

2.1 to perform and complete all of the *Work* and to provide all the labour, equipment and material all as set out in the *Contract Documents*, in strict compliance with the *Contract Documents*; and

2.2 to achieve *Substantial Performance* of the *Work* on or before **November 13, 2020** and achieve *Total Performance* of the Work before **December 4, 2020**; and

2.3 to do the Work for the price, which is the sum of the products of the actual quantities incorporated into the Work and the appropriate Lump Sums set out in Appendix I, the *"Schedule of Quantities and Prices"*, provided by the *Contract Documents*. For the purposes of tender comparison, our offer to complete the Work for the *Tender Price* as set out in Appendix I of this Form of Tender. Our *Tender Price* is based on estimated quantities listed in the *Schedule of Quantities and Prices*, and excludes GST.

3 WE CONFIRM:

3.1 that we understand and agree that the quantities as listed in the *Schedule of Quantities and Prices* are estimated, and that the actual quantities will vary.

4 WE CONFIRM:

4.1 that the following Appendices are attached to and form a part of this tender:

4.1.1 the appendices as required by paragraph 5.3 of the Instructions to Tenderers - Part II; and

4.1.2 the *Bid Security* as required by paragraph 5.2 of the Instructions to Tenderers - Part II.

5 WE AGREE:

5.1 that this tender will be irrevocable and open for acceptance by the *Owner* for a period of **120 calendar days** from the day following the *Tender Closing Date and Time*, even if the tender of another Tenderer is accepted by the *Owner*. If within this period the *Owner* delivers a written notice ("*Notice of Award*") by which the *Owner* accepts our tender we will:

5.1.1 within 5 *Days* of receipt of the written *Notice of Award* deliver to the *Owner*:

a) a Performance Bond and a Labour and Material Payment Bond, each in the amount of 50% of the *Contract Price*, covering the performance of the *Work* including the *Contractor*'s obligations during the *Maintenance Period*, issued by a surety licensed to carry on the business of suretyship in the province of British Columbia, and in a form acceptable to the *Owner*; and

b) a "clearance letter" indicating that the Tenderer is in WorkSafe BC compliance; and

c) a copy of the insurance policies as specified in GC 24 indicating that all such insurance coverage is in place; and

d) a copy of a current City of Courtenay business license or a Mid-Island inter-municipal business license; and

e) a copy of the Tenderers safety program as specified by Supplementary General Condition 4.2.2.

5.1.2 within 10 *Days* of receipt of written "*Notice to Proceed*", or such longer time as may be otherwise specified in the *Notice to Proceed*:

a) commence the *Work*; and
b) sign the *Contract Documents* as required by GC 2.1.2.

6 WE AGREE:

6.1 that, if we receive written *Notice of Award* of this *Contract* and, contrary to paragraph 5 of this Form of Tender, we:

6.1.1 fail or refuse to deliver the documents as specified by paragraph 5.1.1 of this Form of Tender; or

6.1.2 fail or refuse to commence the *Work* as required by the *Notice to Proceed*, then such failure or refusal will be deemed to be a refusal by us to enter into the *Contract* and the *Owner* may, on written notice to us, award the *Contract* to another party. We further agree that, as full compensation on account of damages suffered by the *Owner* because of such failure or refusal, the *Bid Security* shall be forfeited to the *Owner*, in an amount equal to the lesser of:

6.1.3 the face value of the *Bid Security*; and

6.1.4 the amount by which our *Tender Price* is less than the amount for which the *Owner* contracts with another party to perform the *Work*.

7 WE DECLARE THAT:

7.1 no person, firm or company other than the undersigned, has any interest in this tender or in the proposed Contract for which this tender is made;

7.2 this tender is made without any connection, knowledge, comparison of figures, or agreement with any other company, firm or person making a tender for the same work.

7.3 in tendering for this work, and when called upon to enter into an agreement, the Owner, we will be bound to comply with all laws, statutes, and municipal bylaws pertaining to the Work. The agreement will be governed by the laws of the province of British Columbia.

7.4 in submitting this tender, we did not rely upon any information provided by the Owner, or any of the Owner's employees or agents, relating to the conditions, contingencies, risks or other circumstances, local or otherwise, which might influence or affect the performance or the cost of the Work, including, without limiting the nature of the ground, subsoil, substrata of the work site, the means of access to the work site, the quality, quantity, nature or location of the materials to be furnished or removed in performance of the Work, and the conditions under which the labour force will be employed, except the extent that any such information is expressly set forth in the *Contract Documents*. We have relied on our own

examination of the work site and have informed ourselves as to all conditions, contingencies, risks, and circumstances, local or otherwise, which might influence or affect the performance or the cost of the Work. We accept the site prior to the signing of the Contract.

8 WE AGREE:

8.1 The Work shall be completed entirely by the Designated *Total Performance* date.

8.2 There shall be no exclusion of time from the Designated Completion Period for any reason other than delays clearly attributable to the Owner, its agents, employees or any authorized representatives.

8.3 If the designated portion of the Work is entirely completed earlier than the end of the Designated Completion Period, the Owner shall pay the Contractor an early release of the Construction Right-of-Way payment based on $0 per calendar day for each calendar day of early completion.

8.4 The early release of the Construction Right-of-Way payment will be made in the final payment, or in the next progress payment after the designated portion of the Work is entirely completed.

8.5 There shall be no exclusion of time from the Designated Completion Period for any reason **other** than delays clearly attributable to the Owner, its agents, employees or any Authorized Representatives.

9 WE DECLARE THAT:

9.1 We recognize that the lowest or any tender will not necessarily be accepted.

9.2 We recognize that the Owner reserves the right to reject all tenders or to accept the tender which best suits its long-term objectives; and we recognize the Owner reserves the right to accept or reject all or part of this Tender at any time during the period specified by paragraph 5.1 of this Form of Tender.

10 WE DECLARE THAT:

10.1 We do not (or any related company) have any family, ownership, and operating relationships with the City of Courtenay, or any elected official, staff or other officials holding public office in the City of Courtenay and agree that the Owner reserves the right to reject any tender that may be perceived to be in a conflict of interest.

11 WE DECLARE THAT:

11.1 The Tenderer has not:

(a) had a bid bond or performance bond retained or claimed against.

(b) breached a contract for works or services with the Owner or other Public Authority in British Columbia.

(c) been engaged in a legal action against the Owner or other Public Authority in British Columbia, or the elected or appointed officers and employees of the Owner or the Public Authority, in relation to:
- any other contract for works or services
- any matter arising from the exercise of the Owner's or other Public Authority's powers, duties or functions under the Community Charter, Local Government Act or other enactment.

(d) been charged or convicted of an offence in relation to the performance of a contract for works or services with the Owner or other Public Authority.

within five years of the closing date of this Tender.

11.2 Tenderers who are unable to truthfully complete this declaration must provide full particulars of the relevant circumstances. Submission of a false declaration is grounds for rejection of a tender.

OUR ADDRESS is as follows:

_____

_____

Phone: ____ ____ - _____

Fax: ____ ____ - _____

Email: _____

Attention: _____

This Tender is executed this _____ day of _____, 20 ____.

Tenderer:

_____
FULL LEGAL NAME OF CORPORATION, PARTNERSHIP OR INDIVIDUAL

AUTHORIZED SIGNATOR

Appendix 1

SCHEDULE OF QUANTITIES AND PRICES

(See paragraph 5.3.1 of the Instructions to Tenderers - Part II)

(All prices and *Quotations* including the *Contract Price* shall include all *Taxes*, but shall not include *GST*. *GST* shall be shown separately.)

Summary Sheet

Division 1:	General Requirements	$ _____
Division 31:	Earthworks	$ _____
Division 32:	Roads and Site Improvements	$ _____
Division 33:	Utilities	$ _____
SUBTOTAL PRICE		$ _____
CONTINGENCY – 10% OF TENDER PRICE		$ _____
GST		$ _____
TENDER PRICE PLUS GST		$ _____

Item	Section	Brief Description See MMCD Master Municipal Specifications and Supplementary Specifications for Additional Details and Descriptions	Unit	Est. Qty.	Unit Price	Amount
Division 1 General Requirements						
01 53 01 – Mobilization and Demobilization						
1.01	SS 1.9.1	Mobilization and Demobilization	LS	1		
01 55 00 – Traffic Control, Vehicle Access and Parking						
1.02	SS 1.5.1	Traffic control	LS	1		
01 55 01 - Environmental Protection						
1.03	SS 1.6.1	Environmental Protection	LS	1		
					Division 1 Sub-Total	

Division 31 – Earthwork						
31 11 01 – Clearing and Grubbing						
31.01	SS 1.4.2	Clearing and Grubbing	LS	1		
31 11 41 – Shrub and Tree Preservation						
31.02	1.3.1	Protection of Existing Wildlife Tree, Approximately Station 1+340	LS	1		
31 22 01 – Site Grading						
31.03	1.4.1	Topsoil Stripping, Stockpiling and Replacement – Station 1+020 to Station 1+600	m^3	1300		
31.04	1.4.1	Topsoil Stripping, Stockpiling and Replacement – Lift Station Site and Manhole Pads	m^3	260		
31.05	1.4.7	Drainage Ditch Realignment, Excavation and Disposal of Excess Material	m^3	140		
31 24 13 – Roadway Excavation, Embankment and Compaction						
31.06	1.8.7	Import Embankment Fill (Station 1+020 to Station 1+615)	m^3	2450		
31.07	SS 1.8.10	Replace Unsuitable Subgrade	m^3	4000		
31 37 10 – Riprap						
31.08	1.4.1	Riprap Aprons	m^3	60		
					Division 31 Sub-Total	

Division 32 – Roads and Site Improvements						
32 11 16.1 – Granular Sub-Base						
32.01	1.4.3	Gravel Access Road - Station 1+020 to Station 1+615 – 300mm Depth	m^2	3,500		
32 11 23 – Granular Base						
32.02	1.4.2	Gravel Access Road - Station 1+020 to Station 1+615 – 150mm Depth	m^2	3,200		
32 12 16 – Hot-Mix and Warm Mix AC Paving						
32.03	SS 1.5.8	Permanent Pavement Restoration	LS	1		
32 31 13 – Chain Link Fences and Gates						
32.04	1.5.1	1.8m High Chain Link Fence	m	67		
32.05	1.5.2	4.0m Wide Rolling Gate	ea	1		
32.06	1.5.2	Foot Gate	ea	1		
Hydraulic Seeding						
32.07	1.8.1	Hydraulic Seeding	m^2	12,650		
					Division 32 Sub-Total	

Division 33 – Utilities						
33 01 30.1 – CCTV Inspection of Pipelines						
33.01	1.6.2	CCTV Inspection of Sanitary Sewer Pipe	m	1,630		
33 30 01 – Sanitary Sewers						
33.02	1.6.1, 1.6.2	Sewer Pipe PVC SDR 35 – 200 mm diameter – Import Backfill	lm	255		
33.03	1.6.1, 1.6.2	Sewer Pipe PVC SDR 35 – 250 mm diameter – Import Backfill	lm	425		
33.04	1.6.1, 1.6.2	Sewer Pipe PVC SDR 35 – 300 mm diameter – Import Backfill	lm	710		
33.05	1.6.1, 1.6.2	Sewer Pipe PVC SDR 35 – 375 mm diameter – Import Backfill	lm	226		
33.06	1.6.1, 1.6.2	Sewer Pipe PVC SDR 35 – 450 mm diameter – Import Backfill	lm	12.5		
33.07	1.6.7	Sanitary Tie-In 450 mm diameter into existing 450 mm diameter sanitary sewer or existing manhole	ea	1		
SS 33 31 00 – Sanitary Lift Station, Control Vault and Meter Chamber						
33.08	SS 1.6.1	Lift Station #1 (Lift Station, Valve Chamber and Flowmeter Manhole)	LS	1		

33 34 01 – Sewage Forcemain						
33.09	1.8.1, SS 1.8.2	Forcemain PVC SAN – 350 mm diameter – Import Backfill	lm	1,695		
33.10	1.8.3	45 Degree Bend – 350 mm diameter – PVC DR 18 c/w Joint Restraints	ea	2		
33.11	1.8.3	90 Degree Bend – 350 mm diameter – PVC DR 25 c/w Joint Restraints	ea	1		
33.12	1.8.3	Vertical Deflection – 5 Degree Bend – 350 mm diameter – PVC DR 18 c/w joint restraints (Optional)	ea	10		
33.13	1.8.3	Buried Plug Valve	ea	3		
33.14	SS 1.8.11	Forcemain Pigging Chamber	ea	6		
33.15	SS 1.8.6	Air Valve Chamber	ea	2		
33 42 13 – Pipe Culvert						
33.16	1.5.1, 1.5.2	Culvert Pipe 300 mm diameter	lm	91		
33.17	1.5.1, 1.5.2	Culvert Pipe 400 mm diameter	lm	4.5		
33.18	1.5.1, 1.5.2	Culvert Pipe 450 mm diameter	lm	23		
33.19	1.5.1, 1.5.2	Culvert Pipe 600 mm diameter	lm	57		
33.20	1.5.3	Culvert Endwall 300 mm diameter	ea	16		
33.21	1.5.3	Culvert Endwall 400 mm diameter	ea	2		
33.22	1.5.3	Culvert Endwall 450 mm diameter	ea	2		
33.23	1.5.3	Culvert Endwall 600 mm diameter	ea	6		
33.24	SS 1.5.7	Culvert Tie-In 400 mm diameter into existing 400 mm diameter culvert	ea	2		
33 44 01 – Manholes and Catchbasins						
33.25	1.5.1.1	Manhole base, lid, slab, cover and frame – 1050 mm diameter	ea	14		
33.26	SS 1.5.1.2	Manhole Riser – 1050 mm diameter	vm	26		
33.27	1.5.1.1	Manhole base, lid, slab, cover and frame – 1500 mm diameter	ea	2		
33.28	SS 1.5.1.2	Manhole Riser – 1500 mm diameter	vm	2.9		
33.29	SS 1.5.7	Addition of Odour Control on Manholes	ea	2		
33.30	SS 1.5.8	Addition of Bypass Pumping Connection on Manholes	ea	1		
					Division 33 Sub-Total	

Appendix 2

PRELIMINARY CONSTRUCTION SCHEDULE

(See paragraph 5.3.2 of the Instructions to Tenderers - Part II)

*INDICATE SCHEDULE WITH BAR CHART WITH MAJOR ITEM DESCRIPTIONS AND TIME MILESTONE DATES

****MILESTONE DATES:**

- Substantial Performance: November 13, 2020

ACTIVITY	CONSTRUCTION SCHEDULE									
	1	2	3	4	5	6	7	8	9	10

Note: In the case of a discrepancy between the Preliminary Construction Schedule prepared by the Tenderer and the milestone dates prescribed by the Owner above, the milestone dates will prevail.

Appendix 3

EXPERIENCE OF SUPERINTENDENT

(See paragraph 5.3.3 of the Instructions to Tenderers - Part II)

Name: _____

Dates:_____

Project Name:_____

Responsibility:_____

_____

_____

References:_____

Dates:_____

Project Name:_____

Responsibility:_____

_____

_____

References:_____

Dates:_____

Project Name:_____

Responsibility:_____

_____

_____

References:_____

Appendix 4

COMPARABLE WORK EXPERIENCE

(See paragraph 5.3.4 of the Instructions to Tenderers - Part II)

PROJECT	OWNER/ CONTRACT NAME	PHONE NUMBER	WORK DESCRIPTION	VALUE ($)

Appendix 5

SUBCONTRACTORS

(See paragraph 5.3.5 of the Instructions to Tenderers - Part II)

TENDER ITEM	TRADE	SUBCONTRACTOR NAME	PHONE NUMBER

Appendix 6

TENDERER'S CURRENT PROJECTS UNDERWAY

PROJECT	OWNER/ CONTACT NAME	PHONE NUMBER	WORK DESCRIPTION	VALUE ($)	% COMPLETE

Appendix 7

PRIME CONTRACTOR DESIGNATION AGREEMENT

PROJECT TITLE:	**Greenwood Trunk Sewers**
WORK DESCRIPTION:	**Construction of trunk sewers, including gravity sewer, forcemain, and sanitary lift station, between new and existing East Courtenay developments and existing CVRD Greenwood Sewer Trunk.**
LOCATION:	**Courtenay, B.C.**
OWNER:	**City of Courtenay**

This declaration is a WorkSafe BC (formally WCB) requirement for work on City-owned properties, projects, and developments.

As per the requirements of the Workers' Compensation Act Part 3, Division 3, Section 118 (1-3) which states:

Coordination of multiple-employer workplaces

118 (1) In this section:
"multiple-employer workplace" means a workplace where workers of 2 or more employers are working at the same time:
"prime Contractor" means in relation to a multiple-employer workplace,
(a) the directing Contractor, employer or other person who enters into a written Agreement with the owner of that workplace to be the prime Contractor for the purposes of this Part, or;
(b) if there is no Agreement referred to in paragraph (a), the owner of the workplace.

(2) The prime Contractor of a multiple-employer workplace must:
(a) ensure that the activities of employers, workers and other persons at the workplace relating to occupational health and safety are coordinated, and;
(b) do everything that is reasonably practicable to establish and maintain a system or process that will ensure compliance with this Part and the regulation in respect to the workplace.

(3) Each employer of workers at a multiple-employer workplace must give to the prime Contractor the name of the person the employer has designated to supervise the employer's workers at that workplace.

By signing this Agreement, the undersigned accepts all responsibilities of a Prime Contractor as outlined in the Workers' Compensation Act, and WorkSafe BC (OH&S Regulation).

As a Contractor signing this Agreement with the City, you are agreeing that your company, management staff, supervisory staff and workers will comply with the Work Safe B.C. Occupational Health and Safety Regulations OH&S Regulations and the Workers' Compensation (WC) Act.

Any penalties, sanctions or additional costs levied against the City, as a result of the actions of the Prime Contractor are the responsibility of the Prime Contractor.

I, the undersigned, acknowledge having read and understand the information above. By signing this Agreement, I agree as a representative of the firm noted below, to accept all responsibilities of the Prime Contractor for this project.

I fully understand and accept the responsibilities of the Prime Contractor designation in accordance with the Workers' Compensation Act for all work on City-owned property; as described above, and will abide by all WorkSafe BC Regulation requirements.

WorkSafe BC *Notice of Project No.*:_____

Company: _____

Signed:_____ Date:_____
(Authorized Signatory)

AGREEMENT

BETWEEN OWNER AND CONTRACTOR

THIS AGREEMENT made this _____ day of _____, 2020.

Contract: Greenwood Trunk Sewers

Reference No.: Tender T20-11

BETWEEN:

CITY OF COURTENAY
(the "*Owner*")

AND:

_____
(the "*Contractor*")

The *Owner* and the *Contractor* agree as follows:

ARTICLE 1 THE WORK - START/COMPLETION DATES

1.1 The *Contractor* will perform all *Work* and provide all labour, equipment and material and do all things strictly as required by the *Contract Documents*.

1.2 The *Contractor* will commence the *Work* in accordance with the *Notice to Proceed*. The *Contractor* will proceed with the *Work* diligently, will perform the *Work* generally in accordance with the construction schedules as required by the *Contract Documents* and will achieve *Substantial Performance* of the *Work* on or before **November 13, 2020** subject to the provisions of the *Contract Documents* for adjustments to the *Contract Time*.

1.3 Time shall be of the essence of the *Contract*.

ARTICLE 2 CONTRACT DOCUMENTS

2.1 The "*Contract Documents*" consist of the documents listed or referred to in Schedule 1, entitled "Schedule of Contract Documents", which is attached and forms a part of this Agreement, and includes any and all additional and amending documents issued in accordance with the provisions of the *Contract Documents*. All of the *Contract Documents* shall constitute the entire *Contract* between the *Owner* and the *Contractor*.

2.2 The *Contract* supersedes all prior negotiations, representations or agreements, whether written or oral, and the *Contract* may be amended only in strict accordance with the provisions of the *Contract Documents*.

ARTICLE 3 CONTRACT PRICE

3.1 The price for the *Work* ("*Contract Price*") shall be the sum in Canadian dollars of the following:

3.1.1 the product of the actual quantities of the items of *Work* listed in the *Schedule of Quantities and Prices* which are incorporated into or made necessary by the *Work* and the unit prices listed in the *Schedule of Quantities and Prices*; plus

3.1.2 all lump sums, if any, as listed in the *Schedule of Quantities and Prices*, for items relating to or incorporated into the *Work*; plus

3.1.3 any adjustments, including any payments owing on account of *Changes* and agreed to *Extra Work*, approved in accordance with the provisions of the *Contract Documents*.

3.2 The *Contract Price* shall be the entire compensation owing to the *Contractor* for the *Work* and this compensation shall cover and include all profit and all costs of supervision, labour, material, equipment, overhead, financing, and all other costs and expenses whatsoever incurred in performing the *Work*.

ARTICLE 4 PAYMENT

4.1 Subject to applicable legislation and the provisions of the *Contract Documents*, the *Owner* shall make payments to the *Contractor*.

ARTICLE 5 RIGHTS AND REMEDIES

5.1 The duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law.

5.2 Except as specifically set out in the *Contract Documents*, no action or failure to act by the *Owner*, *Contract Administrator* or *Contractor* shall constitute a waiver of any of the parties' rights or duties afforded under the *Contract*, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach under the *Contract*.

ARTICLE 6 NOTICES

6.1 Communications among the *Owner*, the *Contract Administrator* and the *Contractor*, including all written notices required by the *Contract Documents*, may be delivered by hand, or by fax, or by pre-paid registered mail to the addresses as set out below:

The *Owner*: City of Courtenay
830 Cliffe Avenue,
Courtenay, B.C. V9N 2J7
Fax: 250-334-4241
Chris Davidson, P.Eng., Manager of Engineering

The *Contractor*: XXXX

The *Contract Administrator*:

Urban Systems Ltd.
290A England Avenue,
Courtenay, B.C. V9N 6L6
Eric Sears, P.Eng.

6.2 A communication or notice that is addressed as above shall be considered to have been received:

6.2.1 immediately upon delivery, if delivered by hand; or

6.2.2 immediately upon transmission if sent and received by fax; or

6.2.3 after 5 *Days* from date of posting if sent by registered mail.

6.3 The *Owner* or the *Contractor* may, at any time, change its address for notice by giving written notice to the other at the address then applicable. Similarly if the *Contract Administrator* changes its address for notice then the *Owner* will give or cause to be given written notice to the *Contractor*.

6.4 The sender of a notice by fax assumes all risk that the fax will be received properly, and the provisions of paragraph 12.5 of the Instructions to Tenderers apply to the sender.

ARTICLE 7 GENERAL

7.1 This *Contract* shall be construed according to the laws of British Columbia.

7.2 The *Contractor* shall not, without the express written consent of the *Owner*, assign this *Contract*, or any portion of this *Contract*.

7.3 The headings included in the *Contract Documents* are for convenience only and do not form part of this *Contract* and will not be used to interpret, define or limit the scope or intent of this *Contract* or any of the provisions of the *Contract Documents*.

7.4 A word in the *Contract Documents* in the singular includes the plural and, in each case, vice versa.

7.5 This agreement shall ensure to the benefit of and be binding upon the parties and their successors, executors, administrators and assigns.

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

Contractor:

XXXX

_____
(AUTHORIZED SIGNATORY)

_____
(AUTHORIZED SIGNATORY)

Owner:

CITY OF COURTENAY

_____
(AUTHORIZED SIGNATORY)

_____
(AUTHORIZED SIGNATORY)

Schedule 1

Schedule of Contract Documents

The following is an exact and complete list of the *Contract Documents*, as referred to in Article 2.1 of the Agreement.

NOTE: The documents noted with "*" are contained in the "Master Municipal Construction Documents - General Conditions, Specifications and Standard Detail Drawings", 2009 Platinum edition. All sections of this publication are included in the *Contract Documents*.

1 Agreement, including all Schedules;
2 General Conditions*;
3 Supplementary General Conditions;
4 Specifications*;
5 Supplementary Specifications;
6 City of Courtenay Standard Construction Supplementary Specifications;
6 Standard Detail Drawings*;
7 Supplementary Standard Detail Drawings;
8 Executed Form of Tender, including all Appendices;
9 *Contract Drawings* listed in Schedule 2 to the Agreement -"List of *Contract Drawings*";
10 Reference Documents;
11 Instructions To Tenderers - Part I;
12 Instructions to Tenderers - Part II*;
13 The following Addenda: _____

Schedule 2

List of Contract Detail Drawings

(Complete listing of all drawings, plans and sketches which are to form a part of this Contract, other than Standard Detail Drawings and Supplementary Standard Detail Drawings.)

TITLE	DRAWING NO.	DATE	REVISION DATE	REVISION NO.
Cover	C00	February 18, 2020		
Index	C01	February 18, 2020		
Legend	C02	February 18, 2020		
Sanitary Plan and Profile Station 1+000 to 1+200	C03	February 18, 2020		
Sanitary Plan and Profile Station 1+200 to 1+460	C04	February 18, 2020		
Sanitary Plan and Profile Station 1+460 to 1+600	C05	February 18, 2020		
Sanitary Plan and Profile Station 1+600 to 1+980	C06	February 18, 2020		
Sanitary Plan and Profile Station 1+980 to 2+360	C07	February 18, 2020		
Sanitary Plan and Profile Station 2+360 to 2+740	C08	February 18, 2020		
Sanitary Plan and Profile Station 2+740 to 3+120	C09	February 18, 2020		
Sanitary Plan and Profile Station 3+120 to 3+320	C10	February 18, 2020		
Sanitary Plan and Profile Station 3+320 to 3+460	C11	February 18, 2020		
Lift Station 1 – Site Plan	C12	February 18, 2020		
Lift Station 1 – Details	C13	February 18, 2020		
Sanitary Details	C14	February 18, 2020		

Miscellaneous Details	C15	February 18, 2020		
General Structural Notes	S1.1	February 18, 2020		
Structural Details	S3.1	February 18, 2020		
Electrical Notes and Legend	E01	February 18, 2020		
Electrical Site Plan	E02	February 18, 2020		
Electrical Details (1 of 3)	E03	February 18, 2020		
Electrical Details (2 of 3)	E04	February 18, 2020		
Electrical Details (3 of 3)	E05	February 18, 2020		
Kiosk (1 of 3)	E06	February 18, 2020		
Kiosk (2 of 3)	E07	February 18, 2020		
Kiosk (3 of 3)	E08	February 18, 2020		

SUPPLEMENTARY GENERAL CONDITIONS

(TO BE READ WITH "GENERAL CONDITIONS" CONTAINED IN THE 2009 PLATINUM EDITION OF THE PUBLICATION "MASTER MUNICIPAL CONSTRUCTION DOCUMENTS")

TABLE OF CONTENTS

Note: ‡ Indicates amendment recommended by MMCD Board

SUPPLEMENTARY GENERAL CONDITIONS

Contract: Greenwood Sewer Trunks

Reference No. Tender T20-11

DEFINITIONS **1**

Contract Administrator 1.21 ***(delete GC 1.21.1 and replace with the following)*** ‡

1.21.1 **"Contract Administrator"** means the person appointed by the *Owner* and identified by the *Owner* in writing to the *Contractor*. The *Contract Administrator* may be an officer of the *Owner*, a direct employee of the *Owner*, an officer or employee of the consultant who designed the *Work* for the *Owner*, or an independent consultant.

Deleted Items 1.30 Delete GC 1.30.1 ‡

DOCUMENTS **2**

Interpretation 2.2 ***(delete GC 2.2.4(1) and replace with the following)***

The *Contract Documents* shall govern and take precedence in the following order with the Agreement taking precedence over all other *Contract Documents*.

(a) Agreement
(b) Addenda
(c) Supplementary General Conditions
(d) General Conditions
(e) Supplementary Specifications
(f) City of Courtenay Standard Construction Supplementary Specifications
(g) Specifications
(h) Drawings listed in Schedule 2 of the Agreement
(i) Supplementary Detail Drawings
(j) Standard Detail Drawings
(k) Executed Form of Tender
(l) Instructions to Tenderers
(m) All other Contract Documents;

CONTRACT ADMINISTRATOR	**3**	
Contract Administration	3.3	***(delete GC 3.3.1 and replace with the following)*** 3.3.1 The *Contract Administrator* shall provide administration of the *Contract* as described in the *Contract Documents* during all *Work*, until the end of the *Maintenance Period*.
Inspection and Site Inspector	3.4	***(delete GC 3.4.5 and replace with the following)*** ‡ 3.4.5 If at any time and for any reason the *Contract Administrator* determines that inspection or testing of the *Work*, or portion of the *Work*, is required that was not called for in the *Contract Documents*, then the *Contract Administrator* may direct the *Contractor* to perform, or have performed, that inspection or testing, as provided in GC 4.12.6.
CONTRACTOR	**4**	
Safety	4.2	***(add new clause 4.2.2 as follows)*** 4.2.2 Further to GC 4.2.1, the *Contractor* shall demonstrate and maintain an active safety program, to the satisfaction of the *Owner*, for the duration of the *Contract*.
Protection of Work, Property and the Public	4.3	***(delete GC 4.3.1 and replace with the following)*** 4.3.1 In performing the *Work* the *Contractor* shall protect the *Work,* the *Owner's* property and all other person's property from damage. The *Contractor* shall, at the Contractor's own expense, make good any such damage and indemnify the *Owner* and their agents from any loss or expense which arises as a result of the *Contractor's* operations. The *Contractor* shall obtain and provide to the *Owner* written acceptance of any restored damage. ***(add new clause 4.3.7 as follows)*** 4.3.7 The *Contractor* shall locate, mark and protect from damage or disturbance, any and all stakes, survey pins, monuments and markers at the *Place of the Work.* All survey stakes, pins, monuments or markers which, in the opinion of the *Owner*, have been damaged or disturbed shall be made good following construction by a registered B.C. Land Surveyor at the *Contractor's* expense. ***(add new clause 4.3.8 as follows)*** 4.3.8 The *Contractor* shall make themself aware of the City of Courtenay archeological mapping. A copy of this mapping is available from the *Owner* directly. When working in areas of significance, as noted on the mapping, the *Contractor* shall exercise caution in his excavation so as to minimize disruption to any potential items of archeological significance. The *Contractor* shall, upon exposing any item of potential significance, immediately

suspend his operations and contact the *Contract Administrator.*

Construction Schedule 4.6

(delete GC 4.6.2 and replace with the following) ‡

4.6.2 The *Contractor* shall update the Baseline *Construction Schedule* monthly to produce an adjusted Baseline Schedule (the "Adjusted Baseline Schedule") that reflects any adjustments to the *Milestone Date(s)* or the *Contract Time* as provided by the *Contract Documents*, including without limitation if the *Contract Administrator* issues a *Change Order* or other *Contract Document(s)* which adjusts any *Milestone Date(s).* Each Adjusted Baseline Schedule will replace the previous *Baseline Construction Schedule*.

(delete GC 4.6.6 and replace with the following) ‡

4.6.6 The time for the performance of the *Work* shall commence on the date specified in the *Notice to Proceed*, or if not so specified, on the date the *Notice to Proceed* is issued. Subject to a contrary provision in the *Contract Documents*, the *Owner* shall issue the *Notice to Proceed* within 10 Days of receipt of the documentation required from the *Contractor* under paragraph 5.1.1 of the Form of Tender. Failure by the *Owner* to issue the *Notice to Proceed* within the 10 Days shall entitle the *Contractor* to a claim for delay under *GC* 13.1.1.

Superintendent 4.7

(delete GC 4.7.1 and replace with the following) ‡

4.7.1 The *Contractor* shall employ a competent senior representative at the *Place of the Work* (the "*Superintendent*") who shall have the responsibility to ensure that the *Work* is performed in compliance with the *Contract Documents*. Unless otherwise permitted in writing by the *Owner*, the *Superintendent* shall be the person whose experience was submitted in Appendix 3 of the Tender. The *Contractor* shall also employ necessary assistants for the *Superintendent* and the *Superintendent* and assistants shall be in attendance at the *Place of the Work* while *Work* is being performed.

Materials 4.9

(add new clause 4.9.3 as follows)

4.9.3 The *Contractor* will provide documentation to the *Contract Administrator* upon request which verifies that all materials and products comply with the City of Courtenay's Subdivision and Development Servicing Bylaw Approved Products List.

Subcontractors 4.11

(Delete GC 4.11.2 and replace with the following) ‡

4.11.2 The *Contractor* shall employ only the Subcontractors listed in Appendix 5 of the Form of Tender, or others as approved in writing by the *Owner*, and shall not change or employ additional Subcontractors without the approval of the *Owner*, which approval shall not be unreasonably withheld.

CHANGES **7**

Changes 7.1

(delete GC 7.1.3 and replace with the following) ‡

7.1.3 Additional work that the *Owner* may wish performed that

does not satisfy the requirements of subparagraphs (a) and (b) of *GC* 7.1.1(1) is *Extra Work* and not a *Change*. Pursuant to *GC* 8, *Extra Work* may be declined by the *Contractor* or may, upon agreement between the parties, be undertaken as *Extra Work*.

VALUATION OF CHANGES AND EXTRA WORK **9**

Quantity Variations 9.4 ***(delete GC 9.4.1 and replace with the following)*** ‡

9.4.1 If for any reason, including an addition or deletion under *GC* 7.1.1.(1) or *GC* 7.1.1.(2) respectively, the actual quantity of a unit price item varies by more than plus or minus the *Variance Threshold Percentage* from the estimated quantity for that unit price item as listed in the *Schedule of Quantities and Prices* (the "*Tender Quantity*") or as otherwise agreed to pursuant to these *Contract Documents*, then either the *Owner* or the *Contractor* may by written notice request the other party to agree to a revised unit price, considering the change in quantities. A party shall make a request for a revised unit price as soon as reasonably possible after the party concerned becomes aware of the quantity variation.

(delete GC 9.4.2 (2) and replace with the following) ‡

9.4.2 (2) If there is an overrun in the estimated quantity, *GC* 9.4.3 (2) shall apply to the overrun.

(delete clause 9.4.3(b))

FORCE ACCOUNT **10**

Force Account Costs 10.1 **(*delete GC 10.1.1(4) and replace with the following)*** ‡

10.1.1 (4) *Force Account Work Performed* by a *Subcontractor* shall be paid for in the lesser of: (i) the amount as provided by subparagraphs (1), (2) and (3) of this *GC*, plus a markup of 5%, or (ii) the actual amount the *Contractor* pays the *Subcontractor* including a markup of 10% on such actual cost to cover all overhead and profit.

HAZARDOUS MATERIALS **12**

Discovery of Hazardous Materials 12.2 ***(delete GC 12.2.2 and replace with the following)*** ‡

12.2.2 If the *Contract Administrator* observes any materials at the *Place of the Work* that the *Contract Administrator* knows or suspects may be *Hazardous Materials* then the *Contract Administrator* shall immediately give written notice to the *Contractor* and the *Contractor* shall immediately stop the *Work* or portion of the *Work* as required by *GC* 12.2.1 (1).

Note: ‡ Indicates amendment recommended by MMCD Board

DELAYS **13**

Liquidated Damages for Late Completion 13.9 ***(delete GC 13.9.1 and replace with the following)*** ‡

13.9.1 If the *Contractor* fails to meet the *Milestone Date* for *Substantial Performance* as set out in the Form of Tender, paragraph 2.2 as may be adjusted pursuant to the provisions of the *Contract Documents*, then the *Owner* may deduct from any monies owing to the *Contractor* for the *Work*:

(1) as a genuine pre-estimate of the *Owner*'s increased costs for the *Contract Administrator* and the *Owner's* own staff caused by such delay an amount of $2,000 per day or pro rata portion for each *Day* that actual *Substantial Performance* is achieved after the *Substantial Performance Milestone Date*; plus

(2) all direct out-of-pocket costs, such as costs for safety, security, or equipment rental, reasonably incurred by the *Owner* as a direct result of such delay.

If the monies owing to the *Contractor* are less than the total amount owing by the *Contractor* to the *Owner* under (1) and (2) then any shortfall shall immediately, upon written notice from the *Owner*, and upon *Substantial Performance*, be due and owing by the *Contractor* to the *Owner*.

DISPUTES **17**

Referee **17.5** ***(delete GC 17.5.2 (2) and replace with the following)*** ‡

(1) if the parties have not agreed upon a *Referee* within 3 Days of a submission of names by one party to the other as provided by *GC* 17.5.2 (1), then either party may request in writing the Master Municipal Construction Documents Association to appoint the *Referee*. The Association will have the authority to appoint a *Referee* without further consultation with the parties and the parties shall accept the Association's appointment. If for any reason the Association fails to appoint a *Referee* within 5 Days of the written request then such failure shall be deemed to be an agreement between the parties to omit a review of that *Dispute* by a *Referee* and a party may at the end of the 5 Days request a

Settlement Meeting and proceed with the remaining steps in the *Dispute* resolution process as described in this *GC*.

PAYMENT	**18**	
Supporting Documentation	18.2	***(delete GC 18.2.2 and replace with the following)*** ‡ 18.2.2 If requested in writing by the *Contract Administrator* the *Contractor* shall as a precondition to the issuance of the *Payment Certificate* provide a sworn declaration in a form acceptable to the *Contract Administrator*, that as of the date set out in the sworn declaration all amounts which have been incurred directly by the *Contractor* relating to the *Work* that are due and owing to third parties have been paid.
Holdbacks	18.4	***(delete GC 18.4.2 and replace with the following)*** ‡ 18.4.2 Defects and Deficiencies: In addition to other holdbacks as provided by the *Contract Documents*, when considering *Substantial Performance*, the *Owner* may hold back from payments otherwise due to the *Contractor* 200% of a reasonable estimate, as determined by the *Contract Administrator*, on account of deficient or defective *Work* already paid for. This holdback may be held, without interest, until all deficiencies or defects are remedied. The items of defect or deficiency and the amounts of related holdbacks shall be listed separately on the *Payment Certificate*. ***(add SGC 18.4.6 as follows)*** 18.4.6 At the time of *Substantial Performance* the *Contractor* is required to provide record drawing information that meets Section 01 33 01 – Project Record *Drawings*. Should the *Contractor* fail to provide the record drawing information, this will be taken to be a deficiency and the *Owner* may hold back $10,000 from payments otherwise due to the *Contractor*. This holdback may be held until record drawing information is submitted and approved by the *Contract Administrator*, and the conditions of SGC 18.4.2 are met.
Substantial Performance	18.6	***(delete GC 18.6.3 (1) and replace with the following)*** ‡ 18.6.3 (1) a sworn declaration in a form in accordance with SGC 18.2.2; and;
LAWS, NOTICES, PERMITS AND FEES	**20**	
Environmental Laws	20.4	***(add clause 20.4.2 as follows)*** 20.4.2 Further to GC 20.4.1, the *Contractor* shall engage a registered professional skilled and knowledgeable in the appropriate disciplines for production and updating of a Sediment and Erosion Control Plan throughout the duration of the *Contract*.
INSURANCE	**24**	
Required Insurance	24.1	**(*delete GC 24.1.1 (2) and replace with the following)*** ‡ 24.1.1 (2) Commercial General Bodily Injury and Property

Damage liability Insurance Limits: Bodily Injury and Property damage – inclusive $5,000,000. The insurance shall include *Contractor*'s Contingent Liability and Contractual Liability of sufficient scope to include the liability assumed by the *Contractor* under the terms of this *Contract*, and Completed Operations Liability. The policy shall include the *Owner* and the *Contract Administrator* as additional insured's with a cross liability clause. Any property damage deductible shall be for the account of the *Contractor* and shall not exceed $10,000.00 for any one occurrence.

(add GC 24.1.1 (5) as follows) ‡

24.1.1 (5) Boiler and machinery Insurance in the joint names of the *Contractor*, and the *Owner*. The policy shall include as insured's all Subcontractors. The coverage shall be maintained continuously from commencement of use or operation of the boiler and machinery objects insured by the policy and until 10 calendar days after *Substantial Performance*.

(delete GC 24.1.5 and replace with the following) ‡

24.1.5 All policies referred to in this *GC* shall provide that thirty (30) days notice of cancellation will be given in writing to each insured, including the *Owner*, otherwise the policies to remain in full force and effect until the *Work* has been completed. Notwithstanding the foregoing, the Commercial General Bodily Injury and Property Damage Liability insurance referred to in *GC* 24.1.1 (2) shall remain in full force and effect from the commencement of the performance of the *Work* for a period of not less than twelve (12) months following *Total Performance*, and with respect to completed operations coverage for a period of not less than 24 months following *Total Performance*.

(add clause 24.1.7 as follows)

24.1.7 The *Contractor* shall ensure the following are named as additional insured under this *Contract* :

- The City of Courtenay
- Urban Systems Ltd.

SCHEDULE 17.5.3 Letter Agreement with *Referee* ‡

Add following Schedule 17.5.3 to Supplementary General Conditions:

Schedule 17.5.3

Letter Agreement with *Referee*

(Name and Address of *Referee*)

Contract:

Reference No.

BETWEEN:

_____

_____

_____

(the "*Owner*")

AND:

_____

_____

_____

(the "*Contractor*")

We write to confirm your appointment as a *Referee* under the above *Contract*. The terms of your appointment are as contained in *GC* 17.5 of the *Contract Documents*. The parties specifically confirm *GC* 17.5.5, *GC* 17.5.13 and *GC* 17.5.14.

We confirm that you agree to review any Disputes in accordance with the *Contract Documents* that may be sent to you by either of the parties, and perform the functions of a *Referee* as described in the *Contract Documents*. The written *Dispute* and related materials, including a copy of the *Contract Documents*, shall be forwarded to you.

SUPPLEMENTARY SPECIFICATIONS

TABLE OF CONTENTS

ADDITIONAL SPECIFICATIONS TO BE ADDED AS COMPLETE SECTIONS

Division 1

SS 01 77 00	Closeout Procedures
SS 01 91 00	Commissioning
Division 26	Electrical and Controls
Division 33	Utilities
SS 33 01 00	Lift Station and Control Vault
SS 33 32 14	Prefabrication Submersible Sewage Lift Stations
Division 40	Process Mechanical
SS 40 05 01	Common Requirements for Process Piping Process Piping Systems
SS 40 05 07	Piping Supports and Seismic Bracing
SS 40 05 23.24	Stainless Steel Piping
SS 40 05 51	Common Requirements for Process Valves
SS 40 05 62	Plug Valves

SUPPLEMENTARY SPECIFICATIONS

The following Supplementary Specifications included in this section of the *Contract Documents* are modifications or additions to the Specifications in the Master Municipal Construction Document Volume II (Platinum Edition):

SS 01 42 00 Reference Specifications

1.1 Nomenclature

Delete reference 1.1.26 :‡

.26 NAAPI North American Association of Pipeline Inspectors

1.2 Referenced Specifications

Delete Referenced Specifications 1.2.15.1, .2, .5, .10 and .11‡

Add Referenced Specification:‡

1.2.18.36 CSA A3000 Cementitious Materials Compendium

SS 01 53 01 1.9 Payment

Delete section 1.9.1 and replace with the following:

.1 Payment for mobilization and demobilization includes all costs associated with mobilizing to, and demobilizing from the site, bonding and insurance costs, temporary facilities as described in this section, any temporary structures as required on the Contract Drawings, preparation of laydown areas and remediation of laydown and other areas disturbed by the Contractor. 50% of the lump sum will be paid upon mobilization to the site and 50% upon removal of heavy equipment, temporary facilities, and temporary structures from the site as determined by the Contract Administrator

SS 01 55 00 Traffic Control, Vehicle Access and Parking

1.0 General

Delete section 1.0.4 and 1.0.5 and replace with the following:

.4 Give minimum 5 days' notice or as otherwise directed by local bylaws to local police, fire departments, emergency services and municipal works authorities prior to beginning construction and comply in all respects to their requirements.

.5 Advise in writing all property owners and neighboring residences affected by access, service disruptions and specific construction disturbance 14 days and again at least 3 days prior to commencing the Work. The limits of the affected properties are to be confirmed with the Contract Administrator prior to issuing notices.

Add sections 1.0.6 as follows:

.6 Provide weekly written notices two weeks ahead of planned construction activities and schedule to Contract Administrator. Advertise on the radio a "Notice of Closure or Disruption", as directed by the Contract Administrator.

1.4 Traffic Control

Delete section 1.4.10.3 and replace with the following: ‡

.3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.

Add sections 1.4.14 to 1.4.16 as follows:

.14 Submit a traffic management plan to the Contract Administrator prior to the Pre-construction meeting. Content of the plan shall conform to the Ministry of Transportation TMP requirements set out in the Traffic Management Manual for Works on Roadways, 2019.

.15 The Traffic Management Plan for Anderton Road will be required to be approved by the Ministry of Transportation and Infrastructure, prior to performing any work within the Anderton Road Right of Way. Obtaining the approval will be the sole responsibility of the contractor. Content of the plan shall include but not be limited to:

- .1 Hours of work.
- .2 Work zone size, location, and staging through the course of construction including configuration during excavation, backfill, temporary restoration and permanent pavement restoration.
- .3 Access locations for equipment and materials to the work site.
- .4 Traffic control layout including placement of traffic control devices and persons.
- .5 Detour routes and signage
- .6 A public information plan outlining the process and schedule to notify the general public and affected property owners of scheduled work plans, traffic delays, disruptions, and road or lane closures.

.16 Maintain access for emergency vehicles through or around the Site at all times.

1.5 Payment

Delete section 1.5.1 and replace with the following:

.1 Payment will be a lump sum item and paid equally across the contract based on the Contractor's schedule

SS 01 57 01 Environmental Protection

1.0 General

Add section 1.0.3 as follows:

.3 Submit an Erosion and Sediment Control plan to the Contract Administrator prior to the Pre-construction meeting. Content of the plan shall include but not be limited to:

.1 Erosion and control risks
.2 Temporary drainage measures
.3 Locations and details of control measures and monitoring needs

1.2 Temporary Erosion and Sedimentation Controls

Delete section 1.2.2.2 and replace with the following: ‡

.2 Do not operate construction equipment in watercourses.

1.4 Environmental Protection

Add section 1.4.4 to 1.4.5 as follows:

.4 Work will take place on Beaver Meadow Farms property, which is certified as an organic farm. No backfill, embankment, or other materials of organic nature are to be brought onto site without approval from the property owner. Specific materials requiring approval shall include, but not be limited to:

.1 Road gravels and backfill material,
.2 Topsoil,
.3 Erosion and sediment control materials, and
.4 Seed mixtures.

Further to the above, there are specific materials that will <u>not</u> be allowed on site, including hay bales, or other grown construction materials that are not certified organic in nature.

.5 Prior to construction, Contractor to prepare and have approved a plan to ensure the certified organic farm requirements are met. This plan may include provisions to clean all trucks and equipment prior to entering the site.

1.6 Payment

Delete section 1.6.1 and replace with the following:

.1 Payment will be a lump sum item and paid equally across the contract based on the Contractor’s schedule.

Add section 1.9 as follows:

1.9 Construction Mitigation Measures

.1 Wildlife

.1 The majority of the proposed alignment is already cleared of vegetation. However, should any additional vegetation clearing be required, conduct clearing work during the period of September 1 to March 15 to avoid impacting birds during the general nesting season and to maintain compliance with the federal Migratory Birds Convention Act and provincial Wildlife Act. Should owls or raptors be present, clearing must occur prior to January. If land clearing during the nesting season cannot be avoided, a Qualified Environmental Professional (QEP) must first assess the area to ensure that birds and their nests will not be adversely impacted by land clearing activities.

.2 Avoid disturbing areas of pooled surface water in the event that they are utilized by amphibians. If these areas cannot be avoided, have a Qualified Environmental Professional (QEP) conduct a survey to determine if these areas are utilized by amphibians and determine a plan to avoid impacts.

.3 Retain as much vegetation and coarse woody debris within the project area as possible.

.4 If wildlife is observed during works, halt works until the individual leaves the area. Contact the Environmental Monitor for further direction.

.5 Maintain identified wildlife snag.

.2 Fish

.1 Conduct all instream works within the applicable reduced risk timing window for avoiding adverse impacts to fish, wildlife or the aquatic ecosystem of a stream in the Vancouver Island Region. There is a conflict of timing windows between pink salmon (May 15 to August 15) and cutthroat trout (August 15 to September 15). Instream works will only be completed within Ditch B and Ditch A where fish presence is unknown. As Ditch B has a barrier to fish passage and Ditch A is connected to an unnamed tributary with a known occurrence of cutthroat trout, works should be completed between August 15 and September 15 for Ditch A, the unnamed tributary, and Ditch B. Work beneath Ditch C should be conducted between May 15 and August 15.

.3 Water

.1 Do not pump sediment laden water into nearby waterbodies or allow dewatering to enter nearby waterbodies via overland transfer.

.2 Do not dump soil within waterbodies or allow soil or runoff to migrate into waterbodies.

.3 Have a spill response plan and materials in place prior to project initiation.

.4 Establish a staging area for fueling and maintenance of equipment away from waterbodies, and ensure all equipment is clean and leak-free prior to project initiation.

.5 Restrict the operation of heavy machinery to designated areas that are 30 m or more from surface water.

.4 Vegetation

.1 Conduct a weed inventory within the project area to determine weed species present and develop a weed control program as per Section 1.9.6 below.

.2 Maintain riparian vegetation; remove only what is required for the completion of works.

.3 Any land disturbances are to follow approved control and/or removal measures to prevent the spreading of weeds to other areas. Weeds that are found within the project area, including scotch broom, must be removed by physical methods including hand-pulling. Herbicide use is not permitted within the project area.

.4 Stockpile native topsoil (after removing weeds) from land disturbances and utilize for re-seeding whenever possible.

.5 Do not place excavated soil on native vegetation.

.6 Minimize the operation of heavy machinery to project footprint and designated areas to minimize the impact on surrounding areas.

.7 Revegetate cleared land as soon as possible to avoid noxious weeds from becoming established.

.8 Where appropriate, re-seed disturbed areas with native species (certified weed-free) to deter noxious weed invasion and capture overland flow during rain events or snowmelt.

.5 Erosion and Soil

.1 Implement erosion control measures (e.g. silt fencing) at edge of project where surface flows occur, or around surface waters and riparian habitats, prior to development.

.2 Do not use plant materials, including straw or hay bales, as a form of sediment control.

.3 Topsoil material must not be removed from the property.

.4 Sediment fences will be placed where required to minimize sediment transport. Fence stakes will be installed to a depth of 50 cm with stakes on the downslope side of the fence. The filter fabric of the fence will then be buried in a 150 mm by 150 mm trench.

.5 The EM will monitor the effectiveness of the Contractor's erosion and sediment control (ESC) measures. Sandbags, sediment fencing, and

other erosion and sediment control measures will be kept on-site during the construction period and used if needed. If additional erosion and sediment control measures are found to be required, contractor must immediately address.

.6 Delay construction during high precipitation events, if necessary.

.7 Erosion and sediment control measures will be inspected regularly during the construction period and removed upon completion of construction and when establishment of the re-seeding is to a point that the measures are no longer necessary.

.6 Weed Control Plan

.1 Prior to Construction

.1 The Contractor must develop and submit a detailed weed control plan for both the construction and operation phases of the project and provide the plan to the Contract Administrator for review and approval 14 days prior to project mobilization. The maintenance period will be two years, following total performance. Plan to include mechanical means for weed removal.

.2 The Contractor must submit a detailed maintenance schedule prior to the commencement of construction. List all daily, weekly and monthly maintenance services and tasks with approximate dates for completion. Review schedule with the Contract Administrator for approval.

.3 Weeds and/or invasive species to consider are any species listed in the 2014 update to the '*Field Guide to Noxious Weeds and other selected Invasive Plants of British Columbia'*, in addition to species deemed to be a noxious weed under the *Weed Control Regulation* of the *Weed Control Act of British Columbia*, and all other species not permitted on certified organic farmland.

.2 During Construction

.1 Ensure all equipment is clean and free of vegetative/plant material prior to project initiation.

.2 Ensure materials brought to site are weed free and from clean sources.

.3 Stockpile native topsoil (physically remove invasive species) from land disturbances and utilize for re-seeding whenever possible. Ensure stockpiled soil is covered to reduce limit weed establishment and wind/water erosion).

.4 Weeds that are found, including scotch broom, must be removed by physical methods including hand-pulling. Herbicide use is not permitted within the project area.

.5 Revegetate cleared land as soon as possible to avoid noxious weeds from becoming established.

.6 Optional weed control measure: solarizing. Use clear plastic sheets to cover stockpiled native topsoil to allow solar radiation to heat the soil and kill dormant weed seeds. Soil must be wetted prior to covering.

.3 Operations Phase

.1 During the two-year maintenance period, site meetings and inspections shall be conducted at minimum of once every 3 months between Contractor, the Contract Administrator, and the Owner. Contractor's workmanship and performance will be reviewed, and other landscape concerns or issues will be addressed and evaluated.

.2 A Maintenance Log book shall be maintained by the Contractor throughout the maintenance period, which shall be made available to the Owner or Contract Administrator in preparation for monthly site inspections and/or upon request.

.3 Inspections for growth of invasive and noxious plants should be ongoing with frequent maintenance clearing being conducted if they appear. Once the density of weeds reaches 10 broadleaf weeds or 50 annual weeds or weedy grasses per 40 m2, reduce the density of weeds to zero.

.4 Weeds that are found during the maintenance period, including scotch broom, must be removed by physical methods including hand-pulling. Herbicide use is not permitted within the project area.

.5 All weeds will be controlled prior to onset of flower or seed-set. Weeds will be disposed of at an appropriate waste disposal facility and not stored/ composted onsite.

.6 Areas disturbed from weed removal events must be reseeded, with certified weed-free seed mix, immediately to prevent the establishment of noxious weeds.

.7 The Contractor must submit written maintenance logs at the completion of each weed removal event on site. Provide information regarding target weed(s) and results. Include date, time, weather conditions, and name(s) of personnel.

.8 The Owner and / or Contract Administrator shall, at their direction, randomly conduct site inspections during the maintenance period to evaluate the quality and completion of work performed. Deficient work, noted by the Owner and / or Contract Administrator, shall be swiftly corrected by the Contractor.

.9 The Contractor shall be held responsible for any damages to the property, personal property of site employees, staff/visitors and

the properties of adjacent landowners resulting from the actions of the Contractor, the Contractor's employees, subcontractors or representatives who provide service under this contract.

.10 Maintenance shall be conducted for all areas disturbed during the construction of the works.

SS 31 05 17 Aggregates and Granular Materials

2.7 Granular Pipe Bedding and Surround Material

Delete section 2.7.1 and replace with the following: ‡

Percent Passing											
Sieve Designation		**Type 1***			**Type 2***			**Type 3***			
50.0	mm			100			100	100	-	100	
38.0	mm			100			100	90	-	100	
25.0	mm			100			100	20	-	60	
19.0	mm	90	-	100	90	-	100	0	-	15	
12.5	mm	65	-	85	70	-	100				
9.5	mm	50	-	75				0	-	5	
4.75	mm	25	-	50	40	-	70				
2.36	mm	10	-	35	25	-	52				
1.18	mm	6	-	26	15	-	38				
0.600	mm	3	-	17	6	-	27				
0.300	mm				3	-	20				
0.075	mm	0	-	5	0	-	8				

***Type 1:** *standard gradation*

***Type 2:** *to be used only in dry trench conditions and with Contract Administrator's approval*

***Type 3:** *minimum 40% Porosity*

Recycled concrete free from contaminated and other extraneous material, confirming to the Type 1 gradations, may be used as pipe bedding and surround material.

2.11 Recycled Aggregate Material

Add section 2.11.2 as follows:

.2 Aggregates containing recycled material will not be approved for use in base and sub-base gravels for this specific.

Add section 2.11.3 as follows:

.3 Virgin Materials: All aggregates and granular materials shall consist of entirely virgin materials.

2.13 Ministry of Transportation and Infrastructure Aggregates

Add Section 2.13 as follows:

2.13 For restoration of all road gravels at Anderton Road, “high fines surfacing aggregate” and “select granular sub-base aggregate” conforming to the following gradations is to be used:

Sieve Size mm	Percent Passing (%) Sieve Size	
	High Fines Surfacing Aggregate	Select Granular Sub-Base Aggregate
75	---	100
50	---	---
37.5	---	---
25	100	---
19	85-100	15-100
12.5	---	---
9.5	60-85	0-100
6.3	---	---
4.75	40-70	---
2.36	---	---
1.18	20-50	---
.600	---	0-100
.300	10-30	0-15
.075	5-15	0-5

SS 31 11 01 Clearing and Grubbing

1.4 Measurement and Payment

Delete section 1.4.2 and replace with the following:

.2 Payment for all clearing and grubbing items will be a lump sum for clearing and grubbing as required, and will be paid evenly across the contract based on the contractor’s schedule as required.

