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**Westdale Road Sanitary Sewer Upgrade - Drawings**

<table>
<thead>
<tr>
<th>DRAWING NO</th>
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<td>BAYSHORE PLAN &amp; PROFILE STA 2+000 to 2+035</td>
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</table>
INVITATION TO TENDER

WESTDALE ROAD SANITARY SEWER UPGRADE
Tender No. T-2170-2018

Sealed tenders, clearly marked “Westdale Road Sanitary Sewer Upgrade Tender No. T-2170-2018” will be received by the Manager of Purchasing & Stores up to 3:00 p.m. local time, 2018-APR-12, at the Purchasing office, City of Nanaimo, 2020 Labieux Rd, Nanaimo, BC, V9T 6J9. Tenders will be opened in public, in the Purchasing Department, immediately after the closing time.

It is the sole responsibility of the person(s) submitting to deliver the tender to the Manager of Purchasing & Stores before the closing time.

The works consist of the installation of 260m of sanitary sewer main, 18m of storm sewer main, manhole decommissioning, asphaltic concrete paving, and all works incidental thereto as shown on the drawings.

This tender is subject to the Agreement on Internal Trade Annex 502.4.

Digital copies of the contract documents are available at no charge on the City of Nanaimo’s website at www.nanaimo.ca.

All inquiries shall be directed to Chris Lang, Project Manager, Engineering & Public Works Department, 2020 Labieux Rd, Nanaimo, B.C., V9T 6J9, Telephone: 250-755-4495, Email: chris.lang@nanaimo.ca

The City of Nanaimo reserves the right to waive informalities in, or reject any or all tenders, or accept the tender deemed most favorable in the interest of the City.

City of Nanaimo, Purchasing & Stores Department
2020 Labieux Road, Nanaimo, BC, V9T 6J9
Fax Number: 250-756-5327.
ARTICLE 1. TENDER

Sealed tenders clearly marked “Westdale Road Sanitary Sewer Upgrade – Tender No. T-2170-2018” will be received by the Manager of Purchasing and Stores, Purchasing Department, 2020 Labieux Rd, Nanaimo, BC, V9T 6J9, up to 3:00 p.m. local time, 2018-APR-12.

ARTICLE 2. SCOPE OF WORK

The work consists of the installation of 260m of sanitary sewer main, 18m of storm sewer main, manhole decommissioning, asphaltic concrete paving, and all other work incidental thereto as shown on the drawings.

ARTICLE 3. OBTAINING CONTRACT DOCUMENTS

Tender documents are available on the City of Nanaimo’s website at www.nanaimo.ca under Bid Opportunities.

ARTICLE 4. EXAMINE

The Tenderer must carefully examine the Contract Documents and the site of the proposed works, judging for and satisfying himself as to the probable conditions to be encountered. Should a Tenderer find discrepancies in, or omissions from the drawings or other documents, or should he be in doubt as to their meaning, he should, prior to submitting his tender, notify the Engineer in writing. The Tenderer may not claim, after the submission of a tender, that there was any misunderstanding with respect to the conditions imposed by the documents.

The Tenderer's attention is drawn to any addenda which may be issued prior to the time of tender closure.

No verbal agreement or conversation made or had at any time with any officer, agency or employee of the Owner or the Engineer shall affect or modify any of the terms or obligations herein stated, nor deemed to be any representation of warranty.

ARTICLE 5. STANDARDS AND SPECIFICATIONS

The Tenderer is advised that this contract uses the November 2016 City of Nanaimo Standards, Specifications and Measurement and Payment clauses.

It is the Tenderers responsibility to familiarize himself with all tender documentation prior to submission of a tender. The Tenderer may not claim, after submission of a tender, that there was any misunderstanding with respect to the conditions imposed by the documents.

Section numbers referred to in the Measurement and Payment clauses are for guidance only. Tenderers are advised that descriptions of pay items may be in more than one section of the documents. It is the Tenderers responsibility to familiarize himself with these pay item descriptions.
ARTICLE 6. FORM OF SUBMISSION

A digital copy of the Tender Form is also available on the City’s website www.nanaimo.ca. The tender should be submitted on a hard copy of this form and accompanied by the specified Bid Bond in a sealed envelope. E-mail or facsimile tender submissions will not be accepted.