SS 31 11 41 Shrub and Tree Protection

3.0 Execution

Add section 3.1.7 to 3.1.11 as follows:

.7 Including other protection measures noted on the contract drawings

.8 Tree protection measures shall be carried out in accordance with the City of Courtenay Tree Protection Bylaw No. 2850

.9 The Root Protection Area and Tree Protection Barriers, for all trees to be retained within the project area, shall be established and constructed with the City Arborist’s approval prior to the start of any demolition or construction activities on-site.

.10 A City Arborist shall be on-site to observe all work that occurs within the Root Protection Area and to provide guidance and direction on tree protection measures to be carried out.

.11 Tree roots greater than 35mm diameter shall not be cut without review and approval of City Arborist.

SS 31 23 01 Excavating Trenching and Backfilling

1.7 Disposal

Delete section 1.7.1 and replace with the following:

.1 Dispose of all surplus spoil from excavations on-site and/or off-site. Suitability of excavated material for use as native bedding or trench backfill will be governed by 2.0 of this Section. Dumping of spoil on private property will be permitted only upon written approval from property owner and provided all necessary permits and approvals have been obtained.

2.2 Use of Specified Materials

Delete section 2.2.1.4 and replace with the following: ‡

.4 Recycled concrete and asphalt (RCA)

3.5 Backfill and Compaction

Delete section 3.5.4 and replace with the following:

.4 Compaction: place backfill and compact to following Standard Proctor Maximum Dry densities (SPMDD) in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).

.1 Boulevards and easements to minimum 98%.

.2 Roads, driveways, shoulders, re-shaped ditches and sidewalks to minimum 98%.

.3 Use caution in pipe zone to ensure no damage to pipe.

3.6 Surface Restoration

Delete section 3.6.2.2 and replace with the following:

.2 Restore unimproved and grassed surfaces with approved topsoil and sod as shown on Contract Drawings.

Delete section 3.6.2.4 and replace with the following:

.4 Restore lawns with minimum 100mm topsoil and sod to match existing lawn.

Delete section 3.6.3 and replace with the following:

.3 Gravelled roads and driveways:

.1 Restore surface as shown on Contract Drawings.

.2 Complete final restoration immediately upon completion of trench backfilling.

SS 31 24 13 Roadway Excavation, Embankment and Compaction

1.8 Measurement and Payment

Delete section 1.8.10 and replace with the following:

.10 Payment for removal and replacement of areas of unsuitable subgrade will include all remedial work, compaction, materials, disposal and requirements specified in this section. Payment will be based on field measurements by the Contract Administrator of the volume excavated prior to subgrade replacement. Replacement areas will be identified by either proof roll, compaction tests or as identified by geotechnical personnel. All identified areas to be approved by the Contract Administrator prior to removal.

2.2 Specified Materials

Add section 2.2.1.5 as follows: ‡

.5 Recycled concrete and asphalt (RCA)

3.3 Inspection of Native Surface

Delete section 3.3.1 and replace with the following:

.1 Prior to placing embankment fill, proof roll graded native surface using fully loaded single or dual axle dump truck. Contract Administrator may authorize use of other acceptable proof rolling equipment. Remove soft or other unstable material. Replace with approved embankment fill and compact replacement fill to minimum 98% Standard Proctor Maximum Dry Density in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).

3.5 Compaction

Delete section 3.5.2 and replace with the following:

.2 Compact to a density of not less than 98% Standard Proctor Maximum Dry Density.

SS 31 37 10 Riprap

2.1 Riprap

Delete Table in 2.1.1.1.1 and replace with the following: ‡

Percent Heavier Than	Percent Lighter Than	Mass (kg)	Equivalent Weight (N)	Equivalent Diameter (mm)
0	100			As specified
50	50			In
100	0			Contract Documents

SS 32 11 16.1 Granular Subbase

1.4 Measurement and Payment

Delete section 1.4.5 and replace with the following:

.5 Payment for removal of unsuitable subgrade including disposal off site will be made under Section 31 24 13 – Roadway Excavation, Embankment and Compaction.

3.3 Compaction

Delete section 3.3.2 and replace with the following:

.2 Compact to a density of not less than 98% Standard Proctor Maximum Dry Density.

SS 32 11 23 Granular Base

1.4 Measurement and Payment

Delete section 1.4.4 and replace with the following:

.4 Payment for removal of unsuitable subgrade including disposal off-site prior to direct placement of granular base will be made under section 31 24 13 - Roadway Excavation, Embankment and Compaction.

SS 32 12 16 Hot Mix and Warm Mix AC Paving

1.0 General

Delete section 1.0.1 and replace with the following: ‡

.1 Section 32 12 16 refers to those portions of the work that are unique to the supply and placement of hot-mix asphalt (HMA) and warm-mix asphalt (WMA) concrete paving. This section must be referred to and interpreted simultaneously with all other sections pertinent to the works described herein.

Add section 1.0.2 as follows: ‡

.2 WMA represents technologies which allow a reduction in the temperature at which asphalt mixtures are produced and placed. WMA technologies include those in which an additive is mixed with the asphalt cement or added to the mixture during production, and to plant foaming processes.

1.5 Measurement and Payment

Delete section 1.5.2.2 and replace with the following:

.2 if thickness is less than specified, Contract Administrator may calculate amount of asphaltic concrete deficiency and, for payment purpose, reduce the item amount in pro-rata accordingly.

Add section 1.5.2.3 as follows:

.3 if thickness is greater than specified, Contract Administrator may accept the work, if the excess thickness is acceptable, with no additional payment for the excess thickness.

Delete section 1.5.8 and replace with the following:

.8 Payment for permanent reinstatement of pavement includes all work under Section 31 23 01 – Excavating, Trenching and Backfilling – 3.6.7, Payment also includes all construction joint preparation, supply and placing of the asphaltic concrete, compaction, adjusting and cleaning frames, covers and lids of all castings affected, milling, tack coat, line painting, saw cutting and removal of existing asphalt as noted in the contract drawings, and all work required to restore concrete walks to match existing as per Section 03 30 20 – Concrete Walks, Curbs and Gutters. Payment for concrete curb and gutter and sidewalks will be made separately under Section 03 30 20 – Concrete Walks, Curbs and Gutters.

Thicknesses of pavements may be checked by Contract Administrator as per 1.5.2 of this section. If thickness varies from the thickness specified, Contract Administrator may follow the provisions of 1.5.2 of this section.

2.2 Mix Design

Delete sections 2.2.1 and 2.2.2 and replace with the following: ‡

.1 Submit job formula to Contract Administrator for review and approval. The mix design shall identify HMA or WMA. In addition to the regular information provided in the mix design the mix design for Warm Mix Asphalt shall include the following:

.1 WMA technology and/or WMA additives information.

.2 WMA technology manufacture’s established recommendations for usage.

.3 WMA technology manufacturer’s established target rate for water and additives, the acceptable variation for production, and documentation showing the impact of excessive production variation.

.4 Temperature range for mixing.

.5 Temperature range for compacting.

.6 Asphalt binder performance grade test data over the range of WMA additive percentages proposed for use.

Add section 2.2.4 as follows: ‡

.4 Modification of asphalt cement either using additives or by foaming shall be in accordance with the approved mix design of the WMA.

3.1 Plant and Mixing Requirements

Add section 3.1.1.9.4 as follows: ‡

.4 Use minimum 0.3% of anti-stripping agent, if Tensile Strength Ration (TSR) is less than 80%.

3.4 Transportation of Mix

Delete section 3.4.5 and replace with the following: ‡

.5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within specified range under the approved mix design.

SS 32 91 21 Topsoil and Finish Grading

2.3 Native Topsoil

Add Section 2.3.1.1 as follows:

.1 The Contractor shall submit a minimum of 5 growing medium samples taken from the native topsoil stockpiled on-site, demonstrating compliance with all applicable properties necessary to achieve the 'Groundcover Areas' application as outlined in Table 2 of Section 2.10. In the event the existing topsoil does not meet these requirements, soil amendment recommendations shall be submitted to the Contract Administrator for approval prior to placement.

SS 32 92 19 Hydraulic Seeding

2.1 Grass Seed

Add Section 2.1.6 as follows:

.6 Seed mixture to be a certified organic forage seed mixture, or approved equal, to satisfy organic farm requirements. Proposed seed mix (and associated application rates for seed, mulch, fertilizer and tackifier) to be reviewed and approved by Contract Administrator and Property Owner prior to procurement and installation. Under the circumstance that organic seed mixtures are not available, other mixtures may be approved by Beaver Meadows Farm.

2.2 Hydraulic Mulch

Add Section 2.2.4 as follows:

.4 Hydraulic mulch to be a certified organic mixture, or approved equal, to satisfy organic farm requirements. Under the circumstance that organic hydraulic mulch is not available, other hydraulic mulch may be approved by Beaver Meadows Farm.

2.4 Fertilizer

Add Section 2.4.2 as follows:

.2 Fertilizer is to be certified organic, or approved equal, to satisfy organic farm requirements.

3.8 Grass Maintenance

Delete Section 3.8.2.1

Add Section 3.8.3 as follows:

.3 As part of establishment maintenance, the Contractor shall provide temporary supplemental water for all seeded areas per approved methods and schedule provided within the Weed Control Plan

3.9 Conditions for Total Performance

Delete Section 3.9.5

3.10 Guarantee / Maintenance

Delete Section 3.10.1 and replace with the following:

.10 A two year guarantee period will apply for landscape work. Contractor to guarantee all materials and workmanship for a period of two full years from date of Total Performance, unless specified otherwise in Contract Documents.

SS 33 01 30.1 CCTV Inspection of Pipelines

1.3 Submission of Certification

Delete section 1.3.1 and replace with the following: ‡

.1 Submit copy of the CCTV operator's current NASSCO certification certificate to the Contract Administrator at least one week prior to the start of the CCTV inspection operations.

3.1 CCTV Inspection

Delete section 3.1.1 and replace with the following: ‡

.1 CCTV operator to be certified by NASSCO.

3.7 Photographs and/or Digital Images

Delete section 3.7.2.5 and replace with the following: ‡

.5 CSA condition defect code.

3.8 Inspection Reporting Hard Copies & Digital Format

Delete section 3.7.2.5 and replace with the following: ‡

.10 Provide PACP Database file complete with hyperlinked photos and video.

3.12 Coding Accuracy

Delete section 3.12.4 and replace with the following: ‡

.4 An operator failing to meet the accuracy requirements on two occasions will not be permitted to code on the remainder of the project until they have successfully passed the NASSCO Level of Qualification for CSA Operators.

SS 33 30 01 Sanitary Sewers

2.1 Concrete Pipe

Delete section 2.1.3.4 and replace with the following: ‡

.4 Lift insert opening not required to be grouted provided it does not extend beyond the depth of the engineered design.

3.12 Leakage Testing General

Delete section 3.12.3 and replace with the following:

.3 Leakage testing to include the low pressure air test. Perform all tests in presence of Contract Administrator and Owner between 08:00 and 17:00 h, Monday to Friday unless otherwise authorized. Notify Contract Administrator 72 hours in advance of proposed test.

3.20 Connections to Existing Mains

Delete section 3.20.2 and replace with the following:

.2 Make connections to existing sanitary sewer systems unless shown otherwise on Contract Drawings. Notify Contract Administrator minimum 72 h in advance of scheduled connection.

SS 33 34 01 Sewage Forcemains

1.8 Measurement and Payment

Delete section 1.8.2 and replace with the following:

.2 Payment for sanitary sewage forcemains includes saw cut pavement, trench excavation, disposal of surplus excavated material, supply and installation of all pipe, related materials, bolts, gaskets, tie-rods, restraints, thrust blocks, bedding, imported or native backfill as shown on Contract Drawings, cleaning and pressure and leakage testing, flushing, all surface restoration as specified under Section 31 23 01 – Excavating, Trenching, and Backfilling – 3.6, except permanent pavement restoration, and all other work and materials necessary to complete the installation as shown on Contract Drawings and as specified under this Section.

Measurement will be made along centreline of main, through valves and fittings, with no deduction for length of valves or fittings, over surface after work has been completed.

Delete section 1.8.6 and replace with the following:

.6 Payment for air release valve chamber shall include all materials, work and incidentals as shown on the Contract Drawings Details, including but not limited to piping, valving, manhole, frame and lid, air vent, backfill, and drain rock.

Add section 1.8.11 as follows:

11. Payment for forcemain pigging chamber shall include all materials, work and incidentals as shown on the Contract Drawing Details. Payment to include all piping and valving from the pigging chamber up to and including the mainline wye and thrust block.

SS 33 42 13 Pipe Culverts

1.5 Measurement and Payment

Add section 1.5.7 as follows:

.7 Payment for culvert tie-ins to existing or new culverts includes all the materials, work and components as shown on the Contract Drawings and appurtenances necessary to make the connection.

SS 33 44 01 Manholes & Catchbasins

1.4 Material Certification

Delete section 1.4.1 and replace with the following: ‡

.1 Products manufactured to ASTM Standards shall be marked with the applicable specification number. Compliance test results shall be provided at the request of the Contract Administrator.

1.5 Measurement and Payment

Delete section 1.5.1.2 and replace with the following: ‡

.2 Payment for manhole riser sections will be for risers of standard or non-standard heights required to complete manhole from specified invert to finishing level. Payment includes all manhole risers and necessary work as shown on the Standard Detail Drawings.

.1 For sump manhole, measurement will be made vertically for the length of risers required from the surface of base slab of the sump to the underside of the manhole lid.

.2 For benched manhole, measurement will be made vertically for the length of risers required from the lowest invert to the underside of the manhole lid.

.3 For precast manhole tee or riser built over existing mainline pipe, measurement will be made vertically from the crown of the mainline pipe at the downstream end to the underside of the lid.

Add section 1.5.7 as follows:

.7 Payment for manhole odour control features to include supply and installation of carbon filter, meter box with drain rock base, and all piping as per “Odour Control Manhole” Detail in the contract drawings.

Add section 1.5.8 as follows:

.8 Payment for manhole bypass pumping connection to include supply and installation of all piping, fittings and fasteners as noted in the contract drawings.

2.1 Materials

Add section 2.1.7.3 as follows: ‡

.3 Any frame and cover assembly creating a point load on the concrete riser rings will not be permitted.

Delete section 2.1.12 and replace with the following: ‡

.12 Catchbasin lids manufactured to ASTM C478M.

Delete section 2.1.13 and replace with the following:

.13 Cast iron catchbasin frame and grate shall be as shown on Contract Drawings.

Delete section 2.1.15.2 and replace with the following:

.2 Cement: to CSA A3000

Delete section 2.1.17 ‡

3.1 Excavation and Backfill

Add section 3.1.2 as follows: ‡

.2 For manholes, when base gravels are complete, excavate for grade rings and manhole frame assembly. Do not disturb the compacted road base beyond the excavation requirement.

3.3 Manhole Installation

Delete section 3.3.12.2 and replace with the following: ‡

.2 Allowable products are precast concrete risers, and cast-in-place form system. Individual riser height shall be 50 mm, 75 mm, or 100 mm.

Delete section 3.3.12.5 and replace with the following: ‡

.5 Proper layer of grout between the spacers, covering the entire surface of the rings, should be utilized.

Add section 3.3.17 as follows: ‡

.17 Ensure frames conform to design contour of pavement or existing surface. Use of shim and mortar will only be permitted outside of road pavement. One of the following means shall be used to set final grade for frame and cover within road pavement:

.1 Tapered pre-cast concrete, HDPE, or metal adjustment riser rings when use with conventional manhole frame and cover under Standard Detail Drawing S1; or

.2 Integrated height adjustable manhole frame and cover assembly. Any assembly creating a point load on the riser rings will not be permitted.

.3 After grade rings and manhole frame assembly has been installed and adjusted the remaining excavation must be filled to the top of road base or bottom lift of asphalt surface with 30mpa 10mm aggregate concrete or 19mm base gravel compacted to specification. Ensure specified asphalt thickness can be achieved.

Add section 3.3.19 as follows:

.19 Seal manholes riser joints and all adjustment rings with “Conseal” or approved equal.

THURBER ENGINEERING LTD.

GREENWOOD TRUNK SEWER
GEOTECHNICAL INVESTIGATION

Report

to

Urban Systems

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1. INTRODUCTION

This report has been prepared for the proposed development of the Greenwood Trunk Sewer in Courtenay, BC. The scope of the geotechnical services was outlined in Thurber's proposal letter dated June 15, 2018. Approval to proceed was provided by email by Urban Systems on June 24th, 2018.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. PROJECT UNDERSTANDING

We understand that the project involves the following scope:

• Construction of an approximately 3 km long parallel sanitary sewer main, comprising a gravity sewer and a forcemain, as well as two lift stations.

• Consideration of the effects of the sewer construction on the safety and stability of the large pond adjacent to the proposed alignment, including potential dam safety concerns.

3. SITE DESCRIPTION

The site is located in Courtenay, BC, and runs between Klanawa Crescent and Anderton Road. It is currently used as agricultural land, but a gravel access road has been constructed along most of the alignment. The topography is undulating, with the two lift stations located at the lowest points. An irrigation dam is located at the western end of the alignment, and the current design detours around the north side of the pond, before tying into the existing infrastructure on Klanawa Crescent. The proposed alignment is shown on Drawings 23229-1 and -2 in Appendix A.

4. GEOTECHNICAL INVESTIGATIONS

4.1 Previous Investigations by others

A number of auger boreholes were conducted on the adjacent site by McElhanney Consulting Services Ltd (drilled by Geopacific) in 2016, as part of a potential land development project. The relevant boreholes located within 50 m of the proposed alignment are shown on Drawings 23229-1 and -2 in Appendix A, and the test hole logs have been included in Appendix B.

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4.2 2018 Thurber Investigation

The field investigation consisted of drilling eight test holes (TH18-1 to TH18-8) at accessible locations along the alignment. The test holes were drilled by Blue Max Drilling Inc, of Courtenay, BC, using a track mounted auger rig.

Prior to conducting the field investigation, BC One Call was notified to identify utilities in the vicinity of the investigation area. In addition, Kelly's 1st Call Locators of Lantzville, BC. was used to scan for underground utilities at the proposed test hole locations.

Dynamic cone penetration tests (DCPT's) were conducted at all test locations. The DCPT involves driving a 60 mm diameter cone attached to AW drill rods with a 185 mm sleeve. The rod is driven under the energy of a 63.5 kg weight falling from a height of 760 mm and the number of blows required to advance the cone 305 mm into the ground is recorded and included on the test hole logs.

The soils were logged in the field by a Thurber representative and disturbed samples were obtained at selected depths from the augers for visual identification and moisture content determination. Undisturbed Shelby Tube samples of the soft clay were taken at select locations in the event that advanced laboratory testing was required. Soil samples obtained from the drilling investigation were returned to our Victoria Laboratory for routine visual identification (ASTM D2488) and moisture content (ASTM 4959) determination. Atterberg Limits (ASTM D4318) tests were conducted on selected samples from TH18-5 and -8 to evaluate their plasticity. Undisturbed tube samples were retrieved at selected depths from TH18-5 and -8 for possible laboratory consolidation testing (ASTM D2435) to characterize the compressibility of this material.

A 50 mm diameter standpipe piezometer was installed at locations TH18-5 and -8 to permit subsequent monitoring of groundwater levels. All other test holes were backfilled with drill cuttings and bentonite seals in accordance with BC Groundwater hole closure procedures. The results of the field and laboratory testing were used to compile test hole logs that are provided in Appendix A. The approximate locations of the test holes are shown on the attached Drawings 23229-1 and -2 also provided in Appendix A.

5. SUBSURFACE CONDITIONS

Subsurface conditions encountered along the alignment were variable. All recovered samples were subject to routine visual identification and moisture content analysis. In addition to this, select samples of the silty clay recovered from the shelby tubes were subject to Atterberg limits testing. The different material types encountered are discussed below.

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Granular Fill / Organic Material

Organic rich topsoil was encountered at TH18-5 and TH18-8. Fibrous woodchips (hogfuel) were encountered at TH18-8.

The road fill where encountered at the site was comprised of sand and gravel with minimal fines and was placed during construction of the access road prior to the investigation.

Marine Clay

A clay deposit was encountered on the western portion of the alignment, from TH18-4 to TH18-8. It is generally comprised of silty clay, with occasional lenses of sand and gravel, and trace shell fragments. The strength of the clay varies from stiff to very stiff in the upper desiccated zone to soft to firm. Pocket penetrometer and shear vane tests indicate undrained shear strengths in the order of 20 kPa to 35 kPa in some areas. Atterberg limits testing carried out three samples recovered in this unit indicated a consistent plastic limit off 17, liquid limits ranging from 35 to 44, and plasticity index ranging from 18 to 27. Moisture contents carried out on samples recovered in this material ranged from 30% to 46%. Based on the Atterberg Limits testing, the plasticity index ranges between 18 and 27 with an average of 22 indicating medium plasticity silty clay. The Atterberg Limits test results are summarized in Table 1 below and attached in Appendix A for reference.

TABLE 1
Summary of Atterberg Limit Testing

Test Hole ID	Sample Depth (m)	Plasticity Index	USC Classification
TH18-5	3.05	27	CL
	6.10	18	CL
TH18-8	4.57	22	CL

Silty Sand / Sandy Silt

Silty sand and sandy silt was encountered in TH18-4 (above the soft clay) and was compact to loose. Moisture contents carried out on samples recovered in this material ranged from 20% to 22%.

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Lower Granular Soils

A deposit of granular soil was encountered on the eastern portion of the alignment, from TH18-1 to TH18-3. It is comprised of fine to medium sand, with trace silt to some and is generally compact to very dense, with density increasing with depth. Moisture contents carried out on samples recovered in this material ranged from 4% to 8%, except at TH18-1 where moisture contents were 14% to 22%.

'Till like' material

A 'till-like' material was encountered at depth on the western portion of the alignment, from TH18-4 to TH18-8. It is generally comprised of a variable mix of sand, gravel and clay and is compact to very dense, with density increasing with depth. Moisture contents carried out on samples recovered in this material ranged from 11% to 17%.

Refusal

All test holes were advanced to their target depth (10 m for TH18-1, -5 and -8, and 6 m for TH18-2, -3, -4, -6, -7), without encountering auger refusal. DCPT refusal was encountered at variable depths along the alignment, ranging from 2.3 m to 9.8 m. Refusal typically occurred in dense sand or the 'till-like' material.

Groundwater

Groundwater was encountered at variable depths during the drilling investigation. Monitoring wells were installed at three locations, TH18-1, -5 and at -8. Table 2 below outlines the depth to groundwater during drilling and subsequent monitoring. It should be noted that drainage ditches were located near the borehole locations.

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TABLE 2
Groundwater Observations

		Depth to Groundwater (m)	
Test Hole	Hole depth (m)	During drilling	19-Sep-18
TH18-1	15.2	3.4	0.1
TH18-2	6.1	-	-
TH18-3	6.1	2.6	-
TH18-4	6.1	0.8	-
TH18-5	10.7	4	0.2
TH18-6	6.1	4.6	-
TH18-7	6.1	-	-
TH18-8	9.1	1.5	1.0

6. GEOTECHNICAL ASSESSMENT & RECOMMENDATIONS

6.1 Site Seismicity

The 2012 British Columbia Building Code specifies a design level earthquake with a 2% probability of exceedance in 50 years (corresponds to an average return period of 2,475 years). In accordance with the seismic hazard values for the 2015 National Building Code of Canada (NBC), the peak ground acceleration (PGA) at the site for the 2,475-year event is 0.31 g. The 2015 NBC Seismic Hazard Calculation output is attached in Appendix C for reference.

6.2 Potential for Liquefaction

Completion of liquefaction triggering analysis was beyond the scope of the current assessment. The soils encountered along the proposed trunk sewer alignment are generally non-liquefiable because the granular soils are typically compact to very dense and the stiff to soft, silty clay soils are not considered to be liquefiable. However, the upper granular fill soils and sand / silt deposit may become saturated and could potentially liquify or soften during a seismic event.

6.3 Lift Stations

6.3.1 Base Preparation

We understand that the construction of the two lift stations will require excavation down to approximately 10 m depth. For Lift Station 1 (located near TH18-1), very dense, sand is

anticipated to be encountered at design elevation. For Lift Station 2 (located near TH18-5), stiff to very stiff 'till-like' gravelly sandy clay will be encountered at design elevation. Based on shallow groundwater observations, seepage will be encountered during construction. The rate of seepage will depend on the permeability of the deposits. Provisions should be made for temporary dewatering and shoring of the excavation to allow construction to proceed. A layer of crushed gravel or drain rock should be placed on the base of the excavation to provide a working platform and to minimize disturbance of the bearing soils.

6.3.2 Foundation Design

Provided that the base is prepared as described above, the foundations can be designed for a serviceability limit state (SLS) bearing resistance of 200 kPa for less than 25 mm of settlement (actual settlements will likely be less than this, however a detailed settlement analysis has to be carried out if a refinement in the estimated settlement is required; this is not usually done as pump stations can usually tolerate this amount of settlement). For ultimate limit states (ULS) design, a bearing resistance of 300 kPa can be used.

Standard perimeter drains should be provided around any surface structures such as the kiosk and valve chamber. If perimeter drains are eliminated from around the valve chamber, the structure must be designed to resist potential uplift water pressures which can develop through surface water seepage/infiltration into the backfill soil and granular fill placed beneath the slab. It should be assumed that groundwater table is at the ground surface.

The locally excavated silty sand is too silty and likely excessively wet to be re-used as backfill around the pump station excavation. Backfill should consist of clean (< 5% passing 0.075 mm sieve) 75 mm minus crushed sandy gravel and should be placed in maximum 300 mm thick lifts and compacted to at least 95% of the Standard Proctor density in landscaped areas. If backfill is below footings or other surface features, then it should be compacted to at least 98% of Standard Proctor density.

6.3.3 Excavations

The proposed 10 m deep excavations will be very challenging given the soil conditions and the high groundwater table (near surface). It is recommended that the excavations be shored and that the Contractor be made responsible for the design and construction of all temporary shoring. The Contractor should be required to retain a qualified engineer for this purpose. Shoring design should be submitted to the owner for review by the owner's engineer.

6.4 Trench Excavations

We understand that the proposed design depth for the trench will be up to 3 m below ground level. Based on the test hole information, a range of materials will be encountered at this depth along the alignment, and shallow groundwater is likely to be encountered in some sections.

At the eastern portion of the site, very dense sand is anticipated to be encountered at the invert depth. In the area around TH18-4, compact to loose sand and silt is anticipated to be encountered. West of TH18-4, soft to firm marine clay is likely to be encountered. The sand, gravels and silt anticipated to be encountered within the depths of excavation should be sloped no steeper than 1H:1V. The soft marine clay should be sloped not steeper than 1.5H:1V. The cut slopes may need to be flattened or trench boxes may be required if groundwater seepage is encountered.

The following should be considered for the temporary excavation:

- Shoring should be used and would be subject to Part 20 of the Occupational Health and Safety Regulation. The contractor should be made responsible for all temporary excavations and shoring. He should be required to retain a qualified engineer for this purpose. Designs should be submitted to the owner for review by the owner's engineer.

- Either a shoring cage or other type of braced excavation could be used. With a shoring cage, it may be necessary to slope the upper portion of the slope to provide protection to workers.

Where practicable, excavation should be scheduled for the summer months to reduce the potential for significant seepage and groundwater control. The contractor should be responsible for all groundwater control required to allow the services to be installed in accordance with project requirements.

6.4.1 Trench Base Preparation and Backfill

If dry, granular soils are encountered at the invert elevation, they should be surface compacted with a heavy plate tamper prior to the placement of engineered fill material.

If soft / wet conditions are encountered at the base of the trench excavations, then the excavation should be taken down an additional 300 mm and backfilled with clean crushed gravel or drain rock topped with a layer of non-woven geotextile fabric (ie. Nilex 4545 or equivalent).

All bearing surfaces should be inspected by a qualified geotechnical engineer to confirm that the subgrade has been adequately prepared and is acceptable prior to placing engineered fill.

Provided the trench bottom is prepared as outlined above, backfill material should consist of predominantly imported fill materials consisting of 25 mm and 75 mm minus crushed gravel. Granular backfill should be clean (less than 5% passing the 0.075 mm sieve). All backfill materials should be compacted in lifts using vibratory equipment to at least 95% of the Modified Proctor Maximum Dry Density (MPMDD) as per Master Municipal Construction Document specifications for trench backfill. A maximum lift thickness of 300 mm is recommended, although thinner lifts may be required if small plate packers or jumping jack units are employed, particularly around the pipe zone.

6.4.2 Groundwater Control

Groundwater was encountered at or near the surface at the time of drilling and will likely be encountered during trench excavation. Where practicable, excavation should be scheduled for the summer months to reduce the potential for significant seepage and groundwater control. In granular soils, localised dewatering will likely be required.

The contractor should be responsible for all groundwater control required to allow the water main and sanitary sewer services to be installed in accordance with the project requirements.

6.5 Re-use of Excavated Soils

Locally excavated granular soils can be used as backfill. If this material is dry, water may need to be added to achieve compaction. Excavated silt and clay should not be used as backfill material and should be wasted.

6.6 Dam Stability Assessment

To evaluate the temporary construction impacts to the dam, a static slope stability assessment of the irrigation pond was completed using the limit equilibrium analysis software Slope/W. The 2D model incorporated an assumed interior zonation of the dam as shown on the drawing provided by the Dam Safety Officer. The subsurface soil profile encountered downstream of the dam at TH18-8 was assumed to be generally representative of the foundation conditions under the dam (minus the hog fuel fill). We assumed that locally sourced granular fill was used to backfill below the base of the dam after removing the hog fuel.

It should be noted that the method outlined below is not intended to provide a comprehensive evaluation of the safety of the existing dam. The performance of the dam under flood or seismic loading conditions was not evaluated. The property owner must be informed about the potential implications of allowing the construction of important infrastructure downstream of the dam across

his property. This could impact the downstream consequence classification rating of the facility, and the regulatory implications of this are borne solely by the dam/property owner.

A limit equilibrium stability analysis was run to check the static factor of safety (FS) for the embankment under “normal” full supply conditions (about 1.2 m below top). This FS value is somewhat arbitrary since we don’t know the exact materials and methods used to construct the dam. We then assumed a temporary excavation geometry using a 2.3 m trench depth and 1H:1V side slopes for the trunk sewer installation at the location of TH18-8, approximately 11 m downstream of the dam. This resulted in a moderate reduction in the FS. We then moved the excavation further away from the dam until there was no appreciable effect (ie. the FS was the same as for a no trench excavation). To check the sensitivity of silty clay within the dam under drained and undrained conditions, the undrained shear strength (undrained condition) was adjusted until the FS approximated the FS under drained conditions (friction angle, no cohesion)

Table 3 below provides a summary of the soil parameters used in the analysis. Figure 1 in Appendix D shows the geometry used for the analysis.

TABLE 3
Summary of Soil Parameters Used in Stability Analysis

Soil Type	Unit Weight (kN/m^3)	Undrained		Drained	
		Friction Angle (°)	Cohesion (kPa)	Friction Angle (°)	Cohesion (kPa)
Core	18	-	40	28	0
Shell	19	34	-	34	0
Granular Fill	19	33	-	33	0
Firm, grey, silty Clay	19	-	40	30	0
Dense, clayey, Silt (Till)	20	34	-	34	0
Peat	10	28	-	28	0

Table 4 below provides a summary of the factor of safety, the slope section analyzed through TH18-8.

TABLE 4
Summary of Slope Stability Analysis

Trench	Distance from Pond Slope (m)	Static FS (Drained)
No trench	-	1.84
Trench	11	1.80
Trench	20	1.84

Based on the results of the slope stability analysis, we recommend that the temporary trench excavation for the sewer trunk main be located at least 20 m from the toe of the dam.

6.7 Construction Issues

Based on the stability assessment outlined above, a trench excavation located at least 20 m from the toe of the embankment dam will not affect the FS. However, the trench excavation in peat could result in creep (reduced stress levels after excavation) and potential settlement / sloughing.

Based on test hole stratigraphy, it is likely that the trench excavation will be within the peat deposit and possibly extend into the underlying firm to soft grey clay. The confining stress levels are generally reduced after excavating into these soils causing them to swell and creep after being disturbed. It will be important to try to return the excavation to similar conditions that were present before the excavation. We recommend that only sections that can be backfilled the same day be undertaken. The time the trench remains open should be minimized by backfilling with engineered fill as soon as possible and to reduce the potential magnitude of sloughing and settlement that could occur along the trench alignment. Localized dewatering and shoring will likely be required to control groundwater flows and maintain a safe working environment. Due to the condition of the soils exposed along the trench, there could be localized sloughing between the trench wall and the outside of the shoring.

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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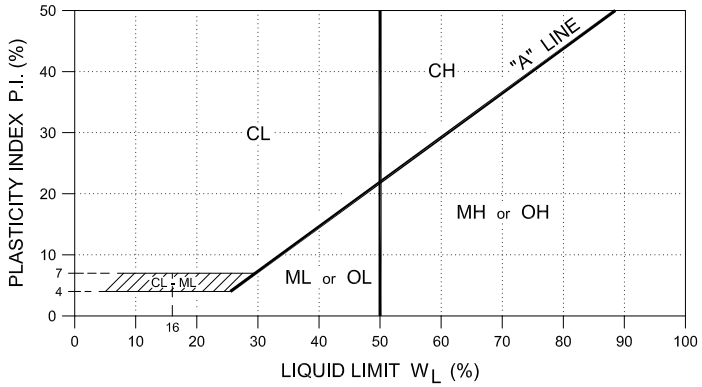
UNIFIED CLASSIFICATION SYSTEM FOR SOILS (ASTM D2487)

MAJOR DIVISION			SYMBOLS GROUP	SYMBOLS GRAPH	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS (MORE THAN 50% BY WEIGHT RETAINED ON No. 200 SIEVE)	GRAVELS MORE THAN 50% COARSE FRACTION RETAINED ON No. 4 SIEVE	CLEAN GRAVELS (< 5% FINES)	GW		WELL GRADED GRAVEL and WELL GRADED GRAVEL with SAND.	$C_U = \frac{D_{60}}{D_{10}} \geq 4 \quad C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			GP		POORLY GRADED GRAVEL and POORLY GRADED GRAVEL with SAND.	NOT MEETING ABOVE REQUIREMENTS
		GRAVELS WITH FINES (> 12% FINES)	GM		SILTY GRAVEL, GRAVEL - SAND - SILT MIXTURES.	FINES CLASSIFY AS ML or MH (3)
			GC		CLAYEY GRAVEL, GRAVEL - SAND - CLAY MIXTURES.	FINES CLASSIFY AS CL or CH (3)
	SANDS MORE THAN 50% COARSE FRACTION PASSES No. 4 SIEVE	CLEAN SANDS (< 5% FINES)	SW		WELL GRADED SAND and WELL GRADED SAND with GRAVEL	$C_U = \frac{D_{60}}{D_{10}} \geq 6 \quad C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			SP		POORLY GRADED SAND and POORLY GRADED SAND with GRAVEL.	NOT MEETING ABOVE REQUIREMENTS
		SANDS WITH FINES (> 12% FINES)	SM		SILTY SAND, SAND - SILT MIXTURES.	FINES CLASSIFY AS ML or MH (3)
			SC		CLAYEY SAND, SAND - CLAY MIXTURES.	FINES CLASSIFY AS CL or CH (3)
FINE-GRAINED SOILS (MORE THAN 50% BY WEIGHT PASSES No. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML		INORGANIC SILTS, SILTS with SAND and SILTS with GRAVEL and SANDY or GRAVELLY SILTS.	P.I. < 4 or PLOTS BELOW THE "A" LINE
		W_L > 50%	MH		INORGANIC SILTS, SILTS with SAND & SILTS with GRAVEL & SANDY or GRAVELLY SILTS, FINE SANDY or SILTY SOILS.	P.I. PLOTS BELOW THE "A" LINE
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	CL		INORGANIC CLAYS of LOW PLASTICITY, GRAVELLY, SANDY, or SILTY CLAYS, LEAN CLAYS.	P.I. > 7 and PLOTS ON OR ABOVE THE "A" LINE
		W_L near 50%	CL-CH		BORDERLINE INORGANIC CLAYS and SILTY CLAYS with LIQUID LIMITS NEAR 50%.	(only used for visual identification)
		W_L > 50%	CH		INORGANIC CLAYS of HIGH PLASTICITY, FAT CLAYS.	P.I. PLOTS ON OR ABOVE THE "A" LINE
	ORGANIC SILTS and CLAYS	W_L < 50%	OL		ORGANIC SILTS and ORGANIC SILTY CLAYS of LOW PLASTICITY.	$\frac{W_L \text{ (oven dried)}}{W_L \text{ (not dried)}} < 0.75$
		W_L > 50%	OH		ORGANIC CLAYS OF HIGH PLASTICITY.	$\frac{W_L \text{ (oven dried)}}{W_L \text{ (not dried)}} < 0.75$
HIGHLY ORGANIC SOILS			PT		PEAT and other HIGHLY ORGANIC SOILS.	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE.

PLASTICITY CHART FOR SOILS PASSING No. 40 SIEVE



NOTES:

1. ALL SIEVE SIZES ARE U.S. STANDARD, A.S.T.M. E11-04.
2. COARSE GRAINED SOILS WITH 5 TO 12% FINES REQUIRE DUAL SYMBOLS (GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC).
3. IF FINES CLASSIFY CL-ML USE DUAL SYMBOL (GC-GM or SC-SM).
4. WHERE TESTING IS NOT CARRIED OUT, THE IDENTIFICATIONS ARE DETERMINED BY VISUAL-MANUAL PROCEDURES DESCRIBED IN ASTM D2488-06.

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SYMBOLS AND TERMS USED ON TEST LOGS

1. PARTICLE SIZE CLASSIFICATION OF MINERAL SOILS

DESCRIPTION		APPARENT PARTICLE SIZE
BOULDERS		> 200 mm
COBBLES		75 mm to 200 mm
GRAVEL	coarse	19 mm to 75 mm
	fine	4.75 mm to 19 mm
SAND	coarse	2 mm to 4.75 mm
	medium	0.475 mm to 2 mm
	fine	0.075 mm to 0.475 mm
SILT		Non-plastic particles, not visible to the naked eye
CLAY		Plastic particles, not visible to the naked eye

NOTE: Metric Conversion is approximate only

2. TERMS DESCRIBING CONSISTENCY (Cohesive Soils Only)

DESCRIPTION	APPROXIMATE UNDRAINED SHEAR STRENGTH
Very Soft	Less than 10 kPa (250 psf)
Soft	10 to 25 kPa (250 - 500 psf)
Firm	25 to 50 kPa (500 - 1000 psf)
Stiff	50 to 100 kPa (1000 - 2000 psf)
Very Stiff	100 to 200 kPa (2000 - 4000 psf)
Hard	Greater than 200 kPa (4000 psf)

NOTE: Metric Conversion is approximate only

3. TERMS DESCRIBING DENSITY (Cohesionless Soils Only)

DESCRIPTION	STANDARD PENETRATION TEST Number of blows per foot (300 mm) *
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

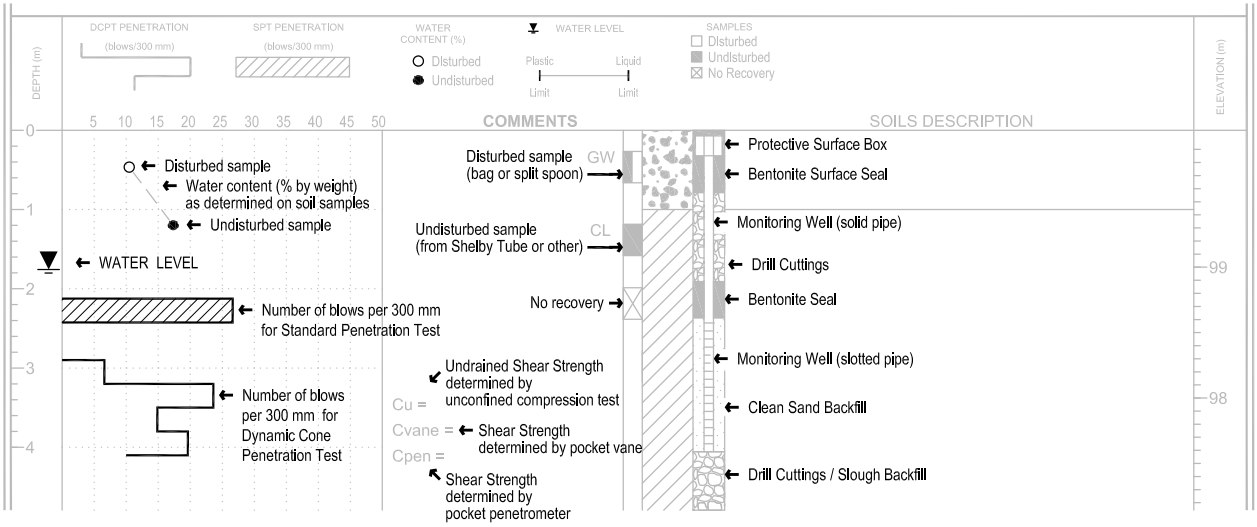
** Directly applicable to sands and, with interpretation, to gravels*

4. PROPORTION OF MINOR COMPONENTS BY WEIGHT

DESCRIPTION	PERCENT BY WEIGHT
and	35 to 50 %
y / ey	20 to 35 %
some	10 to 20 %
trace	less than 10 %

EXAMPLE: Silty SAND, trace of gravel = Sand with 20 to 35% silt and up to 10% gravel, by dry weight. (Percentages of secondary materials are estimates based on visual and tactile assessment of samples).

5. LEGEND FOR TEST HOLE LOGS *(Typical only showing commonly included elements)*



Client: TEL Standard Detail
File No.: n/a
E-File: UCSFS-20140807.dwg

Revised: August 07, 2014

DRAWING 23229-2 MATCHLINE

NOTES:

1. Test Holes were located by hand-held GPS unit; locations are approximate only.
2. Digital base plans provided by Urban Systems Ltd.
3. Aerial images provided by the City of Courtenay.

0 25 50 75 100 150 200 m

SCALE 1:3000

THURBER ENGINEERING LTD.

URBAN SYSTEMS

TEST HOLE LOCATION PLAN

GREENWOOD SEWER TRUNK GEOTECHNICAL INVESTIGATION **(Sheet 1 of 2)** COURTENAY, B.C.

DESIGNED	DRAWN	APPROVED	DATE	SCALE	PROJECT No.	DWG. NO.	REV.
SWS	RRS	BRW.	NOVEMBER 15, 2018	1:3000	23229 - 1		-

Plotted: November 15, 2018

DRAWING 23229-1 MATCHLINE

NORTH

ANDERTON ROAD

2018 TEST HOLE

TH18-4

TH18-3

TH18-2

2018 TEST HOLE
(with monitoring well installed)

TH18-1

BH16-23

BH16-22

BH16-25

BH16-21

BH16-13

BH16-34

BH16-33

BH16-32

BH16-20

BH16-02

BH16-01

2016 BORE HOLE
(by Geopacific)

NOTES:

1. Test Holes were located by hand-held GPS unit; locations are approximate only.
2. Digital base plans provided by Urban Systems Ltd.
3. Aerial images provided by the City of Courtenay.

0 25 50 75 100 150 200 m

SCALE 1:3000

THURBER ENGINEERING LTD.

URBAN SYSTEMS

TEST HOLE LOCATION PLAN

GREENWOOD SEWER TRUNK
GEOTECHNICAL INVESTIGATION

(Sheet 2 of 2)

COURTENAY, B.C.

DESIGNED	DRAWN	APPROVED	DATE	SCALE	PROJECT No.	DWG. NO.	REV.
SWS	RRS	BRW.	NOVEMBER 15, 2018	1:3000	23229 - 2		-

23229-CAD002.dwg

Sheet 1 of 2

LOG OF TEST HOLE

TEST HOLE NO. **TH18-1**

LOCATION: See Drawing 23229-1
N 5509192 E 360600 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 30.4 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 12-Sep-2018

FILE NO.: 23229

DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: Disturbed, Undisturbed, No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve, △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): GASTECH reading, PID reading

ELEVATION (m) | 10 20 30 40 50 60 70 80 90 100 | DEPTH (m)

ELEVATION (m)	COMMENTS		SOILS DESCRIPTION	DEPTH (m)
30	Water Level (18-Sep-2018) DCPT driven 1 m SE of TH18-1.	CL	Very dense, moist, mottled grey-brown, sandy, gravelly CLAY (till-like); gravel to 75 mm diameter	0
29				1
28		SM	Very dense, moist, grey-brown, silty SAND (till-like); trace to some gravel to 75 mm diameter	2
27	60 blows / 280 mm penetration. Water Level (12-Sep-2018) Drill out to 3.7 m depth and re-start DCPT.	SM	Dense to very dense, wet, silty SAND	3
26				4
25	No samples obtained below 4.6 m depth due to sample heave into hole (suspected artesian pressure).		Advance augers in SAND (inferred).	5
24	End DCPT at 5.8 m depth.			6
23				7
22				8
21				9
				10

Sheet 2 of 2

LOG OF TEST HOLE

TEST HOLE NO. **TH18-1**

LOCATION: See Drawing 23229-1
N 5509192 E 360600 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 30.4 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 12-Sep-2018

FILE NO.: 23229

ELEVATION (m) | DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ✱ GASTECH reading ⊠ PID reading | DEPTH (m)

10 20 30 40 50 60 70 80 90 100

COMMENTS

SOILS DESCRIPTION

ELEVATION (m)	DEPTH (m)	SOILS DESCRIPTION
20	10	Advance augers in SAND (inferred).
19	11	
18	12	
17	13	
16	14	
15	15	
15	15	End of Auger Hole at 15.2 m depth. Water encountered at 3.4 m depth while drilling. Upon completion of drilling: 50 mm diameter piezometer installed.
14	16	
13	17	
12	18	
11	19	
	20	

LOG OF TEST HOLE R RRS_23229_GREENWOOD SEWER TRUNK_2018 TEST HOLE LOGS.GPJ THURBER BC.GDT 15/11/18- THURBER VICTORIA FEBRUARY 2012 REVERSE.GLB

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. **TH18-2**

LOCATION: See Drawing 23229-1
N 5509216 E 360370 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 38.7 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 12-Sep-2018

FILE NO.: 23229

ELEVATION (m) | DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: Disturbed, Undisturbed, No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve, △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ✱ GASTECH reading, ⊠ PID reading | DEPTH (m)

10 20 30 40 50 60 70 80 90 100

COMMENTS	SOILS DESCRIPTION
	Moist, brown, sandy GRAVEL (Road Base FILL); gravel to 25 mm diameter
SP Start DCPT at 0.9 m depth.	Compact, moist, brown SAND; trace silt; trace organics
SP 60 blows / 200 mm penetration. DCPT Refusal at 2.3 m depth.	Compact becoming very dense, moist, brown, fine grained SAND; trace silt
SP	
SP	
	End of Auger Hole at 6.1 m depth. No water encountered while drilling. Upon completion of drilling: Hole backfilled with cuttings to surface.

38 37 36 35 34 33 32 31 30 29

0 1 2 3 4 5 6 7 8 9 10

LOG OF TEST HOLE R RRS_23229_GREENWOOD SEWER TRUNK_2018 TEST HOLE LOGS.GPJ THURBER BC.GDT 15/11/18- THURBER VICTORIA FEBRUARY 2012 REVERSE.GLB

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. **TH18-3**

LOCATION: See Drawing 23229-1
N 5509235 E 359996 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 39.5 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 13-Sep-2018

FILE NO.: 23229

DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: Disturbed, Undisturbed, No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve, △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): GASTECH reading, PID reading

ELEVATION (m) | 10 20 30 40 50 60 70 80 90 100 | DEPTH (m)

ELEVATION (m)	COMMENTS	SOILS DESCRIPTION	DEPTH (m)
39		Moist, brown, sandy GRAVEL (Road Base FILL); gravel to 20 mm diameter	0
	SP-SM Start DCPT at 0.9 m depth.	Moist, reddish-brown SAND and GRAVEL (FILL); gravel to 50 mm diameter	1
38		Moist, brown, medium to fine grained SAND; trace to some fibrous organics	
		Compact to very dense, moist becoming wet, grey-brown, silty SAND; medium to fine grained	2
37	SM Water Level (13-Sep-2018)		3
	SM		
36			4
	SM 60 blows / 200 mm penetration. DCPT Refusal at 3.9 m depth.		
35			5
34	SM		6
33		End of Auger Hole at 6.1 m depth. Water encountered at 2.6 m depth while drilling. Upon completion of drilling: Hole backfilled with cuttings to surface.	7
32			8
31			9
30			10

LOG OF TEST HOLE R RRS_23229_GREENWOOD SEWER TRUNK_2018 TEST HOLE LOGS.GPJ THURBER BC.GDT 15/11/18- THURBER VICTORIA FEBRUARY 2012 REVERSE.GLB

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. **TH18-4**

LOCATION: See Drawing 23229-1
N 5509252 E 359718 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 35.9 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 13-Sep-2018

FILE NO.: 23229

ELEVATION (m) | DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: Disturbed, Undisturbed, No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve, △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ✱ GASTECH reading, ⊡ PID reading | DEPTH (m)

10 20 30 40 50 60 70 80 90 100

ELEVATION (m)	DEPTH (m)	COMMENTS		SOILS DESCRIPTION
	0			Moist, brown, sandy GRAVEL (Road Base FILL)
35	1	Water Level (13-Sep-2018)	SM/ML	Moist, brown SAND and GRAVEL (FILL); trace silt; gravel to 75 mm diameter; contains cobbles
34	2		SM	Moist becoming wet, medium to fine grained SAND and SILT
33	3	Start DCPT at 3.4 m depth.		
32	4		SM/ML	
			SM	
31	5			Soft, wet, grey, silty CLAY; low plasticity; trace sand and shell fragments
30	6		CL	
29	7	30 blows / 100 mm penetration. DCPT Refusal at 6.2 m depth.		End of Auger Hole at 6.1 m depth. Water encountered at 0.8 m depth while drilling. Upon completion of drilling: Hole backfilled with cuttings to surface.
28	8			
27	9			
26	10			

LOG OF TEST HOLE R RRS_23229_GREENWOOD SEWER TRUNK_2018 TEST HOLE LOGS.GPJ THURBER BC.GDT 15/11/18- THURBER VICTORIA FEBRUARY 2012 REVERSE.GLB

Sheet 1 of 2

LOG OF TEST HOLE

TEST HOLE NO. **TH18-5**

LOCATION: See Drawing 23229-1
N 5509263 E 359349 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 33.4 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

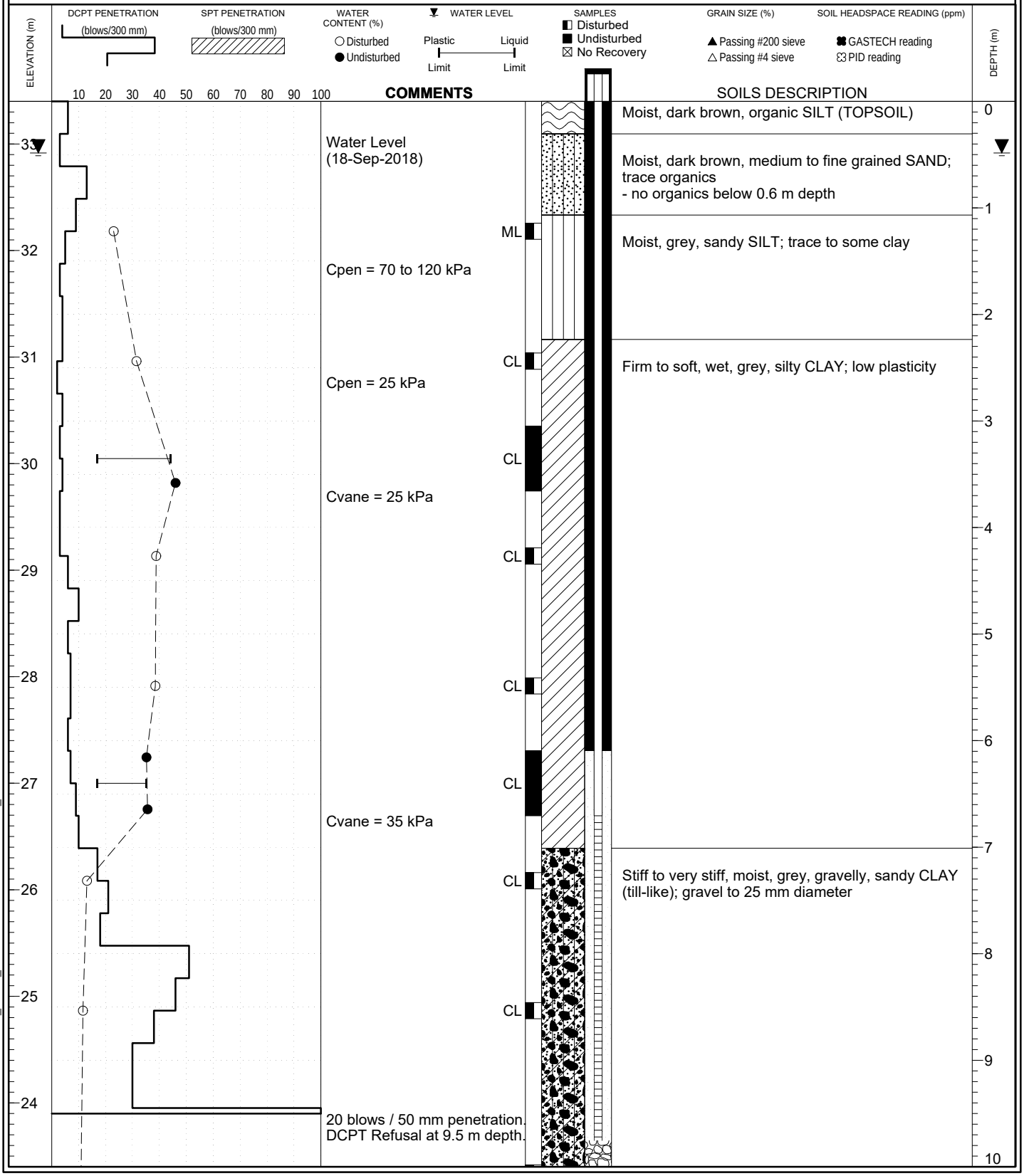
THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 13-Sep-2018

FILE NO.: 23229



LOG OF TEST HOLE

TEST HOLE NO. **TH18-5**

LOCATION: See Drawing 23229-1
N 5509263 E 359349 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 33.4 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 13-Sep-2018

FILE NO.: 23229

ELEVATION (m) | DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ✱ GASTECH reading ⊠ PID reading | DEPTH (m)

10 20 30 40 50 60 70 80 90 100

ELEVATION (m)	COMMENTS		SOILS DESCRIPTION	DEPTH (m)
23		SC	Stiff to very stiff, moist, grey, gravelly, sandy CLAY (till-like); gravel to 25 mm diameter	10
22			End of Auger Hole at 10.7 m depth. Wet conditions encountered at 4.0 m depth while drilling. Upon completion of drilling: 50 mm diameter piezometer installed.	11
21				12
20				13
19				14
18				15
17				16
16				17
15				18
14				19
				20

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. **TH18-6**

LOCATION: See Drawing 23229-1
N 5509288 E 359077 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 34.8 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 14-Sep-2018

FILE NO.: 23229

ELEVATION (m) | DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%) ○ Disturbed ● Undisturbed | WATER LEVEL Plastic Limit Liquid Limit | SAMPLES ◧ Disturbed ■ Undisturbed ☒ No Recovery | GRAIN SIZE (%) ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm) ✱ GASTECH reading ⊠ PID reading | DEPTH (m)

10 20 30 40 50 60 70 80 90 100

COMMENTS		SOILS DESCRIPTION	DEPTH (m)
		Moist, brown SAND and GRAVEL (Road Base FILL); gravel to 40 mm diameter	0
Start DCPT at 1.2 m depth. Cpen = 70 to 120 kPa	CL	Stiff becoming firm, moist, grey, silty CLAY; low plasticity; trace fine sand	1
	CL		2
			3
10 blows / 25 mm penetration. DCPT Refusal at 9.5 m depth.	SM	Very dense, moist, grey, clayey, silty SAND (till-like); trace to some gravel to 50 mm diameter	4
		- becomes wet at 4.6 m depth	5
	SM		6
		End of Auger Hole at 6.1 m depth. Water seepage encountered at 4.6 m depth while drilling. Upon completion of drilling: Hole backfilled with cuttings to surface.	7
			8
			9
			10

34 33 32 31 30 29 28 27 26 25

LOG OF TEST HOLE R RRS_23229_GREENWOOD SEWER TRUNK_2018 TEST HOLE LOGS.GPJ THURBER BC.GDT 15/11/18- THURBER VICTORIA FEBRUARY 2012 REVERSE.GLB

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. TH18-7

LOCATION: See Drawing 23229-1
N 5509403 E 358601 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 35.9 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

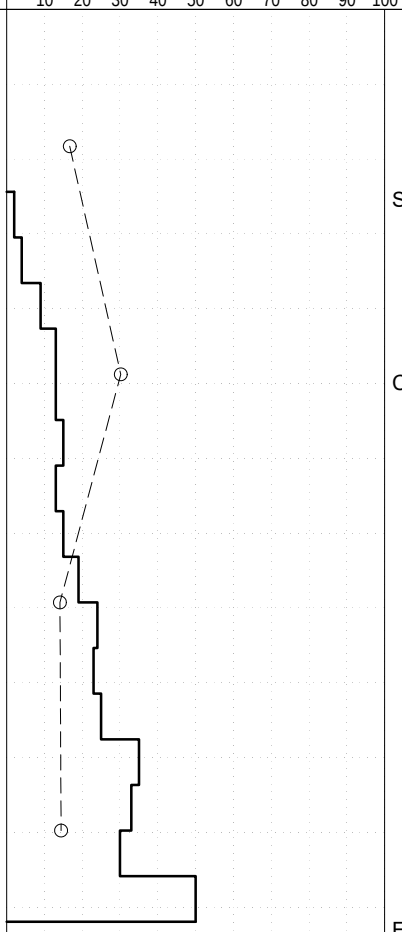
PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 14-Sep-2018

FILE NO.: 23229

ELEVATION (m) | DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: ◧ Disturbed ■ Undisturbed ☒ No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): ✱ GASTECH reading ⊠ PID reading | DEPTH (m)

10 20 30 40 50 60 70 80 90 100



ELEVATION (m)	DEPTH (m)	COMMENTS		SOILS DESCRIPTION
35	0		SM	Moist, dark brown and grey, silty SAND (FILL); some gravel to 50 mm diameter
	1	Start DCPT at 1.2 m depth.		
34	2			Very stiff, moist, brown, silty CLAY; low plasticity; trace sand
		Cpen = 165 to 215 kPa	CL	
33	3			
32	4		SM	Dense, moist, grey-brown, clayey, gravelly SAND (till-like); contains cobbles to 80 mm diameter
31	5			
			CL	
30	6	End DCPT at 6.1 m depth.		
				End of Auger Hole at 6.1 m depth. No water encountered while drilling. Upon completion of drilling: Hole backfilled with cuttings to surface.
29	7			
28	8			
27	9			
26	10			

LOG OF TEST HOLE R RRS_23229_GREENWOOD SEWER TRUNK_2018 TEST HOLE LOGS.GPJ THURBER BC.GDT 15/11/18- THURBER VICTORIA FEBRUARY 2012 REVERSE.GLB

Sheet 1 of 1

LOG OF TEST HOLE

TEST HOLE NO. **TH18-8**

LOCATION: See Drawing 23229-1
N 5509436 E 358740 (Approx.)
UTM NAD 83, Zone 10U

TOP OF HOLE ELEV: 33.5 m (Approx.)

METHOD: Solid Stem Auger

DRILLING CO.: Blue Max Drilling Inc.

INSPECTOR: SWS

THURBER

CLIENT: URBAN SYSTEMS

PROJECT: Greenwood Sewer Trunk
Geotechnical Investigation

DATE: 14-Sep-2018

FILE NO.: 23229

DCPT PENETRATION (blows/300 mm) | SPT PENETRATION (blows/300 mm) | WATER CONTENT (%): ○ Disturbed ● Undisturbed | WATER LEVEL: Plastic Limit — Liquid Limit | SAMPLES: Disturbed, Undisturbed, No Recovery | GRAIN SIZE (%): ▲ Passing #200 sieve, △ Passing #4 sieve | SOIL HEADSPACE READING (ppm): GASTECH reading, PID reading

ELEVATION (m)	DEPTH (m)	COMMENTS		SOILS DESCRIPTION
33	0			Moist, dark brown, organic SILT (TOPSOIL)
	1	655 Water Level (18-Sep-2018)	PT	Wet, fibrous WOOD CHIPS and HOG FUEL
32	2			Wet, grey SAND (FILL)
31	3		ML	Firm, moist, brown, silty CLAY; low plasticity; trace fine sand
30	4		CL	
29	5	Cvane = 35 kPa	CL	
28	6		CL	
27	7		ML	Wet, grey, clayey SAND and SILT (till-like); trace to some gravel to 40 mm diameter
26	8			
25	9		ML	
24	10	40 blows / 25 mm penetration. DCPT Refusal at 9.8 m depth.		End of Auger Hole at 9.1 m depth. Water encountered at 1.5 m depth while drilling. Upon completion of drilling: 50 mm diameter piezometer installed.

LOG OF TEST HOLE R RRS 23229_GREENWOOD SEWER TRUNK_2018 TEST HOLE LOGS.GPJ THURBER BC.GDT 15/11/18- THURBER VICTORIA FEBRUARY 2012 REVERSE.GLB

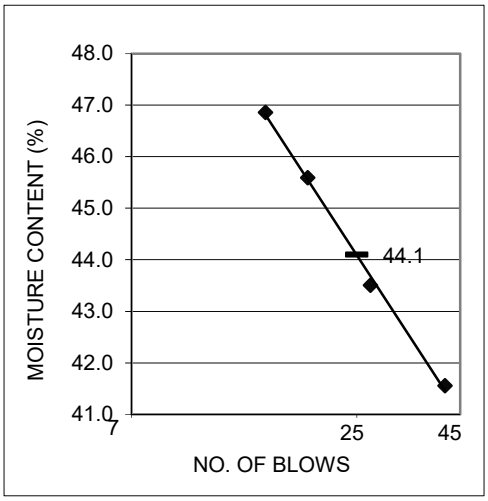
THURBER

Liquid Limit, Plastic Limit & Plasticity Index of Soils
ASTM D4318

Client:	City of Courtenay		
Project:	Greenwood Sewer Trunk		
Project No:	23229	**Date Tested:**	21/Sep/18
Test Hole:	TH18-05 Depth: 10-12ft.	**Tested By:**	RDM
Sample No:		**Checked By:**	AGW

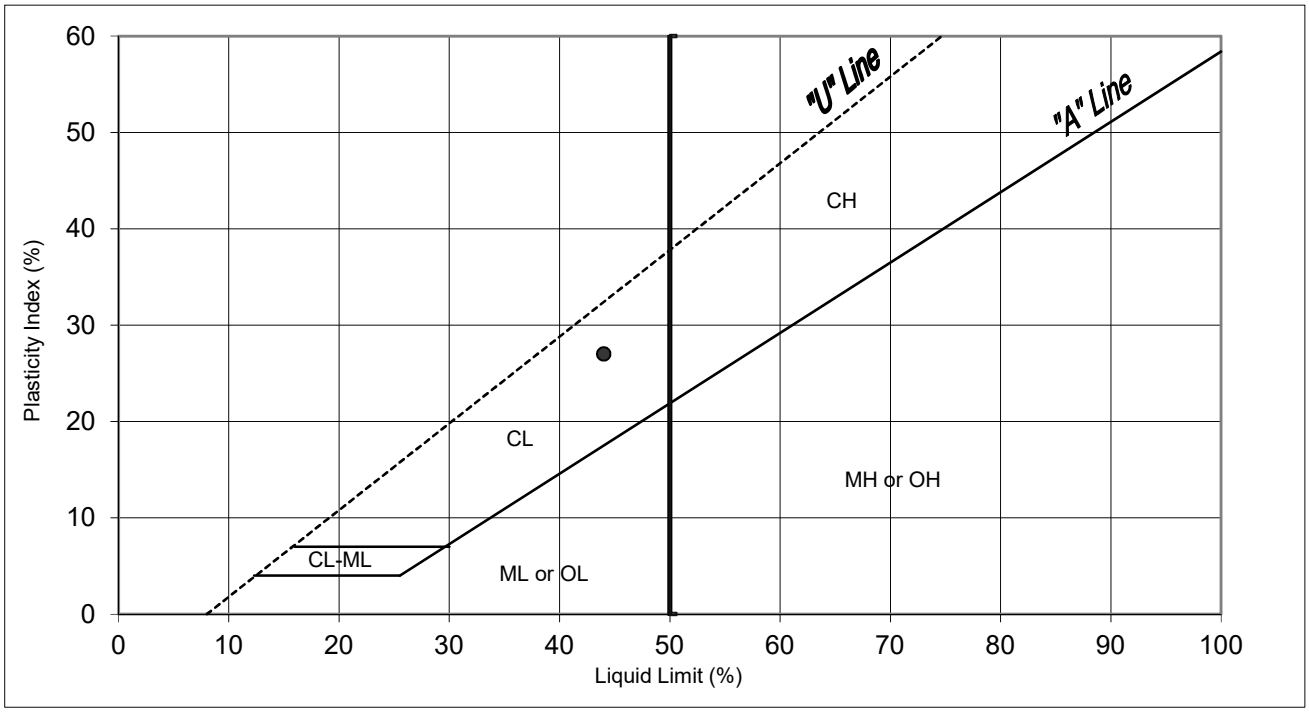
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	41	27	19	15
Container No.	233	258	222	245
Wet Soil + Container	35.78	32.55	31.28	34.71
Dry Soil + Container	29.31	26.82	26.11	28
Wt. Of Container	13.74	13.65	14.77	13.68
Moisture Content	41.6	43.5	45.6	46.9



PLASTIC LIMIT

	1	2		**AVERAGE**
Container No.	253	216		
Wet Soil + Container	21.14	19.4		
Dry Soil + Container	20.1	18.50		
Wt. Of Container	13.62	13.5		
Moisture Content	16.0	18.0		**17.0**



REMARKS
As received moisture content - 46.0 %

Liquid Limit:	**44**
Plastic Limit:	**17**
Plasticity Index:	**27**
Liquidity Index:	**1.07**
USC Classification:	**CL**

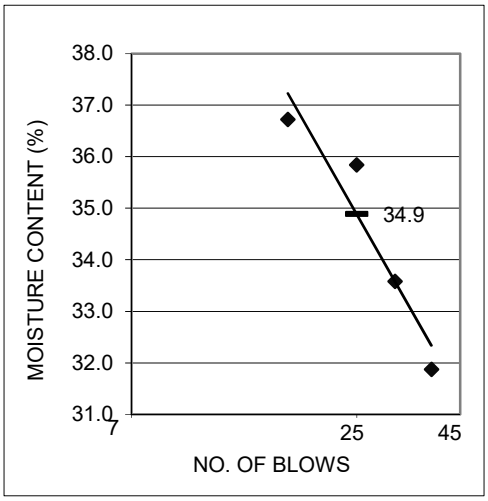
THURBER

Liquid Limit, Plastic Limit & Plasticity Index of Soils
ASTM D4318

Client:	City of Courtenay		
Project:	Greenwood Sewer Trunk		
Project No:	23229	**Date Tested:**	21/Sep/18
Test Hole:	TH18-05 Depth: 20-22ft.	**Tested By:**	RDM
Sample No:		**Checked By:**	AGW

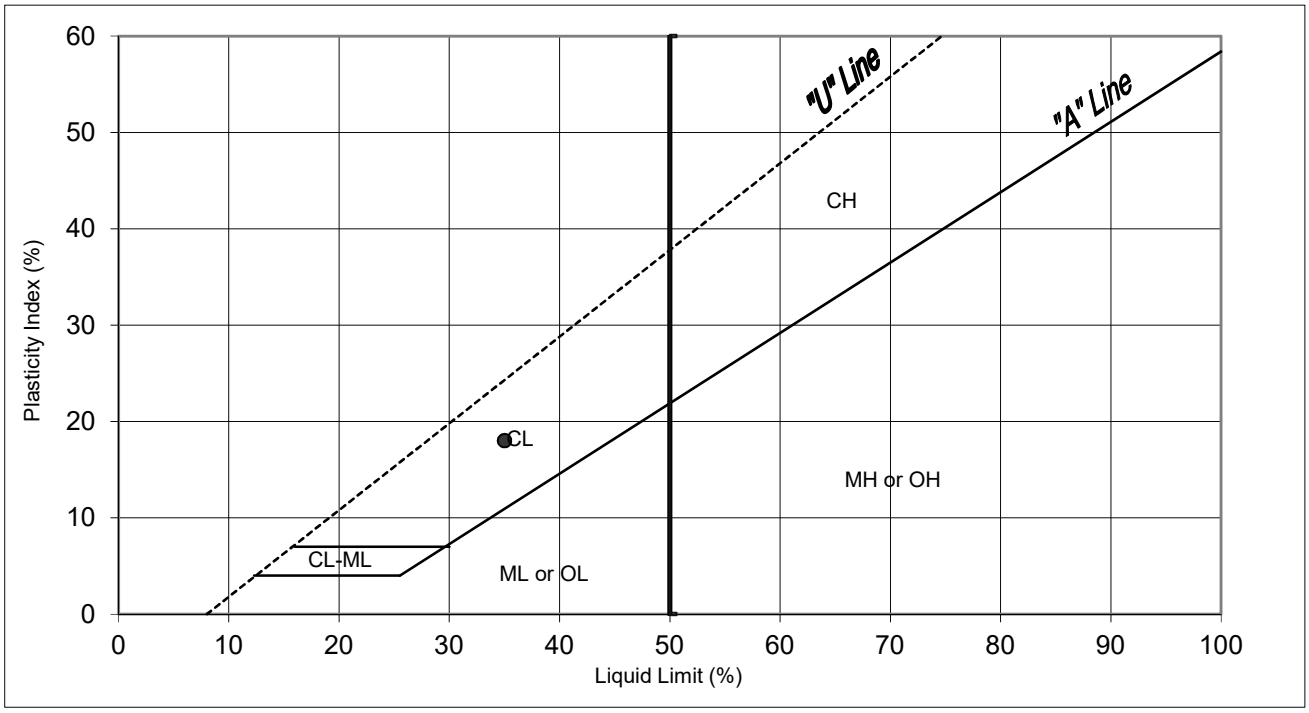
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	38	31	25	17
Container No.	225	252	242	244
Wet Soil + Container	29.52	29.84	34.68	33.93
Dry Soil + Container	25.74	25.79	29.16	28.48
Wt. Of Container	13.88	13.73	13.76	13.64
Moisture Content	31.9	33.6	35.8	36.7



PLASTIC LIMIT

	1	2		**AVERAGE**
Container No.	255	226		
Wet Soil + Container	22.99	21.68		
Dry Soil + Container	21.63	20.66		
Wt. Of Container	13.53	14.42		
Moisture Content	16.8	16.3		**16.6**



REMARKS
As received moisture content - 35.6 %

Liquid Limit:	**35**
Plastic Limit:	**17**
Plasticity Index:	**18**
Liquidity Index:	**1.04**
USC Classification:	**CL**

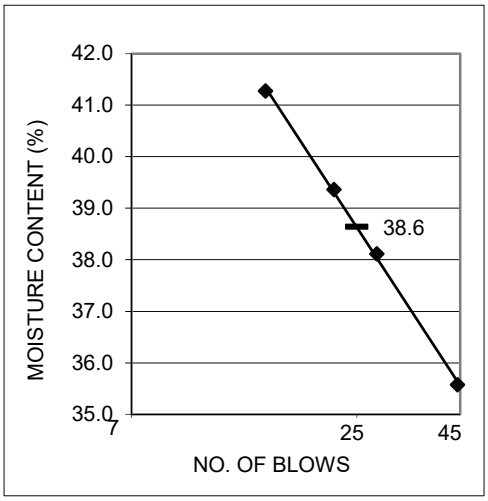
THURBER

Liquid Limit, Plastic Limit & Plasticity Index of Soils
ASTM D4318

Client:	City of Courtenay				
Project:	Greenwood Sewer Trunk				
Project No:	23229			**Date Tested:**	21/Sep/18
Test Hole:	TH18-08	Depth: 15-17ft.		**Tested By:**	RDM
Sample No:				**Checked By:**	AGW

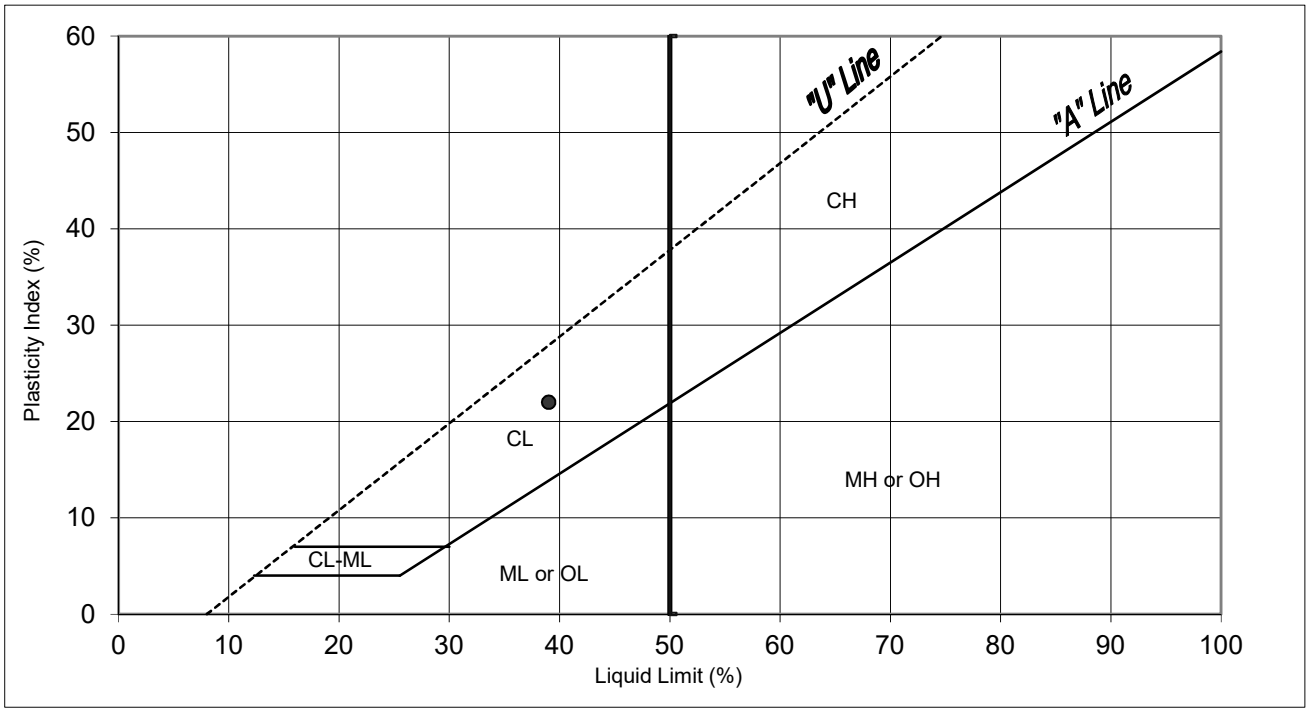
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	44	28	22	15
Container No.	218	220	236	205
Wet Soil + Container	29.79	31.67	32.48	34.66
Dry Soil + Container	25.66	26.7	27.02	28.77
Wt. Of Container	14.05	13.66	13.15	14.5
Moisture Content	35.6	38.1	39.4	41.3



PLASTIC LIMIT

	1	2		**AVERAGE**
Container No.	207	246		
Wet Soil + Container	21.63	21.49		
Dry Soil + Container	20.58	20.27		
Wt. Of Container	14.5	13.32		
Moisture Content	17.3	17.6		**17.4**



REMARKS
As received moisture content - 40.0 %

Liquid Limit:	**39**
Plastic Limit:	**17**
Plasticity Index:	**22**
Liquidity Index:	**1.07**
USC Classification:	**CL**

THURBER

McElhanney Consulting Services Ltd.

BH16-01

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/1/16 **COMPLETED** 2/1/16
GROUND ELEVATION 39.9 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING —
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#176 N: 5,509,052 E: 360,518
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				0.20 Sandy GRAVEL (brown); trace silt, aggregate up to 50mm diameter, compact.	39.70
1	GB 1	MC = 6%		SAND (light grey/brown); trace silt, fine grained, uniform, compact to dense, moist.	
2	GB 2	MC = 7%		2.40	37.50
3				SAND (light grey/brown); trace silt, fine grained sand, uniform, compact, moist.	
4	GB 3	MC = 7%			
5					
6	GB 4	MC = 7%		6.10	33.80

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-02

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/1/16 **COMPLETED** 2/1/16
GROUND ELEVATION 45.8 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#177 N: 5,509,052 E: 360,417
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SAND (light brown); trace silt, uniform, fine grained sand, compact, moist.
1	GB 1	MC = 7%		
2	GB 2	MC = 11%		
3				
4	GB 3	MC = 11%		
5	GB 4	MC = 9%		
6				6.10 39.70

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-03

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/1/16 **COMPLETED** 2/1/16
GROUND ELEVATION 53.4 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#175 N: 5,508,975 E: 360,292
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
				SAND and GRAVEL (brown); trace silt, gravel up to 50mm diameter rounded/sub rounded, oxidized, moist. 53.10
0.30				
1	GB 1	MC = 6%		SAND (light brown); trace silt, fine grained sand, uniform, occasional gravel up to 15-20mm in sand deposit, moist. - Color light grey at 6.1m.
2				
3	GB 2	MC = 6%		
4	GB 3	MC = 12%		
5	GB 4	MC = 6%		
6				
6.10				47.30

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-04

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/1/16 **COMPLETED** 2/1/16
GROUND ELEVATION 69.1 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#174 N: 5,508,593 E: 360,167
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1	MC = 4%		Sandy GRAVEL (brown); trace silt, medium grained sand, gravel up to 50-60mm diamter rounded/subrounded, compact.
				1.10 68.00
2	GB 2	MC = 5%		SAND (light brown); trace silt, fine grained sand, uniform, occasional gravel up to 15-20mm diameter rounded/subrounded in sand deposit, compact, moist.
3				
4	GB 3	MC = 6%		
5	GB 4	MC = 3%		
6				6.10 63.00

Borehole backfilled to surface with cuttings.
No seepage or sloughed encountered.
Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-05

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/1/16 **COMPLETED** 2/1/16
GROUND ELEVATION 44.5 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#194 N: 5,509,024 E: 360,174
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1	MC = 6%		SAND (brown); some gravel, trace silt, gravel up to 20-30mm diameter rounded/subrounded, compact, moist.
2	GB 2	MC = 5%		
3				
4	GB 3	MC = 10%		4.00
				SAND (light grey): fine grained sand, uniform, compact, moist. 40.50
5	GB 4	MC = 7%		
6				6.10
				38.40

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-06

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/1/16 **COMPLETED** 2/1/16
GROUND ELEVATION 69.2 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#173 N: 5,508,872 E: 360,320
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1	5, 12, 24, 40		GRAVEL and SAND (brown); trace silt, trace gravel up to 30-60mm diameter rounded/subrounded, compact to dense, oxidized.
1.80				67.40
2	GB 2			SAND (light brown); trace silt, fine grained sand, uniform, gravel sizes up to 10-20mm diameter in sand deposit, compact, moist.
3				
4	GB 3			
5				
6	GB 4			- Borehole caved to 5.7m following auger withdrawal.
6.10				63.10

Borehole backfilled to surface with cuttings.
No seepage encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-07

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/1/16 **COMPLETED** 2/1/16
GROUND ELEVATION 69 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#172 N: 5,508,842 E: 360,156
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1	2 4 9 6		SAND and GRAVEL (brown); trace silt, gravel up to 40mm diameter rounded/subrounded, compact, moist. - Dense with depth.
2	GB 2	35 42 55		
3				3.20 65.80
4	GB 3			SAND (light grey); trace silt, fine grained sand, occasional gravel up to 20-30mm diameter in sand deposit, compact to dense, moist.
5	GB 4			
6				6.10 62.90

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-08

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 79.6 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 2.10 m / Elev 77.50 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#171 N: 5,508,862 E: 359,891
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				Sandy GRAVEL (brown); trace silt, gravel up to 60mm diameter rounded/subrounded, compact, moist.
1	GB 1	MC = 7%		
1.40				78.20
				Sandy GRAVEL (brown); some silt, gravel up to 70-80mm diameter rounded/subrounded, moist.
2				
2.10 ▽				- Sloughing from 2.0-6.1m following auger withdrawal. - Seepage at 2.1m. 77.50 Sandy GRAVEL (brown); silty, compact, saturated.
3	GB 2	MC = 13%		
4	GB 3	MC = 18%		
5	GB 4	MC = 13%		
6				
6.10				73.50
				Borehole backfilled to surface with cuttings. Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-09

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 80.7 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 0.40 m / Elev 80.30 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#170 N: 5,508,867 E: 359,677
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
1	GB 1	MC = 12%		SAND (brown); coarse grained sand, gravel up to 20mm diameter, oxidized, loose to compact, wet. ▽ - Seepage at 0.4m.	
				1.10	79.60
2	GB 2	MC = 19%		TILL-LIKE - Silty SAND and GRAVEL (light brown); low to medium cemented, gravel up to 15-30mm diameter angular/subangular, dense, moist. - Borehole caved following auger withdrawal.	
				2.60	78.10
3				Silty SAND; trace gravel.	
4	GB 3	MC = 16%			
				4.30	76.40
5				SAND; trace silt, uniform, fine grained.	
6	GB 4	MC = 17%			
				6.10	74.60
				Borehole backfilled to surface with cuttings. Bottom of borehole at 6.10 meters.	

McElhanney Consulting Services Ltd.

BH16-10

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 81.5 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 1.10 m / Elev 80.40 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#169 N: 5,508,868 E: 359,554
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				ORGANIC (redish brown), roots and rootlets, organic odor, sand lenses, moist.	
				0.30	81.20
1				SAND (redish brown); trace silt, moist to wet.	
				1.10 ▽	80.40
	GB 1	MC = 8%		Sandy GRAVEL (brown); trace silt, gravel up to 20mm diameter angular/subangular, loose to compact, moist. - Seepage at 1.1m. - Borehole caved to 1.2m following auger withdrawal.	
				1.60	79.90
2				SAND (light grey); trace silt, fine grained sand, gravel up to 10-20mm diameter, compact, moist.	
	GB 2	MC = 20%			
				2.60	78.90
3				TILL-LIKE - SAND and GRAVEL (light brown); trace to some silt, dense, moist.	
4					
	GB 3	MC = 22%			
5				5.00	76.50
				Silty CLAY (bluish grey); stiff, moist.	
	GB 4	MC = 20%			
6				6.10	75.40
				Borehole backfilled to surface with cuttings. Bottom of borehole at 6.10 meters.	

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-11

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 44.6 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#193 N: 5,509,055 E: 359,944
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
				0.10 ORGANIC; roots, grass, moist. 44.50
1	GB 1	MC = 5%		SAND (light brown); fine grained sand, uniform, compact, moist.
				1.70 42.90
2	GB 2	MC = 5%		SAND (light grey); trace silt, fine grained sand, uniform, compact to dense, moist.
3				
4	GB 3	MC = 7%		
5	GB 4	MC = 5%		
6				6.10 - Borehole caved from 5.9m to 6.1m following auger withdrawal. 38.50

Borehole backfilled to surface with cuttings.
No seepage encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-12

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 72.3 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING —
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#178 N: 5,508,976 E: 359,917
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
	GB 1	MC = 3%		FILL - Sandy GRAVEL (brown); gravel up to 70mm diameter, compact, moist.
0.40				71.90
1				SAND (light brown); trace silt, medium grained sand, uniform, compact to dense, moist.
2	GB 2	MC = 7%		
3				
3.80				68.50
4	GB 3	MC = 11%		SAND (light grey); trace silt, fine grained sand, uniform, moist.
5	GB 4	MC = 10%		
6				
6.10				66.20

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-13

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 48.9 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#192 N: 5,509,095 E: 359,670
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1	MC = 5%		SAND and GRAVEL (brown); trace silt, gravel up to 40mm diameter angular/subangular, compact, moist.
1.40				47.50
2	GB 2	MC = 6%		SAND (light grey); trace silt, fine grained sand, uniform, compact, moist.
3				
4	GB 3	MC = 7%		
5				
6	GB 4	MC = 17%		
6.10				42.80

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-14

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 71.2 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING —
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#179 N: 5,508,986 E: 359,663
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1		MC = 12%		Sandy GRAVEL (brown); trace silt, gravel up to 70mm diameter angular/subangular, compact, moist.
1.30					69.90
		5			TILL-LIKE - SAND and GRAVEL (light brown); trace to some silt, fine grained sand, dense to very dense, moist. - Ground water at 1.30m.
2	GB 2	60	MC = 18%		
3					
4	GB 3		MC = 13%		
4.60					66.60
					SAND (light brown); trace silt, fine grained sand, compact, moist to wet.
5					
6	GB 4		MC = 18%		
6.10					65.10
					Borehole backfilled to surface with cuttings. No seepage or sloughing encountered. Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-15

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/2/16 **COMPLETED** 2/2/16
GROUND ELEVATION 75.1 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 1.00 m / Elev 74.10 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#180 N: 5,508,985 E: 359,470
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
1	GB 1	MC = 13%		Sandy GRAVEL (brown); trace silt, gravel up to 40mm diameter, compact, moist.	
				▽ - Heavy seepage at 1.0m.	
				1.50	73.60
2	GB 2	MC = 17%		SAND (light brown); trace silt, medium grained sand, uniform, compact, wet.	
3				3.00	72.10
4	GB 3	MC = 13%		TILL-LIKE - SAND and GRAVEL (brown); some silt, very dense, moist. - Drilling could not proceed due to large cobble.	
				4.80	70.30

Borehole backfilled to surface with cuttings.
No sloughing encountered.
Bottom of borehole at 4.80 meters.

McElhanney Consulting Services Ltd.

BH16-16

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 75.9 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 2.10 m / Elev 73.80 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#181 N: 5,508,991 E: 359,121
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
1	GB 1	MC = 10%		Sandy GRAVEL (brown); trace silt, gravel up to 40mm diameter angular/subangular, compact, moist.	
				1.50	74.40
2	GB 2	MC = 18%		SAND (light brown); trace silt, fine grained sand, saturated. ▽ - Heavy seepage at 2.1m.	
3				- Sloughing from 0.0 to 3.0m.	
4	GB 3	MC = 24%		- Gradation Analysis: Gravel = 1%, Sand = 82%, Fines = 17%.	
				4.80	71.10
5	GB 4	MC = 21%		SILT (Bluish); some sand, low plasticity, very sensitive, fine grained sand, saturated. - Sea-like odor at 6.0 to 6.1m. - Gradation Analysis: Gravel = 0%, Sand = 69%, Fines = 31%.	
6				6.10	69.80
				Borehole backfilled with cuttings. Bottom of borehole at 6.10 meters.	

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-17

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 54.3 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 1.10 m / Elev 53.20 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#187 N: 5,508,991 E: 359,318
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1	MC = 13%		Sandy GRAVEL (brown); trace silt, gravel up to 50-60mm diameter, compact, moist.
				▽ - Seepage at 1.1m.
				1.40 52.90
2	GB 2	MC = 22%		SAND (dark brown); trace to some silt, fine grained sand, uniform, sensitive, damp to saturated.
				- Gradation Analysis: Gravel = 3%, Sand = 89%, Fines = 8%.
				- Sloughing from at 2.1m.
				2.70 51.60
3				TILL-LIKE - SAND and GRAVEL (light brown); trace to some silt, medium cemented, gravel up to 10-15mm diameter, dense, moist.
				- Auger refusal at 5.6m due to very dense Till-like material.
4	GB 3	MC = 14%		
5	GB 4	MC = 13%		
				5.60 48.70

Borehole backfilled to surface with cuttings.
Bottom of borehole at 5.60 meters.

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BH16-18

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 47.8 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 1.10 m / Elev 46.70 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#188 N: 5,509,080 E: 359,334
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				0.20 ORGANIC; roots, grass.	47.60
1	GB 1	MC = 14%		Silty SAND (brown); some gravel (up to 10mm diameter), compact, moist.	
				1.20 ▽ - Heavy seepage at 1.1m.	46.60
2	GB 2	MC = 8%		SAND and GRAVEL (dark brown); some silt, dense, moist.	
3				3.40	44.40
4	GB 3	MC = 7%		GRAVEL and SAND (brown); some silt, gravel up to 40mm diameter angular/subangular, loose, moist.	
				4.40	43.40
5				SAND (brown); trace silt, fine grained sand, moist.	
6	GB 4	MC = 10%		6.10	41.70

Borehole backfilled to surface with cutttings.
No sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-19

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 45.5 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 1.51 m / Elev 43.99 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#190 N: 5,509,075 E: 359,504
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				0.20 TOPSOIL - ORGANIC; grass.	45.30
1	GB 1	MC = 22%		SAND (brown); trace silt, medium grained sand, compact, moist.	
				1.50 ▽	44.00
2	GB 2	MC = 27%		SILT (bluish light grey); non to low plasticity, firm, interlayered with silty fine grained sand, dense to very dense, moist. - Seeage at 1.5m. - Sloughing from 1.8 to 6.1m from auger removal.	
3					
4	GB 3	MC = 13%		4.70	40.80
5	GB 4	MC = 9%		TILL-LIKE - SAND (light brown); trace silt, medium grained sand, compact to dense, moist.	
6				6.10	39.40

Borehole backfilled to surface with cuttings.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-20

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 44.2 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#211 N: 5,509,097 E: 360,250
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
1	GB 1	MC = 10%		ORGANIC (brown); some sand, roots, oxidized, moist. 0.90 / 43.30
2	GB 2	MC = 18%		SAND (light brown); trace silt, fine grained sand, uniform, compact, moist. - Material changes from light brown to light grey at 6.1m.
3				
4	GB 3	MC = 11%		
5				
6	GB 4	MC = 6%		6.10 / 38.10

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-21

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 35.6 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 1.01 m / Elev 34.59 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#195 N: 5,509,118 E: 359,942
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				0.20 TOPSOIL - ORGANIC (brown); roots, grass, loose, moist.	35.40
1	GB 1	MC = 19%		SAND (light brown); trace silt, medium grained sand, compact, moist.	
				1.00 ▽	34.60
2	GB 2	MC = 18%		SAND (light brown); trace silt, fine grained sand, uniform, compact, moist. - Moderate seepage at 1.0m.	
3					
4	GB 3	MC = 24%			
5	GB 4	MC = 23%			
6				6.10	29.50

Borehole backfilled to surface with cuttings.
Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-22

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 37.1 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 0.80 m / Elev 36.30 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#197 N: 5,509,208 E: 359,775
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				TOPSOIL (brown); sandy, roots, moist.	
				0.80 ▽	36.30
1	GB 1	MC = 22%		SAND (brown); trace silt, fine grained sand, compact, very moist. - Heavy seepage at 0.8m.	
				1.80	35.30
2	GB 2	MC = 20%		Silty SAND (light brown); fine grained sand, uniform, medium dilatancy, sensitive, very moist to wet. - Gradation Analysis: Gravel = 0%, Sand = 76%, Fines = 24%. - Sloughing at 2.0m following auger withdrawal.	
3					
				3.50	33.60
4	GB 3	MC = 16%		Silty SAND (brown); fine grained sand, sensitive, saturated.	
5					
6	GB 4	MC = 22%			
				6.10	31.00
				Borehole backfilled to surface with cuttings. Bottom of borehole at 6.10 meters.	

McElhanney Consulting Services Ltd.

BH16-23

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 38.6 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 4.30 m / Elev 34.30 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#198 N: 5,509,220 E: 359,568
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				FILL - ORGANIC; roots, grass, loose, moist.	
				0.70	37.90
1	GB 1	MC = 11%		SAND (light brown); trace silt, fine grained sand, uniform, moist.	
				1.70	36.90
2	GB 2	MC = 24%		Silty SAND (mottled brown); fine grained sand, compact to dense, moist. - Gradation Analysis: Gravel = 0%, Sand = 78%, Fines = 22%.	
3					
4	GB 3	MC = 25%		▽ - Sloughing from surfact to 4.2m following auger withdrawal. - Seepage at 4.4m.	
				4.60	34.00
5	GB 4	MC = 29% LL = 23 PL = 14		SILT (blue); trace to some sand, non plastic, very sensistive, fine grained sand, fast dilatancy, soft, moist.	
6				6.10	32.50
				Borehole backfilled to surface with cuttings. Bottom of borehole at 6.10 meters.	

McElhanney Consulting Services Ltd.

BH16-24

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 42.2 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 3.30 m / Elev 38.90 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#199 N: 5,509,167 E: 359,487
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	GB 1	MC = 11%		FILL - TOPSOIL; Organic debris.	
1.00					41.20
				SAND (light brown); trace silt, fine grained sand, uniform, moist to damp.	
2	GB 2	MC = 20%			
2.40					39.80
				SAND (light brown); trace to some silt, fine grained sand, uniform, compact, moist.	
3					
3.29 ▽					38.91
				SILT (light brown); some sand, soft, non plastic, fine grained sand, moist. - Seepage at 3.3m. - Sloughing from surface to 3.3m following auger withdrawal.	
4	GB 3	MC = 20%			
5	GB 4	MC = 17%			
6					
6.00					36.20
6.10				SILT (bluish); soft, non to low plastic, moist.	36.10
				Borehole backfilled to surface with cuttings. Bottom of borehole at 6.10 meters.	

McElhanney Consulting Services Ltd.

BH16-25

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 53 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#207 N: 5,509,140 E: 359,733
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
1	GB 1	MC = 16%		FILL - Silty SAND and GRAVEL (brown); compact, moist.	
				1.60	51.40
2	GB 2	MC = 14%		FILL - SAND (light brown); trace silt, fine grained sand, uniform compact, moist.	
3				3.40	49.60
4	GB 3	MC = 19%		SAND (light grey); trace silt, uniform, compact, moist.	
				4.90	48.10
5	GB 4	MC = 13%		TILL-LIKE - Sandy SILT (bluish); gravel up to 30mm diameter, dense, moist.	
6				6.10	46.90

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-26

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 37.1 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 1.60 m / Elev 35.50 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#200 N: 5,509,202 E: 359,288
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
				0.20 FILL - GRAVEL and SAND (brown); compact, moist. 36.90
1	GB 1	MC = 25%		SILT (mottled brown); trace sand (fine grained), non plastic, moist.
				1.60 ▽ 35.50 - Seepage at 1.6m. - Sloughing from 2.0 to 6.1m following auger withdrawal.
2	GB 2	MC = 20%		TILL-LIKE - Silty CLAY (light brown); sandy, very stiff, low to medium plasticity, moist.
3				
4	GB 3	MC = 14%		
5				
6				6.10 31.00

Borehole backfilled to surface with cuttings.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-27

CLIENT Silverado Land Corp. **PROJECT NAME** Crown Isle North

PROJECT NUMBER 2211-47335-00 **PROJECT LOCATION** Courtenay, BC

DATE STARTED 2/4/16 **COMPLETED** 2/4/16 **GROUND ELEVATION** 31.8 m **HOLE SIZE** 0.2

DRILLING CONTRACTOR Drill Well **GROUND WATER LEVELS:**

DRILLING METHOD Solid Stem Auger ▽ **AT TIME OF DRILLING** 1.40 m / Elev 30.40 m

LOGGED BY B. Hannah **CHECKED BY** K. Barth ▼ **AT END OF DRILLING** 1.00 m / Elev 30.80 m

NOTES WP#201 N: 5,509,249 E: 359,370 **AFTER DRILLING** —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
1	GB 1	MC = 142%		TOPSOIL (black); Organic, peat, roots and rootlets, moist.	
2				- Heavy seepage at 1.4m.	
				1.80	30.00
				SAND (grey); trace silt, fine grained sand, uniform, saturated.	
				2.30	29.50
3	GB 2	MC = 21%		SILT (grey); some sand (fine grained), soft, non plastic, fast dilatancy, sensitive, saturated. - Sloughing from 2.4 to 6.4m following auger withdrawal.	
				3.80	28.00
4	GB 3	MC = 32%		Silty CLAY (dark grey); soft, low plasticity, moist to damp.	
5					
6	GB 4	MC = 19%			
				6.10	25.70

Borehole backfilled to surface with cuttings.
Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-28

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 35.4 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 1.00 m / Elev 34.40 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#202 N: 5,509,237 E: 359,115
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
				0.10 TOPSOIL; grass, moist. 35.30
1	GB 1	MC = 29%		Silty CLAY (mottled brown); soft to firm, low plasticity, sand pockets throughout, moist.
				▽ - Seepage at 1.0m.
				1.80 33.60
2	GB 2	MC = 7%		TILL-LIKE - Silty SAND and GRAVEL (grey); gravel up to 30mm diameter, cemented throughout, dense, moist. - Very dense, hard drilling.
3				
4	GB 3	MC = 29%		4.60 30.80

Borehole backfilled to surface with cuttings.
No sloughing encountered.
Bottom of borehole at 4.60 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-29

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 39.2 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 2.60 m / Elev 36.60 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#204 N: 5,509,279 E: 358,932
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				0.20 TOPSOIL (brown); Organics, roots, moist.	39.00
1	GB 1	MC = 25%		Silty CLAY (brown); firm, non to low plasticity, moist.	
				1.80	37.40
2	GB 2	MC = 21%		1.90 CLAY (grey); stiff, moist.	37.30
				TILL-LIKE - CLAY (grey); stiff, low to medium plasticity, gravel up to 10-15mm diameter, moist.	
				▽ - Moderate seepage at 2.6m.	
3				3.00	36.20
				TILL-LIKE - Silty CLAY (grey); medium plasticity, moist to wet.	
4	GB 3	MC = 14%		4.00	35.20
				TILL-LIKE - SAND and GRAVEL; gravel up to 20-40mm diameter, compact, moist.	
5	GB 4	MC = 11%		- Sloughing from 5.5 to 6.1m following auger withdrawal.	
6				6.10	33.10
				Borehole backfilled to surface with cuttings. Bottom of borehole at 6.10 meters.	

McElhanney Consulting Services Ltd.

BH16-30

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 46 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING —
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#203 N: 5,509,170 E: 358,947
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				ORGANIC (brown); roots, moist.	
				0.50	45.50
				SAND (brown); medium grained sand, compact, moist.	
1				0.90	45.10
	GB 1	MC = 25%		CLAY (mottled brown); soft to firm, low plasticity, moist.	
				1.60	44.40
2	GB 2	MC = 12%		SAND and GRAVEL (brown); trace silt, gravel up to 30mm diameter, dense, moist.	
3					
4	GB 3	MC = 12%		- Gravel size increased up to 40-50mm diameter within Till-like material.	
				- Becomes Till-Like at 4.0m.	
5					
	GB 4	MC = 11%			
6				6.10	39.90

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

McElhanney Consulting Services Ltd.

BH16-31

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 51.6 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#206 N: 5,509,200 E: 358,814
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
				TOPSOIL - ORGANIC (brown); roots, moist.	
				0.40	51.20
1	GB 1	MC = 20%		Silty SAND (brown); non plastic, fine grained sand, moist.	
				1.60	50.00
2	GB 2	MC = 12%		TILL-LIKE - SAND and GRAVEL (light brown); trace silt, gravel up to 20-30mm diameter, dense, moist. - Refusal at 4.1m, very dense.	
3				3.10	48.50

Borehole backfilled to surface with cuttings.
No sample recovery from 3.1-4.1m.
No seepage or sloughing encountered.
Bottom of borehole at 3.10 meters.

McElhanney Consulting Services Ltd.

BH16-32

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 37.3 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#208 N: 5,509,164 E: 360,505
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	
			0.20 TOPSOIL - ORGANIC; grass.	37.10
1	GB 1		SAND (brown); trace silt, fine grained sand, uniform, compact.	
			1.60	35.70
2	GB 2		SAND (light grey); fine grained sand, compact.	
3				
			3.40	33.90
4	GB 3		SAND (light grey); fine grained sand, uniform, compact, moist.	
5	GB 4			
6			6.10	31.20

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

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BH16-33

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/4/16 **COMPLETED** 2/4/16
GROUND ELEVATION 42.8 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING —
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING —
NOTES WP#209 N: 5,509,193 E: 360,326
AFTER DRILLING —

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION	
1	GB 1	MC = 6%		GRAVEL (dark brown); trace silt, gravel up to 20-30mm diameter angular/subangular, compact, moist.	
				1.80	41.00
2	GB 2	MC = 7%		SAND (light brown); trace silt, fine grained sand, uniform, compact, moist.	
3					
4	GB 3	MC = 8%			
5					
				5.20	37.60
6	GB 4	MC = 8%		SAND (light grey); trace silt, uniform, compact to dense, moist.	
				6.10	36.70

Borehole backfilled to surface with cuttings.
No seepage or sloughing encountered.
Bottom of borehole at 6.10 meters.

McElhanney Consulting Services Ltd.

BH16-34

CLIENT Silverado Land Corp.
PROJECT NAME Crown Isle North
PROJECT NUMBER 2211-47335-00
PROJECT LOCATION Courtenay, BC
DATE STARTED 2/5/16 **COMPLETED** 2/5/16
GROUND ELEVATION 39.9 m **HOLE SIZE** 0.2
DRILLING CONTRACTOR Drill Well
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 1.50 m / Elev 38.40 m
LOGGED BY B. Hannah **CHECKED BY** K. Barth
AT END OF DRILLING ---
NOTES WP#210 N: 5,509,180 E: 360,199
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION
0				0.20 TOPSOIL - ORGANIC (dark brown); grass. 39.70
1	GB 1	MC = 13%		GRAVEL and SAND (brown); trace silt, gravel up to 40mm diameter, loose, moist.
				1.50 ▽ - Seepage at 1.5m. 38.40
2	GB 2	MC = 19%		Silty CLAY (mottled brown); very stiff, sand pockets, moist.
3				3.10 36.80
				TILL-LIKE - SAND and GRAVEL (grey); some silt, gravel up to 10-15mm diameter, medium cemented, very dense, moist.
4	GB 3	MC = 14%		4.50 35.40
5				SAND (light brown); trace silt, fine grained sand, uniform, compact to dense, moist.
6	GB 4	MC = 9%		6.10 33.80

Borehole backfilled to surface with cuttings.
No sloughing encountered.
Bottom of borehole at 6.10 meters.

GENERAL BH / TP / WELL CROWN ISLE NORTH.GPJ GINT STD CANADA LAB.GDT 4/19/16

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2015 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

September 27, 2018

Site: 49.7174 N, 124.9483 W User File Reference: Greenwood Sewer Trunk

Requested by: Sebastian Suckling, Thurber

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.344	0.543	**0.674**	0.697	**0.655**	**0.449**	**0.290**	**0.102**	**0.036**	**0.313**	**0.531**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. 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 directly calculated values.***

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(0.05)	0.057	0.154	0.228
Sa(0.1)	0.087	0.243	0.359
Sa(0.2)	0.117	0.309	0.452
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Sa(10.0)	0.0038	0.011	0.021
PGA	0.049	0.138	0.207
PGV	0.068	0.211	0.336

References

National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

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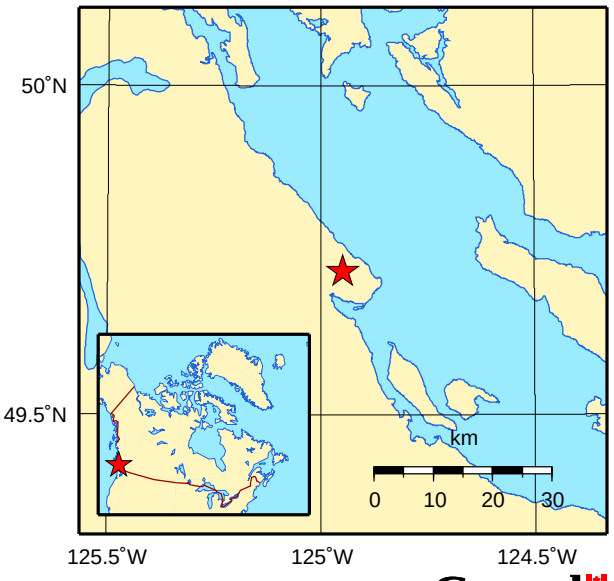

Natural Resources Canada Ressources naturelles Canada

Canada

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GREENWOOD TRUNK SEWER
SECTION 1

Not to Scale

GREENWOOD TRUNK SEWER
IRRIGATION POND
SECTION 1

Name: Core Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1
Name: Shell Model: Mohr-Coulomb Unit Weight: 19 kN/m³ Cohesion: 0 kPa Phi: 34 ° Piezometric Line: 1
Name: firm, grey silty Clay Model: Mohr-Coulomb Unit Weight: 19 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1
Name: granular fill Model: Mohr-Coulomb Unit Weight: 19 kN/m³ Cohesion: 0 kPa Phi: 33 ° Piezometric Line: 1
Name: clayey, Silt and Sand (Till) Model: Mohr-Coulomb Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 34 ° Piezometric Line: 1
Name: Peat Model: Mohr-Coulomb Unit Weight: 10 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1

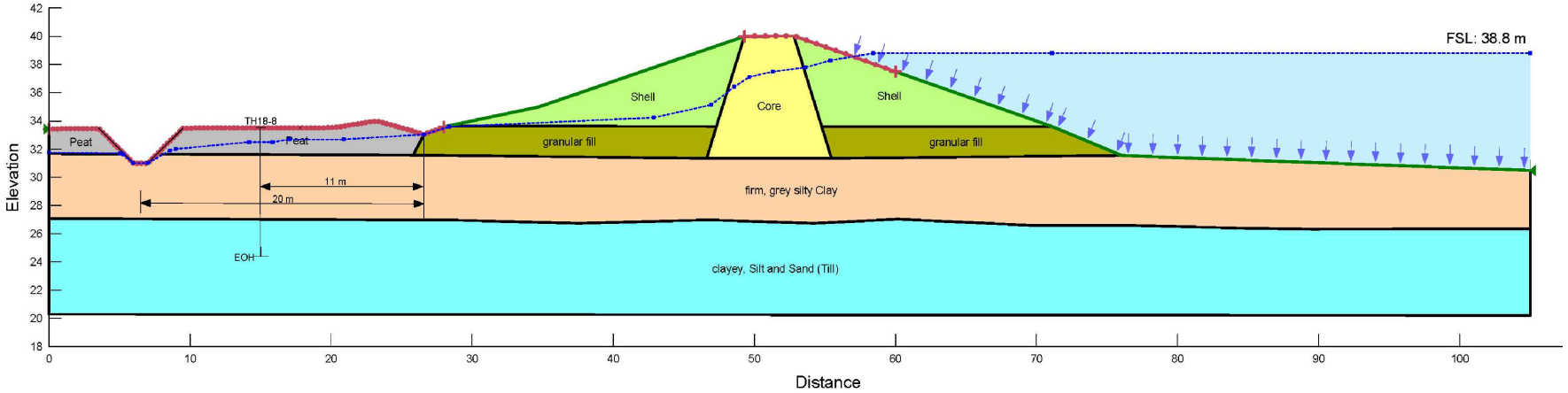


FIGURE 1

Client: Urban Systems
File No.: 23229
E-File: 23229-CAD002.dwg

Date: November 15, 2018

THURBER ENGINEERING LTD.

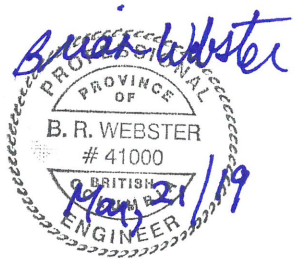
GREENWOOD TRUNK SEWER
SETTLEMENT ANALYSIS AND LIQUEFACTION TRIGGERING ASSESSMENT

Report

to

Urban Systems

Stephen Bean, M.Eng., P.Eng.
Review Principal



Date: March 21, 2019
File: 23229

Brian Webster, B.Eng., P.Eng.
Project Engineer

100, 4396 West Saanich Road, Victoria, BC V8Z 3E9 T: 250 727 2201 F: 250 727 3710
thurber.ca

THURBER

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THURBER

1. INTRODUCTION

This report provides our geotechnical assessment of the potential settlement that could result from a grade raise along the north side of the Greenwood Trunk Sewer detention pond in Courtenay, BC. A preliminary liquefaction triggering assessment was also undertaken to evaluate the potential long-term settlement and post-earthquake movement at the proposed lift station locations.

The scope of work for these geotechnical services was outlined in Thurber's proposal letter dated January 29, 2019. Approval to proceed was provided by email from Urban Systems on February 10, 2019.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. PROJECT UNDERSTANDING

2.1 Access Road

A 4.0 m wide access road is required over the sanitary main generally between Sta: 1+020 to 1+615 as shown on the Issued for 95% Design Review Drawings dated March 5, 2019. Fill thicknesses above existing ground range from less than 200 mm to about 1.5 m. We understand that the construction methodology will be to undertake an open trench excavation to install the sanitary main, then backfill using engineered granular fill to the top of road elevation.

Raising the grade in this area will induce settlement within the underlying peat deposit and firm, silty clay layer. The sub-surface soil conditions encountered at TH18-8 were used to assess potential settlement along the north side of the detention pond. An undisturbed sample of the grey clay deposit was used to assess the compressibility characteristics of the clay layer for settlement analysis.

Peat / hogfuel was encountered to a depth of 1.7 m at TH18-8 but was not encountered at TH18-7 located on the north-west corner of the pond. Therefore, the presence and extent of the underlying peat deposit will be variable along the proposed sanitary alignment. Also, pockets of peat could remain below and around the pipe zone after trench excavation and backfill. Settlement of peat can be difficult to quantify due to its variable, highly compressive nature and will depend on the extent of the deposit that remains after excavation and the thickness of fill that is placed above existing ground.

Recommendations have not been provided for embankment fill type or placement for the construction of the access road.

2.2 Lift Stations

The lift stations are to be designed to meet the 2012 BC Building Code requirements for a post disaster structure. A preliminary liquefaction triggering assessment was undertaken using the soil and groundwater conditions at TH18-1 and TH18-6 to assess the potential seismic induced

settlement and post-earthquake movement that could occur under a design level (1:2,475) earthquake at the proposed lift station locations.

Based on our review of the 95% Design drawings and discussions with Urban on March 11, 2019, we understand that one lift station near Sta: 1+755 is currently proposed. The second lift station near Sta: 3+300 is currently on hold and may be installed as part of future work.

2.3 Detention Pond

We assume that use of the farmer's property along the west perimeter of the pond permits the trench excavation to be offset by about 20 m from the toe of the dam. The 95% design drawings show the alignment to be located about 20 m away from the toe of the dam; however, it appears that fill placement in some areas along the alignment for the road access are about 10 m from the dam toe.

We have not undertaken additional slope stability analysis of the detention pond to determine if placement of fill soils closer than 20 m from the pond toe will affect stability or settlement. Further evaluation and analysis would be required if excavations and fill placement need to be closer than 20 m from the toe of the dam.

3. PRELIMINARY CONSOLIDATION ASSESSMENT

Raising the site grade will induce settlement in the underlying fine-grained soils, particularly the peat and firm to soft, grey clay deposits. A preliminary assessment of consolidation settlement in the clay was therefore completed assuming grade raises of 1.5 m (near Sta: 1+200). This thickness appears to be the maximum grade raise above existing ground to create road access along the alignment. There will also be a net load increase to the effective stress present at the pipe invert from the replacement of existing fill and native silt / clay soils with engineered granular fill.

An undisturbed Shelby tube sample of the grey clay was collected to permit the completion of a one-dimensional consolidation test as per ASTM D2435. Test results are included in Appendix A. A summary of the soil parameters obtained from the consolidation test is provided in Table 1 below.

TABLE 1
Consolidation Parameters

Test Hole ID	Soil Description (ASTM D2487)	Initial Void Ratio, e_o	Estimated Pre-consolidation Pressure, p'_c	γ_{dry} (kN/m^3)	Compression Index, C_c	Recompression Index, C_r
TH18-8: 4.6 m to 5.2 m	silty CLAY (CL)	1.12	275 kPa	16.0	0.47	0.011

The results indicate that the grey clay at TH18-8 is moderately over-consolidated having undergone significantly more consolidation pressure than the effective stress that is currently present at the sample depth.

The above parameters were used to estimate settlements under a 1.5 m grade raise and from using trench backfill / site grading fill with a unit weight of 20 kN/m^3 to replace the existing surficial organic / fill materials and silt /clay soils that may be present within the depths of excavation to pipe invert. The calculated settlements are based on a single consolidation test representing soil conditions at TH18-8 and therefore, may not be representative of all the silt/clay deposits present along the alignment. The confining stress levels are generally reduced after excavating into clay and organic peat soils causing them to swell and creep after being disturbed.