The Schedule of Quantities and Prices in Excel format is available on the City’s website to assist Tenderers with data entry. This information is provided for convenience only and the Tenderer is responsible to confirm accuracy of the digital information provided.

The City of Nanaimo is not a member of Public Construction Council of British Columbia, the British Columbia Construction Association or any other construction association.

The City of Nanaimo does not adopt or agree to be bound by "The Procedures and Guidelines Recommended for Use on Publicly Funded Construction Projects" produced by the Public Construction Council of British Columbia, September, 1989, or any other procedure/guidelines recommended, adopted or produced by any construction association in the tendering and award of the contract on this project.

ARTICLE 7. SCHEDULE OF FORCE ACCOUNT RATES

The Schedule of Force Account Rates shall be completed and a unit price shall be inserted for each item in accordance with Article 40 of Section 2 - General Conditions. The low Tenderer will be required to demonstrate that the force account rates tendered are, in fact, the direct cost of his labour. Failure to submit a correct and complete list may result in the tender being considered incomplete.

ARTICLE 8. TENDERER's QUESTIONNAIRE

The Tenderer must furnish evidence that he has the necessary experience and is prepared to use the necessary personnel and equipment to carry out the work satisfactorily and within the time stated in the Tender Form. The Tenderer's Questionnaire shall be completed in order that his capabilities in this regard can be assessed by the Owner. Failure to complete the Questionnaire may result in the tender being considered incomplete.

ARTICLE 9. LIST OF SUBCONTRACTORS

The Tenderer must indicate, in the list of Subcontractors in the Tender Form, the name of the subcontractor he proposes to employ in each subtrade he proposes to subcontract.

A Tenderer shall submit on the List of Subcontractors of the Tender Form, only one Subcontractor for each subtrade proposed to be subcontracted. The listing of more than one Subcontractor for any subtrade on the List of Subcontractors in the Tender Form shall constitute grounds for rejection of the Tenderer's tender.

Subcontractors shall not be changed or additional subcontractors employed without the written authorization of the Engineer. Failure to submit a complete list may result in the tender being considered incomplete.

Subcontractors should be aware of Articles 20 and 34 of the General Conditions of the Contract as they apply to permits and licences for construction of the works.
ARTICLE 10. PROPOSED ALTERNATE MATERIALS

If a Tenderer intends to use equipment or material other than that specified or shown on the drawings, he must provide the required information in the List of Proposed Alternate Materials in the Tender Form, together with the applicable price variation. Evaluation of proposed alternate materials will be made by the Owner following closing of tenders. The total Tender must be based on use of specified materials.

ARTICLE 11. TEST EXCAVATIONS

Prior to the excavation of test holes on road allowances or privately owned property, the Tenderer is expected to obtain permission from the appropriate governmental agency or owner of the property and to comply with their requirements for restoration of disturbed services and utilities. Failure to comply with ordinances restricting this practice may result in prosecution of the offending party.

ARTICLE 12. FEDERAL AND PROVINCIAL SALES TAXES

Unit and lump sum prices shall include provincial sales tax payable on all applicable materials and equipment incorporated in the work.

GST is not to be included in the unit and lump sum prices. GST shall be shown separately on the Schedule of Quantities Summary page based on the total contract value.

ARTICLE 13. TENDER PRICE

Unit and lump sum prices shall be filled in where indicated in the Schedule of Quantities and Prices of the Tender Form. The unit prices shall be extended in accordance with the quantities shown and the extensions shall be inserted in the space provided. The total tender must be an accurate extension of the unit and lump sum prices submitted and the quantities shown.

In the event of a discrepancy between the unit prices and extended totals, the unit prices will govern and the Engineer will correct the extended totals accordingly.

In the event of a discrepancy between a maximum allowable lump sum price and the submitted lump sum price, the maximum allowable price shall govern and the Engineer will correct the price and extend totals accordingly.