A 30 kPa pressure increase from a 1.5 m grade raise is expected to consolidate the underlying firm, clay in the range of 40 mm to 80 mm, depending on the thickness of the firm clay / silt deposit. A similar magnitude of settlement is expected from replacing existing silt / clay, hogfuel, sand soils with an average unit weight of 14 kN/m^3 (a net load increase of 6 kPa) with up to about 5 m of engineered fill (near Sta: 1+610) to backfill the sanitary main trench and to build the road structure in the area.

This analysis only takes into account settlement within the firm clay and assumes that all of the peat has been subexcavated during trench excavation. If any peat remains below the roadway there will be significant primary consolidation. Secondary compression will occur after primary consolidation has been completed. Unlike primary consolidation, secondary consolidation does not depend upon drainage. Secondary compression is caused by slippage and reorientation of soil particles (creep) under constant load. These settlements occur gradually over long periods of time. An estimate of settlement within the peat deposit could range between 10% to 40% of the thickness of the peat increasing over the loading period. Settlement of the peat would be cumulative to consolidation settlement of the grey clay deposit.

We have assumed that all of the peat below the footprint of the access road will be removed. Since we only have one test hole along this section, the depth of peat could vary significantly.

3.1 Mitigation

If the magnitude of anticipated settlement exceeds tolerable levels, then potential options to reduce settlement could include surcharge loading along sections of the alignment (particularly the west and north portions along the dam) to speed up the consolidation process. This involves placing additional fill (above the grade raise elevation) to induce a faster rate of settlement and thereby allowing the surcharge fills to be removed sooner.

The actual thickness of the surcharge fills will depend on the anticipated road fill to be placed above existing grade and the desired construction schedule. Installation and monitoring of settlement plates would be required to determine when the surcharge could be removed.

THURBER

4. PRELIMINARY LIQUEFACTION TRIGGERING ASSESSMENT

4.1 Site Seismicity

The 2012 British Columbia Building Code specifies a design level earthquake with a 2% probability of exceedance in 50 years (corresponds to an average return period of 2,475 years). In accordance with the seismic hazard values for the 2015 National Building Code of Canada (NBC), the peak ground acceleration (PGA) at the site for the 2,475-year event is 0.31 g. The 2015 NBC Seismic Hazard Calculation output is attached in Appendix B for reference.

4.2 Preliminary Liquefaction Triggering Assessment

A liquefaction triggering assessment was carried out for the site soils at TH18-1 and -6 using the general analysis methodology outlined in the 2007 task force report titled “Geotechnical Design Guidelines for Buildings on Liquefiable Sites in Accordance with NBC 2005”, that was prepared for the Greater Vancouver Region. This is a stress-based approach for evaluating the potential for liquefaction triggering that compares the values for Cyclic Resistance Ratio (CRR) with earthquake induced Cyclic Stress Ratio (CSR) values. When the CRR is greater than the CSR, the factor of safety (FS) against liquefaction is greater than 1.0, which indicates that liquefaction triggering is not anticipated for the interval of the subsurface profile under consideration.

The soils encountered along the proposed trunk sewer alignment are generally non-liquefiable because the granular soils are typically compact to very dense and the stiff to soft, silty clay soils are not considered to be liquefiable. However, the upper granular fill soils and sand / silt deposit may become saturated and could potentially liquify or soften during a seismic event.

At TH18-1, the DCPT was driven to refusal at 3.1 m depth, then the hole was drilled out to 3.7 m and the DCPT was restarted and driven to 5.8 m depth below the ground surface in dense to very dense, silty sand. The upper approximately 1.2 m at TH18-6 was drilled out before starting the DCPT then was driven to refusal at 3.7 m depth in very dense clayey, silty sand.

For the liquefaction triggering assessment, the Dynamic Cone Penetration Test (DCPT’s) data analyzed from TH18-1 and -6 was utilized assuming the groundwater level rises to 0.5 m below the ground surface at the time of a design seismic event. The engineering properties of the granular soils were estimated using DCPT blow counts at the drilled test hole locations.

The liquefaction triggering assessment indicates that liquefaction of the soils around TH18-1 and -6 will likely not occur following a design level earthquake. The post-seismic vertical settlement under the 1 in 2,475-year return period event is anticipated to be less than 10 mm if the water table is at 0.5 m below the ground. However, if the water table rises to the surface, then our analysis indicates that post-seismic induced settlement liquefaction could range up to 40 mm in the vicinity of TH18-1.

5. SUMMARY

- Consolidation settlement from a 1.5 m grade raise or net loading from engineered fill is expected to be less than 80 mm within the clay deposit. This assumes all of the peat is removed beneath the road footprint.
- If any peat remains beneath the access road settlement could be up to 40% of the thickness of the layer occurring over a 25-year load cycle.
- The soils at the proposed lift station locations are not considered to be liquefiable. Post-seismic vertical settlement is expected to be less than 10 mm if the water table rises to about 0.5 m of the surface. If the water table rises to the surface, post-seismic settlement could be up to 40 mm.

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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APPENDIX A

Consolidation Test Report

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ONE DIMENSIONAL CONSOLIDATION TEST REPORT
SUMMARY OF TEST DATA

Urban Systems
Greenwood Trunk Sewer
File Number: 23229

TH18-8, 15.0-17.0 ft.
Report Date: Feb. 21, 2019
Test Dates: Feb. 13 - 20, 2019

Description: Silty CLAY (CL), grey, firm, medium plastic

	Initial	Final		
Wet Density (kg/cu.m.):	1,852	2,018	Sand:	---
Dry Density (kg/cu.m.):	1,322	1,573	Silt:	---
Moisture Content (%):	40.0	28.3	Clay:	---
Void Ratio:	1.118	0.780	Liquid Limit:	39
Saturation:	100	102	Plastic Limit:	17
Specific Gravity:	2.8		Plasticity Index:	22

Test Method: ASTM D2435-03, method B, Cv calculated by the root of Time method

Trimming: The specimen was trimmed with the aid of a cutting shoe to a diameter of 63.61 mm and a height of 16.49 mm and placed in a fixed ring consolidometer.

Procedure: The consolidometer was flooded with distilled water immediately after the application of the first load of 12.5 kPa. Subsequent loads were applied after primary consolidation was complete.

Load Increment (kPa)	Void Ratio (end of increment)	C_v (cm^2/sec)	m_v (cm2/g)	k (cm/sec)
12.5	1.120			
25	1.118			
50	1.116	1.07E-03	3.57E-06	3.81E-09
100	1.107	2.96E-03	8.33E-06	2.47E-08
200	1.082	3.69E-03	1.18E-05	4.36E-08
400	0.936	6.87E-04	3.44E-05	2.36E-08
800	0.776	6.34E-04	2.02E-05	1.28E-08
1600	0.659	7.59E-04	8.10E-06	6.15E-09
400	0.667			
100	0.685			
25	0.715			

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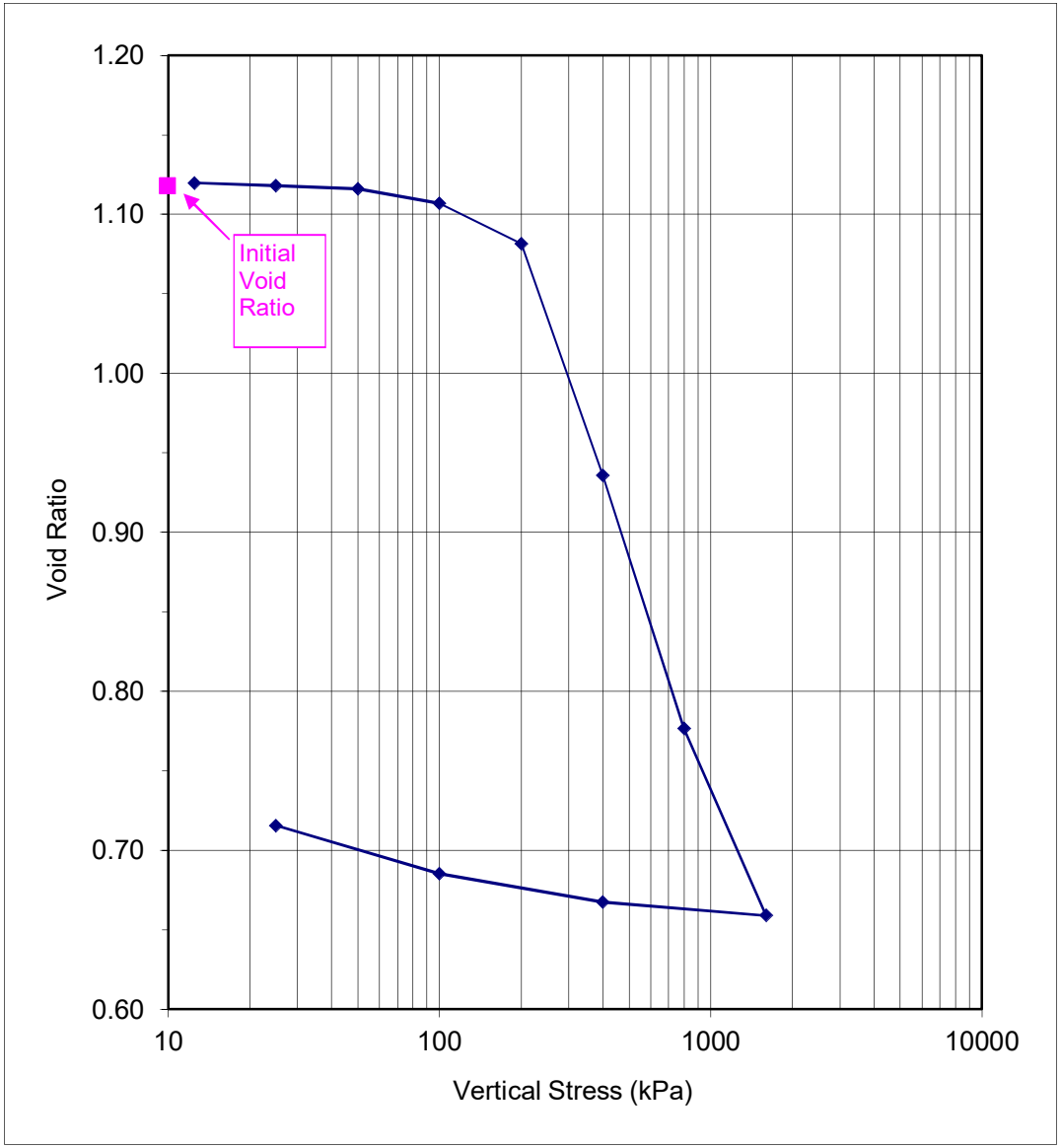
ONE DIMENSIONAL CONSOLIDATION TEST REPORT
TEST SUMMARY PLOTS

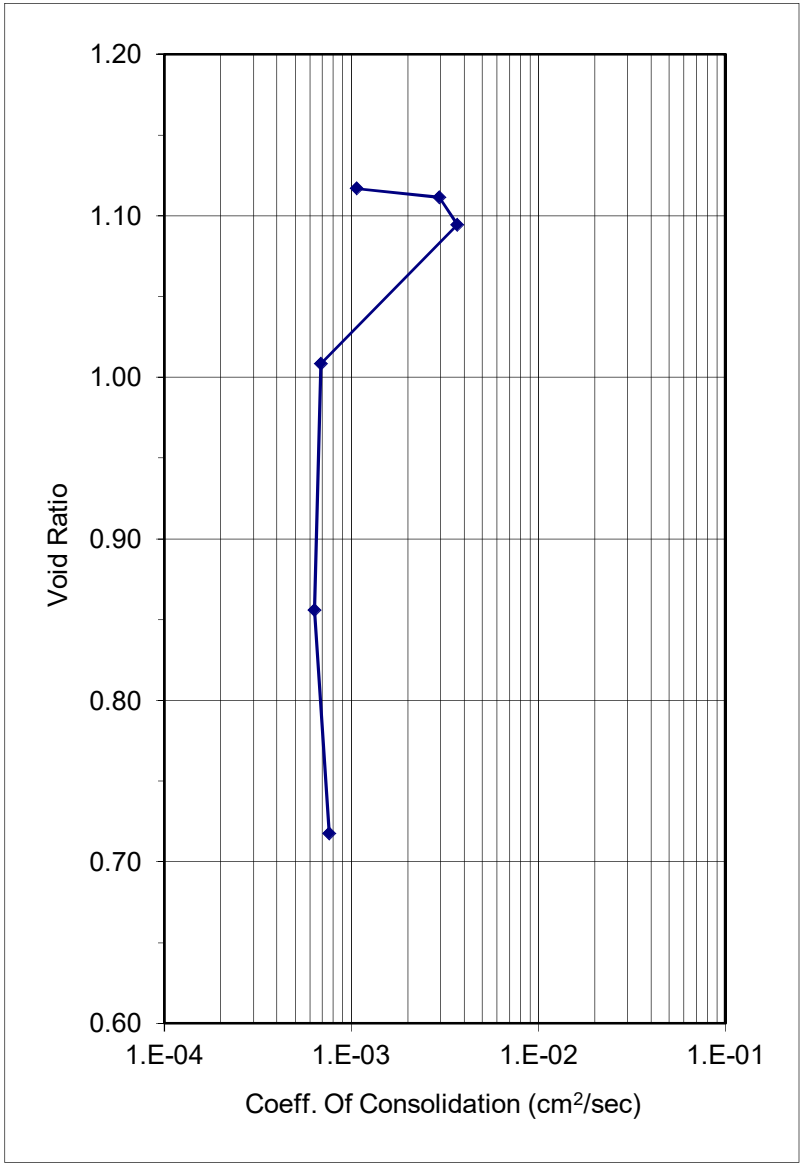
Urban Systems
Greenwood Trunk Sewer
File Number: 23229

TH18-8, 15.0-17.0 ft.
Report Date: Feb. 21, 2019
Test Dates: Feb. 13 - 20, 2019

Void Ratio (end of load increment) Vs Log of Pressure



Average Void Ratio Vs Coefficient of Consolidation



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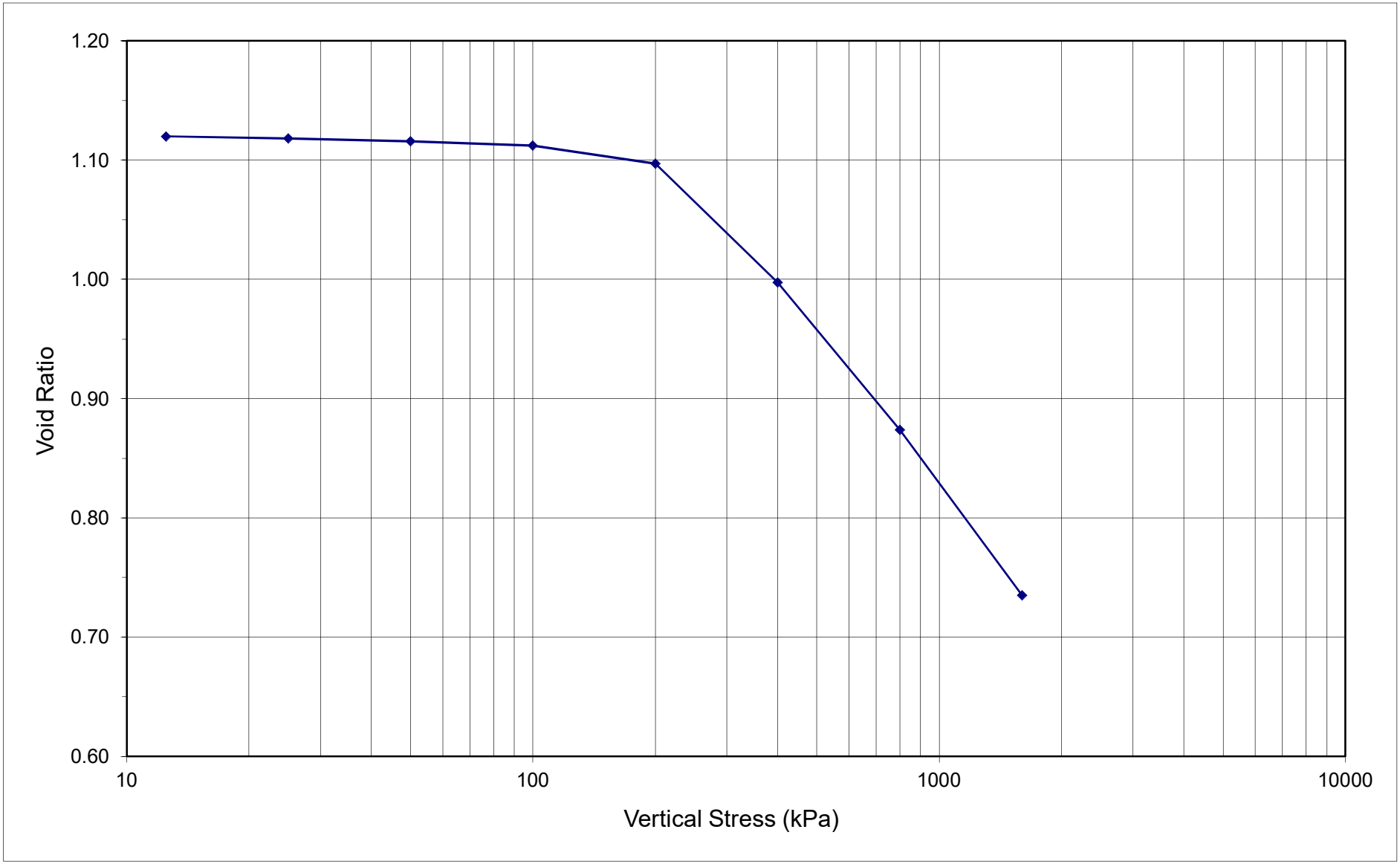
ONE DIMENSIONAL CONSOLIDATION TEST REPORT
TEST SUMMARY PLOTS

Urban Systems
Greenwood Trunk Sewer
File Number: 23229

TH18-8, 15.0-17.0 ft.
Report Date: Feb. 21, 2019
Test Dates: Feb. 13 - 20, 2019

Void Ratio (@T_{100}) Vs Log of Pressure



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APPENDIX B

2015 NBC Seismic Hazard

2015 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

September 27, 2018

Site: 49.7174 N, 124.9483 W User File Reference: Greenwood Sewer Trunk

Requested by: Sebastian Suckling, Thurber

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
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Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. 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 directly calculated values.***

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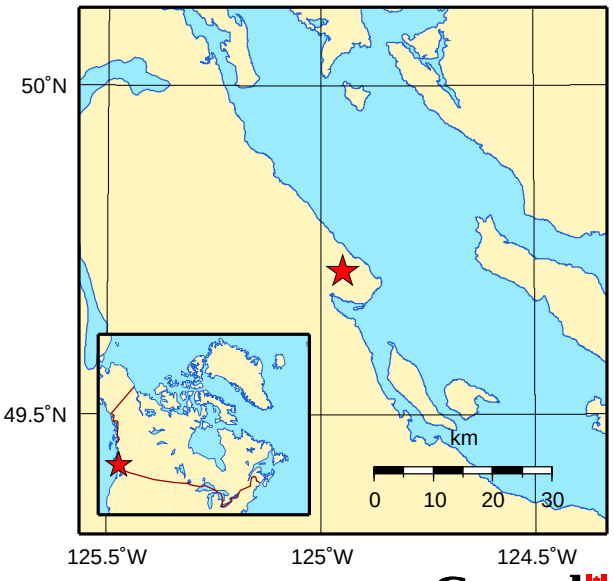
See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français



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REPORT

Environmental Overview

City of Courtenay Greenwood Trunkmain

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File: 3222.0048.01

Contents

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1.0 Introduction

1.1 Background

The City of Courtenay is preparing for the extension of the Greenwood Trunk sewer through the construction of gravity sewers, two pump stations and twin force main. The installation of these works will allow the City to abandon at least three existing sanitary sewer pump stations and create the ability to service development in the northeast corner of the City. The land proposed for the sanitary sewer is listed by the City of Courtenay as an Environmentally Sensitive Area and thus requires an environmental review prior to development.

Urban Systems Ltd. has prepared this environmental overview to meet the requirements outlined in the City of Courtenay's Official Community Plan and to identify potential environmental constraints for consideration in the planning, design and construction of the proposed sanitary sewer.

1.2 Scope of Environmental Overview

Based on available desktop information and a site visit, this environmental overview will:

- Identify valued ecosystem components (sensitive ecosystems, soils, groundwater, surface water, fisheries resources, vegetation, wildlife and species at risk) within the study area*;
- Identify any environmental submissions / applications that will be required in advance of construction – early in final design (e.g., local, provincial and/or federal regulatory requirements).
- Map sensitive and/or important environmental features at a suitable scale using GIS software;
- Recommend mitigation options to reduce or avoid impacts to sensitive or critical resource values;
- Provide recommendations with respect to environmental setbacks, reduced risk timing windows, etc.;
- Provide recommendations for an environmental monitoring strategy during construction.

1.3 Location

The proposed sanitary sewer is located in the northeast corner of the City of Courtenay, approximately 2.65 km west of the Straight of Georgia on the east coast of Vancouver Island. The site being assessed in this environmental review is a linear parcel located between Anderton Road and Mission Road, which is approximately 430 m north of Ryan Road (Figure 1.1).

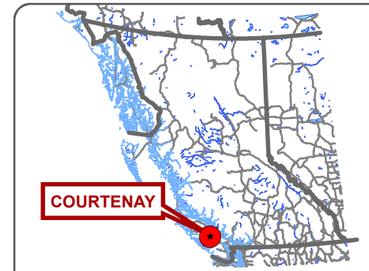
City of Courtenay

Greenwood Development
Sanitary Trunk Detailed Design
Environmental Assessment

Location Map

Municipal Boundary

Project Area



0 250 500 1,000 1,500
Metres

N

Coordinate System:
NAD 1983 UTM Zone 10N

Scale:
1:45,000

Data Sources:

- Reserve boundary, parcels and easements provided by Natural Resources Canada.
- Imagery provided by ESRI basemaps.

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Status:	
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Date:	2018 / 9 / 10

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FIGURE 1.1

1.4 Information Sources

Information sources that were used in the preparation of this environmental overview include:

- Canadian Soil Information Service;
- BC Conservation Data Centre;
- BC Habitat Wizard;
- BC iMap;
- BC Online Contaminated Sites Registry;
- BC Species and Ecosystems Explorer;
- BC Species at Risk Primer;
- Treasury Board of Canada Contaminated Sites Inventory web site; and
- City of Courtenay's OCP mapping

1.5 Regulatory Considerations

Legislation and policies containing environmental direction and potential requirements that may be relevant to the project include the following:

1.5.1 Federal Legislation and Policies

a) *Migratory Birds Convention Act*, 1994 (S.C. 1994, c. 22)

Most migrating birds found in Canada are protected under the *Migratory Birds Convention Act*. The Canadian government has the authority to pass and enforce regulations to protect those species of migratory birds which are included in the Convention.

b) *Species at Risk Act* (S.C. 2002, c. 29)

The federal *Species at Risk Act* (SARA) provides protection to species at risk included on Schedule 1 under the Act and their critical habitat, both of which may be found on federal lands. It also provides protection to aquatic species and migratory birds (covered by the Migratory Birds Convention Act), wherever they are found.

c) *Fisheries Act* (RSC 1985, c. F-14)

The federal *Fisheries Act* provides for the management and control of fisheries, the conservation and protection of fish and the protection of fish habitat and pollution prevention.

1.5.2 Provincial Legislation and Policies

a) *The BC Wildlife Act* (RSBC 1996, c. 488)

The *Wildlife Act* governs the protection and management of wildlife in BC. The Act deals with the protection and maintenance of suitable habitat and the conservation of wild species, in particular, those species that may be at risk of extinction, as well as nesting birds, their nests and their eggs.

b) **The BC *Water Sustainability Act* (SBC 2014, c. 15)**

The *Water Sustainability Act* outlines the requirements for the use of surface and groundwater in BC and the protections afforded to streams for the purpose of sustaining water quantity, quality and aquatic ecosystem health for BC.

c) The BC *Agricultural Land Commission Act* (SBC 2002) and *Agricultural Land Reserve Use, Subdivision and Procedure Regulation* (B.C. Reg. 171/2002)

The *Agricultural Land Commission Act* was brought into force in 1973 to protect BC's agricultural land and sets the legislative framework for the establishment and administration of the agricultural land preservation program. The Agricultural Land Reserve Use, Subdivision and Procedure Regulation, identifies the procedures for submitting applications and notices of intent, and specifies land uses permitted in the ALR.

d) *Dam Safety Regulation* B.C. Reg. 40/2016 (BC *Water Sustainability Act*)

The *Dam Safety Regulation* sets requirements and best practices for all aspects of dam design, construction, operation, maintenance, removal and decommissioning of dams. The *Dam Safety Regulation* came into effect on February 29, 2016, under the *Water Sustainability Act* replacing the former B.C. Dam Safety Regulation (2000).

e) B.C Heritage Conservation Act

British Columbia's archaeological sites are protected under the Heritage Conservation Act (HCA). The provisions of the HCA apply whether sites are located on public or private land. Archaeological sites are protected through designation as "Provincial heritage sites" or through automatic protection by virtue of being of particular historic or archaeological value. Protected archaeological sites may not be altered, i.e. changed in any manner, without a permit issued by the Minister or designate.

1.5.3 Municipal Legislation and Policies

a) City of Courtenay Official Community Plan (Appendix A to Bylaw No. 2387) (2016)

The City of Courtenay's Official Community Plan is a long-term vision for the community that provides a strategy to guide development. Environmental Development mapping identifies Environmentally Sensitive Areas (ESA) within the city boundaries that require additional assessment. Development in an ESA requires an environmental review to determine the location, extent and features of a site, and necessary measures to mitigate potential environmental impact and rehabilitation opportunities.

2.0 Project Description

The proposed project is the construction of a sanitary sewer and two sewage lift stations which will collect sewer flows from the south and convey them to existing sewer infrastructure at Anderton Road to the east and infrastructure in the vicinity of Mission Road to the west. The proposed sanitary sewer right of way will be approximately 11 m wide. There will also be two larger areas of approximately 20 m x 20 m to house the two new lift stations (Figure 2.1).

2.1 Site Description

The land in the project area is relatively flat and is bounded by agricultural land reserve (ALR) farm land to the north and cleared land to the south. The majority of the project alignment follows a newly constructed gravel road with limited adjacent vegetation. Vegetation in the project vicinity consists of cultivated farm fields, ferns, grasses, weeds and occasional shrubs. There are no named streams within the project area; however, there are three (potentially four) drainages that connect to the Little River, a fish-bearing stream 750 m north of the project at the nearest point. Additionally, there is an irrigation pond, four ponds that appear to be man-made, and road side ditches with standing water within 100 m of the project alignment. The permanence and flow of water, and the quality of habitat in these waterbodies is not known, although the four ponds do not appear to support fish populations. Amphibians (frogs) were heard calling at two of the four ponds. There is one spring and four groundwater wells within 100 m of the project (Figure 2.1).

2.2 Land Use

The proposed project area is in the agricultural land reserve and has been disturbed by the construction of a farm access road.

City of Courtenay

Greenwood Development
Sanitary Trunk Detailed Design
Environmental Assessment

Existing Environmental Conditions

- Municipal Boundary
- Agricultural Land Reserve
- Pooled Areas
- Proposed Sanitary Main
- Proposed Right-of-Way/Easement
- Registered Groundwater Well
- Known Fish Occurrences (Habitat Wizard) (cutthroat trout and coho salmon)

0 50 100 200 300
Metres

N

Coordinate System: NAD 1983 UTM Zone 10N

Scale: 1:7,500

Data Sources:

- ALR, municipal boundary, parcels, wells, and known fish occurrences provided by GeoBC.
- Imagery provided by Google Earth Pro (georeferenced by Urban Systems to align with parcels).

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FIGURE 2.1

3.0 Description of the Environment

3.1 Topography

The terrain within the project area is gently sloping downwards to each end of the alignment. Elevation in the project area ranges from 30 m to 40 m asl. Low points along the alignment are at Anderton Road (30 m asl), and at the location of the hatchery (32 m asl). High points along the alignment are adjacent to the farm facility and at the irrigation pond at the west end of the alignment (both 40 m asl).

3.2 Climate

The climate of the Courtenay area is influenced the rainshadow of the Vancouver Island mountains and its proximity to the Straight of Georgia, and can be generalized using the Biogeoclimatic Ecosystem Classification system. This system is used by natural resource practitioners within the province of British Columbia to describe general terrestrial ecosystem characteristics throughout the province, including regional vegetation, as well as biological, geographical and climatic characteristics. The project is located in the Coastal Western Hemlock very dry maritime biogeoclimatic sub-zone (CWHxm).

The CWH is, on average, the rainiest biogeoclimatic zone in BC characterized by cool mesothermal climate. Typical summers are cool, however hot dry spells can be frequent, and winters are mild. The mean monthly temperature is above 10^{o}C for 4-6 months of the year, with the mean monthly temperature of the coldest month being 0.2^{o}C. Mean annual precipitation for the CWH zone is 2,228 mm and ranges from 1,000 to 4,400 mm. Less than 15% of total precipitation occurs as snow (Meidinger and Pojar, 1991).

3.3 Geology and Soils

Soils in the project area are described using the Government of Canada Canadian Soil Information Service online soil classification system (CanSIS). A search of CanSIS for soil information within the project area showed that the project spans six soil classifications that fall into four soil orders defined under the Canadian System of Soil Classification. The four orders are Brunisol, Gleysol, Podzol and Organic. The characteristics of each soil, as reported by CanSIS, vary significantly. Of the six soil classifications identified in the project area, five are of mineral composition and one is organic. There was a large variance between classifications on the permanence of the water table in the soil that ranged from not present to always present, and soil drainage varied from poorly drained to rapidly drained.

3.4 Surface Water and Fisheries Resources

The nearest named surface water resource is the Little River which is located 700 m north of the western end of the project area at its closest point. The Little River is a 3rd order, 6.4 km stream that originates approximately 700 m northwest of the project area and flows in a general north-easterly direction to drain into the Straight of Georgia adjacent to the Comox-Powell River ferry terminal. The Little River supports coho salmon, cutthroat trout, anadromous cutthroat trout, rainbow trout, and steelhead (MOE, 2018). Three

channelized unnamed drainages (potentially four) flow north through the project alignment and the agricultural fields to drain into the Little River. The unnamed drainage "C", which originates from Muir Spring approximately 165 m south of the alignment, is stocked with fish from the nearby fish hatchery. The fish hatchery is operated by the local salmon enhancement society that releases pink, coho and chum salmon into the unnamed drainage "C, which is a tributary to the Little River.

A search for fish occurrences on the government of BC's map-based ecological information database Habitat Wizard, indicates that cutthroat trout and coho salmon occur in the unnamed drainage "C" at the location of the hatchery (Photo 3.1; Fig). Figure 2.1 indicates the location of the fish occurrence, and the fish hatchery immediately adjacent to the project alignment. Substrate in the unnamed drainage "C" downstream of the road crossing at the hatchery consists of gravel, cobble and fines, whereas substrate upstream of the crossing is composed of organics.

Approximately five depressions containing pooled water were observed on google earth imagery to be within 100 m of the project alignment. A field visit confirmed the pooled water and reported that the depressions appear to have been dug-out creating pond-like habitat. The permanence of water in these dug-out ponds is unknown. The irrigation pond at the western end of the project likely contains water year-round. Depending on the period of time that the dug-out ponds contain water, the ponds and the irrigation pond provides potential habitat to amphibians. Additionally, the irrigation pond provides potential habitat to aquatic birds.

A conditional water licence (CO 65707) on Muir Spring allows for the water to be diverted and used by Beaver Meadow Farms for industrial (stock-watering) purpose.

Photo 3.1: The unnamed drainage “C” is a tributary to the Little River and provides habitat to pink, coho and chum salmon and cutthroat trout.

3.5 Groundwater

Groundwater resources in and near the project area were investigated by searching the BC Ministry of Forests, Lands and Natural Resource Operations Water Resource Atlas. The search showed that the project area is underlain by Aquifer 408 IIC (13). Aquifer 408 IIC is a sand and gravel aquifer with moderate productivity, low vulnerability and high demand. The search for groundwater wells revealed that there are two wells within the project alignment, two groundwater wells within 100 m of the alignment, and an additional three wells within 200 m of the project alignment (Figure 2.1). The seven wells located in proximity to the project are described in (Table 3.1).

Table 3.1 – Groundwater wells within a 200 m radius of the project

Well Tag Number	Depth to Water (m)	Well Depth (m)	Diameter (mm)	Well Use	Reported Yield (L/s)
115	n/a	0	0	Private Domestic	0
172	n/a	0	0	Private Domestic	0
45351	n/a	61	203	Unknown	n/a
45437	n/a	110	n/a	Unknown	0
57133	1	44	203	Irrigation	11
58331	n/a	33	203	Irrigation	32
112859	13	31	n/a	n/a	3

3.6 Vegetation

The project area is in the CWHxm biogeoclimatic sub-zone due to the rain shadow effect of the Vancouver Island Ranges. Drier maritime forests of the CWH typically have a substantial component of Douglas-fir along with western hemlock and western redcedar. Salal, dull Oregon-grape, and red huckleberry typify the poorly to moderately developed shrub layer. The moss layer of the CWH is typically well-developed dominated by Oregon beaked moss, splendid feather moss, lanky moss and flat moss (Meidinger and Pojar, 1991).

The field visit in October 2018 documented vegetation conditions in the project area. The project is situated on relatively flat, cleared land that supports little, if any, native vegetation. The alignment follows a gravel road with cultivated fields to the north and disturbed shrub vegetation with a presence of weed species to the south. At the western end of the alignment, vegetation along the unnamed drainage “A” consisted of alder, Himalayan blackberry and horsetail. To the east of the irrigation pond in the vicinity of the dug-out ponds, vegetation consisted of sword fern, Himalayan blackberry, vine maple, horsetail and weed species. The unnamed drainage “B” was lined with alder trees. Riparian vegetation along the unnamed drainage “C” consisted of alder trees, Himalayan blackberry, salmonberry, thimbleberry, red elderberry, sword fern and horsetail. Photos 3.2 to 3.5 show representative environmental conditions along the project alignment from west to east.

Photo 3.2: Representative environmental conditions at the north side of the irrigation pond. The snag tree is an important habitat feature for perching raptors.

Photo 3.3: Representative environmental conditions looking north – the proposed alignment is along the road visible in the photo. The trees at photo left are along the unnamed drainage "B".

Photo 3.4: Representative environmental conditions facing east of the unnamed drainage “C”. Pooled water is present on the south side of the gravel road that runs along the project alignment.

Photo 3.5: Representative environmental conditions just south of the farm at the eastern end of the alignment.

3.7 Wildlife

The project is in an area bounded by agricultural fields to the north and disturbed but undeveloped land to the south. Forested land at the western end of the project alignment connects to significant tracts of forest west and northwest of the project, and new residential development is occurring on land to the southwest. Due to the proximity to recent development, wildlife potentially displaced by development may occur in the general area including agricultural fields and forested areas.

Wildlife common to the CWH that utilize mixed forests and agriculture areas that may frequent the project area include black-tailed deer, black bear, cougar, Roosevelt elk, California myotis, Douglas squirrel, Columbian mouse, deer mouse, spotted skunk, coast mole; a variety of bird species; and reptiles and amphibians such as Northern alligator lizard, pacific treefrog, ensatina salamander, and Northwestern salamander (Meidinger and Pojar, 1991).

Wildlife observed during the October 2018 site visit included goldeneye and mallard ducks on the irrigation pond, a great blue heron in the unnamed drainage “C” (Photo 3.6), two unidentified shorebirds at the large dug-out pond, and an unidentified frog was heard calling. A snag tree on the north side of the irrigation pond was identified as an important habitat feature for potential perching raptors and cavity excavator and nesting bird species. Other habitat features were the dug-out ponds that provide potential habitat to amphibians and aquatic birds, and the unnamed drainages that provide habitat to fish and foraging opportunities for aquatic birds such as the great blue heron.

Photo 3.6. Great blue heron observed foraging in the unnamed drainage “C” at the location of the hatchery.

3.8 Species at Risk

Species at risk are ranked and listed by both federal and provincial government agencies. The federal and provincial species at risk ranking processes are discussed in the following sections.

3.8.1 Federal Species at Risk Act

On the Federal level, species ranking is conducted by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), established under Section 14 of the *Species at Risk Act* (SARA). COSEWIC is a committee of experts that assesses and designates, under Sections 15 to 21 of the SARA, those wild species of animal, plant or other organisms that are in danger of disappearing from Canada. Schedule 1 of the SARA is the official list of species that are classified as extirpated, endangered, threatened and of special concern. It should be noted that only species listed on Schedule 1 of the SARA are considered protected under the Act. Species of special concern are not protected under the Act but may be protected provincially or under regional management plans. Species on Schedules 2 and 3 of the SARA are not protected under the Act but have been assessed by COSEWIC and may eventually be listed under Schedule 1.

Following is a listing of the status categories used by COSEWIC to rank or list a species:

- **Extinct**: a species that no longer exists.
- **Extirpated**: a species no longer existing in the wild in Canada, but occurs elsewhere.
- **Endangered**: a species facing imminent extirpation or extinction.
- **Threatened**: a species likely to become endangered if limiting factors are not reversed.
- **Special Concern**: a species that is particularly sensitive to human activities or natural events, but is not an endangered or threatened species.
- **Data Deficient**: a species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.
- **Not At Risk**: a species that has been evaluated and found to be not at risk.

3.8.2 Provincial Species at Risk

The BC Conservation Data Center (CDC) tracks and categorizes species according to their conservation status in BC. Provincially, the CDC assigns a provincial rank or listing of ‘Red’ or ‘Blue’ or ‘Yellow’ to a species based on its status within BC. The rankings or provincial listing categories described below highlight the wildlife and plant species as well as natural plant communities that require special attention. The CDC listing is an advisory and management tool and is not a legal designation in the province.

- **Red**: any indigenous species, subspecies or plant community that is extirpated, endangered, or threatened in BC. Extirpated elements no longer exist in the wild in BC, but do occur elsewhere.

Endangered elements are facing imminent extirpation or extinction. Threatened elements are likely to become endangered if limiting factors are not reversed.

- **Blue**: any indigenous species, subspecies or community considered to be vulnerable (special concern) in BC. Vulnerable elements are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed elements are at risk, but are not extirpated, endangered or threatened.
- **Yellow**: indigenous species which are not at risk in British Columbia.

3.8.3 Species at Risk Search Methodology

In order to determine a list of potential species at risk that may occur within the project area, the following information review was conducted based on geographic location, biogeoclimatic zone and available habitat:

- A search of the Government of BC's Species and Ecosystems Explorer web site;
- A search of the Government of BC's Conservation Data Center (CDC);
- A search of the web site "Species at Risk and Local Government: A Primer for British Columbia"; and
- A search of the federal Species at Risk Act (SARA) Public Registry for identified Critical Habitat.

3.8.4 Species at Risk Search Results

No federally or provincially listed species at risk occurrences were identified within or near the project (CDC). No Critical Habitat, as defined in the SARA, occurs within or near the project. Federally and provincially listed species at risk with the potential to occur within the project area are listed in Table 3.2. The table summarizes species with the potential to occur and their preferred habitats, addresses potential impacts of the proposed development, and provides recommendations for all designated species at risk including:

- Species listed on Schedule 1 of the Species at Risk Act;
- Species which have been assessed by COSEWIC and may eventually be listed under Schedule 1 (Schedule 2 and Schedule 3 listed species); and
- Provincially designated species at risk (Red and Blue-listed species).

Table 3.2: Species at Risk Search Results Summary

Common Name	Scientific Name	Taxon	Status Under SARA	Status Under COSEWIC	Provincial list Designation	Preferred Habitat	Potential Occurrence in the Proposed Project Footprint	Recommendations
Band-tailed Pigeon	*Patagioenas fasciata*	Bird	1-SC (Feb 2011)	SC (Nov 2008)	Blue	Breeds in natural and human-made habitats including edges and openings in mature coniferous, mixed and deciduous forests, city parks, golf courses. Mineral sites are an important habitat feature, on rangeland this can be satisfied by salt licks. Mineral sites are considered critical habitat by COSEWIC Assessment and Status Report). Overwinter in both deciduous and coniferous woodlands, favouring open woods where berries and oak acorns occur.	Unlikely nesting in the project area due to the lack of suitable habitat.	None
Barn Owl	*Tyto alba*	Bird	1-T (Jun 2018)	T (Nov 2010)	Red	Open foraging habitat with an abundance of primary prey (voles and mice) such as agricultural fields, rough pasture, hayfields, and grassy roadsides. Roost in dense conifers, buildings, hollow trees, nest boxes and occasionally on the ground in tall grass. Breeding requires protected cavity nesting sites.	Unlikely nesting onsite. Possibly for foraging and roosting in the general area.	Conduct vegetation and ground clearing activities to the period of September 1 to March 15 to avoid impacting this species during the nesting period. Alternatively, have an appropriately qualified environmental professional conduct an active nest survey immediately prior to construction.
Barn Swallow	*Hirundo rustica*	Bird	1-T (Nov 2017)	T (May 2011)	Blue	Nests in barns or other buildings, under bridges, in caves or cliff crevices. Forages in open areas, frequently near water.	Unlikely for nesting as there are no structures in the proposed alignment. Possibly utilize the existing vacant structures (out buildings) at the east end of the project area, and slightly north of the proposed alignment.	Conduct any building demolition activities between September 1 and March 15 to avoid impacting this species. Alternatively, have an appropriately qualified environmental professional conduct an active nest survey immediately prior to construction.
Great Blue Heron, *fannini* subspecies	*Ardea herodias fannini*	Bird	1-SC (Feb 2010)	SC (Mar 2008)	Blue	Forages along seacoast, in fresh and saltwater marshes, along rivers and in grasslands, and less at anthropogenic waterbodies. Nest in woodlands near eelgrass meadows, along rivers, and in estuarine and freshwater marshes.	Unlikely for nesting due to a lack of suitable trees, however foraging in the unnamed drainage “C” was confirmed during October 2018 site visit.	Should there be nests in the general area, minimum buffers listed in Environmental Best Management Practices for Urban and Rural Land Development should be adhered to. A buffer of 200 m would apply to the rural location of the project. Avoid impacts to fisheries resources in unnamed Drainage “C” to ensure foraging opportunities are not impacted.

Common Name	Scientific Name	Taxon	Status Under SARA	Status Under COSEWIC	Provincial list Designation	Preferred Habitat	Potential Occurrence in the Proposed Project Footprint	Recommendations
Short-eared Owl	*Asio flammeus*	Bird	1-SC (Jul 2012)	SC (Mar 2008)	Blue	Inhabits extensive areas of open habitat including marshlands, estuaries, grasslands fields and forest clearings. Nests on the ground under low shrubs, reeds or grasses, usually near water. Short-eared owls need undisturbed areas with a reliable supply of prey (small mammals).	Unlikely for nesting due to the disturbed nature of the area. Possibly use adjacent areas for nesting habitat.	Conduct vegetation and ground clearing activities to the period of September 1 to March 15 to avoid impacting this species during the nesting period. Alternatively, have an appropriately qualified environmental professional conduct an active nest survey immediately prior to construction.
Threaded Vertigo	*Nearctula* sp. 1	Mollusc	1-SC (Jul 2012)	SC (Apr 2010)	Blue	Moist deciduous and mixed-wood forests at low elevations. Often associated with bigleaf maple and an of sword fern, salmonberry and shrubs characteristic of moist, rich sites. Snails are arboreal and encountered on trunks of maples.	Unlikely in the project area due to a lack of suitable habitat. Closest known occurrence of the species is at Union Bay, which is 16 km south of the project area.	None
Western Screech-Owl, *kennicottii* subspecies	*Megascops kennicottii kennicottii*	Bird	1-T	T (May 2012)	Blue	Prefers coastal, low-elevation, mixed deciduous-coniferous forest, often near a stream. Can be found in older residential areas with mature trees and woodland. Nests in natural tree cavities or holes excavated by large woodpeckers in large diameter deciduous trees, such as black cottonwood, trembling aspen, paper birch. Coniferous trees also used. Eats small rodents, large insect, small birds.	Possibly use riparian areas along existing ditches to the north of the project area for nesting.	Conduct vegetation and ground clearing activities to the period of September 1 to March 15 to avoid impacting this species during the nesting period. Alternatively, have an appropriately qualified environmental professional conduct an active nest survey immediately prior to construction.
Wandering Salamander	*Aneides vagrans*	Amphibian	1-SC (Feb 2018)	SC (May 2014)	Blue	Is completely terrestrial and lacks an aquatic larval stage. Requires moist microhabitats and always found inside cavities or cracks in decaying logs or under loose bark covering logs or stumps. Prefers logs in early stages of decay (i.e. loose bark, heartwood intact). May prefer Douglas-fir logs, will use western redcedar.	Unlikely occurrence in project area due to a lack of suitable habitat. Possibly use adjacent logged area to the south of the project area.	If individuals are encountered during construction, contact a Qualified Environmental Professional for direction.

3.9 Cultural Resources and Archaeology

A search of the BC Ministry of Forests, Lands and Natural Resource Operations' Integrated Land and Resource Registry was conducted on August 20, 2018. The ILRR provides information on various legal interests on provincial crown land and private land, where available, including tenures, regulated uses, sensitive occurrence records such as archaeological sites, land and resource use restrictions, and reservations. The results of the ILRR search reported no sensitive occurrence records which indicates that there are no known and recorded archaeological sites within the vicinity of the project area.

4.0 Contaminated Sites

4.1 BC Online Provincial Contaminated Sites Registry

On September 5, 2018 two 0.5 km radius searches located 0.5 km from each end of the project area were conducted on the BC Online contaminated sites registry. The search results indicate that no known provincially registered contaminated sites exist within the project area.

4.2 Federal Contaminated Sites Inventory

A search of the Treasury Board of Canada's Federal Contaminated Sites Inventory web site was conducted on August 20, 2018. The search indicated that no known federally registered contaminated sites exist within the project area.

5.0 Recommended Mitigation Strategies

The purpose of this environmental overview is to identify potential environmental constraints for consideration in the planning, design and construction of the proposed sanitary sewer. When sensitive habitat features are identified, a plan can be made to avoid these habitats, which is the best form of environmental mitigation. Sensitive and important habitat identified from available photos and web sources, are the fish-bearing tributary to the Little River, areas of pooled surface water, and trees in the project area.

By following the recommendations in Table 3.2 and the recommendations and mitigation strategies listed below, adverse environmental impacts associated with development of the sewer line can be avoided or minimized.

- Engage a Qualified Environmental Professional to develop a Construction Environmental Management Plan to maintain compliance under the various regulations identified in Section 1.5, and to monitor the construction project for adherence to any regulatory requirements/conditions.
- The proposed alignment is already cleared of vegetation. However, should any additional vegetation clearing be required, conduct clearing work during the period of September 1 to March 15 to avoid impacting birds during the general nesting season and to maintain compliance with the federal *Migratory Birds Convention Act* and provincial *Wildlife Act*. Should owls or raptors be present, clearing must occur prior to January. If land clearing during the nesting season cannot be avoided, a Qualified Environmental Professional must first assess the area to ensure that birds and their nests will not be adversely impacted by land clearing activities.
- Any watercourse crossing should be submitted for review to Front Counter BC under the provincial *Water Sustainability Act*. Specifically, the fish-bearing unnamed drainage “C”, which is a tributary to the Little River.
- Any watercourse crossing should be submitted to DFO for review under the federal *Fisheries Act*. Specifically, the fish-bearing unnamed drainage “C”, which is a tributary to the Little River.
- Maintain riparian vegetation where possible specifically along the fish bearing unnamed drainage “C”.
- Avoid disturbing areas of pooled surface water in the event that they are utilized by amphibians. If these areas cannot be avoided, conduct a survey to determine if these areas are utilized by amphibians and determine a plan to avoid impacts.
- Prepare a sediment and erosion control plan to avoid sediment laden water discharge to the unnamed drainages or the dug-out ponds.
- Minimize vegetation and land clearing activities to within the project footprint only.
- Maintain identified wildlife snag.
- Noxious weeds are identified in the project area. Any land disturbances must follow approved control/removal measures to prevent spreading to other areas.

In addition to the above mitigation, best management practices are provided in Table 5.1 to minimize adverse environmental impacts from general project construction activities.

Table 5.1 Best Management Practices

VEC	Development Activity Impacts	Environmental Effect	Mitigation
Geology and Soils	Excavation, land clearing and construction activities.	Soil compaction from heavy equipment. Removal of natural topsoil. Potential soil contamination from leaking equipment or fuel spills.	• Minimize the operation of heavy machinery to project footprints and designated areas to minimize the impact on surrounding areas. • Establish a staging area for fuelling and maintenance of equipment away from waterbodies, and ensure all equipment is clean and leak-free prior to project initiation. • Have a spill response plan and materials in place prior to project initiation. • Stockpile native topsoil during construction projects and utilize for re-seeding whenever possible.
Groundwater	Excavation, land clearing and construction activities.	Potential groundwater contamination from leaking equipment, fuel/oil spill. Change in groundwater flows.	• Same as above.
Vegetation	Excavation, land clearing and construction activities.	Disturbance of topsoil and loss of vegetation. Spread of noxious weeds.	• Minimize the operation of heavy machinery to project footprints and designated areas to minimize the impact on vegetation. • Stockpile topsoil (as long as weeds are not present) and use to distribute and encourage growth in disturbed areas. • Where appropriate, re-seed disturbed areas with native species (certified weed-free) to deter noxious weed invasion and capture overland flow during rain events or snowmelt. • Revegetate cleared land as soon as possible to avoid noxious weeds from becoming established. • Manage/ remove noxious weed infestation by approved methods.
Surface Water Resources	Overland water flow from excavation, land clearing and construction activities.	Sediment laden water input to areas of pooled surface water or the tributary to the Little River.	• Restrict the operation of heavy machinery to designated areas that are away from surface water. • Implement erosion control measures (e.g. silt fencing) at edge of project when surface flows occur, or around surface waters and riparian habitats, prior to development. • Delay construction during high precipitation events, if necessary. • Remove all erosion control measures upon project completion.
Wildlife and Species at Risk	Excavation, land clearing and construction activities.	Loss of potential wildlife habitat.	• Minimize the amount of vegetation clearing and land disturbance to the project footprint. • Where possible, re-seed disturbed areas with native species of vegetation. • Follow all recommendations provided in Table 3.2 of this report. • Conduct all vegetation clearing between September 1 and March 15 to minimize impacts to nesting birds and to maintain compliance with the federal *Migratory Birds Convention Act*, and *BC Wildlife Act*. Or, alternatively, have an appropriately qualified environmental professional conduct an active nest survey prior to land clearing activities. • Retain as much vegetation and coarse woody debris within the project area as possible.
Heritage/Archaeological Resources	Excavation	Disturbance/removal of heritage archaeological resources	• Should heritage/archaeological resources be discovered during works, stop work immediately, and notify the BC Archaeology Branch of the Ministry of Forest Lands and Natural Resource Operations.
Air Quality	Excavation and land clearing activities	Dust during excavation, and machine exhaust may decrease local air quality and affect people living or working nearby.	• Spray with dust palliatives, if required. • Avoid unnecessary idling of machinery.

6.0 Summary and Conclusion

The City of Courtenay is preparing for the construction of a utilities corridor to support development of a sanitary sewer connection for new development in the northeast corner of the City. The land proposed for the sanitary sewer is located in the Agricultural Land Reserve and is listed by the City of Courtenay as an Environmentally Sensitive Area and thus requires an environmental review prior to development.

The environmental review was prepared to meet the requirements outlined in the City of Courtenay's Official Community Plan and to identify potential environmental constraints for consideration in the planning, design and construction of the proposed sanitary sewer.

The sanitary sewer is proposed in an area that is cleared and contains a newly constructed gravel access road. Any remaining trees are located along drainages on adjacent land.

The project alignment crosses an unnamed fish-bearing drainage ("C"), and there are man-made ponds in the vicinity of the alignment. The project area is within proximity to a large tract of second growth forest to the west and northwest, and cultivated fields and the fish-bearing Little River to the north. The potential for prey species (i.e. small rodents) associated with the fields, and the waterbodies near the project area provide potential foraging opportunities in the general area. A great blue heron was observed foraging in the unnamed drainage "C". Potential impacts to the foraging habitat will be avoided by following mitigation measures identified herein. The vacant structures located just north of the proposed alignment at the east end of the project area provide possible nesting habitat for Barn Swallow.

In an effort to minimize potential adverse impacts to the environment from the proposed development, mitigative measures and best management practices are presented in Tables 3.2 and 5.1, and Section 5.1 of this report.

7.0 References

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DIVISION 1 – GENERAL CONDITIONS

CLOSEOUT PROCEDURES

1.0 GENERAL

1.1 Section 01 77 00 refers to those portions of the Work that are unique to the closeout procedures of the Sanitary Lift Station, Control Vault, and Meter Chamber. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the Work as described herein.

1.2 Measurement and Payment

.1 Payment for the Closeout Procedures shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

2.0 PRODUCTS NOT USED

3.0 EXECUTION

3.1 FINAL CLEANING

.1 Prior *to Substantial Performance of the Work*, remove surplus *Products*, tools, construction machinery and equipment not required for the performance of the remaining *Work*.

.2 Remove waste *Products* and debris and leave the *Work* clean and suitable for occupancy by *Owner*.

.3 Prior to *Total Performance*, remove surplus *Products*, tools, construction machinery, equipment, waste products and debris.

.4 Leave the *Work* clean before the final inspection process commences.

.5 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.6 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors, and ceilings.

.7 Vacuum clean and dust building interiors, behind grilles, louvers and screens.

.8 Wax, seal, shampoo or prepare building floor finishes, as recommended by the manufacturer.

.9 Inspect finishes, fitments, and equipment and ensure specified workmanship and operation.

.10 Broom clean and wash exterior walks, steps and surfaces.

.11 Remove dirt and other disfigurations from exterior building surfaces.

.12 Clean and sweep roofs, gutters, downspouts, areaways, and sunken walls.

.13 Sweep and wash clean site paved areas.

.14 Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

3.2 SYSTEMS DEMONSTRATIONS

.1 Prior to final inspection, demonstrate operation of each system to *Owner* and *Contract Administrator*.

.2 Instruct *Owner's* personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.

3.3 DOCUMENTS

.1 Collect reviewed submittals and assemble documents completed by *Subcontractors*, *Suppliers*, and Manufacturers.

.2 Provide warranties fully executed and notarized.

.3 Execute transition of Performance and Labour and Materials Payment Bond to warranty period requirements.

3.4 REMOVAL OF TEMPORARY FACILITIES

.1 Prior to application for *Substantial Performance of the Work* remove all temporary offices and furniture, hoardings, fencing, tree and plant protection and all other items used to aid the performance of the *Work*. Make good surfaces.

3.5 PROJECT COMMISSIONING

.1 Refer to specification 01 91 00 for details of system commissioning.

.2 Expedite and complete deficiencies and defects identified by the *Contract Administrator*.

.3 Review maintenance manual contents (operating, maintenance instructions, record "as-built" drawings, spare parts, materials) for completeness.

.4 Submit required documentation such as statutory declarations, Workers' Compensation Certificates, warranties, certificates of approval or acceptance from regulating bodies.

.5 Attend "end-of-work" testing and start-up/commissioning demonstrations.

.6 Provide draft commissioning plan to *Contract Administrator* no later than 4 weeks prior to commissioning for review. The commissioning plan shall include the sequence of testing and disinfection of the installed equipment prior to connection into the City system.

.7 Review inspection and testing reports to verify conformance to the intent of the documents and that changes, repairs or replacements have been completed.

.8 Meet with other *Project* Contract Administrators to co-ordinate completion testing approvals.

.9 Review condition of equipment which has been used in the course of the *Work* to ensure all equipment is in "as new condition" with warranties dated and certified from date of *Substantial Performance of the Work*.

.10 Arrange and co-ordinate instruction of *Owner* staff in care, maintenance and operation of building systems and finishes by *Suppliers* or *Subcontractors*.

.11 When partial occupancy of uncompleted *Project* is required by the *Owner*, co-ordinate *Owner's* uses, requirements, access, with *Contractor's* requirements to complete the *Work.*

.12 Co-ordinate *Owner's* moving-in of staff, furnishings, equipment with building accessibility, traffic, and *Contractor's* and *Subcontractor's* cleaning-up and completion activities all to suit *Owner's* work schedule and to not disrupt *Owner's* productivity.

.13 Provide on-going review, inspection and attendance to call-back, maintenance and repair problems during the Warranty Period.

3.6 INSPECTION/TAKEOVER PROCEDURES

.1 During the final inspection, a list of deficiencies and defects will be tabulated. Correct same.

END OF SECTION

COMMISSIONING

1.0 GENERAL

1.1 This section refers to requirements for commissioning the *Works* into operation. This section must be referenced to, and interpreted simultaneously with, all other sections pertinent to the *works* described herein.