The prices tendered shall include the supply of all materials except those specified to be supplied by others, all supervision, labor and equipment and a provision for overhead and profit, and shall represent the entire cost to the Owner for the completed works as specified and shown on the drawings.

ARTICLE 14. REVISIONS TO TENDER

Any revision to the tender by the Tenderer must be in writing by letter, properly executed, and received by the Manager of Purchasing and Stores at the closing location before the closing time.

.1 Letter

Revisions by letter must originate on the Tenderer’s letterhead and be headed "CITY OF NANAIMO TENDER". The revision must substantially comply with the following requirements:

.a state the tender number and description;
INSTRUCTIONS TO TENDERERS

.b state the closing time; and,
.c state the amount by which the tender is to be increased or decreased AND the increase or decrease to each unit price affected.

The revision must be signed by an Authorized Signatory. The positions or titles of the Authorized Signatory should be indicated below the signature.

Letter revisions should be enclosed in an envelope marked "Revision to City of Nanaimo Tender", showing the tender number and description.

.2 Email

Email revisions must comply with the requirements in Article 14.1.

Email revisions must be received as a new email by the Purchasing Department prior to the established closing time. The Tenderer assumes all responsibility for the timely and effective delivery of any emailed revision.

Purchasing Department Email: purchasinginfo@nanaimo.ca

.3 Amount of Bid Bond

The Tenderer must ensure that the total amount of the bid bond is not less than ten percent (10%) of the total tender price. The Tenderer should consider the effect of revisions on the tender price and the bid bond requirements.

.4 Multiple Revisions

Where a Tenderer submits multiple revisions to the original tender price, each revision should be numbered sequentially by the Tenderer. Unless the Tenderer clearly stipulates to the contrary on the face of the revision, each successive revision will nullify and replace any previous revision to the identified item or tender price.

.5 Unclear or Ambiguous Revisions

If in the opinion of the City, any revision is unclear, ambiguous as to meaning or intent, or does not comply with the requirements of Article 14, that revision will be disregarded and the original tender price, or the tender price determined by consideration of any other revisions will prevail.

The City, its employees and agents will not assume any responsibility for timely receipt of any revisions.

ARTICLE 15. TENDER SIGNING

The tender must be executed by an authorized signatory in a position to legally bind their Company to the information contained in the Tender Form.

If the Tenderer is a joint venture, each party to the joint venture shall execute the tender in the manner appropriate to such party.
INSTRUCTIONS TO TENDERERS

ARTICLE 16.  BID BOND

The tender must be accompanied by a Bid Bond using CCDC Document #220 – Bid Bond (2002), or certified cheque, in an amount not less than ten percent (10%) of the tender price. The Bid Bond must be issued by a surety company licenced to conduct business in the Province of British Columbia.

If the successful Tenderer fails for any reason to execute the Contract Agreement and to provide the insurance and surety bonds stipulated in the General Conditions within ten (10) calendar days after the Notice of Award, such time limit being extended only on the written approval of the Owner, his Bid Bond or certified cheque will be forfeited to and retained by the owner in the amount of the difference in money between the total tender and the amount for which the Owner may legally contract with another party to perform the work, if the latter amount be in excess of the former.

Certified cheques submitted by unsuccessful Tenderers will be returned to them as soon as the successful Tenderer has delivered to the Owner, the insurance and surety bonds stipulated in the General Conditions and a fully executed contract for the work, or when the period for which tenders are irrevocable has elapsed, whichever shall first happen. Bid Bonds will not be returned unless otherwise requested by the unsuccessful Tenderer.

ARTICLE 17.  TENDER WITHDRAWAL

A Tenderer may, without prejudice to himself, withdraw his tender on written request received by the Manager of Purchasing and Stores any time prior to the time set for the closing of tenders.

ARTICLE 18.  TENDER REJECTION

.1 The City of Nanaimo reserves the right to reject any or all tenders, or accept other than the lowest tender and to accept the tender which it deems most advantageous to the City of Nanaimo.