1.2 The *Contractor* shall provide, commission and turn over to the *Owner* the complete operating facility.

1.3 For commissioning purposes, the term commissioning shall mean integrating the *Work* of this *Contract* entirely, including integrating the existing equipment with the new systems, with water being introduced and treated through the system.

1.4 Testing and commissioning shall be performed by the *Contractor*, and witnessed by Manufacturer's representative(s) where specified, in the presence of the *Contract Administrator* and the *Owner's* Representative.

1.5 Measurement and Payment

.1 Payment for the Commissioning shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

1.6 Strategy and Procedures

.1 All Divisions to ensure that their *specification* results in all systems being fully operational prior to commissioning.

.2 The *Contractor* shall start up and test all pieces of equipment in accordance with individual Specification Sections.

.3 Where not specifically detailed in individual *Specification* Sections, each piece of equipment shall be started up and tested in accordance with the manufacturer's written instructions and procedures and in accordance with procedures and standards of applicable certification sponsoring associations before the entire plant is commissioned as a whole.

.4 The Contract Administrator shall act as the Commissioning Agent for the Owner.

.5 Following the *Contract Administrator's* acceptance of successful start-up and testing of all individual pieces of equipment as described within specifications of other Divisions, the Contractor shall begin "**Commissioning**".

.6 The *Contractor* shall prepare a Commissioning Plan at least 45 **days** prior to the Commissioning commencement date, and submit to the *Contract Administrator* before the start of commissioning for review and comment.

.7 The commissioning is not to commence until power to the site is established through the BC Hydro network.

.8 The commissioning is not to commence until communication to the station is established through the City SCADA system. The contractor shall work with the City and its vendors to ensure this communication is in place prior to start commissioning. The Contractors Commissioning Plan shall include time and considerations for establishment and confirmation of the SCADA requirements. The contractor will allow for 2 weeks between the final programing of the PLC and the commissioning date to allow for SCADA integration.

.9 Based on the *Contract Administrator's* review comments, the *Contractor* shall revise its Commissioning Plan appropriately. Activities shall only commence once the Commissioning Plan has been approved by the *Owner* and *Contract Administrator.*

.10 During the Warranty Period, the *Contractor*, *Subcontractors*, *Suppliers* and manufacturers shall be available to address questions by the *Owner's* Operations Staff and the *Contract Administrator* at no cost to the *Owner*.

.11 The cost of temporary equipment and labour to commission the facilities will be paid for by the *Contractor.*

.12 Water is not available onsite and any water required for commissioning shall be the responsibility of the contractor.

1.7 Quality Assurance

.1 Testing personnel shall have the experience and qualifications necessary to undertake the specified testing services specified in other sections and to undertake trouble-shooting and operation of the equipment. Summary of qualifications, certifications, training and experience of testing personnel shall be submitted to the *Contract Administrator* if requested.

.2 Comply with applicable procedures and standards of the certification sponsoring association and procedures specified by the manufacturer.

.3 Perform services under direction of supervisor qualified under certification requirements of applicable sponsoring association, if applicable to system and/or equipment.

.4 Laboratory services that are required to demonstrate compliance will be paid for by the Contractor.

1.8 Submittals

.1 As part of the Commissioning Plan submit names of organization and/or *Contractor* personnel proposed to perform services. Designate who has managerial responsibilities for coordination of entire commissioning process and procedures.

.2 Provide a list of tables, data to be recorded and analyses to be performed during the commissioning period.

.3 Submit form of final reports that are to be provided.

1.9 Testing and Commissioning General Procedures

.1 Comply with procedural standards of certifying association under whose standard services will be performed.

.2 Notify Contract Administrator 14 days prior to beginning of operations.

.3 Accurately record data for each step taken during commissioning.

.4 Report to *Contract Administrator* any deficiencies or defects noted during performance of services.

1.10 Final Reports

.1 Organization having managerial responsibility shall make reports.

.2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.3 Identify each instrument used, and latest date of calibration of each.

.4 Include in O&M Manual.

1.11 *Contractor* Responsibilities

.1 Prepare each system for testing and operation.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times in Commissioning Plan.

.4 Record equipment operational data during Test Period and submit for review.

1.12 Preparation

.1 Provide instruments required for monitoring and adjusting operations.

.2 Make instruments available to *Contract Administrator* as requested and as appropriate to facilitate spot checks during commissioning.

.3 Retain possession of instruments and remove at satisfactory completion of commissioning.

.4 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

1.13 Execution

.1 Operate equipment in accordance with manufacturers' instructions and the Commissioning Plan.

2.0 PRODUCTS NOT USED

3.0 EXECUTION

3.1 Testing and commissioning shall normally proceed in seven steps:

.1 Preparation of all equipment and the power supply, control, piping and valve systems ready for initiation of testing of system components.

.2 Testing of all individual items and items forming sub-systems, ready for operation.

.3 Testing an entire system and subsystems and confirmation that the systems and sub-systems perform as required or specified and to the satisfaction of the Supplier's representative for the system or sub-system, in the presence of the Contract Administrator and Owner's representatives.

.4 Completion of any adjustments recommended by the Supplier's Representative or rectification of deficiencies observed by the Owner or the Contract Administrator.

.5 Operation of the systems by the Contractor including training of the Owner's representative.

.6 Operation by the Owner's representative under the direct supervision of the Contractor.

.7 Turn over the accepted system or sub-system to the Owner.

3.2 Perform testing in four phases:

.1 Static Testing

.2 Dynamic Testing,

.3 Wet Testing with water,

.4 Demonstrate to the satisfaction of the Contractor and the Contract Administrator that the equipment and materials furnished, with all auxiliary work, have been fully tested and have been in satisfactory operation for not less than 7 consecutive days, 24 hours per day without interruption, in addition to any test periods or demonstration periods specified elsewhere.

3.3 Testing Individual Equipment

.1 Every individual item of equipment shall be tested by itself and in combination with related items to ensure that the item and the subsystem are in perfect operating condition, comply with specified requirements and are ready for operation.

.2 All testing, checking, calibration, adjustments, making of connections, setting, lubrication and other requirements shall be carried out and a brief report submitted to the *Contract Administrator* for each item tested individually.

.3 Other sections of the specifications may contain specific testing, cleaning, disinfecting, balancing and operation requirements, which are to be followed in conjunction with this Section.

.4 Inspection and testing shall include, but shall not be limited to:

.1 Soundness - without damaged parts,

.2 Completeness in all details as specified,

.3 Correctness of setting, alignment and arrangements of parts,

.4 Proper rotation of motors and drives,

.5 Adequacy and correctness of packing, sealing and lubrication.

.6 Proper operation in hand and automatic control.

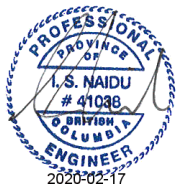
.7 Wet testing with water

DIVISION 26 – ELECTRICAL AND CONTROLS

CERTIFICATIONS PAGE FOR TECHNICAL SPECIFICATIONS PREPARED BY ENGINEER

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations



Seal #1 Seal #2 Seal #3

Irvin Naidu, P.Eng.
PBX Engineering Ltd.
Division 26 Specifications

NOTES:

Each Engineer that has applied a seal above shall indicate which sections of the specifications he or she is certifying and the engineering company they work for. Alternatively, the Engineer may indicate which engineering discipline he or she is certifying as long as the name of the engineering company they work for (the source) is shown on the applicable technical specifications.

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 TECHNICAL SPECIFICATION INCLUDES

.1 This Technical Specification covers items common to Technical Specifications of Division 26. This Technical Specification supplements requirements of Division 1.

.2 This Technical Specification 26 05 00 refers to those portions of the Work that are unique to the supply and installation of all electrical, control, and instrumentation and related appurtenances. This Technical Specification must be referred to and interpreted simultaneously with all other Technical Specifications pertinent to the works described herein.

1.3 RELATED SECTIONS

.1 Technical Specification 26 05 00 - Common Work Results – Electrical

.2 Technical Specification 26 05 02 – Seismic Restraint

.3 Technical Specification 26 05 10 - Testing and Commissioning

.4 Technical Specification 26 05 20 - Wire and Box Connectors (0-1000V)

.5 Technical Specification 26 05 21 - Wires and Cables (0-1000V)

.6 Technical Specification 26 05 28 - Grounding - Secondary

.7 Technical Specification 26 05 29 - Hangers and Supports for Electrical Systems

.8 Technical Specification 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets

.9 Technical Specification 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings

.10 Technical Specification 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings

.11 Technical Specification 26 05 43 01 - Installation of Cables in Trenches and in Ducts

.12 Technical Specification 26 05 81 – Motors

.13 Technical Specification 26 12 16 01 – Dry Type Transformers up to 600V Primary

.14 Technical Specification 26 24 01 - Service Equipment

.15 Technical Specification 26 24 02 - Service Entrance Board

.16 Technical Specification 26 24 16 01 - Panelboards Breaker Type

.17 Technical Specification 26 27 15 - Electrical and Controls Components

.18 Technical Specification 26 27 16 – Electrical Kiosk

.19 Technical Specification 26 27 26 - Wiring Devices

.20 Technical Specification 26 28 16 02 - Molded Case Circuit Breakers

.21 Technical Specification 26 28 23 – Disconnect Switches

.22 Technical Specification 26 32 13 01 - Power Generation - Diesel

.23 Technical Specification 26 36 23 - Automatic Transfer Switches

.24 Technical Specification 26 50 00 – Lighting

.25 Technical Specification 26 52 00 – Emergency Lighting

.26 Technical Specification 26 54 00 - Heaters and Ventilation

1.4 REFERENCES

.1 Definitions:

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in the Technical Specifications, and on Contract Drawings, are those defined by IEEE SP1122.

.2 Reference Standards:

.1 CSA Group

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 1-10 (R2015), General Requirements - Canadian Electrical Code, Part 2.

.3 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 All inspections and tests shall be in accordance with, but not limited to, the following applicable codes and standards except as provided otherwise in this Section

.1 International Electrical Testing Association - NETA

.2 National Electrical Manufacturer's Association – NEMA

.3 Canadian Electrical Manufacturers Association - CEMA

.4 American Society for Testing and Materials - ASTM

.5 Institute of Electrical and Electronic Engineers – IEEE

.1 1584-2002, Guide for Performing Arc-Flash Hazard Calculations

.6 American National Standards Institute – ANSI

.1 ANSI Z535.4-2011, Product Safety Signs and Labels

.7 Canadian Electrical Code - Parts 1 and 2

.8 Canadian Standards Association – CSA

.1 CSA Z462-15, Workplace electrical safety, provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting personal protective equipment to protect against shock and arc flash hazards.

.9 Insulated Power Cable Engineers Association - IPCEA

.10 National Fire Protection Association - NFPA

.11 ANSI/NFPA 70B: Electrical Equipment Maintenance

.12 WCB Regulations

.13 CANICSA-B72-M87: Lightning Protection Code

.14 Municipal By-Laws

.5 All inspections and tests shall utilize the following references:

.1 Project design drawings and specifications

.2 Shop drawings and submittals

.3 Manufacturer's instruction manuals applicable to each particular apparatus

.4 Applicable NETA acceptance testing work scope sections per NETA ATS 2009

1.5 SUMMARY OF WORK

.1 This project involves the construction of a sanitary lift station in the City of Courtenay. The electrical scope of the project includes, but is not limited to, the following items of work:

.1 Coordination with BC Hydro and supply and installation of new BC Hydro service, including service entrance and meter socket:

.1 Pump Station: 347/600V, 200A, 3 phase service.

.2 Trenching and backfilling for underground electrical duct work.

.3 Supply and installation of underground electrical conduits.

.4 Supply and installation of electrical grounding systems.

.5 Supply and installation of concrete pads for generator and electrical kiosk including gaskets between pad and enclosures. Refer to Contract Drawings for foundation details.

.6 Supply and installation of concrete base for luminaire pole.

.7 Supply and installation of luminaire pole.

.8 Supply and installation of electrical kiosks equipped with electrical, controls, and power distribution equipment.

.9 Supply and installation of electrical equipment within the wet wells, valve chambers, actuated valve manholes, and flow meter manholes.

.10 Supply and installation of standby diesel generators complete with electronic trip main breakers, electronic trip load bank breakers, sound attenuated enclosures, and sub-base fuel tanks.

.11 Provide testing and commissioning of the electrical services and systems provided under the Contract Documents.

.12 Providing electrical commissioning of external control and power facilities for the standby generator power systems, including:

- .1 Adjusting settings on electronic trip circuit breakers.
- .2 Commissioning of automatic transfer switch with standby generator, including confirmation of status alarm annunciation.
- .3 Commissioning of 120V power systems for generator battery charging and heating.
- .4 Coordinate commissioning schedule and activities with generator manufacturer.

.13 Provide PLC, HMI, and communications network programming and commissioning services.

.14 Provide electrical assistance during the commissioning of the SCADA system for this Project.

.15 Provide programming and testing services for miscellaneous items including VFDs, electronic breakers and other configurable components.

.16 Provide all permits, licenses and fees required by applicable Governmental Authorities having jurisdiction.

.17 All work shall be performed by qualified personnel.

.18 Provide seismic engineering and associated materials and equipment as described herein.

.19 Provide vibration isolation equipment and materials including seismic restraints and anchoring.

.20 Preparation of Operations and Maintenance manuals.

.21 Provision of training for the operation and maintenance teams.

1.6 MATERIAL SUPPLIED BY OTHERS

.1 The following items will be supplied by the Owner:

.1 Telecommunications modem will be supplied by the Owner for installation by the contractor.

1.7 REMOVAL OF REDUNDANT MATERIAL AND EQUIPMENT

.1 No removal of redundant material and equipment is planned for the Works.

1.8 DEFINITIONS

.1 The word “Install” means the Supply, delivery, and installation of device or equipment referenced to the level required to be complete and operational including, unloading, unpacking, assembling, erecting, applying, finishing, protecting, and cleaning.

.2 The word “Supply” means to obtain and deliver to the Site, ready for unpacking, assembly, and installation.

.3 AHJ: Governmental Authority having jurisdiction.

1.9 DRAWINGS, MEASUREMENTS, AND NOTATION

.1 Contract Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work.

.2 The Contract Drawings show approximate locations of equipment and apparatus but the right is reserved to make such changes in location before installation or performance of the work as may be necessary to meet the exigencies of construction in any way. No extra will be allowed and conversely, no credit shall be expected for such changes unless for each item of work the distance moved exceeds 3m prior to final installation of same.

.3 Take field measurements where equipment and material dimensions are dependent upon building dimensions.

.4 The Contractor shall supply and install all electrical equipment. Standard notations are used on the Contract Drawings to assist the Contractor in identifying what work needs to be done. These standard notations are defined as follows:

.1 “All equipment is proposed unless noted otherwise” – This notation is used on Contract Drawings where the majority of the equipment on the drawing is to be supplied and installed by the Contractor. The notation means that the Contractor shall perform all work shown on the Contract Drawing except for equipment shown as existing (i.e. to remain).

.2 “All equipment is existing unless noted otherwise”: - This notation is used on Contract Drawings where the majority of the equipment is existing. The

notation means that the Contractor shall perform only the Work identified on the Contract Drawings.

.5 The words “provide” and “install” shall be taken to mean supply, install, test, and commission.

1.10 RESPONSIBILITY AND COORDINATION

.1 Provide all labour, materials, equipment, tools, and incidentals necessary to provide a complete electrical installation as indicated on the Contract Drawings and as set out in these Technical Specifications.

.2 Without relieving the Contractor of his responsibilities, the Technical Specifications have been divided into approximate trade sections for convenience. The use of these sections do not, however, limit the responsibility of the Contractor or any Subcontractor or Supplier. The onus of defining the extent of the Subcontractors' work remains with the Contractor, who, when awarding subcontracts, will ensure that the area of responsibility of any particular Subcontractor is set out in full detail.

.3 The Contractor shall advise the Contract Administrator of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Work Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Contract Administrator at a later date. Alternatively, the Contractor shall procure the specified material or equipment at their own additional expense by means of air freight or other special means of transportation.

.4 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Contract Drawings and Specifications, obtain a ruling from the Contract Administrator prior to tender closing. Failing this, the most expensive alternative is to be allowed for.

.5 Advise the Contract Administrator of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.

.6 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all proposed and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced, and replaced if and when required. Advise the Engineer of space problems before fabricating or installing

any material or equipment. Demonstrate to the Engineer on completion of the work that all equipment and material installed can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Engineer's written direction.

.7 Where electrical work and materials are noted as being provided by the Owner or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.

.8 Ensure that any building structure loaded during the installation is adequate to carry such load.

.9 Testing in accordance with Section 26 05 10 Testing and Commissioning.

.10 A contractor is entitled to engage in the regulated work for which the contractor is licensed.

.1 A licensed contractor must not:

.1 Manage or do regulated work that is:

.1 Outside the scope of the license,

.2 Contrary to any term or condition of the license, or

.3 Contrary to any term or condition imposed by the regulations on the use of the license, or

.2 Permit regulated work to be undertaken by persons under the control of the licensed contractor if they are not authorized.

.2 A licensed contractor must:

.1 Maintain current knowledge of the Acts, relevant regulations, relevant directives, relevant safety orders and any other relevant material that the minister makes publicly available, and

.2 Ensure that individuals who do regulated work for the licensed contractor maintain similar current knowledge.

1.11 CODES AND STANDARDS

.1 Complete installation in accordance with CSA C22.1-2015 except where specified otherwise.

1.12 PERMIT, FEES, AND INSPECTION

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of Work.

.2 Pay associated fees.

.3 Arrange for inspection of the work as the installation progresses and as further required by all applicable authorities having jurisdiction.

.4 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.

.5 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work to Consultant.

.6 The Consultant will carry out inspections and prepare deficiency lists for corrective action by Contractor, during construction, upon completion of work, and during the Warranty period.

1.13 DELIVERY AND STORAGE

.1 Store all electrical equipment and devices other than conduits, fittings, boxes, and ducts in a heated and ventilated space, and protect from construction damage. Include in the tender price all costs related to such storage.

.2 Conduits, fittings, boxes, and ducts may be stored outside if properly protected against the weather.

.3 Ship and store floor mounted equipment in upright position.

.4 Ship equipment in adequate containers to assure it arrives undamaged at the site.

.5 Keep equipment doors locked. Protect equipment from damage and dust.

.6 Block moving parts when necessary to prevent damage during movement and shipment of equipment.

.7 Remove from the site, and replace with new, all materials showing evidence of damage or rust.

1.14 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Conditions of the Contract and Section 1 Specification Sections.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Electrical Safety Regulation within the Electrical Safety Act and the Building Code and By-Laws.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform installation tasks.

.2 Submit list showing names and qualifications of key supervisory personnel.

1.15 SAFETY AND PRECAUTIONS

.1 Safety practices shall include, but are not limited to, the following requirements:

.1 Workers' Compensation Board Regulations

.2 Municipal By-Laws

.3 Canadian Electrical Code

.4 Electrical Safety Act of BC

.5 Municipal, Provincial and Canadian Building Code

.2 Tests shall be performed with apparatus de-energized unless otherwise specified (e.g., rotation, phasing).

.3 Power circuits shall have conductors shorted to ground by an approved hotline grounded device.

.4 In all cases, work shall not proceed until the Contractor's safety representative has determined that it is safe to do so.

.5 The Contractor shall have sufficient protective barriers and warning signs available, where necessary, to conduct specified tests safely.

.6 The Project safety procedures shall be reviewed and accepted by the Contractor and all sub-trades.

1.16 CARE, OPERATION, AND START-UP

.1 Instruct Consultant and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.17 APPROVALS

.1 Without limiting or restricting the contents of the Contract General Conditions, requests for approval of the substitution of materials pertaining to electrical work prior to awarding of any contract must be submitted to the Consultant so that they are received by the Consultant at least five (5) working days prior to the close of tender.

.2 All submissions shall include the following information:

.1 Name and identification of specified item.

.2 Manufacturer, brand name, and catalogue number of the alternative item proposed.

.3 Detailed technical data and characteristics of alternative item such as dimensions, voltage, power requirements, performance characteristics, etc.

.4 Request for lighting fixture substitutions must be followed by photometric data and shop drawings.

.5 A list of any and all changes to the installation which may be required as a result of the substitution.

.3 Materials, equipment, apparatus, light fixtures, or other products specified by manufacturers' brand name, type, or catalogue number are so specified in one of two ways:

.1 Specified item followed by the words “or equal” or “approved equal” or preceded by the words “equivalent to” or “equal to”; when the Specification is so worded, it is intended to establish a specific standard of quality and style but the item may be substituted for, provided written approval is stated in the form of an Addendum. It is the responsibility of the Contractor to assure that all features of the specified items are supplied as part of the substitute item. If written approval of a substitute item is not issued in the form of an Addendum, the item shall be supplied precisely as specified.

.2 Specified items not followed or preceded by any such qualifying phrases: When the specification is so worded, the item shall be supplied as specified and NO approved equals or equivalents will be allowed.

.4 Review by the Engineer of alternate materials as permitted above is only a general approval in principal and shall not relieve the Contractor of his responsibility to ensure that any approved alternate materials perform in the same manner and with the same intent as the originally specified material would have otherwise performed.

.5 Where such substitutions alter the design or space requirements indicated on the Drawings, include all material, labour, design, and engineering costs for the revised design and construction including costs of all other trades affected and those incurred by the Architect and/or Engineer.

.6 It is the Contractor's responsibility to ensure substituted products are approved and that suppliers have written approval indicating conditions of any such approval. Alternate manufacturers who do not have such approval shall not be used in the work. If requested by the Engineer, the Contractor for Division 26 shall submit for inspection, samples of both the specified and the proposed substitute items on short notice.

1.18 SUBSTANTIAL PERFORMANCE INSPECTIONS

.1 Before the Engineer is requested to make a Substantial Performance inspection, submit written confirmation that:

.1 All wiring devices, cover plates, motor controls, lighting fixtures, and other equipment are operational, plumb, clean, and correctly labelled.

.2 All distribution equipment (cabinets, panels, distribution transformers, etc.) has been cleaned and vacuumed.

.3 All Test Reports have been submitted.

.4 All auxiliary systems have been tested as required and are in good and proper working order.

.5 All certificates of final acceptance from the authorities having jurisdiction have been received and submitted to the Engineer.

.6 Factory finished equipment has been cleaned, touched up, or refinished as necessary to present a new appearance.

.7 All sealing of conduits, cables, cable trays, wireways, etc. at wall, ceiling, and floor penetrations have been completed.

.8 All lighting fixtures including lenses and reflectors have been properly cleaned as specified.

.9 All loose equipment including spare parts and replacement parts have been turned over to the Owner and receipts obtained for same.

.10 The Maintenance Manuals have been submitted.

.11 All demonstrations and instructions to the Owner have been completed.

.12 Verification letter from Seismic Engineer has been submitted.

.2 Provision of the above shall not be construed as compliance with all administrative documentation required.

.3 Notwithstanding any other provisions of the Contract, failure to complete all of the above shall give cause to deny the issuance of a Substantial Performance Certificate.

1.19 CLOSEOUT SUBMITTALS

.1 Submittals: in accordance with Conditions of the Contract and Section 1 Specification Sections.

.2 Shop Drawings

.1 Refer to Contract Documents.

.2 Notwithstanding the above, submit shop and setting drawings or diagrams to the Engineer sufficiently in advance of requirements to allow time for review and comment. Provide shop drawings in electronic format, Adobe Acrobat "pdf." The drawing will be retained by the Engineer for their office use and a copy will be marked and returned to the Contractor for correction if necessary, further reproduction, and distribution as required. Provide shop drawings in AutoCAD 2008 format where required for major equipment as noted in individual sections herein.

.3 Shop drawings shall be neatly drafted and shall be complete and detailed and shall be provided as stipulated elsewhere in these Specifications.

.4 All shop drawings shall use metric dimensions. Scaled drawings shall use metric scale.

.5 Ensure that all cable pit and cable trench locations are clearly shown and dimensioned on all shop drawings of high voltage and other switchgear.

.6 Shop drawings shall bear specific names for each and every unit assembly defined thereon, the name of the project where installation is to take place, the name of the manufacturer, and the date of the drawing including notation of latest revision, if any.

.7 Except as may be necessary to indicate operation of switchgear and similar apparatus and to show field interconnections, detailed wiring diagrams of component assemblies need not be included with shop drawings unless requested by the Engineer. However, such wiring diagrams shall be included as part of the Maintenance Manual as required by these Specifications.

.8 Indicate details of construction, dimensions, locations of cable pits and trenches, capacities, weights and electrical performance characteristics of equipment and materials.

.9 Shop drawings may be prepared by the Contractor, or manufacturer's drawings will be accepted. Drawings required for one and the same system shall be submitted as a complete package. Incomplete system packages will not be reviewed and will be returned unmarked.

.10 Shop drawings shall be reviewed by the Contractor prior to submission to the Engineer. Shop drawings not bearing Contractor's approval stamp, approval date, signature, and project name will be returned without comment.

.11 Manufacturers' brochures (product data) submitted as shop drawings shall clearly indicate type (i.e., lighting fixture Type AD, intercom station Type B, etc.) and all features as specified as part of the unit(s).

.12 Facsimile Shop Drawings will not be accepted.

.13 Review of Shop Drawings by the Engineer is for the sole purpose of ascertaining conformance with the general design intent. The review shall not mean approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.

.14 Ensure that copies of all shop drawings are available at the job site.

.3 Test Procedures in accordance with Section 26 05 10 Testing and Commissioning.

.4 Maintenance Manuals:

.1 Submission:

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 Copy will be returned after final inspection, with Engineer's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, four final copies of operating and maintenance manuals in English.

.5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.6 If requested, furnish evidence as to type, source and quality of products provided.

.7 Defective products will be rejected, regardless of previous inspections. The Contractor shall replace products at their own expense.

.8 Pay costs of transportation.

.2 Format

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.3 Contents – Each Volume:

.1 Table of Contents: provide title of project;

.1 Date of submission; names,

.2 Addresses, and telephone numbers of Engineer and Contractor with name of responsible parties;

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

.6 Guarantees, Warrantees and Bonds

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.4 Equipment and Systems:

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.12 Additional requirements: As specified in individual specification sections.

.5 "As-Built" Drawings

.1 Refer to Contract Documents.

.2 Notwithstanding the above, maintain in the job site office in up-to-date condition, one (1) complete set of whiteprints of each of the Electrical Contract Drawings and one (1) set of Specifications, including Revision Drawings, marked clearly and indelibly in red, indicating "As-Built" conditions where such conditions deviate from the original directions of the Contract Documents, and indicating final installation of feeders and branch circuits.

.3 "As-Built" drawing markings shall include but shall not be limited to the following:

.1 All changes in circuiting.

.2 Size and routing of all conduits for branch circuits including power, lighting, and systems. Note that branch circuit wiring is generally not shown on Drawings. Accurately record on "As-Built" drawings the size and routing of all installed raceways and cables.

.3 Number and size of conductors in raceways and cables

.4 Location of all junction and pull boxes

.5 Location of all access panels

.6 Location of all conduit or duct stubs, installed equipment, devices, and fixtures

.7 All changes to electrical installation resulting from Addenda, Change Orders, and Field Instructions (Architectural / Engineering Instructions)

.8 Exact location of all services left for future work

.9 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.

.10 Exact labeling of each communication system cable at each data outlet location. Locate label numbers adjacent each communication outlet indicated on drawings. Label numbers to match those at the Communication Room cable end.

.11 Where extensive changes have been made to an area to the point where it is not practical to update the original tender drawing, the area in question shall be enclosed with a heavy dotted line and reference made to the applicable Change Order, Instruction, and/or associated Revision Drawing.

.12 For each and every "As-Built" drawing, reference shall be neatly drawn inside the framed space above the title block, listing all Contemplated Change Orders, Instructions, and Revision Drawing Numbers applicable to the particular "As-Built" drawing in question.

.13 Each "As-Built" drawing as defined above shall bear the Contractor's identification and signature, the date of record, and the notation: "We hereby certify that these Drawings represent the building as built."

.14 All Addenda and Revision Drawings not having their details transferred onto the submitted "as-built" drawings shall be included in the submission using the same drawing format as previously described.

2. PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates for control items in English.

2.2 MATERIALS AND EQUIPMENT

.1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department before delivery to site and submit approval as described in Part 1 – Submittals.

.2 Factory assemble control panels and component assemblies.

.3 All materials and equipment shall be current. Discontinued products or “old stock” is not permitted.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction and Consultant.

.2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify equipment cabinets with nameplates as follows:

.1 Nameplates:

Lamicoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self-tapping screws or permanent self-adhesive, 20 x 90 mm, 1 line, 8 mm high letters.

.2 Identify electrical equipment with labels as follows:

.1 For each device, install label on equipment, panel, and backside of panel, where applicable.

.2 Labels:

Embossed plastic labels with 6mm high letters unless specified otherwise.

.3 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.4 Allow for average of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system.

.6 Wording on nameplates and labels to be approved by Engineer prior to manufacture.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of cable.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
Communication Systems	Green	Blue
Security Systems	Red	Yellow

2.9 MANUFACTURERS AND CSA LABELS

.1 Visible and legible, after equipment is installed.

2.10 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.2 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 Repair or replace, at no cost to the Owner, any equipment or structures damaged by the execution of Contract to its original condition.

2.11 TEST EQUIPMENT

.1 All test equipment shall be furnished by the Contractor.

.2 Test instrument calibration

.1 The Contractor shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.

.2 Up-to-date calibration labels shall be visible on all test equipment.

.3 Use of torque wrenches

.1 Use calibrated torque wrenches for all bolted connections on buses and power cable terminations. Mark the head of the bolt with a coloured marking pen after its being torqued to manufacturer's recommended value.

3. EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and other recyclable packaging material in accordance with Waste Management Plan.

.4 Divert unused wiring materials from landfill to metal recycling facility.

3.3 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.4 PROTECTION

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.5 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.6 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 plastic, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.7 FASTENING AND SUPPORTS

.1 Secure equipment to masonry, tile and plaster surfaces with nylon shields.

3.8 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.9 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.10 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Conditions of the Contract and Section 1 Specification Section:

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: communications.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Provide test results to Engineer.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

3.11 SYSTEM START-UP AND DEMONSTRATION

.1 Demonstrate to and instruct the Owner's representative on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction and include all costs in the tender.

.2 Systems to be demonstrated shall include, but not be limited to, the following:

.1 Entire power distribution system including protection systems and interlocking schemes.

.2 Backup power system and automatic transfer switch operation.

.3 Routing and installation of major feeders, duct banks and manholes and grounding.

.4 Labeling and identification schemes.

.5 Pump motor control and protection systems.

.6 Heating and ventilation systems.

.7 Communication systems.

.8 Grounding systems.

.9 Use of Maintenance Manuals.

.3 Arrange an acceptable time with the Owner and the Engineer and submit a program of instruction and demonstration for the Engineer's approval. Assume that the Owner's representative is not familiar with any of the special equipment and/or systems installed.

.4 Submit to the Engineer, at the time of Substantial Performance inspection, a complete list of systems stating for each system:

.1 Date instructions were given to the Owner's staff.

.2 Duration of instruction.

.3 Name of persons instructed.

.4 Other parties present (manufacturer's representative, Engineer, etc.).

.5 Signature of the Owner's staff stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

.5 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.6 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.12 REPORTS

.1 Contractor shall prepare test reports on the systems tested. Include a copy of each test report in the Operation and Maintenance Manuals.

.2 The Contractor shall prepare test reports including the following:

.1 Summary of project

.2 Description of equipment tested

.3 Description of test

.4 Test results including re-testing results

.5 Test dates

.6 Tester's name

.7 Witnesses (when required)

.8 Corrective work

.9 Acceptance criteria

.10 Conclusions and recommendations

.11 Appendix, including appropriate test form

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 26 24 02 – Service Entrance Board

1.3 REGULATORY REQUIREMENTS

.1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.

.2 The Contractor's Seismic Consultant shall submit original signed BC Building Code Letters of Assurance Schedules S-B and S-C to the Prime Consultant.

.3 Importance Factor: 1.5.

.4 Use the Electrical Contractors Association of BC details in the absence of any local requirements.

.5 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.4 SCOPE

.1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

.2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01 and other Division 26 specification sections.

.3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.

.4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints,

as well as all costs for the services of the Seismic Restraint Engineer. This Engineer, herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

.5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender. The contractor shall include for all costs related to seismic restraint.

.6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.

.7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.

.8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.

.9 Include all costs associated with the Seismic installation and certification in the base tender.

1.5 SHOP DRAWINGS & SUBMITTALS

.1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.

.2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

2. PRODUCTS

1.6 SLACK CABLE SYSTEMS

.1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or equal.

.2 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.

.3 Coordinate requirements of slack cables with suppliers prior to installation.

3. EXECUTION

1.7 GENERAL

.1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

1.8 CONDUITS

.1 Provide restraint installation information and details on conduit and equipment as indicated below:

.2 Vertical Conduit:

.1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.

.2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.

.3 Riser joints shall be braced or stabilized between floors.

.3 Horizontal Conduits:

.1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

.4 Do not brace conduit runs against each other. Use separate support and restraint system.

.5 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.

.6 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.

.7 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.8 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

.9 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to consultants for their reference.

1.9 FLOOR MOUNTED EQUIPMENT

.1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Seismic Consultant shall design anchors and bolts.

1.10 LIGHT FIXTURES

.1 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.

.2 Fixtures which are hung independently of ceiling systems shall have minimum of two seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.

.3 Cables shall be corrosion resistant and approved for the application.

.4 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SECTION INCLUDES

.1 Testing and commissioning services and equipment to assure that all electrical equipment is operational within industry manufacturers' tolerances, calibrated per the power system studies, complies with all applicable codes, is installed in accordance with design specifications, and functions in the system in the manner designed by the Engineer.

.2 Inspections, calibrations, and acceptance tests for all equipment systems shall be performed. The inspections and testing activities shall be divided among the following groups, as specified in this Section:

.1 The original equipment manufacturer's authorized service representative shall provide special equipment, labour, and technical supervision, when required, in addition to what is supplied by the Contractor.

.2 Inspections, calibrations, and acceptance tests for equipment and systems not requiring the services of the manufacturer's representative shall be performed by the Contractor.

.3 In cases where equipment and systems require the involvement of two or all of the parties, the parties mentioned above shall coordinate and perform all inspection and testing requirements. The Contractor shall be responsible for coordination of the work and ensuring that the requirements of this Section are met.

1.3 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 26 05 81 - Motors

.3 Section 26 27 15 – Electrical and Controls Components

.4 Section 26 54 00 – Heaters and Ventilation

1.4 REFERENCES

.1 All inspections and tests shall be in accordance with, but not limited to, the following applicable codes and standards except as provided otherwise in this Section.

.1 International Electrical Testing Association - NETA

.2 National Electrical Manufacturer's Association – NEMA

.3 Canadian Electrical Manufacturers Association - CEMA

.4 American Society for Testing and Materials - ASTM

.5 Institute of Electrical and Electronic Engineers – IEEE

.1 1584-2015, Guide for Performing Arc-Flash Hazard Calculations

.6 American National Standards Institute – ANSI

.1 ANSI Z535.4-2011, Product Safety Signs and Labels

.7 Canadian Electrical Code - Parts 1 and 2

.8 Canadian Standards Association – CSA

.1 CSA Z462-15, Workplace electrical safety, provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting personal protective equipment to protect against shock and arc flash hazards.

.9 Insulated Power Cable Engineers Association - IPCEA

.10 National Fire Protection Association - NFPA

.11 ANSI/NFPA 70B: Electrical Equipment Maintenance

.12 WCB Regulations

.13 CANICSA-B72-M87: Lightning Protection Code

.14 Municipal By-Laws

.2 All inspections and tests shall utilize the following references:

.1 Project design drawings and specifications

.2 Shop drawings and submittals

.3 Manufacturer's instruction manuals applicable to each particular apparatus

.4 Applicable NETA acceptance testing work scope sections per NETA ATS 2009

1.5 QUALIFICATIONS

.1 The Contractor shall retain the services of an individual that is qualified to test electrical equipment and is approved by the Engineer.

1.6 COORDINATION

.1 Coordinate the Acceptance Testing with the Owner and Engineer.

.2 Coordinate the factory field-testing and assistance per the requirements of this Section.

1.7 SUBMITTALS

.1 Submittals shall be in accordance with Conditions of the Contract and Section 1 Specification Sections.

.2 Submit the qualifications of the individual(s) doing testing and commissioning according to this Section for approval.

.3 Submit the coordinated test schedule for approval.

.4 Submit detailed test procedures corresponding to the requirements in this Section for approval. The test procedures shall be detailed test instructions, written with sufficient step-by-step information to allow a test to be repeated under identical conditions. List all setpoint values and acceptable results for each condition tested.

.5 Submit a preliminary copy of the hand-written field test results to the Engineer and the Contractor within one (1) week after the test is completed.

.6 Prior to energization of equipment, submit a letter certifying that the electrical installation being energized complies with contract documents, applicable codes, and proper system operation.

.7 The test reports shall be compiled and submitted in formal form with a summary.

1.8 OPERATIONS AND MAINTENANCE (O&M) MANUALS

.1 Operations and Maintenance Manuals shall be in accordance with Conditions of Contract and Section 26 05 00.

1.9 SCHEDULING

.1 Perform all testing after installation and before energizing. All systems shall pass tests prior to being put into service.

.2 The Contractor, in coordination with the equipment manufacturer's representatives, shall confirm the test schedule with the Engineer prior to the test. The Contractor shall coordinate the test schedule so that the Engineer can witness the testing, if required.

.3 The Contractor shall deliver test results to the Engineer within 7 working days of any given test.

.4 Testing and calibration of electrical equipment shall be completed prior to the start of commissioning activities. When required during commissioning, the Contractor shall retest and re-calibrate equipment to support the commissioning activities.

1.10 MEETINGS

.1 Pre-installation conference: the Contractor shall request a pre-testing conference with the Engineer (conference calls accepted).

1.11 SAFETY AND PRECAUTIONS

.1 Safety practices shall include, but are not limited to, the following requirements:

.1 Workers' Compensation Board Regulations

.2 Municipal By-Laws

.3 Canadian Electrical Code

.4 Electrical Safety Act of BC

.5 Municipal, Provincial and Canadian Building Code

.2 Tests shall be performed with apparatus de-energized unless otherwise specified (e.g., rotation, phasing).

.3 Power circuits shall have conductors shorted to ground by an approved hotline grounded device.

.4 In all cases, work shall not proceed until the Contractor's safety representative has determined that it is safe to do so.

.5 The Contractor shall have sufficient protective barriers and warning signs available, where necessary, to conduct specified tests safely.

.6 The Project safety procedures shall be reviewed and accepted by the Contractor and all sub-trades.

1.12 TEST EQUIPMENT

.1 All test equipment shall be furnished by the Contractor.

.2 Test instrument calibration

.1 The Contractor shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.

.2 The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain.

.3 Up-to-date calibration labels shall be visible on all test equipment.

.3 Use of torque wrenches

.1 Use calibrated torque wrenches for all bolted connections on buses and power cable terminations. Mark the head of the bolt with a coloured marking pen after its being torqued to manufacturer's recommended value.

2. EXECUTION

2.1 REQUIREMENTS

.1 Perform acceptance tests in accordance with manufacturer's recommendations, WCB regulations, and testing specifications NETA ATS-2009.

.2 Voltage adjustments shall be in accordance with CSA CAN3-C235.83, Preferred Voltage Levels for AC Systems, to 50,000 V.

.3 The test plan, procedures, test results, and reports shall be reviewed, under the supervision of and approved by the Engineer.

.4 Division of responsibility

.1 The Contractor shall torque down all accessible bolts, perform routine insulation resistance and continuity tests on branch and feeder circuits, and perform rotational tests for all distribution and utilization equipment, prior to, and in addition to tests performed by the Contractor specified in this Section.

.2 The Contractor shall supply a suitable and stable source of test power at each test site.

.3 The Contractor shall clean all the electrical equipment prior to testing.

.4 The Contractor shall be responsible for implementing all final settings and adjustments on protective devices and electrical equipment in accordance with the Power System Protective Device Studies.

.5 Any questions or concerns identified shall be promptly addressed to the Engineer.

.6 Any system, material, or workmanship which is found defective on the basis of electrical inspections and tests shall be reported directly to the Engineer.

.7 If a test reveals a fault or problem, the materials of equipment under test will be repaired or replaced and the entire test will be repeated. Tests will not be accepted until the problem is corrected. Submit additional written test reports

.8 Maintain a written record of all tests and, upon completion of the project, assemble and certify a final test report. The field test reports shall be compiled and signed by the individual performing the testing.

.9 Power systems protective device calibration

.1 Adjustments, settings, and modifications

.1 The Contractor shall calibrate necessary field settings, adjustments, and minor modifications to conform to the coordination study without additional cost (examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, ranges, etc.).

.2 Adjust or replace protective devices to the values provided in the coordination study.

.3 The trip characteristics, when adjusted to setting parameters, shall fall within the manufacturer's published time-current characteristic tolerance.

.2 The Contractor shall verify that the protective devices have been adjusted and set in accordance with the approved Power System Study.

.10 Acceptance criteria

.1 Each function and test shall be performed under conditions which simulate actual operating conditions as closely as possible.

.1 To that end, the Contractor shall provide all necessary materials, equipment, and temporary system voltages and currents to simulate fault conditions on the system being tested in order to prove and verify proper operation (fuses excepted).

.2 At satisfactory completion of all verified tests, the building electrical system being tested shall be returned to the condition required by the contract documents as a complete and operational system.

.2 The Contractor shall perform general inspections at the job site and shall also review the following:

.1 Assembly of the accessory equipment, and the interconnecting wiring for control circuits.

.2 General inspection of the following: appearance, finish, alignment of doors, covers, and similar parts; quality of workmanship; possible shipping and other damage; missing, broken or incorrectly applied devices; loose or missing accessories, bushings, or hardware; loose or broken wires; proper installation of all equipment; verification that shop drawings and instructions have been shipped with all equipment and are available.

.3 Support of electrical equipment: inspect and check all electrical equipment for support and seismic bracing.

.4 Spare equipment: the Contractor shall inspect and verify spare equipment inventory as specified by Division 26.

.11 System Operational Testing requirements and procedures

.1 The following equipment and systems shall be inspected and tested by the Contractor per manufacturer's instructions and additional requirements noted.

.2 The following tests require that the Contractor provide materials, tools, and labour (qualified personnel) to prepare equipment and devices for testing and to perform tests and to make adjustments and recalibrations for re-testing as necessary and to reconnect systems after the testing is completed. Include in the Tender, all costs associated with the provision of labour to remove and re-install panel plates, to disconnect/reconnect cables, and perform any labour other than testing, and to provide any materials and tools.

.1 Transformers

.1 Oil and Dry type rated equal to and greater than 600 V.

.2 Tests

.1 Inspect for physical damage, proper installation, anchorage, and grounding.

.2 Verify transformer is supplied and connected in accordance with the Contract documents.

.3 Insulation-resistance (megger) test all windings, high to low and ground, low to high and ground.

.4 Verify phase rotation sequence of transformer secondary windings.

.5 Adjust the transformer taps to the nominal system voltages per CSA CAN3-C235.83.

.3 Inspect and check for operation of all other overcurrent protection devices (switch/fuses, circuit breakers). Verify fuse/circuit breaker sizes in accordance with the Drawings.

.4 Insulation resistance (megger) test of all incoming bus ducts and feeders and extensions to all relocated outgoing feeders and all new outgoing feeders. Ensure that all electronic and other voltage sensitive equipment is disconnected before the tests are applied and reconnect same at completion of test.

.5 After each switchboard has been energized, manually operate each and every circuit breaker or switch and prove that when operated, the device in fact opens all underground conductors at the load end of the feeder and that the device and load have been labeled correctly.

.2 Cable

.1 Apply grounds for a time period adequate to drain all insulation-stored charge.

.2 Field test DC voltages (kV) per NETA ATS 2009 standards:

.3 Other utilization equipment

.4 Switches

.1 Verify correct wire bending radii at terminations per wire manufacturer's recommendations and CEC.

.5 Protective relays and devices

.1 Conduct tests according to the manufacturer's recommended testing procedures.

.2 Calibrate and set all settings according to the Protective Device Coordination Study.

.3 The following equipment shall be inspected and tested by the Contractor. Coordinate activities with the manufacturer's authorized service representatives.

.1 The Contractor shall use his own forces and the forces of his suppliers and Subcontractors for the following tests:

.1 Test secondary voltage levels of all transformers and adjust taps to within 2% of the rated operating voltage of the connected equipment unless directed otherwise by the Engineer. Test reports shall include phase and neutral currents.

.2 Control and switching - all circuits shall be tested for the correct operation of devices, switches, and controls, including sequenced operation of systems where applicable.

.3 Include in the written reports to the Engineer, the time and date on which each load was measured and the voltage at time of test.

.2 General power system tests

.1 Megger test all 120 V and higher circuits, feeders, and equipment.

.2 Check resistance to ground before energizing any equipment.

.3 Phase balance - when load conditions are commensurate with actual operating conditions, measure the load and the voltage on each phase at each switchboard, splitter, motor control centre, motor distribution centre, distribution panelboard, and lighting and power panelboard and report the results, including neutral currents, in writing to the Engineer. Rearrange circuit connections as necessary to balance the load on each phase to within 15% of average load. After making any such changes, make available to the Engineer marked prints showing the modified connections.

.4 Motor loading - measure the line current of each phase of each motor with the motor operating under load and report the results along with the motor nameplate current in writing to the Engineer. Upon indication of any unbalance or overload, thoroughly examine the electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Engineer.

.5 Phase relationship tests: Check connections to all new and existing equipment, outlets and devices for proper phase relationship. During such check, disconnect all devices which could be damaged by the application of voltage or reversed phase sequence.

.3 Low voltage feeder and branch circuit conductors (600 V and below)

.1 Test for continuity of each lighting and heating circuit originating from branch distribution panels.

.2 Test for grounds in each circuit; test shall consist of the physical examination of the installation to ensure that all required ground jumpers, devices, and appurtenances do exist and are mechanically firm.

.3 Perform a 500V M-Ohm meter test on each circuit between the conductor and ground. The insulation resistance shall not be less than 2 megohms for circuits under 120V, 6 M-Ohms between conductor and ground on those circuits (120 - 600 V) with total single conductor length of 2,500 feet and over, nor less than 8 M-Ohms for those circuits (120 - 600 V) with single conductor length of less than 2500 feet. If conductor fails test, replace wiring or correct defect and retest.

.4 Perform torque test for every conductor tested and terminated in an overcurrent device or bolted type connection; torque all connections per manufacturer's recommendations.

.4 Panelboards

.1 Inspect for physical damage, proper installation, supports, and grounding.

.2 Verify that neutrals are grounded only at the main service.

.3 Load balance tests: Check all panelboards for proper load balance between phase conductors and make adjustments as necessary to bring unbalanced phases to within 15% of average load.

.4 Electronic and adjustable Breakers: provide adjustments as required to align with connected equipment.

.5 Grounding systems

.1 Verify that neutrals are grounded only at the main service by removing the service neutral grounding conductor and meggering the neutral bus.

.2 Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system-neutral, and/or derived neutral points. Investigate resistance values, which exceed 0.5 ohm. If this resistance

cannot be obtained with the ground system, notify the Contractor and, in turn, the Engineer for further instruction.

.6 Heating and Ventilation Systems

.1 Purpose to ensure that systems are functional. Verification includes:

.1 Confirmation of thermostat settings for heating and cooling.

.2 Confirmation of operation of heaters and fans.

.7 Lighting Systems

.1 Purpose to ensure that systems are functional. Verification includes:

.1 Confirmation that lighting within each enclosure is activated by the associated door switch.

.8 Emergency Lighting Systems

.1 Purpose to ensure that systems are functional. Verification includes:

.1 Confirmation that lighting is activated on utility failure.

.2 Confirmation of runtime on batteries.

.9 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:

.1 Measurements of tension and power.

.2 Connecting joints and equipment fastening.

.3 Measurements of signals (dB, lux, baud rate, etc).

.4 Compliance with manufacturer's specification, product literature and installation instructions.

.10 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Specific Operational Requirements are listed within Section 26 27 15 - Electrical and Controls Components. Operational verification includes:

.1 Operation of VFDs and pump motors.

.2 Operation of each device individually and within its environment.

.3 Operation of each device in relation with relay control logic and PLC integration.

.4 Operation of buttons, switches, and pilot lights.

.5 Operation of the external devices, including:

.1 Flow Meter

.2 Pressure Transducers

.3 Actuated Valves

.6 Coordinate with District staff to commission stations.

.7 Demonstrate:

.1 Manual and automatic station control operation

.2 Continuity between switches/pilot lights/field devices and the PLC.

.3 Loss of power controls and backup power operation.

.4 Alarming.

.12 Fibre Optic Cables

.1 Perform tests on fibre optic cable before and after installation as specified below and correct deficiencies:

.1 East segment of each fibre shall be tested using an optical time domain reflectometer (OTDR) and power meter equipment.

.2 Perform tests at 850nm and 1300nm in each direction on each fibre to: ANSI/EIA/TIA-526-14-A for single-mode fibre.

.3 The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A and the OTDR Manufacturer's specifications.

.13 Labels

.1 Upon completion of the inspection, calibration, and testing, attach a label to all devices tested. These labels shall indicate the date tested, the Contractor company name, and tester's initials.

.14 Re-testing

.1 Any fault in material or in any part of the installation revealed by these tests shall be investigated, replaced, or repaired by the Contractor and the same test repeated by the Contractor at Contractor's expense until no fault appears.

2.2 DEMONSTRATION AND TRAINING

.1 Demonstrate and instruct the Owner's personnel on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction, and include all such costs in the Tender. Systems to be demonstrated and trained on shall include, but not be limited to, the following:

.1 Entire power distribution systems (primary and backup).

.2 Operation of circuit breakers, interlocking schemes, etc.

.3 Motor control equipment and associated components.

.4 Instrumentation and field monitoring/control devices.

.5 Routing and installation of major feeders, grounding and raceways.

.6 Labeling and identification schemes.

.7 Use of Maintenance Manuals.

.2 Arrange an acceptable time with the Owner and the Engineer and submit a program of instruction and demonstration for the Owner's approval. Assume that the Owner's personnel are not familiar with any of the special equipment and/or systems installed.

.3 Submit to the Engineer, at the time of Substantial Performance inspection, a complete list of systems demonstrated and training completed, and state for each system:

.1 Date that instructions were given to the Owner's staff.

.2 Duration of instruction.

.3 Names of persons instructed.

.4 Other parties present (manufacturer's representative, Engineer, etc.).

.5 Signature of the Owner's staff stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

2.3 REPORTS

.1 Contractor shall prepare test reports on the systems tested. Include a copy of each test report in the Operation and Maintenance Manuals.

.2 The Contractor shall prepare test reports including the following:

.1 Summary of project

.2 Description of equipment tested

.3 Description of test

.4 Test results including re-testing results

.5 Test dates

.6 Tester's name

.7 Witnesses (when required)

.8 Corrective work

.9 Acceptance criteria

.10 Conclusions and recommendations

.11 Appendix, including appropriate test forms

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.3 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical

.2 Section 26 05 21 – Wire and Cables (0-1000V)

1.4 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18.1-13, Metallic Outlet Boxes
.2 CAN/CSA-C22.2 No.18.2-06 (R2011), Nonmetallic Outlet Boxes
.3 CAN/CSA-C22.2 No.18.3-12, Conduit, Tubing, and Cable Fittings
.4 CAN/CSA-C22.2 No.18.4-04 (R2013), Hardware for the Support of Conduit, Tubing
.5 CAN/CSA-C22.2 No.18.5-13, Positioning Devices
.6 CSA C22.2 No.65-13 (R2008), Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable and flexible conduit as required to: CAN/CSA-C22.2No.18 (all subsections).

3. EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant or provide photographic evidence of areas of concern.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SECTION INCLUDES

.1 Materials and installation for wire and cables.

1.3 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical

.2 Section 26 05 20 - Wire and Box Connectors (0 - 1000V)

.3 Section 26 05 43 01 – Installation of Cables in Trenches and in Ducts

.4 Section 26 27 15 – Electrical and Controls Components

1.4 REFERENCES

.1 CAN/CSA C22.2 No .0.3-09 (R2014), Test Methods for Electrical Wires and Cables

.2 CAN/CSA C22.2 No. 38-14, Thermoset-insulated wires and cables

.3 CAN/CSA C22.2 No. 127-15, Equipment and lead wires

.4 CAN/CSA-C22.2 No. 131-14 (R2014), Type TECK 90 Cable

1.5 PRODUCT DATA

.1 Submit product data in accordance with Conditions of the Contract and Section 1 Specification Section.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 BUILDING WIRES

.1 Wire: to CAN/CSA C22.2 No. 38.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketed.

.3 Grounding conductors to 26 05 28 Grounding - Secondary.

2.2 TECK 90 CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.

.3 Insulation:

- .1 Cross-linked thermosetting polyethylene rated type RW90 XLPE.
- .2 Rating: 600V and 1000V, as required.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride.

.7 Connectors:

- .1 Watertight approved for TECK cable.

2.3 CONTROL AND INSTRUMENTATION CABLES

.1 Internal cabinet wiring shall be TEW (tinned).

- .1 Wire: to CAN/CSA C22.2 No. 127-15.
- .2 Size
  - .1 120VAC: 14AWG.
  - .2 24VDC: 18AWG.
- .3 Color Code
  - .1 AC Hot: Red
  - .2 AC Neutral: White
  - .3 DC Positive: Blue
  - .4 DC Negative: Grey
  - .5 Generator Start: Yellow
  - .6 Ground: Green
- .4 Analog instrumentation wiring shall be two-conductor shielded, 18AWG with white and black conductors.

.2 LAN cabling shall be minimum rating of Cat 6, Blue.

2.4 ARMOURED CONTROL AND INSTRUMENTATION CABLES

.1 Cable: to CAN/CSA-C22.2 No. 239-09.

.2 Conductors:

.1 Circuit conductors: 7 strand tinned copper.

.3 Insulation:

.1 Cross-linked thermosetting polyethylene rated type RW90 XLPE.

.2 Rating: 600V and 1000V, as required.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride.

.7 Certification:

.1 FT-4 Flame Rated

.2 Temperature: 105°C dry, 75°C wet, and -40°C

.3 Suitable for installation in Class I, Zone 1 and Zone 2, and Class II, Division 1 and 2 Hazardous Locations.

.8 Connectors:

.1 Watertight approved for armoured control and instrumentation cable.

2.5 SHIELDED VFD CABLES

.1 Minimum bend radius: 7.5 x cable diameter

.2 Temperature range: -40 degrees celsius to +90 degrees Celsius

.3 Voltage rating: 600V

.4 Construction:

.1 Overall: 3 power wires plus 1 insulated ground wires

.2 Conductors: fine stranded bare copper

.3 Insulation: PVC

.4 Shielding: Overall shield and tinned copper braid

.5 Standard of acceptance: Lapp Group OLFLEX VFD Slim.

.6 Connectors:

3. FIBRE OPTIC CABLE

.1 Single-Mode (OS2), 12 Core, Loose Tube, Indoor/Outdoor, Gel-Free, all-dielectric construction.

.1 Standard of Acceptance: Corning Freedm 012ESF-T4101D20

4. EXECUTION

4.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

4.2 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0-1000 V).

.2 Cable Colour Coding: to Section 26 05 00 Common Work Results - Electrical.

.3 All cabling shall be installed in conduit except in electrical/mechanical rooms where cabling is terminated.

.4 Fastenings:

.1 One hole stainless steel straps to secure surface cables 50 mm and smaller. Two hole stainless steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers.

4.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 43 01 – Installation of Cables in Trenches and in Ducts.

4.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Install cabling as follows:

.1 In conduit systems in accordance with Section 26 05 43 01 – Installation of Cables in Trenches and in Ducts.

.2 Install cable exposed, securely supported by straps or hangers.

.1 Group cables wherever possible on channels.

4.5 INSTALLATION OF ARMOURED CABLES

.1 Install cabling as follows:

.1 In conduit systems in accordance with Section 26 05 43 01 – Installation of Cables in Trenches and in Ducts.

.2 Install cable exposed, securely supported by straps or hangers.

.1 Group cables wherever possible on channels.

4.6 INSTALLATION OF CONTROL AND INSTRUMENTATION CABLES

.1 Ground control cable shield at control cabinet only.

.2 Cut and heatshrink shield at terminations to field devices.

4.7 INSTALLATION OF ARMOURED CONTROL AND INSTRUMENTATION CABLES

.1 Install cabling as follows:

.1 In conduit systems in accordance with Section 26 05 43 01 – Installation of Cables in Trenches and in Ducts.