.2 To determine whether a Tenderer is qualified to do the work, the following criteria will be used:

   .a The Tenderer’s ability and agreement to complete the work within the Construction Schedule;

   .b The Tenderer’s ability to work with the owners, consultants and representatives;

   .c The Tenderer’s ability to effectively manage and do the work using the named superintendent and submitted contractors and subcontractors;

   .d The Tenderer’s history with respect to quality of the work, scheduling, changes in the work, and force account work.

A Tenderer is requested to provide any information it determines will assist the City of Nanaimo in using these criteria.
INSTRUCTIONS TO TENDERERS

.3 The City of Nanaimo may reject a tender if:

.a After investigation and consideration, the City concludes that the Tenderer is not qualified to do the work and/or cannot do the work and perform the Contract in a manner satisfactory to the City of Nanaimo.

.b A tender contains qualifying conditions or otherwise fails to conform to these Instructions to Tenderers.

.c A tender is incomplete, is considered incomplete in the Instructions to Tenderers, is obscure or irregular, which has erasures or corrections in the Tender Form, in which prices are omitted or are unbalanced, or which has an insufficient or irregular surety. The Tenderer’s attention is drawn to the requirement in the Tenderer’s Questionnaire to name the superintendent on the project and give his or her previous experience.

.d The City of Nanaimo may, in its absolute discretion, reject a Tender submitted by Tenderer if the Tenderer, or any officer or director of the Tenderer is or has been engaged either directly or indirectly through another corporation in a legal action against the City of Nanaimo, its elected or appointed officers and employees in relation to:

.i any other contract for works or services; or

.ii any matter arising from the City of Nanaimo’s exercise of its powers, duties, or functions under the Local Government Act or another enactment.

within five years of the date of this Call for Tenders.

In determining whether to reject a tender under this clause, the City of Nanaimo will consider whether the litigation is likely to affect the Tenderer’s ability to work with the City of Nanaimo, its consultants and representatives and whether the City of Nanaimo’s experience with the Tenderer indicates that the City of Nanaimo is likely to incur increased staff and legal costs in the administration of this contract if it is awarded to the Tenderer.

.e The City of Nanaimo, however, may at its sole discretion elect to retain for consideration a tender which is non-conforming because it does not contain the content or form required by these Instructions to Tenderers or because a Tenderer has not complied with the procedures set out in the Instructions to Tenderers provided that the Tenderer complies substantially with the Instructions to Tenderers.

.4 The City may reject all tenders if for any reason the City considers to be in its best interest to do so, including without limitation for any of the following reasons;

.a the lowest tender that the City considers otherwise acceptable is higher than the funds budgeted or otherwise available for the project;

.b the City decides not to proceed with the project or to defer the project;

.c if only one bid is received, then the tender will be reissued unless a financial analysis indicates that the sole bid represents a good value for the taxpayers; or

.d the City is delayed in obtaining, or is unable to obtain, all approvals or consents it considers necessary, whether required by law or otherwise.

.5 The City of Nanaimo reserves the right to consider and to reject any tender or all tenders without notice to a Tenderer or Tenderers and without permitting a Tenderer to provide additional information.

.6 In no event will the City of Nanaimo be responsible for a Tenderer’s costs of preparing or submitting a tender.
ARTICLE 19. AWARD

Awards shall be made on tenders that will give the greatest value based on quality, service and price.

The Owner will, following receipt of an acceptable tender, issue in writing a Notice of Award to the successful Tenderer. This notice will be given as soon as possible following the closing of tenders and unless otherwise agreed to by the Tenderer, not later than sixty (60) days following the closing of tenders.

ARTICLE 20. NO CLAIM FOR COMPENSATION

Except as expressly and specifically permitted in these Instructions to Tenderers, no Tenderer 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 it has no claim.

ARTICLE 21. SOLICITATION OF COUNCIL MEMBERS

“If a member of Council, or a person who was a member of Council in the previous six months has a direct or indirect interest in the contract, then the Tenderer shall report this to Council in accordance with Section 107 of the Community Charter upon being notified of the award of the contract.

The Tenderer warrants and represents that it has not received any information or a record from any Council member or former Council member contrary to Section 108 of the Community Charter.”

The successful Tenderer will be required to direct all communications related to their contract through the appropriate staff members as set out in Article 9 and Article 21 of the General Conditions of Contract.