.2 Install cable exposed, securely supported by straps or hangers.

.1 Group cables wherever possible on channels.

4.8 INSTALLATION OF SHIELDED VFD CABLES

.1 Install cables per manufacturer's directions and as follows:

.1 In conduit systems in accordance with Section 26 05 43 01 – Installation of Cables in Trenches and in Ducts.

.2 Group cables wherever possible on channels.

.2 Terminate cables with connections as specified by the cable manufacturer and in accordance with Section 26 05 20 – Wire and Box Connectors (0-1000V).

.3 Ground cable shields as indicated by manufacturer's directions.

4.9 INSTALLATION OF FIBRE OPTIC CABLES

.1 Install cables per manufacturer's directions and as follows:

.1 In conduit systems in accordance with Section 26 05 43 01 – Installation of Cables in Trenches and in Ducts.

.2 Terminate cables with connections as specified by the cable manufacturer using manufacturer approved products.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

.2 Section 26 24 01 – Service Equipment

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 EQUIPMENT

.1 Rod electrodes: copper 19mm dia. by 3 m long.

.2 Plate electrodes: In accordance with the CEC.

.3 Grounding conductors: medium hard drawn, 7 strand, bare stranded copper, size as indicated.

.4 Insulated grounding conductors: green, size as indicated.

.5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.6 Grounding rod inspection well:

.1 High density polyethylene construction

.2 Minimum 250mm top opening.

.3 Bolt down cover with skid resistant surface.

.7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Bonding jumpers, straps.

.5 Pressure wire connectors.

.8 Pump motors shall be equipped with AEGIS SGR bearing connection kits, sized to suit motor.

3. EXECUTION

3.1 INSTALLATION GENERAL

.1 Install exterior buried grounding loop system as indicated on the drawings.

.2 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Bond single conductor, metallic armoured cables to cabinet at supply end.

3.2 ELECTRODES

.1 Install rod electrodes and make grounding connections within inspection wells.

.2 Bond separate, multiple electrodes together.

.3 Use size copper conductors for connections to electrodes, sized as indicated.

.4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral secondary 120V system.

3.4 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.5 JUNCTION BOXES AND VAULTS

.1 Bond lids of in-ground junction boxes and vaults.

3.6 MASTER GROUNDING BAR

.1 Refer to Section 26 24 10 - Motor Control Centres.

.2 Ground items of electrical equipment in MCC to ground bus with individual bare stranded copper connections, sized as indicated on the drawings.

.3 Ground items of water system to ground bus with individual bare stranded copper connections, sized as indicated on the drawings.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results - Electrical

1.2 PRODUCT DATA

.1 Submit product data in accordance with Conditions of the Contract and Section 1 Specification Section.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

2. PRODUCTS

2.1 SUPPORT CHANNELS AND STANCHIONS

.1 Select channel as indicated in the drawings:

- .1 U shape, stainless steel, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended with stainless steel hardware.
- .2 All materials to assembly stanchions shall be from same manufacturer.

3. EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Consultant or provide photographic evidence of areas of concern.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Refer to Section 26 05 02 – Seismic Restraint.

.2 Contractor to note that the intent of this specification is for the Contractor to provide under the base contract all seismic restraint of electrical equipment.

.3 Provide custom fabricated flexible sections allowing horizontal and vertical movement of cable trays at building expansion or seismic joints.

.4 Provide loops in cables and flexible connections in raceways where such services leave a suspended trapeze rack or other support and extend down to floor-braced equipment or wall-mounted equipment.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole stainless steel straps to secure surface conduits and cables 53 mm and smaller.
- .2 Two-hole stainless steel straps for conduits and cables larger than 53 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 10 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 10 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1500 mm on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results – Electrical

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23th Edition.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance Conditions of the Contract and Section 1 Specification Section.

.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 Provide shop drawings: in accordance with Section 26 05 00 Common Work Results - Electrical.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 JUNCTION AND PULL BOXES

.1 Marine-grade aluminum enclosure construction with screw-on flat covers for surface mounting. All mounting hardware to be stainless steel.

.2 Provide hinged lockable covers where noted on the drawings.

.3 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.2 ENCLOSURES

.1 Application: house electrical equipment within Pump Stations providing a degree of protection from falling dirt, dust, oil, and water.

.2 Enclosures shall be a rigid, wall mounted, and rated CSA Type 3R.

.3 Construction:

- .1 Enclosures shall be fabricated from marine grade aluminum.
- .2 Smooth, continuously welded seams without knockouts, cutouts, or holes.
- .3 Welded brackets for enclosure mounting.
- .4 Formed lip on door and enclosure to prevent ingress of flowing liquids and contaminants.
- .5 Continuously hinged door with provision for removal by pulling hinge pin.
- .6 Door secured with multi-point latch system including provision for padlocking.
- .7 Permanently secured continuous gasket around door.
- .8 Removable inner back and side panels, as required.
- .9 Bonding studs on door, enclosure, and panels.
- .10 Literature pocket located on inside of door.
- .11 Heating and ventilation per the drawings.

.4 Finish:

- .1 Door and enclosure shall be finished in recoatable smooth ANSI 61 gray powder coating inside and out.
- .2 Inner panels shall be finished with white powder coating.

.5 Enclosure dimensions on Drawings are approximate only. Contractor to determine final enclosure dimensions to layout all of proposed equipment.

.6 All enclosure assemblies shall be from the same manufacturer, shall bear the C.S.A. seal of approval, or other certification mark acceptable in the Province of British Columbia, and be manufactured by an electrical control panel manufacturer regularly engaged in this type of work.

.7 Shop drawings for the electrical enclosures to be submitted in accordance with Section 26 05 00 Common Work Results - Electrical.

.8 Standard of acceptance: Hammond Manufacturing, or equivalent.

2.3 RTU ENCLOSURE

.1 A new RTU Enclosure shall be supplied and installed as indicated in the Drawings.

.2 Standard of Acceptance: EUROBEX 5412 ES362412 with included back panel.

3. EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Install equipment and terminal blocks as indicated in cabinets.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage, and phase.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical

1.3 REFERENCES

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 240V outlet boxes for 240V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

.7 FS or FD NEMA 4X RPVC boxes with factory-threaded hubs, mounting feet, and gasketed covers to be used throughout project.

.8 Provide clear while-in-use gasketed cover for interior outlets.

2.2 WEATHER-PROOF OUTLET BOXES

.1 RPVC boxes for outlets rated for outdoor environments.

.2 Connected to teck 90 cables as required, minimum size 102 x 54 x 48 mm.

.3 Provide weather proof clear lockable while-in-use covers for all GFI locations.

2.3 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

3. EXECUTION

3.1 INSTALLATION

.1 Recess mount lighting and outlet boxes located on building exterior.

.2 Surface mount boxes located in building interior.

.3 Support boxes independently of connecting conduits.

.4 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results – Electrical

.2 Section 26 52 00 – Emergency Lighting

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA-C22.2 No.18.3-12, Conduit, Tubing, and Cable Fittings
- .2 CAN/CSA-C22.2 No.18.4-04 (R2013), Hardware for the Support of Conduit, Tubing and Cable
- .3 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 45.2-08 (R2013), Electrical Rigid Metal Conduit – Aluminum, Red Brass, and Stainless Steel.
- .5 CSA C22.2 No. 83-M1985 (R2013) – Electrical Metallic Tubing
- .6 CSA C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit.
- .7 CAN/CSA C22.2 No. 227.2.1-04 (R2013), Liquid Tight Flexible Nonmetallic Conduit.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

- .1 Submit cable manufacturing data.

.3 Quality assurance submittals:

- .1 Test reports: submit certified test reports.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 CONDUITS

.1 Rigid aluminum conduit: to CSA C22.2 No. 45.2.

.2 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One hole stainless steel straps to secure surface conduits 53 mm and smaller. Two hole stainless steel straps for conduits larger than 53 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1500 mm oc.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90 degree bends are required for 27 mm and larger conduits.

.3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

3. EXECUTION

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits below slab.

.3 Surface mount conduits except where they are in a secure area designated as a wire chase already. Concealed conduit may be required in aesthetic locations. If in doubt, consult Owner and Consultant for direction.

.4 Use rigid pvc conduit underground.

.1 For rigid pvc conduit stubs in the metering manhole install threaded RPVC adapter, reducers, metal liquidtight fitting and flex as required for complete installation.

.5 Use rigid pvc conduit between slab and device or wall mounted junction box.

.6 Use liquid tight flexible metal conduit for connection to devices.

.7 Minimum conduit size for lighting and power circuits: 21mm

.8 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.9 Mechanically bend steel conduit over 21 mm diameter.

.10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.11 Install fish cord in empty conduits.

.12 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 27 mm and larger below slab and encased in 75 mm concrete envelope. Provide 53 mm of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.7 CLEANING

.1 Clean all underground ducts with a mandrel prior to pulling cables.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 26 05 21 – Wire and Cables (0-1000V)

2. PRODUCTS

2.1 Not Used

.1 Not Used.

3. EXECUTION

3.1 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.1 Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct hipot testing at voltage recommended by manufacturer.

.2 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

.3 Hold maximum voltage for specified time period by manufacturer.

.4 Record leakage current at each step.

.7 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical

.2 Section 26 05 10 – Testing and Commissioning

1.3 PRODUCT DATA

.1 Mechanical Contractor will submit product data sheets for motors including product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish. Obtain approved data sheets from Mechanical Contractor before connecting equipment.

.2 Obtain Manufacturer's Instructions regarding electrical connections from Mechanical Contractor.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 MATERIALS

.1 Provide motors for water pumps as specified in Mechanical sections.

3. EXECUTION

3.1 INSTALLATION

.1 Dry out motor if dampness present in accordance with manufacturer's instructions.

.2 Make wiring connections per manufacturer’s recommendations. Include connections for:

.1 Power

.2 Pump Monitoring Sensors

.3 Check for correct direction of rotation.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and Section 26 05 10 – Testing and Commissioning.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CSA C9-02 (R2016), Dry-Type Transformers
- .2 CAN/CSA-C22.2 No.47-13, Air-cooled Transformers (Dry Type)

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.5 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 – Common Work Results - Electrical.

2. PRODUCTS

2.1 15KVA TRANSFORMERS

.1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA C22.2No.47 and CSA C9.

.2 Design:

- .1 Type: ANN.
- .2 Configuration: single phase
- .3 Windings: Copper
- .4 Single phase, 15 kVA, 600 V input, 120/240V output, 60 Hz
- .5 Voltage taps: standard
- .6 Insulation: Class 220º C, 150 º C temperature rise
- .7 Basic Insulation Level (BIL): standard
- .8 Hipot: standard
- .9 Average sound level: standard
- .10 Impedance at 170ºC: standard

.11 Mounting: floor mounted within electrical kiosk

.3 Standard of Acceptance: Hammond HPS Sentinel series or approved equal.

2.2 250VA TRANSFORMERS

.1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA C22.2No.47 and CSA C9.

.2 Design:

.1 Panel mount.

.2 Molded terminal blocks for primary and secondary connections.

.3 Configuration: single phase

.4 Windings: Copper

.5 Single phase, 250VA, 600 V input, 120V output, 60 Hz

.6 Voltage taps: standard

.7 Insulation: Class 130º C, 80º C temperature rise

.8 Mounting: within motor control panel.

.3 Standard of Acceptance: Hammond Manufacturing or approved equal.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

3. EXECUTION

3.1 INSTALLATION

.1 Mount dry type transformer as indicated.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize transformers after installation is complete.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical

.2 Section 26 05 28 - Grounding - Secondary

.3 Section 26 24 02 - Service Entrance Board

.4 Section 26 28 16 02 - Molded Case Circuit Breakers

1.3 REFERENCE

.1 BC Hydro

.1 Refer to BC Hydro Requirements for Secondary Voltage Revenue Metering (https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/distribution/standards/ds-rmr-secondary-voltage-750v-and-less.pdf)

.2 Information Bulletin, March 7, 2016, Builders Scope for Conduit Installation for BC Hydro Meter Communications.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 EQUIPMENT

.1 Enclosed circuit breaker: to Section 26 28 16 02 - Molded Case Circuit Breakers, rating as indicated.

.2 Meter Socket:

.1 Pump Stations: 200A, 347/600V, CSA Type 3R, supplied with screw type ring.

.2 Valve Chambers: 100A, 120/240V, Type 3R enclosure, supplied with screw type ring.

.3 Include provision for exterior antenna per BC Hydro Revenue metering bulletin dated March 2016.

3. EXECUTION

3.1 INSTALLATION

.1 Install service equipment.

.2 Connect to incoming service.

.3 Connect to outgoing load circuits.

.4 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary

.5 Make provision for power supply authority's metering.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results – Electrical

.2 Section 26 05 02 – Seismic Restraint

.3 Section 26 24 01 - Service Equipment

.4 Section 26 28 16 02 - Molded Case Circuit Breakers

1.3 REFERENCE

.1 BC Hydro

.1 BC Hydro Requirements for Secondary Voltage Revenue Metering (https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/distribution/standards/ds-rmr-secondary-voltage-750v-and-less.pdf)

.2 Distribution Standards: Underground Electrical: ES53

.2 Electrical Contractors Association of British Columbia

.1 Seismic Restraint Standards Manual

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.5 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data.

.2 Indicate on shop drawings.

.1 Overall length, height and depth.

.3 Include time-current characteristic curves for circuit breakers and fuses.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for complete assembly including components of service entrance board incorporation into a manual.

1.7 SOURCE QUALITY CONTROL

.1 Notify Engineer in writing 7 days in advance that service entrance board is ready for testing.

.2 Submit digital copy of certified factory test results.

2. PRODUCTS

2.1 SERVICE ENTRANCE AND DISTRIBUTION BOARD

.1 Rating: 347/600V, 3-phase, 4 wire, 200 A (100%), short circuit current 10kA (RMS symmetrical).

- .1 Cubicles: free standing, dead front, size as indicated.
- .2 Standard height – 2460mm (90 inches).
- .3 Barrier metering section from adjoining sections.
- .4 Bus bars and main connections: 600 A copper.
- .5 Identify phases with colour coding.

.2 Cable pull section:

- .1 Refer to BC Hydro metering to the Requirements for Secondary Voltage Revenue Metering (http://www.bchydro.com/ext/metering/).
- .2 Refer to BC Hydro Distribution Standards: Underground Electrical: ES53.
- .3 Each bus to have lugs to accept service conductors.

.3 Main breaker section:

- .1 Main Circuit Breaker Section:
  - .1 Barrier main circuit breaker section from adjoining sections.

2.2 MAIN CIRCUIT BREAKER

.1 Solid State Electronic Trip Breaker as indicated on drawings.

.2 Common-trip breaker: with single handle for multi-pole applications.

.3 Moulded case circuit breaker to operate by means of solid state trip unit with associated current monitors and self powered shunt trip to provide inverse time current trip under overload condition, and long time/short time/instantaneous tripping for short circuit protection.

.4 Programmable electronic solid state trip unit with separately adjustable long time, short time, and instantaneous.

.5 Circuit Breaker to have auxiliary contact for PLC notification of breaker status, where indicated.

.6 Circuit breaker with interchangeable trips as indicated.

.7 Minimum symmetrical RMS interrupting capacity rating: 10kA

.8 Refer to single line diagram. System has been designed to achieve arc flash incident energy levels of less than XX calories/cm^2 for all points downstream of main utility circuit breaker. Provide circuit breakers as required to achieve same.

.9 120V solenoid controlled open/close actuation unit.

2.3 GROUNDING

.1 Copper ground bus extending full width of cubicles and located at bottom.

.2 Lugs at each end for grounding cable, size as indicated.

2.4 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results – Electrical

.1 Service entrance board exterior: ASA 61 gray.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results – Electrical.

.2 Nameplates:

.1 White plate, black letters.

.2 Complete board labeled: “Main Distribution – 347/600V”

.3 Main circuit breaker labeled: "Main Circuit Breaker ".

.4 Branch circuit breakers labeled.

3. EXECUTION

3.1 INSTALLATION

.1 Locate service entrance board and fasten to kiosk wall.

.2 Install seismic restraint for all equipment. See Section 26 05 02 – Seismic Restraint.

.3 Install service distribution board and BC Hydro metering to the Requirements for Secondary Voltage Revenue Metering.

.4 Connect main service to line terminals of main bus in pull section.

.5 Connect load terminals of distribution breaker's to feeders.

.6 Check factory made connections for mechanical security and electrical continuity.

.7 Run one grounding conductor bare copper sized per the drawings from neutral bus to ground bus to main ground.

.8 Check trip unit settings against co-ordination study to ensure proper working and protection of components.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.3 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

.2 Section 26 28 16 02 - Moulded Case Circuit Breakers.

1.4 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29-11, Panelboards and enclosed Panelboards.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.6 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2. PRODUCTS

2.1 PANELBOARDS

.1 Panelboards based on CSA C22.2No.29.

.2 Panelboards: product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.3 347/600V panelboard: bus and breakers rated for 10kA interrupting capacity.

.4 120/240V panelboard: bus and breakers rated for interrupting capacity as indicated.

.5 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.6 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.7 Two keys for each panelboard and key panelboards alike.

.8 Copper bus with neutral of same ampere rating as mains.

.9 Mains: suitable for bolt-on breakers.

.10 Trim with concealed front bolts and hinges.

.11 Trim and door finish: baked grey enamel.

.12 Two (2) Lock-out devices for each panel installed. Turn over lock-out devices to Owner.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16 02 - Molded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker (where applicable): separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Nameplate for each panelboard.

.3 Nameplate for each circuit in distribution panelboards.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

3. EXECUTION

3.1 INSTALLATION

.1 Locate panelboards in motor control centre.

.2 Connect loads to circuits.

.3 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

PART 1 General

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-Q9000, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures - Section 26 05 00 – Common Work Results - Electrical.

.2 Submit product data sheets for Motor Control Centre and all associated materials and equipment.

.3 Manufacturer's Instructions: Provide special handling criteria, installation sequence, cleaning procedures and wiring instructions.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures - Section 26 05 00 – Common Work Results - Electrical.

.2 Indicate:

.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.

.7 Product datasheets

.8 Material datasheets

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Closeout Submittals - Section 26 05 00 – Common Work Results - Electrical.

PART 2 Products

2.1 Standard of Acceptance – MCC Manufacturers

.1 Eaton

.2 Rockwell Automation

.3 Schneider Electric

.4 Siemens

2.2 SUPPLY CHARACTERISTICS

.1 600 V, 60Hz, connected 3 phase, 4 wire, grounded neutral on system.

2.3 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 CSA Type 3R rated.

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, 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 bottom into wireway with terminals as indicated. Refer to Section 26 24 02 – Service Entrance Board.

.8 Removable lifting means.

.9 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.10 Shipment to site, as indicated complete with hardware and instructions for assembly and installation.

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 tin plated copper busbars in separate compartment self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: 600 A (100%) as indicated.

.2 Branch vertical busbars: 600 A (100%) as indicated.

.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 10 kA rms symmetrical, minimum.

.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 Rating: 300A

.3 Vertical Ground Bus Type: Plug-in Zinc Plated Steel

2.8 CIRCUIT BREAKERS

.1 To Section 26 28 16 02 – Molded Case Circuit Breakers.

2.9 120/208V PANEL

.1 Provide for 24 circuit 120/240V 225A integrated panelboard.

.2 Panel to specifications Section 26 24 16 01 - Panelboards Breaker Type.

2.10 TRANSFER SWITCH SECTION

.1 Provide for automatic transfer switch section.

.2 Automatic transfer switch to specifications Section 26 36 23 – Automatic Transfer Switches.

2.11 MOTOR STARTERS

.1 Provide for VFD motor starter sections.

.2 VFDs to specifications Section 26 27 15 – Electrical and Controls Components.

2.12 SURGE PROTECTION DEVICE

.1 Provide for transient voltage surge suppression as indicated on the drawings.

.2 Short Circuit Current Ratings:

.1 Service Entrance – 200kA per Phase

.3 Standard of acceptance: same manufacturer as MCC.

2.13 STARTER UNIT COMPARTMENTS

.1 Units size as required, circuit breaker in units with lock-out provision. 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.

.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 padlock 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 Devices and components by one manufacturer to facilitate maintenance.

.7 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

.8 Provide control transformers as required.

2.14 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with electrical drawings.

2.15 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.1 Individual compartment nameplates.

2.16 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Motor control centre exterior colour: ASA-61 Grey

.3 Motor control centre interior panels: White.

2.17 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.

PART 3 Execution

3.1 INSTALLATION

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and 26 05 10 – Testing and Commissioning.

.2 Ensure moving and working parts are lubricated where required.

.3 Prove satisfactory performance of motor control centre in conjunction with total control systems tests.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

.2 Section 26 05 10 - Testing and Commissioning

.3 Section 26 05 21 - Wires and Cables (0-1000V)

.4 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data accordance with Section 26 05 00 - Common Work Results - Electrical.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for all equipment for incorporation into manual specified in Section 26 05 00 - Common Work Results - Electrical.

.2 Include data for each type and style of equipment.

2. PRODUCTS

2.1 CONTROL ENCLOSURE

.1 Pump stations:

.1 Provide controls cabinet integral to MCC in accordance with Section 26 24 19 – Motor Control Centres.

.2 Valve Chambers:

.1 Provide RTU enclosure within electrical kiosk in accordance with Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets

.3 Equipment layouts shown on the Contract Drawings represent approximate locations only, Contractor shall provide shop drawings for all Controls Enclosures including detailed equipment layouts, panel dimensions, and wiring diagrams.

2.2 CONTROLS ENCLOSURE ADDITIONAL COMPONENTS

.1 Selector switches:

.1 Panel mountable, two, three or four position, as required, 22mm.
.2 120VAC/24VAC/DC rated, as required.
.3 Bezel Material: Chromium Plated Metal

.2 Indicators/Pilot Lights:

.1 Panel mountable, round, LED-based, 22mm, 120VAC/24VAC/DC rated, as required.
.2 Bezel Material: Chromium Plated Metal
.3 Colour as indicated on drawings.

.3 Push buttons:

.1 Panel mountable, 120VAC/24VAC/DC rated, as required, momentary contacts, normally open, 22mm.
.2 Bezel Material: Chromium Plated Metal
.3 Colour: Black

.4 HMI:

.1 Standard of Acceptance: Schneider Electric Magelis HMIGTO5310.

.5 Ethernet Bulkhead Receptacle:

.1 Standard of Acceptance: Video Products Incorporated RJ45-6WTP-CS-JCK

.6 Network switch:

.1 Standard of Acceptance: **To Be Confirmed**

.7 PLC/RTU Equipment:

.1 Lower I/O Module: 5607
  .1 32 Digital Inputs
    .1 Voltage: 24V
  .2 16 Digital Outputs
  .3 8 Analog Inputs

.1 0-20mA, single-ended.

.4 2 Analog Outputs

.2 Communications Serial Ports:

.1 1x RS232 Ports

.2 1x RS232/485

.3 1x RS485

.3 Programming Environment: Telespace, IEC 61131-3, C Language

.4 Expansion Module: 5304

.1 4 Analog Outputs

.5 Analog Outputs: 2-Channels, 0-20mA.

.6 Standard of Acceptance: Schneider Electric SCADAPack 357E

.8 Interposing relays:

.1 Provide interposing relays as shown on plans, 120VAC, 24VAC/VDC as required. All relays to have check button and indicator lights; DIN mount, finger-safe, form C.

.9 Power Supply

.1 24VDC Power Supply

.1 Standard of Acceptance: Phoenix Contact Quint-PS/1AC/24DC/20

.2 UPS

.1 Standard of Acceptance: Always On UPS Systems: GES-102N

.3 Circuit Breakers

.1 Standard of Acceptance: Phoenix Contact UT 6-TMC series with Phoenix Contact FBS Series plug-in bridges.

.4 Terminals and interconnect wiring:

.1 In accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 DIN rail mounted terminals c/w dividers and end stops as required. Provide 10 spare terminals on each section and additional spare terminals as noted on the Drawings.

.3 Utilize plastic finger wiring ducts for organization of all interior and field wiring. Ducts are to be filled to no more than 50% of capacity.

.4 Use ferrules at termination points on stranded wires.

.5 A space of 200 mm must be kept clear for field wiring. All wiring labels must be clearly visible at completion.

.5 Radio

.1 Provision to be made for future installation of SCADA radio within Controls Enclosures (under future contract).

.2 Provision to include space in control enclosure, circuit breaker, and any necessary terminal blocks.

.3 Standard of Acceptance: GE MDS Transnet EL805

.6 Fibre Optic Patch Panel

.1 Closet Connector Housing Panel, Duplex, UPC, 12F, Single-Mode (OS2)

.2 Standard of Acceptance

.1 Housing: Corning SPH-01P

.2 Closet Connector Housing Panel: Corning CCH-CP12-A9

.3 Fan-out Kit: Corning FAN-BT25-12

.4 Connectors: Corning 95-200-99-X

2.3 MOTOR CONTROL CENTER COMPONENTS

.1 Provide motor control centre in accordance with Section 26 24 19 – Motor Control Centres.

.2 Equipment layouts shown on the Contract Drawings represent approximate locations only, Contractor shall provide shop drawings for the Motor Control Centre including detailed equipment layouts and panel dimensions.

2.4 MOTOR CONTROL CENTRE ADDITIONAL COMPONENTS

.1 Variable Frequency Drive

.1 Pump Motors

.1 The VFDs shall be selected in accordance with the pump motor ratings, sized on the requirement of 70HP.

.2 Overload rating:

.1 150% for one minute of motor FLA

.2 125% continuous of motor FLA.

.3 Provide Terminal blocks for field wiring.

.4 Include inputs for VFD start/stop.

.5 Include relay outputs for VFD running and fault status.

.6 Provide push button for fault reset on the exterior of motor control panel.

.7 Provide adequate ventilation for stated site conditions.

.8 Mount within motor control centre.

.9 Provide remote mounted control panel installed on front door of motor control panel.

.1 Include panel platform for docking of control panel.

.10 Standard of Acceptance: Eaton SVX9000 + Panel Holder Mounting Kit

.2 DV/DT Equipment:

.1 Provide open frame dv/dt filter as indicated on the drawings on the load side of the VFD.

.2 Mount within motor control centre.

.3 Standard of Acceptance: Transcoil V1K Series.

.3 Line Reactor Equipment:

.1 Provide open frame line reactor as indicated on the drawings on the line side of the VFD.

.2 Mount within motor control centre.

.3 Standard of Acceptance: Transcoil KDR Series

.4 Phase Loss Monitoring Relay

.1 Provide relay capable of determining phase loss, phase reversal or phase imbalance.

.2 Mount within Motor Control Centre.

.3 Standard of Acceptance: Controlab Inc. DSP-1L 600V

.5 Contactor

.1 Provide motor contactors for HVAC starting.

.2 Mount within Motor Control Centre.

.3 Termination Method: Screw Clamp

.4 Contact Rating: 600V / 15A

.5 Coil Voltage: 120VAC

.6 Auxiliary contacts: 2 NO, 2NC

.7 Motor protection: thermal overload relay sized to suit

.6 Wiring Identification

.1 Provide wiring identification in accordance with electrical drawings.

.7 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.1 Individual compartment nameplates.

2.5 EXTERNAL CONTROL COMPONENTS

.1 Security Panel

.1 Standard of Acceptance: DSC Maxsys 4020 16 Zone Security Panel w/ Door mounted LCD4501 Keypad

.2 Flow Meter:

.1 Refer to Mechanical Drawings and Specifications.
.2 Flow meter sensors to be installed within pump station and valve chambers.
.3 Flow meter transmitter to be installed within booster station.

.3 Pressure Transducers:

.1 Refer to Mechanical Drawings and Specifications.
.2 To be installed within pump stations and valve chambers.

.4 Valve Actuator

.1 Refer to Mechanical Drawings and Specifications.
.2 Voltage: 120VAC
.3 Open/Close control inputs.
.4 Open/Closed position indicator feedback switches.

.5 Valve Chamber Flood Switch:

.1 Specific Gravity: 0.71g/cm^3
.2 Materials:
.1 Float: Stainless Steel
.2 Stem: Stainless Steel
.3 Protection: IP54
.4 Cable: 1m PVC cable
.5 Standard of Acceptance: Barksdale 0111-577

.6 Fibre Splice Closure:

.1 Preloaded with splice trays
.2 To be installed within outdoor fibre vaults.
.3 Standard of Acceptance: Corning SCF-4C18-01-36

2.6 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Nameplates:

.1 White plate, black letters.

.2 Complete board labeled: "Controls Cabinet"

.3 Other labels to be worded as per the Plans.

3. EXECUTION

3.1 INSTALLATION

.1 Install control panel as indicated in the drawings.

.2 Apply touch up paint as required.

.3 Make field power and control connections as indicated.

.4 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and datasheet.

.5 Supply all necessary equipment and wiring to provide the points connected to the equipment as shown on the plans.

.6 Assemble the pump station control panel to include, but not limited to, the following components:

.1 PLC

.2 Network Switch

.3 Power Supply

.4 Circuit Breakers

.5 Relays

.6 GFCI Receptacle

.7 Terminal Blocks

.8 Fibre Optic patch panel

.9 Front Panel

.1 HMI

.2 Selector Switches

.3 Pilot Devices

.4 Ethernet bulkhead receptacle

.5 Wiring to the front panel shall be enclosed within spiral wrap to allow for ease of door movement and protection.

.10 Finger ducting: Unless installed in conduit, all wiring within the Control Panel shall be routed using finger ducting.

.11 Supply and install din rail mounted interposing relays as shown on the plans.

.7 Assemble the pump station Motor Control Centre to include, but not limited to, the following components:

.1 VFDs including line reactors and DV/DT filters

.2 Ventilation Fans

.3 Phase Monitoring Relay

.4 Surge Protection Device

.5 HVAC controls and motor starters

.6 Transformer

.7 Panelboard

.8 Service Equipment

.9 Main Circuit Breaker

.10 Finger ducting: all wiring within the Motor Control Panel shall be routed using finger ducting.

.11 Supply and install din rail mounted terminal blocks and interposing relays as required.

.12 Finger ducting: Unless installed in conduit, all wiring within the sections shall be routed using finger ducting.

.8 Assemble the valve chamber control panel to include, but not limited to, the following components:

.1 PLC

.2 Network Switch

.3 Power Supply

.4 Circuit Breakers

.5 Relays

.6 GFCI Receptacle

.7 Terminal Blocks

.8 Fibre optic patch panel

.9 Front Panel

.1 HMI

.2 Selector Switches

.3 Pilot Devices

.4 Wiring to the front panel shall be enclosed within spiral wrap to allow for ease of door movement and protection.

.10 Finger ducting: Unless installed in conduit, all wiring within the Control Panel shall be routed using finger ducting.

.11 Supply and install din rail mounted interposing relays as shown on the plans.

.9 External sensors and connections:

.1 Supply, install and connect mechanical control equipment as shown on drawings including:

.1 Flow meter sensors/transmitters.

.2 Pressure transmitters.

.3 Electrical valve actuators.

.4 Chamber flood switches.

3.2 CONTROLS

.1 The Contractor shall demonstrate end-to-end functionality of each PLC point to the field equipment to the Owner's Representative prior to installation of the software.

.2 The pump controls shall be programmed to allow for alternating duty and standby operation.

3.3 MAINTENANCE MATERIALS

.1 Provide:

.1 Ten (10) spare fuses of each type used in the panel.

.2 One (1) control relay of each type used in the control panel.

.3 Any other components which the Contractor recommends to be kept as spares.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate system to prove satisfactory performance of complete system during 24 hour period.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results – Electrical

.2 Section 26 05 21 – Wires and Cables (0-1000V)

.3 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets

.4 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

.5 Section 26 50 00 – Lighting

.6 Section 26 54 00 – Heating and Ventilation

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23th Edition.

.2 C22.2 NO. 94.1-15 - Enclosures for electrical equipment, non-environmental considerations

.3 C22.2 NO. 94.2-15 - Enclosures for electrical equipment, environmental considerations.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance Conditions of the Contract and Section 1 Specification Section.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide shop drawings: in accordance with Section 26 05 00 Common Work Results - Electrical.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 26 05 00 - Common Work Results – Electrical.

1.6 QUALITY ASSURANCE

.2 Site Reviews:

.1 Allow for in-factory visits by Engineer, and other delegates as deemed necessary, to review kiosk at the following completion milestones:

.1 At kiosk enclosure manufacturer's location before application of powdercoat, but after prepping for powdercoat.

.2 At kiosk enclosure manufacturer's location following application of powdercoat, but before mounting of internal components.

.3 At kiosk manufacturer's location following installation of internal components.

.4 At Owner's maintenance yard following shipment.

.2 A schedule indicating the above milestone dates shall be submitted within one week of award. The Engineer shall be notified in writing a minimum of two weeks before each of the above milestone dates to confirm inspection dates and times.

2. PRODUCTS

2.1 ELECTRICAL KIOSK

.1 Electrical Kiosk shall be a four-section, rigid, free-standing, vandal resistant kiosk, rated CSA Type 3R and certified to CAN/CSA C22.2 No. 94.1-15 and CAN/CSA C22.2 No. 94.2-15.

.2 Kiosk dimensions on Drawings are approximate only. Contractor to determine final kiosk dimensions to layout all of proposed equipment.

.3 All kiosk assemblies shall be from the same manufacturer, shall bear the C.S.A. seal of approval, or other certification mark acceptable in the Province of British Columbia, and be manufactured by an electrical control panel manufacturer regularly engaged in this type of work.

.4 General Material Requirements:

.1 All materials shall be new.

.2 Equipment shall be fabricated from marine grade 5052-H32 sheet aluminum of a least 3.2 mm (1/8 in.) thickness.

.3 Use stainless steel hardware, grade 16 stainless unless otherwise noted.

.5 Connecting Hardware:

.1 Miscellaneous hardware other than screws, nuts, bolts and washers shall be stainless steel.

.2 Connecting hardware (i.e. screws, nuts, bolts and washers) 3/8" diameter or smaller and shall conform to the following:

.1 All hardware shall have unified national thread form (ANSI) and shall be 18-8 or 316 stainless steel.

.2 All nuts and bolts 1/4-20 and large shall have unified national threads and hexagon heads, and shall bear suitable markings to identify their grade and origin of manufacture.

.3 All machine screws smaller than 1/4-20 (ex. 8-32 UNC, 10-24 UNC) shall be Robertson pan-head. All screw heads shall be sized so only one screwdriver is required when working on the panels.

.4 No sheet metal or self-tapping screws shall be used.

.6 Fabrication Mechanical Requirements

.1 The kiosk shall be fabricated with sufficient bracing to form a structure capable of withstanding transportation, wind, snow and ice loading. The kiosk manufacturer is responsible for obtaining certification from APEGBC registered professional engineer.

.1 Recommended anchor locations shall be provided on shop drawings.

.2 Anchor requirements shall be provided based on wind, snow and seismic loading criteria for the geographic location of the installation.

.3 Importance factor of one (1) shall be considered for the installation.

.2 All exterior corners shall be rounded to a radius of 3.17mm (1/8 inch) minimum.

.3 All sharp edges shall be de-burred to a radius of 0.4mm (1/64 inch) minimum in order to reduce hazards to service personnel.

.4 Welding:

.1 All welds shall be in accordance with CAN/CSA W59.2 – Welded Aluminum Construction.

.2 All exterior seams shall be of continuously welded construction. All exterior welds shall be ground smooth.

.3 All welds shall be free of slag and spatter.

.5 Roof:

.1 The roof shall have a minimum 75 mm overhang and provide rain gutters over all doors and openings.

.2 Lifting eyes or loops shall be securely welded to the roof.

.6 Doors:

.1 Doors shall have internal bracing when required to prevent excessive distortion.

.2 Doors shall be at least 100mm above concrete pad.

.3 All kiosk doors are to be lockable. The latches must contain minimum 13 mm diameter hole to receive padlock. Door handles must contain provision for double padlock capability.

.4 All double doors to be overlapping with no center mullion.

.5 The door handle shall be galvanized steel and powder coated the same colour as the kiosk. Latch handle shall swing towards hinge side of door.

.6 Doors shall have three point latching devices with vertical bars that are riveted to actuator bar.

.7 Handles, latches and padlocks shall be recessed such that they cannot be struck off or cut with a standard hacksaw.

.8 Door hardware to be mounted with tamper resistant hardware.

.9 Each door shall have a hydraulic dampener to hold the door in the open position at 90 degrees.

.10 Hinges shall be hidden and not accessible from the outside with the door closed. Hinge body to be aluminum with stainless steel hinge pin. Hinges to be of permanently lubricated design

.7 Door Gaskets:

.1 The gasket shall be of one continuous piece per side (ex. Four strips per opening) and shall be permanently bonded to the metal.

.2 The gasket shall be of an appropriate length so as not to have gaps at gasket joints or to shrink over time.

.3 The surface of the gasket shall be covered with a silicon lubricant to prevent sticking to the mating surface.

.4 The hinge shall be designed to prevent binding of the gasket.

.8 Plan Pouch and Laptop Shelf

.1 Kiosk shall include a waterproof plan pouch (400mm high x 300mm wide minimum) on inside of door in the Controls Compartment. The pouch shall be secured using stainless steel fasteners.

.2 Kiosk shall include fold down door-mounted equipment/laptop shelf in the Controls Compartment. Shelf shall be mounted such that top of shelf is located 1100mm (36”) above the top of finished grade.

.7 Kiosk Finish

.1 General Requirements:

.1 The powder coating process shall be tested on at least one piece from a given batch of aluminum components to ensure a high quality coating for that type of component before the complete batch is powder coated. If

there is uncertainty about the quality or appearance of the powder coating, Owner approval shall be acquired.

.2 Items to be powder coated shall be free of dents, scratches, weld burns, ripples, pits, and abrasion before powder coating.

.3 Removable components which may be damaged by the powder coating process shall be removed before powder coating and reassembled after powder coating.

.4 Mask all threaded hardware and tapped holes, as required.

.2 Pre-Treatment:

.1 The powder coating pre-treatment shall include the following steps:

.1 Alkaline cleaning, or equivalent as required, to remove process oil, grease, and dirt.

.2 Rinsing, as required.

.3 Multi-metal iron phosphate coating or dried in place pre-treatment to increase corrosion resistance and improve paint adhesion. Follow chemical supplier's specifications. Chemical concentration, temperature, and timing specifications must be followed precisely.

.4 Rinsing, as required.

.5 Non-chrome, or equivalent, sealing coating to provide additional corrosion protection. Follow chemical supplier's specifications. Chemical concentration, temperature, and timing specifications must be followed precisely.

.3 Drying / Pre-Heating:

.1 All items to be powder coated must be completely dry and pre-heated as required to help prevent out-gassing before powder coat application.

.4 Application:

.1 Powder coat shall be of type Polyester-TGIC.

.2 Powder coat colour: RAL1015 (or a similar RAL code to be provided by the Owner at the time of shop drawing review).

.3 For porous castings, a powder coat type shall be selected to help prevent out-gassing.

.4 Powder coat must be applied to meet the powder coat manufacturer's specifications.

.5 Powder coat thickness shall be no less than 2.5 mils at any location.

.6 Ful-coverage of interior and exterior surfaces is required, with no light spots allowed on exterior surfaces.

.5 Final Appearance:

.1 All powder coatings shall be smooth, substantially free of contamination, flow lines, light spots, powder build-up, powder washout, streaks, sagging, runs, blisters, and other defects that would in any way impair serviceability or detract from the general appearance.

.2 The final product shall be free of thickness variations, poor adhesion, orange peel, blistering, pinholes, craters, powder puffs, drips, colour variations, clouding or grainy/wavy flow, dents, scratches, weld burns and abrasions harmful to its strength and general appearance.

.8 Equipment Mounting Panels:

.1 The kiosk shall be provided with full height inside mounting panels.

.2 Panels shall be minimum 10 gauge galvanized steel painted white.

.3 Panels shall be removable and suitable for drilling and tapping in order to mount internal components.

.9 Kiosk Environmental Requirements

.1 General:

.1 The supplier shall provide heaters of suitable wattage and fans of suitable CFM for the volume and internal heat generation of the components inside of the enclosure to prevent condensation from -20 to +50 degrees Celsius under all prevailing temperature and humidity conditions.

.2 Provide sufficient airflow to keep equipment temperature to below its maximum temperature rating to prevent equipment overheating of the equipment under all prevailing temperature conditions for the area in which it will be installed.

.3 Provide positive pressure ventilation to ensure that dust does not enter the cabinets.

.2 Insulation:

.1 The supplier shall insulate all sides, doors, and roof of the kiosk.

.2 Insulation shall be 25mm Polyisocyanurate Insulation Sheathing. All edges and seams to be sealed with foil tape.

.3 On doors, insulation shall be concealed by full height 20 gauge aluminum plates.

.4 On sides and roof, insulation shall be located between outer shell and mounting panels.

.3 Ventilation:

.1 Ventilating louvers shall be vermin, insect and rainproof with easily replaceable fiberglass, non-circular automotive type filters.

.2 Ventilation louvres shall be adequately sized and die punched.

.3 The controls compartment of the kiosk shall be equipped with one or more 120VAC exhaust fans. The number of fans and louvers will vary according to the kiosk size, prevailing temperature conditions and kiosk equipment heat load.

.4 Electrical connections shall be by two insulated spade connectors.

.5 There shall be no exposed electrical parts.

.6 Fans shall be covered with a protective guard.

.7 Fans shall be serviceable and replaceable without having to remove any other component in the kiosk.

.4 Kiosk Heating:

.1 The power distribution and control compartments shall be equipped with 120VAC heaters to Section 26 54 00 – Heaters and Ventilation.

.2 Heaters shall be serviceable and replaceable without removing any component in the kiosk. Heaters shall be located to prevent burning of adjacent components.

.3 Heaters shall be suitably shielded to prevent accidental burning.

.4 There shall be no exposed electrical parts.

.5 Thermostat:

.1 Kiosks shall be equipped with one or more 120/240VAC thermostats to Section 26 54 00 – Heaters and Ventilation.

.2 Thermostats shall be serviceable and replaceable without removing any component in the kiosk.

.3 There shall be no exposed electrical parts.

.4 Control of heater shall be from a thermostat integral to heater enclosure.

.5 Control of fan shall be from a wall-mount thermostat.

.10 Kiosk Lighting:

.1 Kiosk lights shall be LED to Section 26 50 00 - Lighting.

.2 There shall be a door switch on each door wired to turn on and off the kiosk lighting

.11 Conduit and Wiring:

.1 Wiring between components within the kiosk shall be in EMT.

.2 Conduit to Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

.3 Wiring to Section 26 05 21 – Wires and Cables (0-1000V)

.12 Electrical Assemblies:

.1 Equipment within the kiosk shall be within EEMAC 1 enclosures to Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.

.2 Enclosures shall be gray powder coat finish inside and out over pretreated surfaces.

.3 Additional equipment are listed on the drawings and electrical specifications.

.13 Shop Drawings:

.1 Shop drawings for the electrical kiosk to be submitted in accordance with Section 26 05 00 Common Work Results - Electrical.

.2 Detailed dimensioned layout shop drawings including plans, elevations, sections, equipment layout and wiring diagrams.

.3 Wiring diagrams for the power distribution, fan, and heating.

.4 Include slab anchoring locations and dimensioned foundation template.

3. EXECUTION

3.1 INSTALLATION

.1 The kiosk will be placed on top of a concrete pad specified elsewhere and anchored per kiosk manufacturer's recommended fastening methods, by others.

.2 Install equipment and terminal blocks as indicated in cabinets.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Kiosk shall be labelled with the supplier's company name, model number, panel rating and date of manufacture. This label shall be located on the inside of the kiosk in an easy to read location.

.3 Install size 2 identification labels indicating system name, voltage, and phase.

END OF SECTION

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.3 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.4 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA-C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CSA-C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA-C22.2 No.55-15, Special Use Switches.
- .4 CSA-C22.2 No.111-10 (R2015), General-Use Snap Switches (Bi-national standard, with UL 20).
- .5 CSA-C22.2 No. 177-13, Clock-operated Switches
- .6 CSA-C22.2 No. 184-15, Solid-State Lighting Controls

1.5 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Conditions of the Contract and Section 1 Specification Sections.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 WALL SWITCH OCCUPANCY SENSORS

.1 15A, 120V, single pole, wall switch occupancy sensor to: CSA-C22.2 No. 184-15.

.2 Technology: PIR/Ultrasonic

- .1 180 degree field of view, 2400 square feet coverage.

.3 Manual on/off override switch.

.4 Compatible with LED drives, electronic, and magnetic ballasts.

.5 Adjustable delayed-off time.

.6 Colour: White

.7 Switches of one manufacturer throughout project.

2.2 ASTRONOMICAL TIME SWITCH

.1 15A, 120 V, single pole, switches to: CSA-C22.2 No.177-13.

.2 Astronomical clock capable of adjusting to local sunrise/sunset times.

.3 Ability to program timed events weekdays, weekends, any combination of days.

.4 Manual on/off override switch.

.5 Compatible with LED drives, electronic, and magnetic ballasts.

.6 Colour: White

.7 Switches of one manufacturer throughout project.

2.3 SWITCHES

.1 15A, 120 V, single pole, switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose ac switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.
.2 Silver alloy contacts.
.3 Urea or melamine moulding for parts subject to carbon tracking.
.4 Suitable for back and side wiring.
.5 White toggle.

.3 Toggle operated fully rated for tungsten filament, fluorescent, and LED lamps, and up to 80% of rated capacity of motor loads.

.4 Provide switches with occupancy sensors for control of interior lighting.

.5 Switches of one manufacturer throughout project.

2.4 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R/20R as indicated, 125 V, 15/20 A as indicated, U ground, to: CSA-C22.2 No.42 with following features:

.1 White urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Eight back wired entrances, four side wiring screws.
.5 Triple wipe contacts and rivetted grounding contacts.

.2 Other receptacles with ampacity and voltage as indicated.

.3 Receptacles of one manufacturer throughout project.

.4 Ground Fault interrupting capabilities as indicated.

2.5 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.

.2 Cover plates from one manufacturer throughout project.

.3 Stainless steel for lighting and hvac control wiring devices.

.4 Weatherproof RPVC cover plates for surface-mounted FS or FD Type boxes.

.5 Weatherproof clear, lockable, while-in-use cover plates for all GFI locations.

2.6 HEAT DETECTORS

.1 Sensor Type: Combination fixed temperature/rate-of-rise thermal sensor

.1 Fixed temperature: 57 Degrees Celsius
.2 Rate of Rise: 8.3 Degrees Celsius / minute
.3 Restorable rate of rise element to allow for field testing

.2 Contact Rating: 120VAC, 3A

.3 Back box mounting

.4 External unit in-alarm indication

.5 Colour: White

.6 Heat detectors of one manufacturer throughout project.

3. EXECUTION

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical or as indicated.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Heat Detectors:

.1 Protect heater detector finish with paper or plastic film until painting and other work is finished.

.2 Mount heat detector on ceiling in center of room.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

1.3 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results for Electrical.

.2 Section 26 24 01 – Service Equipment

.3 Section 26 24 02 – Service Entrance Board

.4 Section 26 24 16 01 – Panelboards Breaker Type

1.4 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-13, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE).

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.6 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Include time-current characteristic curves for breakers.

2. PRODUCTS

2.1 BREAKERS GENERAL

.1 Molded case circuit breakers based on CSA C22.2 No.5.

.2 Bolt-on molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.5 Circuit breakers in Panelboards to have minimum interrupting capacity ratings as indicated on the drawings.

2.2 THERMAL MAGNETIC BREAKERS

.1 Molded case 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.

2.3 SOLID STATE ELECTRONIC TRIP BREAKERS

.1 Solid State Electronic Trip Breakers as indicated on drawings.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Moulded case circuit breaker to operate by means of solid state trip unit with associated current monitors and self powered shunt trip to provide inverse time current trip under overload condition, and long time/short time/instantaneous tripping for short circuit protection.

.4 Programmable electronic solid state trip unit with separately adjustable long time, short time, and instantaneous.

.5 Circuit Breakers to have auxiliary contact for PLC notification of breaker status, where indicated.

.6 Circuit breakers with interchangeable trips as indicated.

.7 Circuit breakers to have minimum interrupting capacity ratings as indicated on the drawings.

.8 Refer to single line diagram. System has been designed to achieve arc flash incident energy levels of less than 1.2 calories/cm^2 for all points downstream of main utility circuit breaker. Provide circuit breakers as required to achieve same.

.9 Standard of Acceptance: Eaton FDE with OPTIM 310+ trip unit.

2.4 ENCLOSURE

.1 Provide Nema 1 enclosures for breakers where indicated.

3. EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Non-fusible, disconnect switch in NEMA Type 3R enclosure, size as indicated.

.2 Type: Heavy Duty

.3 Provision for padlocking in on-off switch position by three locks.

.4 Mechanically interlocked door to prevent opening when handle in ON position.

.5 Quick-make, quick-break action.

.6 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches as indicated.

END OF SECTION

1. GENERAL

1.1 DESCRIPTION OF SERVICES

.1 Supply to site one direct injection outdoor emergency standby (unattended) diesel generator set and all associated equipment as described herein, including:

- .1 Diesel engine.
- .2 Alternator.
- .3 Alternator control panel.
- .4 Battery charger and battery.
- .5 Load Bank.
- .6 Fuel supply system.
- .7 Exhaust system.
- .8 Steel mounting base.
- .9 Custom generator enclosure.

.2 Generator set to be: 156kVA/125kW, 347/600V, 60Hz, 3 PH., 4W.

.3 All equipment shall be of current production by a firm who manufacturers the generator and control panel and who assembles the standby generator set as a matched unit. All equipment shall be new, factory tested, and delivered ready for installation.

.4 Provide factory testing.

.5 Provide delivery to site and offload.

.6 Provide field commissioning services to test a complete and operable standby electric generating system, including all devices and equipment specified herein, or required for the service.

.7 Provide full fuel tank, parts, spare parts, tools, and equipment.

.8 Supply documentation as described herein.

.9 Provide a five (5) year warranty on all equipment against defects in materials and workmanship.

.10 The supplier shall be the manufacturer's authorized distributor, who shall provide initial start-up services, conduct field commissioning services, and provide warranty service. The supplier shall have 24-hour service availability and factory-trained service technicians authorized to do warranty service on all warrantable products. The supplier shall be able to provide onsite parts and service within 24 hours of initial call up

.11 On-site generator set installation will be completed by Others. The genset supplier shall provide miscellaneous installation and commissioning services at a later date, including:

.1 Install fuel system.

.2 Install exhaust system.

.3 Complete field commissioning services.

1.2 REFERENCES

.1 American Petroleum Institute (API)

.1 API Std. 650, Welded Steel Tanks for Oil Storage 12th Edition.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-3.6-2010, Regular Sulfur Diesel Fuel.

.3 Canadian Environmental Protection Act (CEPA)

.1 CCME PN 1326, Environmental Code of Practice for Above ground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.

.4 CSA International

.1 CSA-B139-09 (R2014), Installation Code for Oil Burning Equipment.

.2 C22.2 NO. 94.1-15 - Enclosures for electrical equipment, non-environmental considerations

.3 C22.2 NO. 94.2-15 - Enclosures for electrical equipment, environmental considerations.

.5 International Organization for Standardization (ISO)

.1 ISO 3046-1-2002, 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 1-2014, Motors and Generators.

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S601-14, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids 5th Edition.

.2 CAN/ULC-S603-14, Standard for Steel Underground Tanks for Flammable and Combustible Liquids.

.8 Canadian Electrical Code, Current Version, and B.C. Amendments

.9 Seismic design of equipment, accessories, and their anchorage shall be signed and sealed by a seismic engineer registered in the province of British Columbia.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit product data and shop drawings in accordance with these Specifications.

.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 for generator, and include:

.1 Engine: make and model, with performance curves.

.2 Alternator: make and model.

.3 Voltage regulator: make, model and type.

.4 Battery: make, type and capacity.

.5 Battery charger: make, type and model.

.6 Main circuit breaker: make, type and model.

.7 Load bank circuit breaker: make, type and model.

.8 Alternator control panel: make and type of meters and controls.

.9 Governor type and model.

.10 Generator enclosure, model and type.

.11 Exhaust system and muffler model and type.

.12 British standard or DIN rating of engine.

.13 Cooling air requirements in m 3 /s

.14 Flow diagrams for diesel fuel.

.15 Flow diagrams for cooling air.

.16 Outdoor enclosure.

.17 Fuel supply system and fuel tank.

.18 Continuous full load output of set at 0.8 PF lagging.

.19 Load profile.

.20 Schematic and wiring diagrams of engine, generator, and control panel, complete with interconnecting wiring diagram for automatic transfer switch.

.21 Single line diagram showing all breakers, switches, metering and protective relays.

.22 Complete bill of materials, including manufacturer’s name, catalogue numbers and capacity.

.23 Slab anchoring method and dimensioned foundation template.

.2 Submit dimensioned drawing showing complete generating system and fuel tank mounted on steel base, including vibration isolators, exhaust system, cooling system, drip trays, and enclosure. Indicate on drawings:

.1 Horizontal and vertical dimensions.

.2 Minimum door opening required for moving unit.

.3 Clearance requirements from equipment.

.4 Weight of entire assembly with full tank and fluids.

.5 Exact locations and details where necessary of interconnecting services including house load electrical connections, communications connections, general electrical connections, etc.

.3 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 Alarm on:

.1 Low coolant.

.2 Low fuel.

.3 Low battery voltage.

.4 Automatic shut down and alarm on:

.1 Overcranking.

.2 Over/under speed.

.3 High engine temp.

.4 Low lube oil pressure.

.5 Short circuit.

.6 Alternator over/under voltage.

.7 Lube oil high temperature.

.8 Over temperature on alternator.

.9 Tank leakage.

.4 Provide:

.1 Two (2) sets operations and maintenance manuals - On Delivery

.2 Two (2) set engine shop manuals & two (2) set Complete Parts Manual - On Delivery

.3 Two (2) sets shop drawings to be submitted PRIOR to MANUFACTURE for approval by Owner.

.4 One (1) compact disk or USB flash drive containing searchable PDF files of all final manuals, including maintenance manuals, engine shop manual, parts manual, and shop drawings.

.5 Filter survey (complete) application - On Delivery

.6 Complete belt survey (size, application) - On Delivery

.7 Hose survey (size, application) - On Delivery

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for diesel generator and ancillary systems.

.2 Provide Operation and Maintenance Manual for particular unit supplied and not general description of units manufactured by supplier. Manual shall include, but not be limited to, the following items, in sections and with referenced index:

.1 Title page showing pertinent details of the subject generator set.

.2 Table of contents.

.3 Certified copy of factory test reports

.4 Genset ID record including serial numbers and pertinent configuration.

.5 Engine operator's manual.

.6 Voltage regulation equipment operation manual.

.7 Voltage regulation equipment data sheets including batteries, and battery charger.

.8 Control panel equipment data sheets.

.9 Fuel system operator's manual and data sheets.

.10 Ventilation system operator's manual and data sheets.

.11 Exhaust system operator's manual and data sheets.

.12 Mechanical drawings and complete bill of materials as described in action and informational submittals

.1 Include components manufacturer name, and part number in material list to allow ease of purchase for replacement or spare parts.

.13 All other parts listings, maintenance and repair data, wiring diagrams, and schematics for the equipment supplied.

.14 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.5 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with these Specifications.

.1 Extra Material/Spare Parts: provide the following:

.1 One complete set of engine belt(s).

.2 Four spare control fuses for each type and rating, including spares for internally located fuses within specific components.

.3 Six spare indicating light bulbs for each size and type supplied on the equipment.

.4 Two spare control relay and socket per rating and contact arrangement.

.5 Two spare contactor operating coil.

.6 Six fuel filter elements for each type of fuel filter/water separator.

.7 Six lubricating oil filter elements.

.8 Three air cleaner elements.

.2 Provide conclusive evidence that Canadian distributor has been established and will stock in Canada spare parts likely to be required during normal life of engine.

.3 Provide complete set of any specialized tools required for proper care, adjustment and maintenance of equipment supplied.

1.6 WARRANTY

.1 Warranty shall be provided for all products against defects in materials and workmanship, for a five (5) year period from the field start-up date (commissioning).

.2 Provide terms of warranty.

1.7 EARTHQUAKE RESTRAINT

.1 Manufacturer must provide certification by a professional engineer that all installed components and their contents will remain intact, and operable after an earthquake, in accordance with the National Building Code standard for the area of installation.

.2 The contractor is responsible for obtaining structural and seismic certification from APEGBC registered professional engineer. Structural certification shall include details for fastening methods.

2. PRODUCTS

2.1 STANDARD OF ACCEPTANCES

.1 Generator/Alternator/Load Bank unit manufacturers of acceptance, produced to suit specifications:

.1 Kohler
.2 CAT
.3 Detroit Diesel
.4 Cummins

2.2 SYSTEM DESCRIPTION

.1 Generating system shall consist of a fully automatic diesel engine driven electrical generation plant completely equipped with the following:

.1 Diesel engine.
.2 Alternator.
.3 Alternator control panel.
.4 Generator control panel and annunciator.
.5 Main electronic trip circuit breaker.
.6 Load bank electronic trip circuit breaker.
.7 Battery charger and battery.
.8 Fuel supply system, including sub-base fuel tank.
.9 Exhaust system.

.10 Custom outdoor enclosure.

.11 Steel mounting base.

.2 System designed to operate as standby.

.3 All components necessary for the satisfactory operation of the standby power system shall be included and installed.

.4 Complete unit shall be CSA approved and meet NFPA current regulations.

2.3 DIESEL ENGINE

.1 Diesel engine: to ISO 3046-1.

.2 Diesel engine-generator set is to be a 4-cycle, 1800 rpm, diesel engine generator set with low reactance brushless generator, single phase RMS sensing automatic voltage regulator, set-mounted control panel, and high ambient cooling system 50 degrees C.

.3 Engine shall be designed to operate on #2 diesel fuel. Diesel engine requiring premium fuels will not be considered.

.4 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: 20 m.

.2 Installed outdoors.

.5 Performance:

.1 The voltage regulation in a steady state shall be within +/-1.5% for any constant load between no load and rated load at 0.8 P.F.

.2 The adjustment range of the voltage regulator shall be tested and shall be at least +/-10% of the nominal voltage.

.3 Maximum transient voltage dip shall not exceed 25% below rated voltage on application of the single largest surge load step at a 0.8 power factor.

.4 Maximum transient voltage rise shall not exceed 12% above rated voltage on removal of full load at 0.8 power factor.

.5 Transient recovery time within +/- 1.5% shall be less than 2 seconds.

.6 Governor:

.1 Stability plus or minus 0.5%.

.2 Speed regulation no load to full load 2.5% maximum.

.3 Automatic frequency regulation shall be isochronous from steady state no load to steady state rated load.

.4 Frequency regulation shall be adjustable from isochronous to 5% droop.

.7 The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, with the engine-generator set at operating temperature.

.8 The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.

.9 The unit shall be capable of delivering 10% overload for one hour in every twelve hours of continuous operation, without exceeding maximum permissible temperature rise.

.10 The unit shall be capable of providing stable voltage and pick up of loads within 10 seconds.

.11 The generator shall be equipped with surge suppression and the excitation system shall include an instantaneous overcurrent shutdown capability after 10 seconds.

.6 Cooling System:

.1 Engine shall be cooled by a mounted closed loop radiator system rated for full load operation in 50 degrees C ambient as measured at the generator air inlet.

.2 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of at least 50 degrees C.

.3 Block heater: thermostatically controlled lube oil or liquid coolant heater to allow engine to start in lowest ambient temperature experienced at installation location.

.1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle.

.4 All coolant hoses, including block heater hoses, silicon type.

.5 Cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier.

.7 Fuel system: solid injection, mechanical fuel transfer pump, fuel filters and air cleaner, fuel rack solenoid energized when engine running.

.8 Lubrication system:

.1 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.

.2 Lube oil cooler.

.3 Engine sump drain valve.

.4 Oil level dip-stick.

.5 Engine oil drain to exterior of sound attenuated kiosk, complete with manual shut-off valve located inside enclosure.

.9 Starting system:

.1 12 or 24V dc electric starting motor.

.2 Heavy duty, 12 or 24V lead-acid battery (minimum 200 ampere-hour capacity) with sufficient capacity to crank engine in all ambient temperatures experienced at site for 1 min without using more than 25% of ampere hour capacity.

.3 Batteries must be accessible and include Battery mounting rack, fully enclosed plastic box and interconnecting cables of generous length.

.4 Battery charger : fully automatic, three stage, trickle type. Charge at standby to boost charge after use.

.1 Regulation: plus or minus 1% output for plus or minus 10% input variation.

.2 Automatic boost for 6 hours every 30 days

.3 Equipped with dc voltmeter, dc ammeter and on-off switch.

.4 Minimum charger capacity: 7 A.

.5 Dry contacts: change state on low battery voltage, battery disconnected, and battery fault.

.6 Charger shall be mounted at the generator enclosure.

.10 Vibration isolated engine instrument panel with:

.1 Lube oil pressure gauge.

.2 Coolant temperature gauge.

.3 Fuel level gauge (units shall be % remaining in tank).

.4 Running time meter: non-tamper type.

.11 Guards to protect personnel from hot and moving parts.

.1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.

.12 Drip tray.

2.4 ALTERNATOR

.1 The AC generator shall be: synchronous, four pole, revolving field, brushless type, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc(s).

.2 All insulation system components shall meet NEMA MG1 temperature limits for Class H, 125^{o}F insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 80^{o}C at 40^{o}C ambient.

.3 A permanent magnet generator (PMG) shall provide excitation power for immunity from voltage distortion caused by non-linear loads. The PMG shall sustain excitation power for optimum motor starting and to sustain short circuit current at approximately 300% of rated current for not less than 10 seconds

.4 Rating: 156kVA/125kW, 347/600V, 60Hz, 3 PH., 4W.

.5 Output at 50 degrees C ambient:

.1 100% full load continuously.

.2 110% full load for 1 hour.

.3 150% full load for 1 minute.

.6 The automatic voltage regulator shall be temperature compensated, solid-state design. The voltage regulator shall be equipped with single phase RMS sensing. The regulator shall control buildup of AC generator voltage to provide a linear rise and limit overshoot.

2.5 MAIN BREAKER AND LOAD BANK BREAKER

.1 Mounted on unit and wired to generator.

.1 347/600V, 3 pole, 100% continuous load rated.

.2 Circuit breaker to have minimum 10kA symmetrical rms interrupting capacity rating. Manufacturer to provide circuit breaker with higher symmetrical rmc interrupting capacity if required to meet actual available fault current.

.3 Operate by means of solid state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long/short time/instantaneous tripping for short circuit protection.

.4 Programmable electronic solid state trip unit with separately adjustable long time, short time, and instantaneous.

.5 Breaker shall include a set of Form-C contacts to indicate open/closed position.

.6 Circuit breaker shall be so located that the feeder conduits rise straight out of the floor into the bottom of the breaker enclosure.

.7 Refer to single line diagram. System has been designed to achieve arc flash incident energy levels of less than XX calories/cm^2 for all points downstream of main utility circuit breaker. Provide circuit breakers as required to achieve same.

.8 Standard of Acceptance: XXXX.

2.6 CONTROL PANEL

.1 The CSA Type 3 weatherproof enclosed control panel shall be mounted on the generator set with vibration isolators, and contain a digital solid-state based generator controller.

.2 Control panel mounted indicating meters and devices shall include:

.1 Engine Oil Pressure Gauge, Coolant Temperature Gauge, DC Voltmeter, and Running Time Meter (hours).

.2 Voltage adjusting rheostat, locking type, to adjust voltage ±5% from rated value.

.3 Analog AC Voltmeter, dual range, 80 mm, 2% accuracy.

.4 Analog AC Ammeter, dual range, 80 mm, 2% accuracy.

.5 Analog Frequency/RPM meter, 45-65 Hz, 1350-1950 rpm for 1800 rpm diesel engine set 80 mm, ±0.3 Hz accuracy.

.6 A selector switch is to be provided so that the voltage and current for each phase can be monitored.

.7 Panel illuminating light.

.8 Battery charging ammeter.

.9 Voltmeter selector switch, rotary, panel mounting, four position, labelled "Off-Phase A-Phase B-Phase C".

.10 Ammeter selector switch, rotary, maintained contacts, panel mounting, designed to prevent opening of current circuits, four position labelled "OFF- Phase A-Phase B-Phase C".

.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 “Auto” pilot light.

.5 “Off” pilot light.

.4 Run/Off/Auto Selector Switch, rotary, panel mounting, labelled “Run-Off-Auto”.

.5 Fault Annunciation Indication, flush panel mounted, for each item below:

.1 Low oil pressure

.2 Low coolant level

.3 High engine temperature

.4 Over temperature on alternator

.5 Over/under speed

.6 Overcrank

.7 Over/under voltage

.8 Fuel leakage

.9 Low fuel level.

.10 Low battery voltage.

.11 Short circuit.

.6 Communications:

.1 Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine.

.2 Local and remote area network capability including monitoring software.

2.7 SAFETY SHUTDOWNS, ALARMS, AND CONTROL

.1 Digital engine controller to be mounted on unit.

.2 Each of the items below should have configurable shutdown feature and separate fault annunciation:

.1 Low oil pressure
.2 Low coolant level
.3 High engine temperature
.4 Over temperature on alternator
.5 Over/under speed
.6 Overcrank
.7 Over/under voltage
.8 Fuel leakage
.9 Low fuel level.
.10 Low battery voltage.
.11 Short circuit.

.3 Engine start delay (0-240 sec.)

.4 Overcrank delay (0-240 sec.)

.5 All wiring and contacts shall terminate in the generator control panel and shall land on clearly identified and easily accessible terminal blocks intended for customer use.

.6 The control panel shall provide the following relays and operations:

.1 Run Relay: minimum 3 sets of NO/NC contacts that change state on generator run.

.2 Common Fault Relay: minimum 3 sets of NO/NC contacts that change state on Critical Fault. Critical faults are defined as alarms which cause the generator to shut down or to be otherwise unavailable. Include tank leakage as a critical fault.

.3 Common Warning Relay: minimum 3 sets of NO/NC contacts that change state on Warning. Warnings are alarms which do not cause the generator to shut down or cause the generator to otherwise be unavailable.

.4 Run Mode Relay: minimum 2 sets of NO/NC contacts that change state on Run/Off/Auto selector position.

.5 Off Mode Relay: minimum 2 sets of NO/NC contacts that change state on Run/Off/Auto selector position.

.6 Auto Mode Relay: minimum 2 sets of NO/NC contacts that change state on Run/Off/Auto selector position.

The noted contacts shall be available for customer use and available for connection in the generator control panel in a clearly identified terminal block.

.7 Run/Off/Auto selector for unit control, with the switch wired to activate the following:

.1 Run position: cause the Run Mode Relay to activate.

.2 Off position: annunciate on the generator control panel, cause the Off Mode Relay to activate.

.3 Auto position: annunciate on the generator control panel, illuminate a green 'auto' light on the control panel, cause the Auto Mode Relay to activate.

.8 Generator Load (Output) Breaker Position:

.1 Off position: annunciate on the generator control panel, generate a Critical Fault and cause the Common Fault Relay to change state.

.9 Voltage control rheostat: mounted on inside of control panel.

.10 Controls as necessary to support load bank.

2.8 STEEL MOUNTING BASE

.1 Complete generating set and fuel tank mounted on 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 Assembly fitted with seismic restraints, vibration isolators and control console resiliently mounted.

.1 Spring type isolators with adjustable side snubbers and adjustable for levelling.

.3 Sound insulation pads for installation between isolators and concrete base.

2.9 FUEL SYSTEM

.1 Fuel tank to be sized for 24 hours of continuous operation at full load.

.2 Above-ground fuel tank to be belly-style, included in the generator base and shall be double-contained/double-walled, and be supplied complete with a leakage sensor.

.3 Include fill and vent lines with weatherhoods, fuel level gauge and vent alarm, drain and end plug, feed and return lines, with flexible terminations at engine, shut-off cock, renewable cartridge filter, fire valve.

.4 Primary and secondary fuel filters to be spin-on type of easy access.

.5 Low fuel level alarms for remote indication: 1/8, 1/4, and 1/3 fuel level sensors.

2.10 EXHAUST SYSTEM

.1 The exhaust flex-connector and all exposed exhaust components, including muffler, shall be fully insulated by means of a thermofibre blanket-type heat resistant wrapping, 25 mm thick, with SS mesh inner liner and silicone/aluminized outside cover secured by stainless steel lacing hooks and wire.

.2 A hospital grade silencer/muffler shall be supplied to attain the sound pressure ratings indicated in this specification.

.3 Exhaust silencer with condensate drain, plug and flanged couplings, shall be all mounted within the genset enclosure.

.4 Cap on muffler exhaust with additional lockable screen over top to prevent vandals from dropping debris inside.

.5 Fittings and accessories as required.

.6 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

2.11 ENCLOSURE

.1 Weatherproof, sound attenuated, rigid, free-standing, vandal-resistant, highly corrosion resistant enclosure complete with heating and lighting.

.2 CSA Type 3R rated and certified to CAN/CSA C22.2 No. 94.1-15 and CAN/CSA C22.2 No. 94.2-15.

.3 All enclosure assemblies shall be from the same manufacturer, shall bear the C.S.A. seal of approval, or other certification mark acceptable in the Province of British Columbia, and be manufactured by an enclosure manufacturer regularly engaged in this type of work.

.4 Sound attenuated on inside surface to obtain **68dBA** when measured at a distance of **7 meters** from any side of the enclosure and 1 meter above ground.

.1 Compliance with this requirement shall be demonstrated during factory testing and will be verified on site.

.2 Sound level verification shall be performed with genset at full load.

.5 General Material Requirements:

.1 All materials shall be new.

.2 Equipment shall be fabricated from marine grade 5052-H32 sheet aluminum of a least 3.2 mm (1/8 in.) thickness.

.3 Use stainless steel hardware, grade 16 stainless unless otherwise noted

.6 Connecting Hardware:

.1 Miscellaneous hardware other than screws, nuts, bolts and washers shall be stainless steel.

.2 Connecting hardware (i.e. screws, nuts, bolts and washers) 3/8” diameter or smaller and shall conform to the following:

.1 All hardware shall have unified national thread form (ANSI) and shall be 18-8 or 316 stainless steel.

.2 All nuts and bolts 1/4-20 and large shall have unified national threads and hexagon heads, and shall bear suitable markings to identify their grade and origin of manufacture.

.3 All machine screws smaller than 1/4-20 (ex. 8-32 UNC, 10-24 UNC) shall be Robertson pan-head. All screw heads shall be sized so only one screwdriver is required when working on the panels.

.4 No sheet metal or self-tapping screws shall be used.

.7 Fabrication Mechanical Requirements

.1 The enclosure shall be fabricated with sufficient bracing to form a structure capable of withstanding transportation, wind, snow and ice loading. The kiosk manufacturer shall be responsible for obtaining certification from APEGBC registered professional engineer. Kiosk manufacturer shall include anchor requirements considering wind loading, seismic loading, dead loads, and snow loading.

.2 All exterior corners shall be rounded to a radius of 3.17mm (1/8 inch) minimum.

.3 All sharp edges shall be de-burred to a radius of 0.4mm (1/64 inch) minimum in order to reduce hazards to service personnel.

.4 Welding:

.1 All welds shall be in accordance with CAN/CSA W59.2 – Welded Aluminum Construction.

.2 All exterior seams shall be of continuously welded construction. All exterior welds shall be ground smooth.

.3 All welds shall be free of slag and spatter.

.8 Roof:

.1 The roof shall have a minimum 75 mm overhang and provide rain gutters over all doors and openings.

.2 Lifting eyes or loops shall be securely welded to the roof.

.9 Doors:

.1 Doors shall have internal bracing when required to prevent excessive distortion.

.2 Doors shall be at least 100mm above concrete pad.

.3 All enclosure doors are to be lockable. The latches must contain minimum 13 mm diameter hole to receive padlock. Door handles must contain provision for double padlock capability.

.4 All double doors to be overlapping with no center mullion.

.5 The door handle shall be galvanized steel and powder coated the same colour as the enclosure. Latch handle shall swing towards hinge side of door.

.6 Doors shall have three point latching devices with vertical bars that are riveted to actuator bar.

.7 Handles, latches and padlocks shall be recessed such that they cannot be struck off or cut with a standard hacksaw.

.8 Door hardware to be mounted with tamper resistant hardware.

.9 Each door shall have a hydraulic dampener to hold the door in the open position at 90 degrees.

.10 Hinges shall be hidden and not accessible from the outside with the door closed. Hinge body to be aluminum with stainless steel hinge pin. Hinges to be of permanently lubricated design

.10 Door Gaskets:

.1 The gasket shall be of one continuous piece per side (ex. Four strips per opening) and shall be permanently bonded to the metal.

.2 The gasket shall be of an appropriate length so as not to have gaps at gasket joints or to shrink over time.

.3 The surface of the gasket shall be covered with a silicon lubricant to prevent sticking to the mating surface.

.4 The hinge shall be designed to prevent binding of the gasket.

.11 Plan Pouch

.1 Enclosure shall include a waterproof plan pouch (400mm high x 300mm wide minimum) on inside of door in the controls area. The pouch shall be secured using stainless steel fasteners.

.12 Enclosure Finish

.1 General Requirements:

.1 The powder coating process shall be tested on at least one piece from a given batch of aluminum components to ensure a high quality coating for that type of component before the complete batch is powder coated. If there is uncertainty about the quality or appearance of the powder coating, Owner approval shall be acquired.

.2 Items to be powder coated shall be free of dents, scratches, weld burns, ripples, pits, and abrasion before powder coating.

.3 Removable components which may be damaged by the powder coating process shall be removed before powder coating and reassembled after powder coating.

.4 Mask all threaded hardware and tapped holes, as required.

.2 Pre-Treatment:

.1 The powder coating pre-treatment shall include the following steps, or equivalent:

.1 Alkaline cleaning, or equivalent as required, to remove process oil, grease, and dirt.

.2 Rinsing, as required.

.3 Multi-metal iron phosphate coating or dried in place pre-treatment to increase corrosion resistance and improve paint adhesion. Follow chemical supplier's specifications. Chemical

concentration, temperature, and timing specifications must be followed precisely.

.4 Rinsing, as required.

.5 Non-chrome, or equivalent, sealing coating to provide additional corrosion protection. Follow chemical supplier's specifications. Chemical concentration, temperature, and timing specifications must be followed precisely.

.3 Drying / Pre-Heating:

.1 All items to be powder coated must be completely dry and pre-heated as required to help prevent out-gassing before powder coat application.

.4 Application:

.1 Powder coat shall be of type Polyester-TGIC.

.2 Powder coat colour: RAL code to be provided by the Owner at the time of shop drawing review.

.3 For porous castings, a powder coat type shall be selected to help prevent out-gassing.

.4 Powder coat must be applied to meet the powder coat manufacturer's specifications.

.5 Powder coat thickness shall be no less than 2.5 mils at any location.

.6 Full-coverage of interior and exterior surfaces is required, with no light spots allowed on exterior surfaces.

.5 Final Appearance:

.1 All powder coatings shall be smooth, substantially free of contamination, flow lines, light spots, powder build-up, powder washout, streaks, sagging, runs, blisters, and other defects that would in any way impair serviceability or detract from the general appearance.

.2 The final product shall be free of thickness variations, poor adhesion, orange peel, blistering, pinholes, craters, powder puffs, drips, colour variations, clouding or grainy/wavy flow, dents, scratches, weld burns and abrasions harmful to its strength and general appearance.

.13 Enclosure shall be vandal resistant.

.1 Externally accessible fasteners shall preferably be blind head although allen head will be permissible.

.2 Air inlet and outlet openings shall be designed such that objects of any size directed at the enclosure from vertically downward to horizontally flat cannot enter. Air inlet and outlet openings shall be sized such that inlet air velocity is below the level at which water penetration will occur.

.14 Enclosure Environmental Requirements

.1 General:

.1 The supplier shall provide heaters of suitable wattage and fans of suitable CFM, as required, for the volume and internal heat generation of the components inside of the enclosure to prevent condensation from -20 to +50 degrees Celsius under all prevailing temperature and humidity conditions.

.2 Insulation:

.1 The supplier shall insulate all sides, doors, and roof of the enclosure.

.2 All edges and seams to be sealed with foil tape.

.3 On doors, insulation shall be concealed by full height 20 gauge aluminum plates.

.4 On sides and roof, insulation shall be located between outer shell and interior panels.

.3 Ventilation (as required):

.1 Ventilating louvers shall be vermin, insect and rainproof with easily replaceable fiberglass, non-circular automotive type filters.

.2 Ventilation louvres shall be adequately sized and die punched.

.3 120VAC exhaust fans, as required. The number of fans and louvers will vary according to the enclosure size, prevailing temperature conditions and enclosure equipment heat load.

.4 Electrical connections shall be by two insulated spade connectors.

.5 There shall be no exposed electrical parts.

.6 Fans shall be covered with a protective guard.

.7 Fans shall be serviceable and replaceable without having to remove any other component in the enclosure.

.4 Enclosure Heating (as required):

.1 Heaters shall be serviceable and replaceable without removing any component in the enclosure. Heaters shall be located to prevent burning of adjacent components.

.2 Heaters shall be suitably shielded to prevent accidental burning.

.3 There shall be no exposed electrical parts.

.5 Thermostat:

.1 Thermostats shall be serviceable and replaceable without removing any component in the enclosure.

.2 There shall be no exposed electrical parts.

.3 Control of heater shall be from a thermostat integral to heater enclosure.

.4 Control of fan shall be from a wall-mount thermostat, white in colour.

.15 Engine oil drain to exterior of sound attenuated kiosk complete with manual shut-off valve located inside kiosk.

2.12 EQUIPMENT IDENTIFICATION

.1 Control panel:

.1 Size 5 nameplates for controls including alternator breakers and program selector switch.

.2 Size 3 nameplates for meters, alarms, indicating lights and minor controls.

3. EXECUTION

3.1 SOURCE QUALITY CONTROL

.1 Site Reviews:

.1 Allow for in-factory visits by Engineer, and other delegates as deemed necessary, to review generator at the following completion milestones:

.1 At genset enclosure manufacturer's location before application of powder coat, but after prepping for powdercoat.

.2 At genset enclosure manufacturer's location following application of powdercoat, but before mounting of internal components.

.3 At genset manufacturer's location following installation of internal components, which will include a review of the overall genset testing.

.4 At Owner's maintenance yard following shipment.

.2 A schedule indicating the above milestone dates shall be submitted within one week of award. The Engineer shall be notified in writing a minimum of two weeks before each of the above milestone dates to confirm inspection dates and times.

.2 Factory test generator set including engine, alternator, control panels, and accessories in presence of Engineer. Provide fuel and fluids as required for testing.

.3 Notify Consultant 10 days in advance of date of factory test. Consultant may wish to witness test.

.4 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, kV.A, V, A, r/min, Hz.

.2 Mark check sheet and record data on forms in duplicate as test proceeds.

.5 The engine generator set and the testing results shall meet current CSA standard C282 including the following tests:

.1 With 100% rated load, operate set for 4 hours, taking readings at 15 minute 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, 2-3, 1-3.
.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.
.15 Alternator cooling air outlet temp.

.2 At end of 4 hours run increase load to 110% rated value, and take readings every 15 minutes for 1 hour.

.3 After completion of 5 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.
.10 Tank leakage.

.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.

.6 Demonstrate:

.1 Automatic starting of set and automatic transfer of load on failure of normal power.

.2 Operation of manual bypass switch.

.3 Automatic shut down of engine on resumption of normal power.

.4 That battery charger reverts to high rate charge after cranking.

.7 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

3.2 ACCEPTANCE OF EQUIPMENT AND STORAGE

.1 Delivery and Acceptance Requirements:

.1 The Owner shall coordinate delivery with the genset supplier.

.2 The Owner shall inspect all equipment on acceptance and report any visible damage or missing components. The genset and all associated accessories shall be stored in a secure heated and ventilated building.

.2 After the genset is installed (by Others) at the pump station, temporary power shall be connected to the unit to energize the space heating.

.3 Once delivery has been accepted, the Owner shall be responsible for all equipment for the remaining duration of the project.

3.3 INSTALLATION OF THE GENSET

.1 The Owner-arranged Contractor shall provide all necessary hoists, skids, temporary supports and beams to assist with installing the genset.

.2 The generating set shall be positioned on the seismic restraints spring type vibration isolators, supplied with the set, and carefully aligned and positioned as detailed on the shop drawings.

.3 The vibration isolator seismic restraints and anchor bolts shall be installed as per the manufacturer's instructions. The installation must be inspected and certified by the manufacturer's representative.

.4 Ensure that there are no rigid connections or incidental physical contacts between isolated equipment and the building structure or nearby systems.

.5 Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.

.6 Complete wiring and interconnections as indicated.

3.4 INSTALLATION OF EXHAUST SYSTEM

.1 The exhaust system shall be installed by the genset manufacturer or authorized representative.

.2 The exhaust assembly shall be installed by workers experienced in this field.

3.5 INSTALLATION OF THE FUEL SYSTEM

.1 Flexible fuel supply and return lines between the genset and the fuel tank shall be installed as per the manufacturer's instructions by the genset manufacturer or authorized representative. After the system is complete, all fuel lines shall be purged with air, reconnected and tested for leaks.

.2 Supply and install vent extension and all valves and fittings not specifically supplied with the fuel day tank.

.3 Install day tank and secure to the concrete housekeeping slab with anchors as specified by the manufacturer. Fuel lines will be placed in a tidy manner that will not present a tripping hazard.

.4 All unused surplus bungs in the fuel tank shall be plugged.

3.6 FIELD COMMISSIONING

.1 Notify 10 working days in advance of test date.

.2 Provide fuel for testing and leave full tanks on acceptance.

.3 Demonstrate:

- .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
- .2 Unit start and shut down on "Manual" control
- .3 Unit start and transfer on "Test" control.
- .4 Unit start on "Engine start" control.
- .5 Operation of manual bypass switch.
- .6 Operation of automatic alarms and shut down devices.

.4 Run unit on 100% load for minimum period of 4h to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling. No adjusting of speed or voltage shall be made after the load tests have commenced.

.5 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

.6 Test reports from shop/factory that sensors were tested, as per our specification and trip points documented. Provide certified documents.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 SECTION INCLUDES

.1 Materials and installation for automatic load transfer equipment which can monitor voltage on all phases of normal power supply, initiate cranking of standby generator unit, transfer loads and shut down standby unit.

1.3 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

.2 Section 26 32 13 01 – Power Generation - Diesel

1.4 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.178.1-14, Transfer Switch Equipment.

1.5 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.

.3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.

.4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

2. PRODUCTS

2.1 STANDARD OF ACCEPTANCES

.1 200A model: Thompson Technology Model TS 870 c/w TSC 900 controller and all options and accessories to suit specification

2.2 TRANSFER SWITCH

.1 To CSA C22.2 No. 178.

.2 Rating: 347/600V, 200A, 3-Phase, 3 Wire, 3-Pole.

.3 Operation: Open Transition

.4 Transfer switch to be mechanically held type.

.5 Enclosed style for mounting within kiosk.

.6 Switch to be sized to the service size.

.7 Warm up and transfer timers - cool down timer.

.8 Exercise Timer with load on, 7 day, with battery backup.

.9 Neutral delay timer.

.10 Auxiliary contacts:

- .1 2 sets NO/NC contacts for Transfer Switch in Utility position
- .2 2 sets NO/NC contacts for Transfer Switch in Emergency position
- .3 2 sets NO/NC contacts for Utility Power Available
- .4 2 sets NO/NC contacts for Transfer Switch “Not in Auto”
- .5 2 sets NO/NC contacts for Transfer Switch internal fault

.11 Front panel indicators:

- .1 Utility Power available (Green)
- .2 Generator Power available (Green)
- .3 Transfer Switch in Utility Position (Green)
- .4 Transfer Switch in Emergency Position (Red)
- .5 Transfer Switch Fault Condition (Red)

.12 Controller input for “Transfer Inhibit” functionality via relay dry contact.

.13 Voltage sensing on all phases.

.14 Controller to include Ethernet Modbus Remote Communication Port

.15 Front panel selector switch with positions for:

.1 Test

.2 Auto

.3 Off

3. EXECUTION

3.1 INSTALLATION

.1 Auto Transfer Switch shall be mounted inside MCC.

.2 Connect transfer equipment.

.3 Install and connect battery and remote alarms.

3.2 FIELD QUALITY CONTROL

Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical and Section 26 32 13 01 – Power Generation – Diesel.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C78.374-2015 Light-Emitting Diode Package Specification Sheet for General Illumination Applications

.2 ANSI C78.377-2015 American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products

.2 Illuminating Engineering Society (IES)

.1 IES LM-79-08: Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

.2 IES LM-80-15: Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules

.3 IES LM-82-12: LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

.4 IES LM-84-14: Approved Method for Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires

.5 IES LM-85-14: Approved Method for Electrical & Photometric Measurements of High Power LEDs

.6 IES TM-21-11: Projecting Long Term Lumen Maintenance of LED Light Sources

.7 IES TM-28-14: Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires

.8 IES TM-30-15: IES Method for Evaluating Light Source Color Rendition

.3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41.1-2002 (R2008), IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits

.2 ANSI/IEEE C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits

.4 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

.5 ICES-005-2016, Lighting Equipment

.6 National Electrical Manufacturers Association (NEMA)

.1 NEMA SSL 1-2010 Electronic Drivers for LED Devices, Arrays, or Systems

.7 Underwriters' Laboratories of Canada (ULC)

.1 UL 1449 (2014), Standard for Surge Protective Devices

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.

2. PRODUCTS

2.1 WET LOCATION LINEAR LED FIXTURES

.1 Fiberglass housing: reinforced polyester.

.2 Polyurethane gasketing in the housing to providing a continuous seamless seal for the diffuser.

.3 Eight sturdy cam latches to clamp the diffuser tightly for a positive seal between housing, gasketing and diffuser.

.4 Lens: UV-stabilized, impact resistance diffused acrylic shielding

.5 LED based light source: 4000K, 6300 lumens

.6 Standard of Acceptance: Cree WS Wet Location LED Linear Luminaire

2.2 EXTERIOR WALL MOUNT LED FIXTURE

.1 Die-cast, extruded aluminum housing.

.2 Dark-sky compliant.

.3 Wall mounting.

.4 IESNA Type II Medium distribution.

.5 LED light source: 3000K Color Temperature, 2500 lumens.

.6 Standard of Acceptance: Cree XSPW LED Wall Pack Luminaire

2.3 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Coordinate outdoor wall pack installation to not interference with structural design elements.

2.4 WIRING

.1 Connect luminaires to lighting circuits:

2.5 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

PART 1 GENERAL

1.1 DOCUMENTS

.1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 26 05 21 – Wire and Cables (0-1000V)

1.3 REFERENCES

.1 CSA International

.1 CSA C22.2 No.141-(latest edition), Emergency Lighting Equipment.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.

1.5 WARRANTY

.1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: 120 VAC.

.3 Output voltage: 12 V DC.

.4 Operating time: 30 minutes.

.5 Battery: sealed, maintenance free, as indicated.

.6 Fully gasketed cast aluminum back plate with clear polycarbonate cover.

.7 Certified Nema 4X for wall or ceiling mount.

.8 Illuminated exit signs as indicated.

.1 Same manufacturer as emergency lighting.

.9 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

.10 Solid state transfer circuit.

.11 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.12 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.13 Lamp heads: integral on unit or remote as indicated on drawings, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED

.14 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.15 Finish: white.

.16 Auxiliary equipment:

.1 Time delay relay.

.2 Battery disconnect device.

.3 Bracket.

.4 RFI suppressors.

.5 Push to test button for quick testing of the operation of the unit.

.6 Self-test feature

2.2 WIRING OF REMOTE HEADS

.1 Conduit: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: RW90 CU type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

2.3 ILLUMINATED EXIT SIGNS

.1 Illuminated exit signs: to CSA 22.2 No.141-10 standard for pictogram Exit Signs.

.2 Die-cast aluminum pictogram edge-lit exit sign.

.1 LED

.3 Certified NEMA-4X for wall or ceiling mount.

.4 Sealed, vandal resistant polycarbonate faceplate.

.5 Integral LED emergency lights.

.6 Same manufacturer as emergency lighting.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

.3 Connect exit lights to unit equipment.

END OF SECTION

Consulting Engineers:
PBX Engineering Ltd.

CITY OF COURTENAY
Greenwood Pump Stations

1. GENERAL

1.1 DOCUMENTS

.1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results – Electrical

.2 Section 26 05 10 – Testing and Commissioning

.3 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets

1.3 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures - Section 26 05 00 - Common Work Results – Electrical

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for unit heaters, ventilation unit and all controls for incorporation into manual specified in Closeout Submittals - Section 26 05 00 – Common Work Results - Electrical.

2. PRODUCTS

2.1 UNIT HEATERS

.1 Element: stainless steel, factory sealed.

.2 Manufacturing: heavy-duty, 18-gauge steel cabinet; adjustable louvers and protective screen; thermal protection with automatic reset

.3 Finish: epoxy-polyester powder coat

.4 Warranty: 10 years for the element and 1 year for other components

.5 Installation: wall or ceiling-mounted with universal mounting bracket (included)

.6 Motor: permanently lubricated ball bearing motor for long lasting operation

.7 Thermally-protected motor.

.8 Wattage & voltage: per drawings

.9 Control: per drawings

.10 Standard of acceptance: Ouellet OAS Series or approved equal.

2.2 VENTILATION

.1 Refer to mechanical specifications.

.2 Wet Well Ventilation Fan

- .1 Hazardous location classification: Class 1 Div. 2
- .2 Motor: explosion proof construction, 0.5HP, 60Hz, approved for vertical installation (fan facing downward)
- .3 Fan guard
- .4 Horizontal mounting
- .5 Standard of Acceptance: Ruffneck EFX Series or approved alternate.

2.3 CONTROLS

.1 Refer to electrical drawings for details on heating and ventilation control.

.2 Provide control equipment as shown on electrical drawings. Devices to be industrial quality, line voltage (120/240 volts), single-pole, white.

.3 Provide clear plastic thermostat guard for all heating/cooling wiring devices: thermostats, astronomical time switch.

3. EXECUTION

3.1 INSTALLATION

.1 Mount heaters on kiosk wall as indicated.

.2 Electrically connect ventilation as shown in Manufacturers Installation Instructions.

.3 Install control equipment in locations indicated on drawings.

.4 Make power and control connections.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 10 – Testing and Commissioning.

.2 Ensure that heaters, ventilation and controls operate correctly.

END OF SECTION

DIVISION 33 - UTILITIES

SANITARY LIFT STATION, CONTROL VAULT AND METER CHAMBER

1.0 GENERAL

1.1 Section 33 31 00 refers to those portions of the Work that are unique to the supply and construction of the Sanitary Lift Station, Control Vault, and Meter Chamber. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the Work as described herein.

1.2 Related Work

Section SS 01 77 00	Closeout Procedures
Section SS 01 91 00	Commissioning
Section 03 20 01	Concrete Reinforcement
Section 03 30 53	Cast-in-Place Concrete
Section 31 05 17	Aggregates and Granular Materials
Section 31 23 01	Excavating, Trenching, and Backfilling
Section 33 30 01	Sanitary Sewers
Section SS 33 32 14	Prefabricated Submersible Sewage Lift Station
Section 33 34 01	Sewage Forcemains
Section SS 40 05 01	Common Requirements for Process Piping Systems
Section SS 40 05 07	Piping Supports and Seismic Bracing
Section SS 40 05 23.24	304 Stainless Steel Piping
Section SS 40 05 51	Common Requirements for Process Valves
Division 26	Electrical

1.3 Approved Equals

.1 Approval Equals of alternative equipment shall be in accordance with Instructions to Tenderers Part II.

1.4 Product Delivery, Storage, Handling

.1 All materials and equipment shall be delivered, handled and stored subject to the provisions contained herein and according to the manufacturer's recommendations.

.2 Provide temporary storage facilities and dry storage where required for sensitive items.

.3 Take precautions to maintain equipment in good condition and to avoid corrosion or other damage which may affect equipment and material performance.

.4 The Contractor shall recognize the time interval required for complete construction before the structure is suitable for equipment installation. If equipment is manufactured before it is required at the site, the Contractor shall provide suitable heated dry storage space for the equipment, to the approval of the Contract Administrator.

.5 All material or equipment damaged or otherwise harmfully affected during delivery, storage, handling or installation shall be replaced by the Contractor at the Contractor's expense.

1.5 Project Record Documents

.1 Provide Project Record Documents including Equipment and Systems Manuals, Product Data, Materials and Finishes and Operation and Maintenance Data and Instructions in accordance with Section 01 33 01 Project Record Documents.

1.6 Measurement and Payment

.1 Payment for the Sewage Lift Station, control chamber, and flow meter manhole shall be paid as a lump sum price and shall include supply and installation of all items associated with the above noted elements including the prefabricated sewage lift station, installation of piping up to and including plug valves on inlet and discharge piping, piping, supports, mechanical restraints, thrust blocks, granular pipe bedding, excavation, concrete foundations, tanks and chamber supply and install, backfill and compaction, site grading and gravel surface, valve chamber piping, pig launch, flow meter, manhole and waterproofing, supply and installation of all process mechanical piping, valving and all equipment, supply and installation of all electrical works including lighting, electrical kiosk and genset, and any other work specified in the Contract Drawings and Specifications to provide a completed and operational system. Payment shall also include Testing and Commissioning and shall include the coordination of manufacturer's representatives on-site for testing if necessary, commissioning and training, testing of materials, works and equipment, O and M manuals and materials and any other work related to testing and commissioning that would be required in the Contract Drawings and Specifications to provide a completed and operational station.

.2 Payments will be 75% upon installation of materials and 25% upon successful testing and commissioning.

1.7 Submittals

.1 Before fabrication, provide manufacturer data for each type of pipe material and for each fitting, coupling, and related appurtenance used to complete the work covered in this section.

.2 Shop Drawings: Shop drawings for all piping systems, as per General Condition 5.0, shall be furnished prior to fabrication. Indicate in orthogonal and/or isometric drawings as required to furnish the assembly details, the welds, flanges, valve placement, supports, and the provisions for thrust restraint, as well as any other pertinent details.

Where specified or when directed by the Contract Administrator, provide mill test results or product samples.

.3 Operating/Maintenance Manuals:

.1 Not less than two (2) weeks prior to application for Substantial Performance of the Work, the Contractor shall submit to the Contract Administrator a draft copy of the operating and maintenance manuals for review and acceptance. Prior to application for Substantial Performance of the Work two (2) hard copies and one (1) electronic copy of operating and maintenance manuals containing information required by the Specifications shall be submitted. All instructions in the manuals shall be in simple language to guide the Owner in the proper operation and maintenance of the installation. A deficiency in the amount of $10,000 will be withheld until the operating and maintenance manual with sufficient information to the satisfaction of the Contract Administrator are submitted.

.2 Bind contents in a three-ring, hard covered, plastic jacketed binder. Organize contents into applicable sections of work, parallel to Specifications break-down. Name of facility to be embossed onto binder cover.

.3 In addition to information called for in the Specifications, include the following:

.1 Title sheet, labeled "Operation and Maintenance Instructions", and containing project name and date.

.2 List of contents.

.3 Reviewed Shop Drawings of all equipment.

.4 Record drawings of all civil, mechanical, electrical, control, and alarm installations.

.5 Full description of entire mechanical, electrical, control, and alarm system and operation.

.6 Names, addresses and telephone numbers of all major Subcontractors and Suppliers.

.7 Operating instructions for all equipment.

.8 Maintenance instructions for all equipment, including frequency of maintenance tasks.

.9 Equipment parts lists.

.10 Emergency operating procedures.

.11 Certified head/capacity curves for pumps.

.4 Each section shall be separated from the preceding section with a plasticized cardboard divider with a tab denoting contents of the section.

.4 Record Drawings: Provide drawings per Section 01 33 01.

.5 Welder Qualifications

.1 All welders shall be qualified for the particular welding procedure they will perform. All welders shall have a valid Welders Performance Qualification Record (WPQR) book issued under the authority of the provincial boiler and pressure vessel safety program. Any weld test specimen coupon(s) submitted by the Contractor shall clearly identify the welder(s).

.2 Provide copy of welders' certification to Contract Administrator prior to starting work.

2.0 PRODUCTS

2.1 Provide all products in accordance with the Contract Drawings and all relevant sections of Specifications required to provide a complete and operational sewage lift station.

3.0 EXECUTION

3.1 Follow the recommended installation details and procedures for all equipment as found in the supplier's technical data, supplemented by the shop drawings.

3.2 Provide commissioning in accordance with Execution, Start-up and Commissioning sections.

END OF SECTION

PREFABRICTED SUBMERSIBLE SEWAGE LIFT STATIONS

1.0 GENERAL

.1 Section 33 32 14 refers to those portions of the Work that are unique to the supply and installation of prefabricated submersible sewage lift stations. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 Related Work

.1	Closeout Procedures	Section SS 01 77 00
.2	Commisioning	Section SS 01 91 00
.3	Electrical	Division 26
.4	Concrete Reinforcement	Section 03 20 01
.5	Cast-in-Place Concrete	Section 03 30 53
.6	Aggregates and Granular Materials	Section 31 05 17
.7	Excavating, Trenching, and Backfilling	Section 31 23 01
.8	Sanitary Sewers	Section 33 30 01
	Sewage Forcemains	Section SS 33 34 01
.9	Common Requirements for Process Piping Systems	Section SS 33 32 14
.10	Piping Supports and Seismic Bracing	Section SS 40 05 07
.11	304 Stainless Steel Piping	Section SS 40 05 23.24
.12	Common Requirements for Process Valves	Section SS 40 05 51
.13	Plug Valves	Section SS 40 05 62

1.2 Shop Drawing and Data Sheets

.1 Before fabrication, the supplier shall submit shop drawings to the City for review. The submission shall include data sheets for all equipment to be ordered, along with a full drawing package for the electrical kiosk (external kiosk, internal layouts, wiring and controls diagrams)

.2 Lift station structural drawings, stamped by a Professional Engineer registered in British Columbia, shall be provided for the fibreglass wet well, the reinforced concrete base, the electrical kiosk enclosure and the anchoring systems for the generator, electrical kiosk and wet well.

1.3 Requests for Approved Equals

.1 Any requests for approved equal shall contain sufficient documentation regarding the service organization which is available to back up the tendered pumping units. In particular, the service organization shall:

- have been in existence a sufficient length of time to have established a reputation which can be backed up with references;
- have a number of qualified employees whose major commitment is to carry out service calls; and
- have a well-equipped local maintenance shop.

.2 The Contractor shall also be prepared to demonstrate the availability of commonly required spare parts. If these are not kept in stock locally, the anticipated delivery period must be clearly indicated in the Form of Tender.

1.4 Commissioning Plan .1 As per Section 01 91 00

1.5 Measuremaent and Paymet .1 Payment for the portions of this work are considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

2.0 PRODUCTS

2.1 Structure .1 Chamber:

.1 The main chamber shall contain the pumps and associated equipment and shall be a vertical cylinder.

.2 The shell shall be constructed of Fibreglass Reinforced Plastic (FRP) and shall provide sufficient rigidity to resist deflection during installation and to resist pump loads and vibrations.

.3 The main chamber shall be reinforced with external reinforcing rings.

.4 Four (4) lifting "eyes" adequate for the entire weight of the completed station, including all installed equipment, shall be provided.

.5 Where inflow, discharge and ventilation lines, pass through the tank wall, the wall shall be reinforced.

.6 The connecting flanges shall be ANSI B-16.1, Class 125, unless shown otherwise on drawings.

.7 Color of the fibreglass interior shall be sanitary white. The exterior shall be dark green.

.8 Hold down lugs, complete with hold down bolts, shall be provided with sufficient strength to anchor the lift station to the reinforced concrete base, preventing flotation.

.9 The wet well shall be smooth and free of projections and pockets which could impede flow and collect sediment.

.10 An aluminum access ladder shall be provided as per Work Safe BC requirements. After installation of the complete lift station, all equipment shall be capable of servicing from the upper chamber.

.11 Electrical connection points shall be provided for the pump motors, light, and float conduits.

.2 **Physical Properties of FRP Fabrication:**

.1 The material of all tanks shipped shall meet the following minimum requirements:

Property at 73° F.	ASTM Test	Value
Tensile Strength	D638	8,000 - 16,000 psi
Compressive Strength	D695	14,000 - 27,000 psi
Flexural Strength	D790	16,000 - 30,000 psi
Flexural Modulus	D790	1.0×10^6 psi
Hardness (average)	D790	Barcol 40

.2 Fiberglass tank to be helically filament wound utilizing chemically inert ISO resins. The laminate shall contain at least 60% and not over 70% glass by weight. All FRP work shall meet or exceed the following standards:

C.G.S.B.	41-GP-22
A.S.T.M.	3299 and 2563-2.4
A.S.T.M.	D883-69

.3 The maximum load rating permitted on the top of the tank must be posted on a plaque on the inside of the lid. The plaque must clearly visible when the lid is open.

.3 **Construction**

.1 Laminates shall be dense, without voids, dry spots, foreign inclusions, air bubbles, pinholes, or delamination and shall not be cracked or crazed. Such deficiencies shall be removed by grinding and replaced with hand laid matt and roving exceeding the amount removed. The fabricated unit shall have a smooth white inner surface and shall have a dimensional tolerance of plus or minus 6mm from design dimensions.

.2 Bonded joints shall be made by wrapping with strips of fibreglass mat soaked in resin. The wrap material shall be at least as thick as the heaviest plastic section joined, and it shall extend to either side of the joint a sufficient distance to make the joint at least as strong as the pieces joined. Interior joints shall be coloured white to match the interior surfaces; exterior joints shall be of the same colour as the exterior surface.

.3 The inside surfaces of bonded joints shall be sealed with one layer of mat and then coated with resin to a minimum of 2.5mm thick.

.4 All exposed interior and exterior surfaces shall have sufficient resin coating 0.51mm minimum thickness, to avoid exposure of glass fibres.

.5 To prevent "flowing" of the final resin coat, it shall be bonded by using "Veil" glass fibre.

.6 All cut edges and drilled holes shall be coated with resin so that no glass fibres are exposed and voids filled.

.7 Structural elements having edges exposed shall be reinforced with chopped strand glass mat.

.8 The minimum tank wall thickness shall be 16mm and shall be externally reinforced to resist soil, bearing, hydraulic,

and handling loads, both internal and external. Wall thickness to be increased as required to resist loading.

.9 The resin used shall be a commercial grade and shall be evaluated by test of previous service to be acceptable for use in domestic sewage applications and suitable for installation underground throughout Canada.

.10 Ultraviolet light inhibitors to be used on all external surface in accordance with resin manufacturer's instructions.

2.2 Submersible Sewage Pumps

.1 Pumps to be equipped with ANSI discharge flange. Pumps shall be a centrifugal, submersible, non-clog, bottom suction, capable of passing a 76mm solid. Pumps and motors shall incorporate the following:

Impeller: Cast iron.

Volute/Motor Frame: Cast iron, close coupled to seal chamber. Volute to be equipped with quick discharge nozzle to provide an automatic rapid and leakproof gravity lock type connection or disconnection from the fixed elbow. Sliding guide brackets to slide along guide rails.

Shaft: Stainless Steel.

Seals: Double mechanical seals (tungsten carbide to carbide upper and tungsten carbide to tungsten carbide lower).

Bearings: Anti-friction suitable for a minimum bearing life of 50,000 hours B10 life under operating conditions.

Fluid Operating Temp.: 0°C to 20°C.

Fluid Specific Gravity: 1.0

Fluid Type: Domestic Sewage

Fasteners: Stainless Steel (ASTM TYPE 316).

.2 Motors shall be CSA approved submersible squirrel cage induction type with Class F insulation and non-hydroscopic windings. Service factor shall be 1.0. Use EEMAC Design B. If higher starting torque is required for the equipment loading, use EEMAC Design C.

Pump motors shall come equipped with means of communicating seal leaks and over-temperature conditions.

.3 Power cables shall be factory-sealed into the motors and flush valve. They shall be of a type of construction acceptable to the electrical inspector. Cables shall be of sufficient length to reach the Control Kiosk without splices.

Power cables shall be equipped with a disconnect switch located inside the wet well, complete with lockout. Disconnect switches to be Meltric Decontactors or approved equal.

.4 The pump motor nameplates shall be mounted in the Kiosk or Panel.

.5 Pumps shall be painted with epoxy and equipped with sacrificial zinc anodes to provide corrosion protection.

.6 Pump P2 to be equipped with Flygt Model 4901 Mix Flush Valve or approved equal.

.7 Contractor shall supply the following spare equipment:

- one (1) impeller
- one (1) spare pump

2.3 Fixed Discharge Connection

.1 Fixed discharge elbow, quick disconnect type, with steel soleplate, lower guide rail holder and drilled for anchor bolts.

2.4 Lifting Chains

.1 Lifting chains to be Grade 80 Accoloy A8 material, rated with a working load of 1900 kg and shall be NAR approved for overhead lifting, finish to be galvanized. Chain length to be sufficient to connect between pump and chain hoist.

2.5 Guide Rail Assembly

.1 Schedule 40 galvanized steel pipe c/w upper guide bar holder.

.2 All fittings and connectors to be galvanized.

2.6	**Ventilation Duct Work & Fan**	.1	Inlet duct shall be provided for air blown into the lift station and a vent shall release exhaust air.
2.7	**Lighting Fixture**	.1	The wet well light shall be an explosion-proof, wall-mounted, LED fixture suitable for Class 1 locations, complete with globe and guard, RAB Type EB 123 or equal. Switch by General Contractor.
2.8	**External Piping**	.1	As per the Contract Drawings.
2.9	**Internal Piping**	.1	Sewage piping as noted on the contract drawings
2.10	**Level Regulators**	.1	Provide five ENM-10 Flygt level regulators to stop both pumps, start lead pump, start standby pump, high level alarm, low level alarm for 24 volt operation, each with sufficient cable suitable for the installation.
		.2	Provide one aluminum liquid level hanger, with wall bracket mount and flat switch conductor hooks for excess cable. Hanger shall also provide threaded strain-relief squeeze connectors for each level regulator.
2.11	**Bolts**	.1	All bolts, including those for the check valve and plug valve, shall be ASTM Type 316 Stainless Steel.
2.12	**Access Covers**	.1	Access covers shall be designed to allow removal of the pumps from the stations without removing or damaging other equipment.
		.2	Each cover shall be hinged and include hydraulic assist for easy opening with less than 225 N lifting force and shall be provided with a padlock hasp with a box enclosure to prevent vandalizing of the lock.
		.3	A brass padlock shall will be installed by the City at the developer's cost.
		.4	Each cover shall be provided with a positive means of locking open.
		.5	Safe-Hatch (or approved equal) shall be included to provide fall through protection.

2.13 Floor Gratings	.1	Fibreglass or Borden Type B aluminium Size No. 6 suitable for a bearing load of 5 kN/m², or 200 kg plus dead weight of one pump whichever is greater.
2.14 Miscellaneous Metals	.1	Aluminium: to ASTM 655.
	.2	conforming to CSA G40.2-M1977; Type W with yield strength of 300 MPa, shop primed.
	.3	stainless steel ASTM Type A316 Stainless Steel unless otherwise noted.
	.4	Miscellaneous metalwork, including brackets, nuts and bolts, cables, turnbuckles, and eye bolts shall be stainless steel or aluminium. Sharp edges and weld splatter shall be removed prior to installation.
2.15 Hydrostatic Tests	.1	Pressure piping within the FRP wet well and valve chamber shall be hydrostatically tested to a pressure no less than 1.5 x the shut off pressure of the lift station pumps. The test pressure shall be held for a period of not less than two (2) hours, with no leakage permitted. Sewage forcemains external to the lift station shall be tested in accordance with Section 33 34 01 – Sewage Forcemains. Should any test disclose leakage greater than that specified above, the Supplier shall locate and repair the defect and retest the section to ensure that the leakage is within the allowable limits.
2.16 Power Supply and Controls	.1	As per Division 26.

3.0 EXECUTION

3.1 Excavation and Backfilling

.1 To requirements of Section 31 23 01 Excavation, Trenching and Backfilling.

.2 Start backfilling only after the concrete has acquired a suitable degree of strength and only after obtaining written permission from the Contract Administrator. No backfilling of walls shall take place before the slabs have been cast and have reached a minimum of 75% design strength.

.3 Use only the approved portion of the excavated material and other approved imported granular fill.

.4 Deposit backfill in layers not exceeding 150mm thickness, and compact to obtain 95% of Standard Proctor Density or otherwise indicated on the Contract Documents.

.5 Keep heavy compacting equipment away from structure by at least 1.5 metres. This portion shall be compacted using hand operated tampers.

.6 Make all fills and embankments to elevations, contours, and slopes shown on the drawings.

.7 Grade top layer carefully to smooth regular surface, with a minimum thickness of 100mm of topsoil, when indicated on the drawings.

.8 Allow for any settlement which may occur in order that the finished fills or embankments will be to the final grades as shown on the drawings.

.9 Excavate and remove all materials whatever their nature and condition to depths and dimensions necessary for the construction of the structure and piping to the limits shown on the drawings.

.10 Furnish all equipment for construction, temporary supports including shoring, bracing, cribs, coffer dams, etc. and for de-watering.

.11 Install and operate an adequate de-watering system for construction of the structures in the dry.

.12 All equipment used for de-watering and excavation shall be of a suitable and rugged type to assure continuous operation.

.13 Make special provisions to relieve the water pressure and prevent flotation or damage to parts of the works in case of accidental stoppage of de-watering equipment.

.14 Where over excavation is required, fill with specified sub-base or lean concrete unless otherwise indicated in the Contract Documents.

.15 Stockpile excavated granular material meeting backfill specification designated by the Contract Administrator. Save for re-use.

.16 Notify the Contract Administrator for inspection and approval after the excavation is completed.

.17 Do not place any concrete until the Contract Administrator has approved the depth of excavation and the character of the foundation material.

3.2 External Piping

.1 To requirements of Sections 31 23 01 - Excavating, Trenching and Backfilling, Section 33 30 01 - Sanitary Sewers, and Section 33 34 01 - Sewage Forcemains.

3.3 Concrete Work

.1 To Section 03 30 53 - Cast-in-Place Concrete and Section 03 20 01 - Concrete Reinforcement and contract drawings

3.4 Electrical

.1 To Division 26.

3.5 Piping Installation

.1 Pipe shall be adequately supported on adjustable pipe saddle supports or from pie hangers or brackets during construction and completion to prevent abnormal stresses being imposed on items of equipment such as pump flanges.

.2 Valves shall be installed in accordance with the manufacturer's recommendations.

.3 Before installing bolted connections, pipe ends, and gaskets shall be absolutely clean. Gaskets shall be lubricated with soapy water and bolts with thread lubricant. Bolts shall be tightened progressively by the crossover method and not in rotation around the joint. Bolts shall be torqued to the manufacturer's requirements. Wrenches used for tightening bolts shall be in good condition and properly sized to prevent rounding of nuts and bolt heads.

.4 During all stages of construction, piping shall be protected from damage from any cause. Openings in the piping system shall be securely covered, capped, or plugged to prevent collection of dirt, debris, or other extraneous matter during the entire construction.

.5 Damaged work shall be removed and replaced with new material to the satisfaction of the City.

3.**6 Pumps and Accessories**

.1 Locate discharge elbows on the sump floor at exact locations required so that guide rails which connect from them to the access frame will be in perfect alignment.

.2 Firmly anchor discharge elbows to the floor at their proper location.

.3 Install guide rails.

.4 Lower pumps on guide rail system until contact is made with discharge elbows. Ensure that system functions to give leaktight connection.

3.7 Start-Up

.1 Lift station shall be completed, including work of other sections, before start-up.

.2 Start-up of equipment to take place in the presence of a trained representative of the Equipment Supplier and City. Copies of final operating and maintenance manuals shall be provided to the City at least two (2) weeks in advance of start-up.

.3 Set level and align all equipment to the complete satisfaction of the City.

.4 Carefully check the operation and controls of the equipment.

.5 Notify the City when the operation and controls of the equipment are satisfactory.

.6 Provide the necessary facilities for the City to check the operation of the equipment.

.7 The Contractor shall make provisions for adequate supply of water to the wet well and forcemain for testing purposes. Testing will include checking performance of all pumps, floats, and controls. At minimum the following tests will be conducted.

.1 Pump Condition - i.e. pump body, impeller running free, quick disconnect connection, cable connections, gaskets and oil level.

.2 Wet Well Condition - i.e. pump sliding free on guide rails, pump cable with sufficient slack, floats suitably positioned and will not snarl, no cable splices or junction box in the wet well, well clean.

.3 Control Panel Condition - i.e. components including motor overloads correctly rated for the pumps. Record over-load settings on schematic, date and sign.

.4 Start-Up Operation - i.e. supply voltage suitable, pump rotation correct, operation of pumps - by float switches - HOA selectors - lead pump selector - overloads isolate associated control, alarm float.

.5 Pump Load Checks - ie. load current on all phases for single and parallel pump operation, supply voltage under load. Confirm pumping rate and operating head.

.6 Alarm panel test to confirm all zones are correctly configured and operational.