ARTICLE 22. CONSTRUCTION SCHEDULE

The City of Nanaimo requires that this contract be **completed by 2018-SEP-28**.

ARTICLE 23. CONSTRUCTION LAYOUT

Layout for construction shall be as detailed in Article 7 of the General Conditions of the Construction Contract.

The Contractor shall be required to maintain an "as-constructed" drawing set for the project, with all changes and notes marked in red ink. This set shall be available to the Engineer for review on request and, submitted to the Engineer upon completion of the project along with the “as-constructed” digital survey file.

The lump sum bid price under Item 2.1 shall not exceed 5% of the total contract price and shall be full compensation for:

1. All construction layout of the work required to execute the contract and construct the works in accordance with the Design, Standard Specifications, and other listed specifications forming part of this contract.
.2 Development of an "as-constructed" drawing set and digital survey file for the project.

Payment shall be made by a percentage of the lump sum bid equal to the percentage of work completed for each progress payment.

ARTICLE 24. TESTING

The City of Nanaimo may employ a Materials Testing Consultant during the work to test all work and materials deemed necessary and determine whether they are in accordance with the Specifications. The Contractor shall coordinate his work with the Consultant to ensure that the testing is done efficiently and that no delays are caused. (See General Conditions Article 26).

ARTICLE 25. MATERIALS

No claim by the Contractor of unsuitability or unavailability of any material, nor his unwillingness to use, nor his inability to produce, first class work with same, will be considered unless submitted to the Engineer in writing 7 days before the tender closing date.

ARTICLE 26. WorkSafeBC

.1 The Tenderer is advised the workplace may have the following known operations and/or site conditions that could present a potential hazard to workers and other persons at the workplace. Other hazards may exist.

- Asbestos Pipe
- Confined Space
- Underground Utilities
- Excavations
- Overhead Power Lines
- Energized Equipment
- Traffic > 30 km/h
- Tree Removal
- Hazardous Materials
- Mobile Equipment

.2 As excavation and removal of asbestos cement pipe is required, the Contractor will be required to complete a risk assessment and develop the necessary safework procedures in accordance with WorkSafeBC regulations. For the Contractor’s information, the City of Nanaimo’s “Asbestos Cement Pipe Safe Work Procedures” are included in Appendix 2.

.3 The work will require excavation around and near buried electrical, communication and gas utilities. The Contractor will be required to complete a risk assessment and develop the necessary safework procedures in accordance with Worksafe BC regulations.

.4 If the successful Tenderer is designated as the Prime Contractor in the Tender Form, they shall fulfill the Prime Contractor responsibilities as defined in:

.a WorkSafeBC Occupational Health and Safety Regulation, Notice of project, Section 20.2, and Coordination of multiple employer workplaces, Section 20.3;

.b Workers Compensation Act (BC), Coordination at multiple-employer workplaces, Section 118, Subsections (1) & (2); and

.c General Requirements, Section 3.10 WorkSafe BC.

.5 The Prime Contractor will be required to coordinate the safety of all workers on the work site, including their employees, their subcontractors, City work crews and their contractors, and private utilities, (BC Hydro, Telus, Shaw and FortisBC).
Prior to commencing work, the successful Tenderer will be required to forward a copy of their current OH&S Safety Program document, WorkSafeBC Notice of Project, and WorkSafeBC Clearance Letter.

ARTICLE 27. FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT

All documents submitted to the City will be held in confidence by the City, subject to the provisions of the Province of British Columbia’s Freedom of Information and Protection of Privacy Act.

ARTICLE 28. PRIVATE PROPERTY

The Tenderer is advised that the project will require the Contractor to work on private property. The City has obtained the necessary permission to enter from the affected property owners and will provide the approved property permissions and conditions forms. The Contractor will be required to employ construction methods that minimize damage to private property.

ARTICLE 29. TRAFFIC CONTROL AND ACCESS

Further to the traffic control and access to properties outlined in the other sections of the documents, the Tenderer is advised of the following traffic control and access requirements:

.1 Access to businesses, private properties, and residences shall be maintained at all times.