.8 Liaise with the Contract Administrator to ensure that the Design Engineer, the City, the Contractor, and the Equipment Supplier are present for the start-up and testing program.

.9 The City will not take over operation and maintenance of any equipment until the work of all related sections has been completed in the area in which the equipment is located and all

equipment has operated in its intended manner to the satisfaction of the City.

.10 Cost of any temporary power costs for the start-up procedure shall be the responsibility of the Contractor.

3.8 Protection

.1 Protect the work and material of all other sections from damage and make good all damage thus caused, to the satisfaction of the City.

.2 Be responsible for work and equipment until finally inspected, tested, and accepted, protect work against theft, injury, or damage, and carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers and plugs during construction to prevent entry of obstructing materials.

3.9 Cleaning

.1 Any dirt rubbish, or grease on walls, floors, or fixtures for which the Contractor is responsible must be removed and the premises left in first class condition in every respect.

.2 De-water station wet well and remove all dirt and grit from bottom of station.

3.10 Maintenance Manuals

.1 Supply three copies of hard backed bound manuals with all the information required for maintenance, operation, parts catalogue and lubrication.

The following information shall be included in the manual:

.1 Table of contents.
.2 As constructed shop drawings.
.3 Equipment, layout drawings.
.4 Electrical, control, and alarm wiring diagrams.
.5 Normal and emergency operating instructions for all equipment.
.6 Maintenance instructions for all equipment.
.7 Safe work procedure for confined space entry into the wet well and valve chamber (to be prepared by a Qualified Professional).
.8 Equipment data sheets.
.9 Certified head/capacity curves for pumps.
.10 Equipment part lists.

.2 Each section shall be separated from the preceding section with a plasticized divider with a tab denoting contents of the section.

.3 Review all of these instructions with the City representatives before the commencement of the maintenance period.

General catalogues will not be accepted and bulletins must deal specifically with the equipment provided.

END OF SECTION

DIVISION 40 – PROCESS MECHANICAL

COMMON REQUIREMENTS FOR PROCESS PIPING SYSTEMS

1.0 GENERAL

1.1 Summary

1.1.1 This Section specifies general requirements for the supply and installation of process piping, valves, fittings and related appurtenances associated with the *Work*. More detailed requirements are contained in other Sections. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* describe herein.

1.1.2 Design, select, locate and provide expansion joints, pipe guides and anchors required for final piping layout. Typical details, anchors, and thermal expansion allowance shown on the drawings are provided only for general guidance.

1.1.3 All materials not specifically listed or specified, but required to complete the installation are the responsibility of the *Contractor*.

1.1.4 Related Requirements

(a) Section 31 23 33: Excavating, Trenching and Backfilling

(b) Section 33 34 00: Sewage Forcemains

(c) Section SS 40 05 23.24: 304 Stainless Steel Piping

(d) Section SS 40 05 51: Common Requirements for Process Valves

(e) Section SS 40 05 07: Supports, Anchors and Seismic Bracing for Process Piping

(f) Section SS 40 05 62: Plug Valves

1.2 References

1.2.1 Definitions

(a) Process Piping: Piping systems that are any of the following;

(i) Located above ground

(ii) Located inside structures or ponds

(iii) Located below ground within 1 m of structures or ponds

(iv) Double block and bleed assemblies.

(b) Maximum working pressure: The greatest continual pressure at which the piping system operates.

(c) Test pressure: The hydrostatic pressure used to determine system compliance.

(d) Interior: Within an environmentally controlled enclosure where the temperature is maintained above 5°C.

(e) Submerged: Regularly or occasionally immersed in liquid; inside covered tanks and/or channels, and within 3 m above maximum water level of open tankage. Also includes pipes and appurtenances within manholes, vaults and channels.

(f) Outdoor: Exposed, above ground, outside or within an enclosure that is not environmentally controlled.

(g) Buried: Placed directly in soil and/or granular fill.

(h) *Contractor's Engineer:* A professional engineer registered in the Province of British Columbia qualified to do detailed piping thermal expansion design at the *Contractor's* cost.

1.2.2 Reference Standards

(a) Conform with the most recent version of all standards referenced in this Section.

(b) ANSI B1.1: Unified Inch Screw Threads, UN and UNR Thread Form

(c) ANSI/AWWA C606: Grooved and Shouldered Joints

(d) ASME B31.3: Power Piping

(e) ASTM B16.21: Nonmetallic Flat Gaskets for Pipe Flanges

(f) ASTM A193: Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

(g) ASTM A194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

(h) ASTM A307: Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength

(i) ASTM A354: Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners

(j) ASTM A563: Carbon and Alloy Steel Nuts

(k) ASTM B32: Solder Metal

(l) ASTM B633: Electrodeposited Coatings of Zinc on Iron and Steel

(m) ASTM B766: Electrodeposited Coatings of Cadmium

(n) ASTM F436: Hardened Steel Washers Inch and Metric Dimensions

(o) AWWA C110: Ductile-Iron and Gray-Iron Fittings

(p) AWWA C200: Steel Water Pipe, 6 In. (150 mm) and Larger

(q) AWWA C227: Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe

(r) AWWA C228: Stainless Steel Pipe Flange Joints for Water Service – Sizes 2 IN. Through 72 IN. (50 mm through 1,800 mm)

(s) AWWA C651: Disinfecting Water Mains

(t) AWWA M11: Steel Pipe – A Guide for Design and Installation.

(u) AWWA/APHA/WEF: Standard Methods for the Examination of Water and Wastewater

(v) CSA G164: Hot Dip Galvanizing of Irregularly Shaped Articles

(w) CSA W47.1: Fusion Welding of Steel Company Certification

(x) CSA W48: Electrode and Filler Metals Certification

(y) EJMA Standards: Standards of the Expansion Joint Manufacturers Association

(z) SSPC SP-1: Solvent Cleaning

(aa) SSPC SP-3: Power Tool Cleaning

(bb) SSPC SP-6: Commercial Blast Cleaning

1.3 Coordination

1.3.1 Prior to construction, coordinate with other divisions to locate openings and place sleeves in cast in place concrete and/or masonry.

1.3.2 Prior to demolition, coordinate with other divisions to locate pipe, sleeve and duct penetrations through existing structures.

1.4 Submittals - For Review

1.4.1 Before fabrication, provide manufacturer data for each type of pipe material and for each fitting, valve, coupling, and all specified appurtenances used to complete the work covered in this section.

1.4.2 For all piping systems greater than 25 mm in diameter provide isometric drawings to indicate assembly details; pipe size, welds, flanges, couplings, valve placement, vents and drains, cathodic protection, seismic restraint system, expansion joints, guides, anchors, supports and provisions for thrust restraint, wall penetrations, as well as any other pertinent details.

1.4.3 Provide details of any shop fabricated fittings.

1.4.4 Where directed by the *Contract Administrator*, provide mill test results or product samples.

1.4.5 For expansion joints provide manufacturer's catalog data, shop drawings and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details.

1.4.6 If requested, the piping fabricator shall submit a demonstrated fillet and butt weld on a test sample of pipe to be examined and approved by a certified inspection company. The test specimens will be submitted to the *Contract Administrator's* inspection company at the *Owner's* expense. Any retesting required by the Owner shall be completed at the *Contractor's* expense.

1.4.7 Bacteriological testing results following disinfection of potable water piping.

1.4.8 Provide a copy of this specification section and all referenced sections with each paragraph check-marked to show compliance or highlighted with notes indicating deviation.

1.5 Submittals - For Information Only

1.5.1 Submit copies of all original submittals and all related correspondence made as part of regulatory submissions required by the British Columbia Power Engineers and Boiler Pressure Vessel Safety Act and Regulations and any submissions required by other regulatory authorities.

1.5.2 Provide anchor and thermal expansion design details including locations, load information, design calculations and illustrative drawings, and calculations to substantiate expansion joint selection and amount of pre-compression, stamped and signed by the *Contractor's* Engineer.

1.5.3 Current and complete documentation of welder's qualifications prior to the commencement of any welding. All welders who work on this project must provide the correct documentation.

1.5.4 Radiographic weld test and other shop inspection and test results.

1.5.5 Prior to commencing any welding of stainless steel pipe, submit a Welding Procedure Specification (WPS) including a written description of welding techniques including but not limited to materials, methods, and quality control. Certify that the technique is acceptable for the intended service condition. Written procedures to be signed and sealed at the *Contractor's* cost by a professional engineer registered in BC qualified for welding design.

1.6 Submittals – For Operation and Maintenance Manuals

1.6.1 Provide manufacturer's data, supplier contact information, and shop drawings for:

(a) Expansion joints

(b) Couplings

1.7 Quality Assurance

1.7.1 Provide complete, fully tested and operational process piping systems.

1.7.2 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.

1.7.3 Complete all regulatory submissions as required by the BC Power Engineers and Boiler Pressure Vessel Safety Act and Regulations, and all other submissions as required by other regulatory authorities.

1.7.4 All welding of pipe and fittings shall be undertaken by welders certified for pipe welding for each applicable pipe welding procedure through the BC Industry Training Authority (ITA) and holding a Level A or Level B Interprovincial Red Seal Ticket. For stainless steel welding, a Level A Red Seal Ticket is required.

1.7.5 Where pressure piping falls under the BC Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation, welders shall also be pressure pipe certified with the BC Safety Authority for each applicable weld procedure.

1.7.6 The fabricator shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.

1.7.7 All pipe fabrication and welding shall be in accordance with ASME B31.3 normal fluid service code for pressure piping or where applicable Section IX of the Boiler and Pressure Vessel Code.

1.7.8 Perform visual examinations of all welding to reveal any surface or root defects, unacceptable weld fit-ups, arc strikes, weld spatter, or insufficient heat tint removal. Perform visual examination of shop welding before shipping.

1.7.9 Provide radiographic inspections required to meet the welding standards cited in this Section. At the discretion of the *Contract Administrator*, 5% of welds may be subject to radiographic inspection in the shop, the cost of which will be borne by the *Owner* unless tests prove the weld defective, then the cost to correct the defective work plus the cost of additional radiographic inspection shall be borne by the *Contractor*.

1.7.10 Spot-radiographic inspection of welds, or alternative method, may be conducted at the option and at the expense of the *Owner*. The *Contract Administrator* will designate such company to carry out inspection of welds at the site of erection, and the *Contractor* shall fully co-operate with the *Contract Administrator* and representatives in supply such labour and working space as may be required. Welding judged unacceptable shall be repaired using a method satisfactory to the *Contract Administrator* at no additional cost to the *Owner*. The *Contractor* shall pay for the spot-radiographic inspection of all welds which are judged unacceptable.

1.7.11 For each defective weld, two additional radiographic inspections at locations identified by the *Contract Administrator* will be required, plus a radiograph of the repair. Costs for such additional radiographic inspections including the radiograph of the repair shall be borne by the *Contractor.*

1.7.12 The *Contract Administrator* may use any method of inspection necessary to establish quality control and ensure adherence to welding procedures. Any weld test specimen coupons submitted shall clearly identify the welder(s).

1.8 Delivery, Storage and Handling

1.8.1 Protect pipe and pipe coatings from damage.

1.8.2 Store on site as recommended by materials manufacturer to prevent damage, undue stresses, or weathering. Store materials a minimum of 200 mm above ground with sufficient supports to prevent bending.

1.8.3 Protect non-UV light inhibited plastic materials from sunlight.

1.8.4 Provide shipping devices to maintain the face-to face dimension of each expansion joint during shipment, storage and installation.

1.9 Measurement and Payment

1.9.1 The payment for the common requirements for process piping is considered incidental to other payment elements of the contract and shall include supply and installation of all necessary elements.

2.0 PRODUCTS

2.1 Bolts, Studs, Washers, and Tie-rods

2.1.1 Bolts and Studs

(a) Provide hex head bolts and studs, threads to ANSI B1.1, standard coarse thread series.

(b) Connecting stainless: Grade B8 ASTM A193, C1.1.

(c) Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, cadmium plated to ASTM B766. Bolt sizes to AWWA C110.

(d) Connecting steel, or unless otherwise specified: Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.

(e) Axial stress in bolts shall not exceed 40% or material yield strength based on unthreaded body area.

2.1.2 Nuts and Washers

(a) Provide hex head nuts, threads to ANSI B1.1, standard coarse thread series. Greater than 25 mm, provide heavy hex.

(b) Connecting stainless steel: Provide nuts to ASTM A194 Grade 8.

(c) Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to ASTM F436. Nuts and washers to be cadmium plated to ASTM B766. Always include washers.

(d) Connecting steel, or unless otherwise specified: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.

2.1.3 Tie-rods

(a) Provide tie-rods continuously threaded to ASTM A354 and fabricated in accordance with B1.1 (screw threads, coarse thread series). Tie rods to be steel cadmium plated in accordance with ASTM B766.

2.2 Corporation Stops (not used)

2.3 Expansion Joints (not used)

2.4 Fittings

2.4.1 Provide fittings with wall thickness equal to or greater than the pipe, of the same, material, coating, lining and pressure rating as pipe or better.

2.4.2 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.

2.4.3 Provide concentric reducers in vertical lines unless indicated otherwise.

2.4.4 Provide smooth flow long radius elbows for liquid service unless otherwise specified.

2.4.5 Provide smooth flow standard radius elbows for process air service unless otherwise specified.

2.5 Joints – Flanges

2.5.1 Flanges for mating to equipment or valves must be compatible with those items. In all situations similar faced flanges only shall be mated. Companion flanges for connection to cast iron or ductile iron or PVC equipment or valve flanges shall be flat faced and flush with the equipment or valve flange.

2.5.2 Class 150 – flat faced with full face gaskets, unless mating to raised face valves, lap joint flanges or equipment.

2.5.3 Class 300 – Not used.

2.5.4 If not specified or shown otherwise use slip-on flanges.

2.5.5 Provide flange isolation kits where dissimilar metals are joined.

2.5.6 Gaskets

(a) Conform to ASTM B16.21 and AWWA C228 Table 1.

(b) Minimum gasket thickness 3.175 mm.

(c) Provide full face gaskets for flat faced flanges

(d) Provide ring type gaskets for raised face flanges.

(e) Provide gasket materials suitable for the temperature, pressure and corrosivity of the fluid conveyed in the pipeline.

(i) Provide liquid service gaskets of EPDM or neoprene.

(ii) Provide air service gaskets of compressed Kevlar with neoprene binder, suitable for service conditions.

2.6 Joints – Threaded Couplings

2.6.1 Provide screwed joints with American Standard threads.

2.6.2 Provide Teflon tape suitable for pipe material and service.

2.7 Joints – Grooved Joint Couplings

2.7.1 Provide pipe grooving, couplings and gaskets conforming to ANSI/AWWA C606. Victaulic, Shurjoint, Gruvlok or approved equal.

2.7.2 Provide flexible style couplings for buried service pipe, and adjacent to pump or blower suction and discharge where used for noise and vibration control. Provide rigid type couplings in other applications unless noted otherwise on *Drawings.*

2.7.3 Gaskets

(a) Provide for liquid service Victaulic Grade “E” EPDM flush seal gasket or approved equal.

(b) Provide for gas service Victaulic Grade “L” gasket or approved equal.

2.7.4 Provide cut grooves on schedule 40, standard wall or thicker pipe, roll grooves for Sch 10 and Sch 5.

2.7.5 Grooved joint flange adapters shall be used only where specifically indicated.

2.8 Joints – Flexible Couplings

2.8.1 Provide cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts. Robar, Dresser or equal.

2.8.2 If joint restrained add restraining rods and gussets welded to the pipe. Provide sufficient restraint to resist pressure equal to twice the system test pressure, as recommended by the manufacturer.

2.8.3 Provide gasket suitable for service conditions.

2.9 Joints – Welding

2.9.1 Use welding materials conforming to CSA W48.

2.9.2 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

2.10 Joints – Soldered

2.10.1 Use only lead free solder conforming to ASTM B32 and the BC Plumbing Code.

2.11 Lining and Coating

2.11.1 Do not paint stainless steel pipe.

2.11.2 Provide factory applied linings and coatings as specified for specific pipe services

2.11.3 Galvanizing: Hot dip zinc coat to CSA G164, minimum 440 g/m^3.

2.12 Piping

2.12.1 Piping materials will be clearly marked to indicate size, type, class/schedule and coatings.

2.13 Piping Identification

2.13.1 Label pipes with commodity code and flow direction arrows.

2.13.2 Labels and tags: legend and arrows printed on vinyl coated pressure sensitive cloth tape.

2.13.3 Colours for identification materials: to CSA B53 – Code for identification of Piping Systems

2.13.4 For pipes 75 mm dia. (outside surface) and larger:

(a) legend – 40 mm high characters

(b) arrows – 40 mm wide (maximum)

2.14 Spray Nozzles (not used)

3.0 EXECUTION

3.1 Preparation

3.1.1 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

3.1.2 Make all minor modification to suit equipment and structural element locations and elevations, at no expense to the *Owner*.

3.1.3 Advise the *Contract Administrator* of all modifications. Indicate all piping modifications on the shop drawings submitted prior to fabrication or installation. Do not commence work on related piping until the *Contract Administrator's* approval has been received.

3.1.4 Prior to valve and pipe appurtenance installation, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that valve location and orientation provides suitable access to all valve operators. Ensure that sufficient easily disassembled joints are provided to allow for removal and replacement of all valves and pipe appurtenances.

3.2 Pipe Handling

3.2.1 Inspect each pipe, fitting and piping appurtenance prior to installation. Do not install damaged material or materials with damaged linings or coatings.

3.2.2 Repair pipe with damaged protective coatings in accordance with coating manufacturer's directions and to the satisfaction of the *Contract Administrator*.

3.2.3 Remove all foreign matter from inside of piping and piping appurtenances prior to installation.

3.2.4 Use proper implements, slings, tools and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.

3.3 Conflicts

3.3.1 Confirm the pipework routing with the *Contract Administrator* prior to commencement of fabrication and installation. Advise the *Contract Administrator* of any conflicts with existing services, structures, or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict, as instructed by the *Contract Administrator*.

3.4 Buried Pipe Installation

3.4.1 Refer to Specification Sections:

(a) 33 34 00: Sewage Forcemains

3.5 Interior and Outdoor Pipe Installation

3.5.1 Piping installed in interior building spaces shall be fabricated and installed in accordance with the ASME Pressure Vessel Code.

3.5.2 Make adequate provision in piping runs for expansion, contraction, slope and anchorage.

3.5.3 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag and stress.

3.5.4 Provide temporary supports as necessary during construction to prevent overstressing equipment, valves or pipe.

3.5.5 Accurately cut all piping for fabrication to field measurements.

3.5.6 Install pipes in straight alignment. Variance from the true alignment shall not exceed 10 mm in any direction or as required in ASME B31.3 whichever is less.

3.5.7 Fabricate and assemble pipe runs to ensure that pipework is not stressed to achieve the designed alignment and that no stresses are transferred to equipment or equipment flanges. “Springing” of pipework to ensure alignment is not permitted. The *Contractor* shall undo and subsequently remake all pipework connections where so instructed by the *Contract Administrator* to ensure that springing does not occur. Take care not to damage equipment, piping appurtenances, valves, flanges, or other joints.

3.5.8 Do not cut or weaken the building structure to facilitate installation unless specifically detailed on the Drawings or approved by the *Contract Administrator* in writing.

3.5.9 Slope process air piping to condensate drains.

3.6 Connections to Equipment and Existing Piping

3.6.1 Verify fit and materials at each connection prior to making the connection.

3.6.2 Where joining piping to existing equipment, confirm flange type on the equipment and install matching pipe flanges to suit.

3.6.3 Modifications to either new or existing materials required to make connections shall be approved by the *Contract Administrator* in writing prior to the connections being made.

3.7 Pipe Joints

3.7.1 General

(a) Provide joints that can be readily disassembled at the minimum within 1.0 m of any connection to equipment, on both sides of structural penetrations, and within 0.6 m of all threaded end valves.

(b) Allow a minimum of 150 mm to face or 75 mm to edge of flanges or grooved joint couplings from wall, floor or ceiling unless otherwise shown.

3.7.2 Threaded

(a) Unless specifically noted on the *Drawings*, threaded couplings shall only be used on piping with nominal diameters less than 65 mm.

(b) Ream the ends of all pipes to remove all burrs and cuttings when fabricating threaded joints.

(c) Clean out pipe prior to joining.

(d) Apply Teflon tape to male threads and join pipe. Do not use extra tape to make up for slack in the joint.

(e) Install threaded pipe with as few joints as possible. Short lengths of pipe coupled tighter shall not be used, except where a union is specifically shown on the drawings.

(f) If it is necessary to back off a screwed joint after it is made, the thread shall be cleaned and new compound applied.

(g) Threads shall not be caulked.

(h) Bushings shall not be used.

(i) Nipples in threaded piping shall be shoulder nipples. Close nipples shall not be used unless specifically indicated.

3.7.3 Flanged

(a) Clean flanges and gaskets prior to connection.

(b) Lubricate gaskets with soapy water and apply anti-seize compound to stainless steel bolts.

(c) Bring flanges into close parallel and lateral alignment.

(d) Tighten bolts progressively, proceeding from side to side of the flange. Wrenches used for tightening bolts shall be in good condition and properly sized to prevent rounding of nut and bolt heads. Apply manufacturer's torque recommendations when connecting to valves and equipment. Do not over torque bolts.

(e) Do not use washers to take up excess bolt length.

(f) Bolt projection beyond nuts shall be approximately two full threads.

(g) Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place strain on equipment.

(h) Install flange adapters in accordance with manufacturer's recommendations.

(i) Install lap joint flanges in vibration free service only. Do not install in buried or submerged environments.

3.7.4 Grooved Joint Couplings

(a) Install grooved joints and grooved joint flange adapters as recommended by manufacturer using manufacturer's recommended lubricants on gaskets.

(b) All grooving tools and accessories to be manufactured by grooved product supplier.

3.8 Welding – General

3.8.1 All piping is to be shop welded.

3.8.2 Metal surfaces in and adjacent to the welding groove shall be dry before welding commences and kept dry and free from dirt, loose scale, slag, grease or any other foreign contaminant.

3.8.3 All welds after welding is complete must be cleaned and surface prepared as required for the final coating, finish or passivation method to be applied.

3.8.4 The end of each pipe shall be carefully fitted to butt accurately with proper gap to the preceding pipe or fitting. Before placing the pipe in position, the ends of the pipe shall be made truly circular by an approved method and, if necessary, for large pipes "spiders" shall be placed in each to keep them truly circular.

3.9 Field Welding

3.9.1 In general field welding is not acceptable. Field welding may be performed only under exceptional circumstances and with the prior written consent of the *Contract Administrator.*

3.9.2 Field welding shall conform to the general requirements of AWWA C206 "Field Welding of Steel Water Pipe Joints", and the quality requirements under "Welding-General" in this specification.

3.9.3 Field welding shall not be done under conditions that would impair the completed weld including but not limited to: moisture; blowing sands or dust; high winds; low temperatures. If in the *Contract Administrator's* opinion, protection from prevailing weather conditions is necessary, then all welding shall cease until this protection

is provided at the *Contractor's* cost, and welds done under poor conditions shall be re-made. The *Contractor* shall be prepared for such events and will not be compensated for downtime associated with delays of this nature.

3.9.4 When the ambient temperature is below 0°C all welding operations shall cease unless an appropriate welding procedure has been submitted. Written procedures to be signed and sealed at the *Contractor's* cost by a professional engineer registered in BC qualified for welding design.

3.9.5 In general, field welds shall be butt type, suitably bevelled to the satisfaction of the Contract Administrator.

3.9.6 Pipes cut in the field for closing pieces and other field joints shall be cut to a smooth uniform level. Edges shall be smooth and not serrated and shall be ground smooth if they are rough after cutting.

3.10 Pipe Structural Penetrations

3.10.1 Refer to Structural Drawings and Specifications

3.10.2 Coordinate with other divisions to locate and place sleeves or cast-in-place pipe sections prior to the construction of concrete and masonry building elements.

3.10.3 For pipe grouted or cast into concrete or block walls provide anchor rings in accordance with AWWA M11.

3.11 Drains, Vents, Flushing Connections, Sample Points

3.11.1 Provide manual air vents at the high points of each reach of pipeline. Refer to the Standard Details. Pipe air vents to the nearest floor.

3.11.2 Provide manual drains a the low points of each reach of pipeline. Refer to the Standard details. Pipe drains to a sump, gutter floor drain, or other approved collection point.

3.11.3 Mount drain and vent isolation valves in a location accessible from floor level and no greater than 1.2 m above the floor.

3.11.4 Install flushing connections as shown.

3.12 Pipe Coating and Lining

3.12.1 Coat and line all fittings and joint types to match the pipe in which they are installed.

3.12.2 In general, field lining and coating in the field is not allowed, except to repair damaged coating and lining.

3.12.3 Prepare all coated or shop primed surfaces in the field by cleaning in accordance with SSPC SP-1 (Solvent cleaning). Clean damaged areas of shop primed surfaces in accordance with SSPC SP-3 (Power Tool Cleaning). Repaint as

recommended by coating manufacturer with primer for shop primed surfaces, or sealer for coated surfaces.

3.12.4 Prepare bare metal surfaces in accordance with SSPC SP-6 (Commercial Blast).

3.12.5 Apply primer and finish coats in accordance with manufacturer's recommendations.

3.13 Insulation

3.13.1 Insulation and surfaces to be clean and dry when installed. Remove damaged materials and replace with new materials.

3.13.2 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified.

3.14 Testing

3.14.1 All piping shall be pressure tested, and witnessed by the *Contract Administrator*.

3.14.2 Review pipe pressure testing procedures with *Contract Administrator* at least 1 week prior to commencement of pressure testing.

3.14.3 Give *Contract Administrator* 24 hours notice of testing.

3.14.4 Thoroughly clean all piping prior to pressure testing.

3.14.5 Prior to pressure testing ensure piping is adequately restrained.

3.14.6 Do not insulate, bury, concrete surround or otherwise conceal work until piping systems are tested and accepted.

3.14.7 Supply all equipment, gauges and materials including fluids for pressure testing.

3.14.8 Install fittings for air relief, gauges and drainage as needed to complete testing. After testing remove and plug fittings.

3.14.9 Cap and plug all lines that are normally open ended. Remove on completion of testing.

3.14.10 Isolate all low pressure equipment or pipeline appurtenances during testing to protect the equipment or pipeline appurtenances from damage.

3.14.11 Repair and replace any defective work using new material.

3.14.12 Testing Piping Carrying Liquid Commodities

(a) Test welded metal piping to AWWA C200.

(b) There shall be no loss of pressure during testing, and no visual evidence of leakage.

(c) Test duration: 2 hours.

(d) Test pressure: 1.5 times the maximum working pressure. Confirm system working pressure with *Contract Administrator* prior to pipe testing.

3.14.13 Testing Piping Carrying Gaseous Commodities (not used)

3.15 Cleaning and Flushing

3.15.1 After installation and prior to testing, perform initial cleaning of process and utility pipelines.

3.15.2 Clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline. Remove instrumentation or piping appurtenances that may be damaged by this procedure and replace after cleaning. Give lines smaller or equal to 150 mm an initial flush with clean water for piping normally conveying liquid commodities, or purge with air or inert gas for piping normally conveying air or gas.

3.15.3 If recommended by equipment supplier, prior to equipment testing install temporary screens with visible locator tabs in the suction piping of equipment. Maximum screen opening size; 25 mm or as recommended by equipment manufacturer.

3.15.4 Flush with clean water and drain pipes conveying liquid commodities after testing. Dispose of testing and flushing water in a manner which causes no damage to buildings or siteworks in a manner approved by the *Contract Administrator*.

3.15.5 For piping conveying air or gas less than or equal to 150 mm diameter, purge with air and/or inert gas before testing. Upon completion of testing and cleaning, drain and dry the piping with a dry air stream.

3.16 Disinfection (not used)

3.17 Operations and Maintenance Manuals

3.17.1 Include copies of all manufacturer’s information provided in shop drawing submittals for all piping appurtenances in the operations and maintenance manuals.

3.17.2 Include name and contact information of supplier for each piping appurtenance in the operations and maintenance manuals.

END OF SECTION

1.0 GENERAL

1.1 Summary

1.1.1 This Section specifies the supply and installation of piping supports, anchors, thrust restraints and seismic bracing. This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.2 Design, select, locate and provide pipe hangers, supports, anchors, thrust restraints and seismic bracing.

1.1.3 No attempt has been made to indicate all necessary pipe supports, anchors, thrust restraints and seismic bracing in the drawings. Details provided are intended as a general guide for quality only. The intent has been to indicate general arrangements and typical spacing, but does not relieve the *Contractor* of the responsibility of designing and supplying a complete support system.

1.1.4 Related Requirements

.1 Section SS 40 05 01: Common Requirements for Process Piping Systems.

.2 Section SS 40 05 23.24: 304 Stainless Steel Piping

.3 Section SS 40 05 51: Common Requirements for Process Valves

1.2 References

1.2.1 Definitions

.1 *Contractor's Engineer:* A professional engineer registered in the Province of British Columbia qualified to do detailed piping structural design at the *Contractor's* cost.

.2 *Service loads:* All static and dynamic loads which must be resisted by pipe hangers and supports including but not limited to:

(i) Weights of pipes, valves, fittings, insulating materials, suspended hanger components, normal fluid contents.

(ii) Weight of hydrostatic test fluid or cleaning fluid

(iii) Reaction forces due to operation of all valves

(iv) Wind, snow or ice loadings on outdoor piping

(v) Loads from future piping shown on drawings

(vi) Vibration

(vii) Thrust forces caused by moving liquids and internal pressure

(viii) Forces resulting from thermal expansion/contraction due to commodity and ambient temperature fluctuations

.3 *Design Loads:* That combination of service loads producing the maximum load effects to be resisted by the pipe hangers and supports in accordance to the B.C. Building Code.

.4 *Seismic Loads*: In accordance to the B.C. Building Code.

.5 *Allowable Load*: the maximum design load as recommended by the manufacturers: maximum allowable stress levels not to exceed those listed in MSS SP-58.

1.2.2 Reference Standards

.1 Conform with the most recent version of all standards referenced in this Section.

(i) B.C. Building Code

(ii) B.C. Plumbing Code

(iii) ANSI/ASME B31.3 Process Piping

(iv) MSS SP-89 – Pipe Hangers and Supports: Fabrication and Installation Practices

(v) MSS SP 58, Pipe Hangers and Supports – Materials, Design and Manufacture

(vi) MSS SP-60 – Pipe Hangers and Supports – Selection and Application

(vii) SMACNA – Guidelines for Seismic Restraints

1.3 Submittals - For Review

1.3.1 Details including precise location and factored design loads where piping is supported by any proposed supplementary structural members. Review by *Contract Administrator* will be for support by the existing structure. Sizing of proposed supplementary structural members will remain the responsibility of the *Contractor's Engineer.*

1.3.2 Manufacturer's pipe hanger and support cut sheets.

1.3.3 Details of pipe thrust restraints and harnesses. Sizing of proposed thrust restraints and harnesses remain the responsibility of the *Contractor's Engineer*.

1.4 Submittals – For Information Only

1.4.1 Before commencement of installation, provide hanger, support, anchor and seismic restraint system design details including dimensions, dimensioned

locations, load information, design calculations and illustrative drawings, stamped and signed by the *Contractor's Engineer*.

1.5 Delivery, Storage and Handling

1.5.1 Deliver materials and unload at site using methods which do not damage coatings or any parts.

1.5.2 Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.

1.6 Site Conditions

1.6.1 S_a (0.2) = 0.173, S_a (0.5) = 0.118, S_a (1.0) = 0.066, S_a (2.0) = 0.031, PGA (g) = 0.082, Site Class C.

1.7 Measurement and Payment

1.7.1 The payment for the common requirements for process piping in considered incidental to other payment elements of the contract and shall include supply and installation of all necessary elements.

2.0 PRODUCTS

2.1 General

2.1.1 Design pipe support systems to support *Design Loads* with a factor of safety of 4.0 or as required for seismic bracing, whichever is greater.

2.1.2 Provide seismic restraints to resist pipe movements and loads occurring as a result of seismic events.

2.1.3 Where structural bearings are not in suitable locations, provide supplementary structural members.

2.1.4 Support plastic piping with at least 50 mm measured around the pipe perimeter and 50 mm longitudinal smooth bearing surface in contact with the pipe.

2.2 Maximum support spacing for horizontal straight runs of pipe is as listed in the following table. Provide additional supports as required to support the design loads.

Pipe Size	Stainless Steel (m)
	Liquid Service
25 mm	2.1
38 mm	
50 mm	3.0
65 mm	
75 mm	3.7
100 mm	4.3
150 mm	5.2
200 mm	5.8

2.3 Materials

2.3.1 Steel hot dip galvanized after fabrication: Use in only valve room.

2.3.2 Cadmium plated steel nuts, bolts, washers and threaded rods: Use in only valve room.

2.3.3 304 stainless steel: In dry interior conditions where clamping directly to or welding to stainless steel pipe, in wet interior conditions (pump wet well) with open tanks or channels, in outdoor conditions and in submerged conditions.

2.3.4 Type 304 Stainless steel nuts, bolts, washers and threaded rods for corrosive, outdoor and submerged conditions.

2.3.5 Reinforced cast in place concrete.

2.3.6 Provide isolation to prevent contact between dissimilar metals.

2.3.7 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located less than 2300 mm above the floor.

2.4 Manufactured Pipe Hangers and Supports

2.4.1 Acceptable Manufacturers:

.1 Unistrut or approved equal

.2 B-Line, Myatt, Standon or approved equal

2.4.2 Acceptable Types:

.1 Pipe stanchion with saddle and yoke

.2 Pipe stanchion with adjustable roller hanger

.3 Riser Clamp

.4 Offset Pipe Clamp

.5 Framing Channel Pipe Strap

.6 Framing Channels and Connection Fittings

.7 Framing Channel Post Base

2.5 Thrust restraints

2.5.1 Prevent transmission of pipe movement and thrust forces onto equipment flanges or connections.

2.5.2 Where thrust restraints are used to prevent pipe movement and the transmission of thrust forces onto equipment flanges or connections:

.1 Design pipe thrust restraints for thrust loads developed by 1.5 times the maximum pipe test pressure.

.2 Provide compression coupling joints with rod type thrust harnesses anchored in accordance with AWWA M11.

.3 Minimum tie-rod diameter – 19 mm.

2.6 Anchors

2.6.1 Anchor locations shown on the drawings are preliminary only. Provide number and location of anchors as determined by *Contractor's Engineer.*

2.6.2 Reinforce piping as required at anchor locations to withstand applied forces.

2.7 Seismic Restraints

2.7.1 Unless otherwise required by local building codes, seismic restraints may be omitted from:

.1 Compressed air piping less than 25 mm diameter.

.2 All piping suspended by individual hangers 300 mm or less in length from the top of the pipe to the bottom of the support for the hanger.

2.7.2 Do not brace piping systems to dissimilar points of a building or to dissimilar building systems that may respond in a different mode during an earthquake.

2.7.3 Size restraints to fit the outside diameter of insulation, where insulation is specified.

2.7.4 Do not use branch lines to brace main lines.

2.7.5 Do not limit thermal expansion and contraction of the piping system by seismic bracing.

2.7.6 Provide a means to reduce noise and vibration transmission between linked fitting parts.

3.0 EXECUTION

3.1 Provide pipe support system to adequately secure the pipe and prevent undue vibration, and stress, and to prevent the transmission of forces to equipment and tanks.

3.2 Support piping in accordance with the pipe manufacturer's recommendations.

3.3 Support piping so that no pockets will be formed in the span due to sagging of the piping between supports.

3.4 Support piping so that temporary supports will not be required when removing parts of the piping system for equipment maintenance.

3.5 Provide hangers and or base supports within 1 metre of each change in direction on each piping leg, on one side of each valve, and on the first spool piece or fitting from a piece of equipment.

3.6 Secure supports to elbows where elbows change the run of a horizontal pipe to a vertical direction.

3.7 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.

3.8 Do not support piping from masonry wall construction.

3.9 Do not support piping from equipment or other pipes.

3.10 Do not drill or burn holes in the building structural steel without prior written permission from the *Contract Administrator*.

3.11 Do not use hanger components for rigging and erection purposes.

3.12 When fabricating products under this specification, use welding procedures to minimize distortion and avoid damage to finished work or bonded materials. Finished products to be true to line, free from twists, bends, open joints, sharp corners and sharp edges.

3.13 Recoat cut ends of galvanized framing channel with zinc dust-zinc oxide coating.

3.14 Hanger and support components in contact with plastic pipe to be free of burrs and sharp edges.

3.15 Rollers to roll freely without binding.

3.16 Locate any cast in place concrete supports to prevent encasement in concrete of valves, pipe appurtenances or easily disassembled pipe joints.

3.17 Finished floor beneath base plates and framing channel post bases to be roughed prior to grouting. Grout between base plate and floor to be free of voids and foreign material. Adjust stanchions to obtain required pipe slope and elevation prior to grouting of baseplates.

3.18 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

3.19 Locate the first seismic restraint on a piping system not more than 3.0 m from the main riser, entrance to a building or piece of equipment.

3.20 Install seismic bracing within 45 degrees above and 45 degrees below horizontal relative to the horizontal centreline of the pipe.

END OF SECTION

304 STAINLESS STEEL PIPING

1.0 GENERAL

1.1 Summary

1.1.1 This section applies to supply, fabrication, and installation of 304 Stainless Steel process piping as identified on the drawings:

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Related Requirements

.1 Section SS 33 32 14: Prefabricated Sewage Lift Stations

.2 Section SS 40 05 01: Common Requirements for Process Piping Systems

.3 Section SS 40 05 51: Common Requirements for Process Valves

1.2 References

1.2.1 Reference Standards

.1 Conform with the most recent version of all standards referenced in this Section.

(i) ANSI/ASME B16.5:

(ii) ANSI/ASME B16.9:

(iii) ANSI/ASME B16.11:

(iv) ANSI/ASME B16.21:

(v) ANSI/ASME B36.19: Stainless Steel Pipe

(vi) ASTM A182: Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings and Valves and parts for High Temperature Service

(vii) ASTM A240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications

(viii) ASTM A312: Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes

(ix) ASTM A380: Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems

(x) ASTM A403: Wrought Austenitic Stainless Steel Piping Fittings

(xi) ASTM A480: Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

(xii) ASTM A778: Welded, Unannealed Austenitic Stainless Steel Tubular Products

(xiii) ASTM A967: Chemical Passivation Treatments for Stainless Steel Parts

(xiv) AWWA C220: Stainless Steel Pipe ½ In (13 mm) and Larger

(xv) AWWA C226: Stainless-Steel Fittings for Waterworks Service, Sizes ½ in. through 72 in (13 mm through 1800 mm)

(xvi) AWWA C227: Bolted, Split-Sleeve Restrained and Non-restrained Couplings for Plain-End Pipe

(xvii) AWWA C606: Grooved and Shouldered Joints

1.3 Delivery, Storage and Handling

1.3.1 Protect materials from contamination from dirt or road salt by shrink wrap or other suitable packaging, and end caps, prior to and during shipment.

1.3.2 Store materials in such a way to prevent scratching and scoring of the surface and to avoid contact with dirt or carbon steel.

1.4 Design Conditions

1.4.1 Commodity RS: Raw Sewage.

.1 Normal commodity temperature range: 10 to 25 °C.

.2 Normal service operating pressure range: 0 to 205 kPa (30 psi)

.3 Maximum (intermittent short term) operating pressure: 350 kPa (50 psi)

.4 Test pressure: 520 kPa (75 psi)

1.5 Measurement and Payment

1.5.1 The payment for this section is considered incidental to other payment elements of the contract and shall include supply and installation of all necessary elements.

2.0 PRODUCTS

2.1 Provide piping systems as detailed below with components suitable for the operating conditions.

Component	Size Range (mm)	Description	Applicable Standards
Pipe (general)	<75	304L Stainless Steel. Sch 40S, welded	ASTM A312 ANSI/ASME B36.19
	75 to 150	304L Stainless Steel. Sch 40S, welded	ASTM A312 ANSI/ASME B36.19
	200 to 600	304L Stainless steel, Sch 40S, welded.	ASTM A778 ANSI/ASME B36.19
Pipe above roof line, and where penetrating structures	50 to 150	304L Stainless Steel. Sch 40S, welded	ASTM A312 ANSI/ASME B36.19
	200 to 600	304L Stainless Steel. Sch 40S, welded	ASTM A778 ANSI/ASME B36.19
Coating		Not applicable	
Lining	All	No. 1 mill interior finish or better	ASTM A480
Fittings	<75	304L Stainless Steel, Class 3000, socket weld Sch 40S bore, or threaded.	ASTM A182, ANSI/ASME B16.11
	75 to 600	304L Stainless Steel, Sch 40S, buttweld. Elbows S.R. unless indicated otherwise. No mitred elbows allowed.	
Fittings above roof and where buried	75 to 600	304L Stainless Steel, Sch 40S, buttweld. Elbows S.R. unless indicated otherwise. No mitred elbows allowed.	
Unions	<75	304L Stainless Steel, Class 3000, socket weld Sch 40S bore, or threaded.	ASTM A182, ANSI/ASME B16.11

Couplings, Grooved Joint	75 to 300	Grooved Joint Couplings. Indoors, Rigid: Enamel coated Ductile Iron: Victaulic Style W07 or approved equal. Outdoors, Rigid: Stainless Steel, Victaulic Style 489 with SS trim, or approved equal Indoors Flexible: Enamel coated Ductile Iron, Victaulic Style 77, SS trim (or approved equal) Outdoors and Buried: Stainless steel. Flexible Type Victaulic Style 77S or 475, SS trim or approved equal)	AWWA C606
Flanges – slip on or weld neck	75 to 600	304 Stainless Steel, Class 150. Slip-on or weld neck. Machine flat face where connecting to flat faced flanges	ASTM A182 ANSI/ASME B16.5.
Flanges – lap joint. Not for buried service.	75 to 600	304 Stainless Steel stub end, Sch 40S butt weld except above roof Sch 40S, Interior: Hot dip galvanized backing ring Outdoor: 304 SS backing ring	ASTM A774 ANSI/ASME B16.5
Gaskets	All	Flanges, Non-metallic, non-asbestos, flat ring	ANSI/ASME B16.21
	All	Couplings; Grooved Joint, Victaulic Grade E EPDM flush seal or approved equal for liquid service.	AWWA C606

3.0 INSTALLATION

3.1 Stainless Steel Pipe Welding and Fabrication

3.1.1 Stainless steel fabrication shall be done in an approved CSA W47 fabrication shop set up to handle, fabricate and weld stainless steel using handling procedures designed to eliminate carbon contamination of the stainless steel including but not limited to: the use of stainless steel tools including wire brushes, chisels, files and hammers, welding gloves and grinding wheels. Only 300 series stainless steel brushes or wheels shall be used on austenitic and nickel alloys.

3.1.2 Areas used for fabrication of austenitic and nickel alloys shall be separated from carbon steel areas by methods suitable to prevent contamination by dirt, carbon

steel shavings, grinding dust and sparks, and zinc dust from painting operations. Welding gloves and tools used during the fabrication of stainless steel shall not have been used on previous carbon steel work.

3.1.3 Where tape is used for backing purge gas the tape shall use an adhesive backing such that when no longer required it can be completely removed with residual adhesive removed by a suitable solvent or abrasive.

3.1.4 Clean piping to a pre-weld zone extending 50 mm on either side of the weld with alcohol or acetone.

3.1.5 All welding of the root pass of austenitic stainless steel pipe shall be done using the Gas Tungsten Arc Weld (GTAW) process with shielding gas protection of the backside of the weld sufficient to reduce oxygen content to a level that can avoid granulation and ensure a high quality corrosion resistant weld. Large bore piping may be internally back welded to achieve the same result.

3.1.6 The Shield Metal Arc Weld (SMAW) process may only be used for fill passes or fillet welds.

3.1.7 Solar Flux is not acceptable.

3.1.8 Clean welds after fabrication in accordance with ASTM A380.

3.1.9 Pickle and passivate welds after fabrication in accordance with AWWA C220, ASTM A380 and ASMT A967 by immersing in a liquid bath of pickling solution NSF certified for drinking water. Large bore piping shall be cleaned with a pickling paste that is NSF 61 certified for drinking water.

3.1.10 Any noticeable discolouration on the piping after welding shall be removed by pickling.

3.1.11 Once sufficient pickling time has elapsed to re-passivate the stainless-steel surface, clean the piping of all acids by thoroughly rinsing the pipe with water.

3.1.12 Thread stainless steel pipe in accordance with threading machine manufacturer's instructions.

3.2 Pipe Grooving

3.2.1 Groove stainless steel pipe in accordance with grooving machine manufacturer's instructions.

3.2.2 Contamination from iron particles by pressure contact with rollers or tooling should, if at all possible, be avoided. Where stainless steel rollers or tools are unavailable, adhesive plastic films or tape can be used to prevent direct contact. They shall be removed after fabrication.

3.3 Fabricated Fittings

3.3.1 Shop fabricated fittings made from rolled stock in accordance with ASTM A240 shall be in a solution annealed condition. Shop fabricated fittings made from pipe shall be in accordance with AWWA C220, ASTM A312, ASTM A778. Design standard shall be in accordance with AWWA C226 and thickness of all reinforcement collars and pads shall be determined by the appropriate formula in the latest edition of AWWA M11.

3.4 Pipe Coating: Do not paint stainless steel piping.

END OF SECTION

COMMON REQUIREMENTS FOR PROCESS VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This Section specifies supply and installation of all valves and related appurtenances installed on process piping systems. This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.2 Related Requirements

(a) Section 33 32 14: Prefabricated Submersible Sewage Lift Stations

(b) Section 33 30 01: Sanitary Sewers

(c) Section 33 34 00: Sewage Forcemains

(d) Section SS 40 05 01: Common Requirements for Process Piping Systems

(e) Section SS 40 05 07: Piping Supports and Seismic Bracing

(f) Section SS 40 05 23.24: 304 Stainless Steel

(g) Section SS 40 05 62: Plug Valves

1.2 References

1.2.1 Reference Standards

(a) Conform with the most recent version of all standards referenced in this Section.

(i) ANSI B1.20.1: Pipe Threads, General Purpose, Inch

(ii) ANSI B16.1: Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250

(iii) ANSI B16.5: Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard

(iv) MSS SP-25: Marking System for Valves, Fittings, Flanges and Unions

(v) AWWA C504 (for gear actuators only): Rubber-Seated Butterfly Valves, 3 In, (75 mm) through 72 In. (1800 mm).

1.3 Submittals - Review

1.3.1 Provide catalogue cuts and/or shop drawings for each type of valve and actuator indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and maximum pull on actuator, and valve end configuration.

1.3.2 Provide valve pressure/temperature rating. For bidirectional valves provide rating for both sealing directions.

1.3.3 For butterfly and globe valves provide headloss vs. percent open curves.

1.3.4 Canadian Registry Number (CRN) designated by the Province of British Columbia.

1.3.5 A copy of the specific valve specification sections marked to indicate with check marks where the valve supplied meets the specification and with written amendments with explanation where the product differs from the specification.

1.3.6 On piping submittals, indicate direction of sealing.

1.4 Submittals – For Operations and Maintenance Manuals

1.4.1 Submit operation and maintenance data for incorporation into operation and Maintenance manual, including detailed exploded views, a complete numbered list of replacement and repair parts, and supplier and parts manufacturer's contact information.

1.5 Quality Assurance

1.5.1 If a CRN is not available, provide a letter notarized in Canada and stating:

(a) The standard or code under which the valve was manufactured (ANSI, MSS, AWWA, etc.)

(b) If not stated under the code in Item (a), state the pressure/temperature rating of the valve body, seat, and all seals.

(c) The quality control program under which the valve was manufactured.

1.5.2 Provide valves marked in accordance with MSS SP-25 for type, size, rating, and where applicable, direction of flow.

1.6 Delivery, Storage and Handling

1.6.1 Deliver valves and unload at site using methods which do not damage casings, coatings or any valve or actuator parts.

1.6.2 Clear tag each valve stating size, type, coatings and mating parts.

1.6.3 Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.

1.7 Measurement and Payment

1.7.1 The payment for this section is considered incidental to other payment elements of the contract and shall include supply and installation of all necessary elements.

2.0 PRODUCTS

2.1 General

2.1.1 Provide valves of the same type, size range and service from a single manufacturer.

2.1.2 All valves to have true alignment or bores.

2.1.3 Unless otherwise indicated on the Process and Instrumentation drawings valves shall be the same size as the pipe run in which they are to be installed.

2.1.4 Valves to open counter-clockwise.

2.1.5 The process drawings indicate major process valves required for the process to operate as intended. Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but is not shown in the drawings, inform the *Contract Administrator* and provide details and suggestions for remedial action. Do not commence piping in the related pipe run until obtaining the *Contract Administrator's* approval.

2.2 Valve Ends

2.2.1 Valves less than 75 mm diameter shall have female threaded connections conforming to ANS B1.20.1. Valve sizes greater or equal to 75 mm shall have flanged connections to ANSI B16.1 or ANSI B16.5. Valves with grooved joint ends are not to be used without the written approval of the *Contract Administrator.*

2.2.2 Not used.

2.2.3 Lug style water body valves shall have tapped holes.

2.3 Manual Lever or Handwheel Actuators

2.3.1 Provide lever actuators for quarter turn valves. Operator to be perpendicular to the pipe run when the valve is closed.

2.3.2 Provide lever operator for ball valves less than 150 mm diameter, butterfly valves less than 250 mm diameter, and plug valves less than 100 mm diameter, unless noted otherwise on drawings.

2.3.3 Not used.

2.3.4 Provide handwheel actuator for butterfly valves 250 mm and greater.

2.3.5 Maximum pull on the end of the lever arm or at the rim of a handwheel not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. If greater force is required, provide a gear operator.

2.3.6 Provide padlockable lockout feature on all control valves and manual isolation and shut-off valves.

2.3.7 Provide valve stem extensions where additional clearance is required for pipe insulation or where operation without the extension is difficult.

2.3.8 Minimum hand wheel diameter:

(a) 38 mm valve: 75 mm handwheel

(b) 50 mm valve: 85 mm handwheel

(c) 250 mm valve: 400 mm handwheel

2.3.9 Minimum lever operator length:

(a) 25 mm valve: 125 mm lever

(b) 38 mm valve: 150 mm lever

(c) 50 mm valve: 150 mm lever

(d) 75 mm valve: 175 mm lever

(e) 100 mm valve: 225 mm lever

(f) 150 mm valve: 250 mm lever

(g) 200 mm valve: 300 mm lever

2.4 Manual Gear Actuators

2.4.1 Provide manual gear actuators for valves not specified to have a manual lever or handwheel actuator.

2.4.2 Gear operator to be worm gear type equipped with a non-rising stem handwheel and an integrated visual indicator of the valve position. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant recommended by the gear operator manufacturer for the specific application. Gear operators for direct bury or submergence to be manufactured in accordance with AWWA C504.

2.4.3 Equip operators with mechanical stop-limiting devices to prevent over travel of the disc, ball or plug in the open and closed positions, self-locking to hold the valve in any intermediate position between full open and full closed. Actuator components between the input and the stop limiting device shall be designed to withstand, without damage, a rim pull of 890 N for a handwheel or chainwheel and an input torque of 400 N m for wrench nuts.

2.4.4 Actuator shall provide 1.25 times required operating torque under full rated line pressure for direct bury or submergence applications, or for commodities with 2% or greater solids content; 1.0 times required operating torque under full rated line pressure in other applications.

2.4.5 Maximum pull at rim of hand wheel with gear operator – 300 N.

2.4.6 Manual operators for buried service valves to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures up to 700 kPa. Where angle valve stem extensions are employed, they shall be angle geared. Provide valve stem extension to surface with cast iron valve box, lid and rock plate.

2.4.7 Actuator body to be exterior epoxy coated.

2.4.8 Orientation of valve as per mechanical drawings or to allow for the greatest degree of hand wheel access.

2.4.9 For manual valves on pipes 75 mm and greater mounted over 2 m above the operating floor, provide chain wheel gear operators, sized so that a force of 150 N is sufficient to open the valve when one side of valve is at test pressure and the other side is at atmospheric pressure. Chain pulley to mesh positively with the chain. Extend chain from valve operator to 1.2 m above the operating floor or as directed by the *Contract Administrator,* with exact dimensions field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

2.5 Electric Actuators

2.5.1 Not used.

2.6 Valve Identification

2.6.1 Tag all values using AISI 304 stainless steel tags with 12 mm high engraved letters and numbers. Fill numbers and letters with black paint. Attach tag to valve using a 304 stainless steel chain or braided wire. Inscription to include valve ID number from the Process and Instrumentation drawings, valve size in mm, manufacturer and model number.

2.7 Coating

2.7.1 Coat all carbon steel, ductile iron and cast iron valves and actuators for corrosion protection.

2.7.2 All valves and actuators to be provided with standard shop finish rated and warrantied for the intended service application.

2.8 Spare Parts

2.8.1 Provide one spare valve of each type (plug, check, ball, etc.) including the appropriate operator for each valve type and size equal to or less than 250 mm diameter.

3.0 EXECUTION

3.1 Preparation

3.1.1 The valve and piping arrangement indicated on the drawings is based on typical dimensions for valves of the specified type. Make all necessary modifications in the *Work* to allow for discrepancies between the valve dimensions shown and those supplied for the *Work,* at no extra cost.

3.1.2 Ensure that valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available for automatic actuators.

3.1.3 Ensure that valve location and orientation provides sufficient space for tightening of flange and valve nuts with a standard wrench.

3.1.4 Ensure that valve actuators can operate without conflicting with other piping, equipment, structures or insulation. Do not cut insulation to allow valve actuators to operate. Where conflicts are identified, inform the *Contract Administrator* and propose modifications. Do not commence work on the affected piping run until modifications are approved.

3.2 Installation

3.2.1 Install all valves in accordance with manufacturer's instructions.

3.2.2 In horizontal pipe runs other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball and plug valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.

3.2.3 Mount butterfly valves and trunnion ball and plug valves with the shaft in a horizontal orientation. Plugs to rotate to top of pipe to open. Disks to swing up in direction of flow to open.

3.2.4 Provide spool pieces between butterfly valves, swing check valves and fittings as required to allow for free disc movement.

3.2.5 Do not over torque bolts to correct for misalignment.

3.2.6 Support valves in position using temporary supports until valves are fixed in place.

3.2.7 Not used.

3.2.8 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.

3.3 Coating

3.3.1 Repair and damage to shop coating as recommended by valve manufacturer, including and not limited to:

(a) Steel brushing for removal of any rust

(b) Solvent cleaning of repair and surrounding area

(c) Priming coat

(d) Two coats of top coat

3.4 Testing

3.4.1 All valves to be shop tested according to current applicable AWWA Standards and the standards under which the valves were manufactured.

3.4.2 Operate valves under simulated and/or real process conditions to ensure valves operate as intended.

3.4.3 Pressure test valves in conjunction with the pipes in which the valves are installed.

END OF SECTION

PLUG VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This section specifies plug valves provided as identified on the drawings:

1.1.2 This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

(a) Specific operating conditions for valves installed in piping identified as screened raw sewage.

1.1.4 Related Requirements

(a) Section 33 34 01 Forcemains

(b) Section SS 33 32 14: Prefabricated Submersible Sewage Lift Stations

(c) Section SS 40 15 23.24: 304 Stainless Steel Piping

(d) Section SS 40 05 51: Common Requirements for Process Valves

(e) Section SS 40 23 00: Common Requirements for Process Piping Systems

1.2 Measurement and Payment

1.2.1 The payment for this section is considered incidental to other payment elements of the contract and shall include supply and installation of all necessary elements.

2.0 PRODUCTS

2.1 Acceptable manufacturers for above ground use: Valmatic, Dezurik, Keystone or approved equal.

2.2 Provide valves as detailed below.

Component	Description
Body	Cast iron to ASTM A126, Class B, or ASTMA48, Class 40 and fully encapsulated with resilient facing per ASTM D2000-BG
Valve Ends	Flanged in accordance with ASME B16.1, Class 125
Coating	Interior and exterior fusion bonded epoxy coating
Plug	Buna-N encapsulated ductile iron to ASTM A536 or ASTM A126
Bearings	316 Stainless Steel
Seats	Resilient Seated
Hardware and fasteners	Stainless steel

2.3 Direct Bury Applications

2.3.1 Valves to be Valmatic Cam-Centric Plug Valve with worm gear actuator.

2.3.2 Flanged or Mechanical joint connections.

2.3.3 Actuators packed with grease and sealed for temporary submergence of 6 m of water. Exposed worm shafts and hardware shall be stainless steel. Epoxy coated interior and exterior.

3.0 INSTALLATION

3.1 Not used.

END OF SECTION