.2 A Traffic Control Management Plan shall be prepared in accordance with the contractors construction schedule and the MoTI standards (see Appendix 3), and submitted for approval prior to the Preconstruction Meeting.

ARTICLE 30. BYPASS PUMPING

The Tenderer is advised that bypass pumping will be required to facilitate the work and is to be included in the sanitary sewer pipe unit cost. (See Measurement and Payment section 6.70). Expected sewer flows for the sanitary sewers on Westdale Road and Bayshore Drive can be found on drawings 22475 and 22477.

ARTICLE 31. BAYSHORE PARK – MATERIAL/EQUIPMENT STORAGE

The City of Nanaimo will permit the Contractor to utilize Bayshore Park for a site office, as well as material and equipment storage as required. This area is shown in Appendix 4 and will be available from May 1, 2018, to September 28, 2018. The Contractor will be required to maintain the property during its use and take appropriate measures to ensure that no mud is tracked onto City Streets, dust control is in place, and the site is well kept at all times. The Contractor will not carry on, or do, or allow anything to be carried on that may be or becomes a nuisance to the Owner or the public and increases the hazard of fire or liability of any kind. The Contractor will be responsible to ensure the security of all material and equipment stored within the property. The Contractor will be responsible to ensure at the end of the land-use, the site is restored to equal or better condition than it was in prior to its use. No payment will be made to the Contractor for building access, bringing power to the site, maintenance, setup, or any other costs associated with the use of the property. The Contractor understands and agrees that the City may withdraw the rights granted to the Contractor for the use of Bayshore Park with 72 hours written notice to vacate the property at its sole discretion.
ARTICLE 32. FLOW MONITORING STATION – WESTDALE ROAD

The Tenderer is advised that the scope or work requires the Contractor to tie into an existing flow monitoring station, including other works to be completed in close proximity. It is the responsibility of the Contractor to exercise diligence and take all necessary precautions to avoid damage to the flow monitoring station or related appurtenances. Any damage shall be repaired to existing or better condition to the satisfaction of the Owner. A detail and photos of the flow monitoring station are provided in Appendix 5.

ARTICLE 33. SUPPLEMENTAL SPECIFICATIONS

The Tenderer is advised Section 1 – Supplemental Specifications are included with this contract to revise the standard specification to suit specific project requirements.

Changes include:

a. As-Built Drawing Submissions
BID BOND

No. $  

Know All Men by These Presents That

hereinafter called the Principal, and 
as Principal
a corporation created and existing under 
the laws of
, and duly authorized to transact the business of Suretyship in
, as Surety, hereinafter called the Surety, are held and firmly bound unto

as Obligee,
hereinafter called the Obligee, in the amount of
Dollars, ($                                  ) lawful money of Canada, for the payment of which sum, well and truly to be made, the
Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly 
and severally, firmly by these presents

Whereas, the Principal has submitted a written tender to the Obligee, dated the 
day of                                             20__, for

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

The Principal and the Surety shall be liable for a greater sum than the specified penalty of this Bond.

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

In Witness Whereof, the Principal and the Surety have Signed and Sealed this Bond this 
day of                                  20__  

Signed and Sealed (SEAL)

In the presence of (SEAL)

(SEAL)

Endorsed by
The Royal Architectural Institute of Canada
The Association of Consulting Engineers of Canada
The Canadian Construction Association
The Engineering Institute of Canada
The Specification Writers Association of Canada

Approved by
Insurance Bureau of Canada

__________________________  Attorney-in-fact
CONSENT OF SURETY COMPANY

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

as principal for the works specified in the Contract Documents entitled

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<td>WESTDALE ROAD SANITARY SEWER UPGRADE</td>
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which Contract may be awarded within sixty (60) days from the closing date of tenders to

at the price(s) set forth in the tender. The Bonds shall be issued in the form and manner specified within the Contract Documents.

We hereby further declare that our Company is licensed to conduct business in the province or territory wherein the work is located and has a net worth greater than the amount of the required guarantee.

___________________________________________
Surety Company

___________________________________________
Signature for Surety Company

___________________________________________
Title

PLACE __________________________

DATE: __________________________
TO: Manager of Purchasing and Stores  
City of Nanaimo  
2020 Labieux Rd  
Nanaimo, BC V9T 6J9

To Whom It May Concern:

The undersigned Tenderer, having carefully examined the Contract Documents and the locality of the proposed work, and having full knowledge of the work required and of the materials to be furnished and used, hereby agrees to provide all necessary materials, supervision, labour, and equipment and perform and complete all work and fulfill everything as set forth and in strict accordance with the Contract Documents and Addenda numbered *______ for the prices stated in the Schedule of Unit Prices and Approximate Quantities of the Tender Form.

The undersigned also agrees:

1. That the Owner is in no way obligated to accept this Tender.

2. That, should the Tender Form be improperly completed or be incomplete, the Owner shall have the right to disqualify and/or reject this Tender.

3. That this Tender is made without knowledge of the Tender prices to be submitted for this work by any other company, firm or person.

4. That this Tender is made without any connection or arrangement with any company, firm, or person submitting a Tender for this work.

5. That this Tender is made without any undisclosed connection or arrangement with any other company, firm, or person having an interest in this Tender or in the proposed Contract.

6. That this Tender is irrevocable for sixty (60) days after the closing date for receipt of Tenders, and that the Owner may at any time within such period accept this Tender whether any other Tender has previously been awarded or not, and whether notice of Award of another Tender has been given or not.

______________________________  Tenderer’s Initials ________________

◆ To be Completed by the Tenderer
# ACKNOWLEDGEMENT TO RECEIPT OF ADDENDA

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<th>DATE RECEIVED</th>
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Bidder to acknowledge receipt of the addenda (if any)

To be Completed by the Tenderer

Tenderer’s Initials ______________
7. To execute the Contract Agreement and deposit with the Owner a Performance Bond and Labour and Material Payment Bond as specified in Article 32 of the General Conditions of the Construction Contract and the insurance documents as specified in Article 52 of the General Conditions of the Contract within ten (10) days of the date of the Notice of Award of the Contract, such time limit being extended only on the written approval of the Owner.

8. To commence and proceed actively with the work within fourteen (14) days following receipt of the Notice to Proceed, and to complete all work under the Contract within the time limit set out in Article 22 of the Instructions to Tenderers and subject to the provisions of Article 41 of the General Conditions of the Construction Contract - Extension of Contract Time.

9. That should the undersigned fail to complete the work in the time specified above he shall compensate the Owner in accordance with Article 37 of the General Conditions of the Construction Contract.

10. To do all extra work not reasonably inferable from the Specifications or Drawings but called for in writing by the Engineer and to accept as full compensation therefore, payment in accordance with the provisions of Article 39 of the General Conditions of the Construction Contract.

11. That it is understood the estimate of quantities shown in the Tender Form serves only to provide a basis for comparing tenders, and that no representations have been made by either the owner or the Engineer that the actual quantities will approximately correspond therewith, and further, that the Owner has the right to increase or decrease the quantities in any or all items and to eliminate items entirely from the work.

12. That payment for the work done will be made on the basis of the quantities measured by the Engineer and at the prices shown in the Tender Form which includes the cost of all pre-selected materials and equipment and which shall be compensation in full for the work done under the terms of the Contract.

Tenderer’s Initials ______________

♦ To be Completed by the Tenderer
The following tendered rates shall be in accordance with Article 40 of the General Conditions and will form the basis of payment for personnel force account work for this contract. List all occupations to be used on the project.

**PERSONNEL**

<table>
<thead>
<tr>
<th>LIST OF OCCUPATIONS</th>
<th>HOURLY RATE (incl. 20% markup)</th>
<th>O.T. HOURLY (incl. 20% markup)</th>
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<tbody>
<tr>
<td>SUPERINTENDENT</td>
<td></td>
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<tr>
<td>FOREMAN</td>
<td></td>
<td></td>
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<tr>
<td>OPERATOR</td>
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<tr>
<td>PIPELAYER</td>
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<td></td>
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<tr>
<td>LABOURER</td>
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<tr>
<td>FLAGGER</td>
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</tr>
</tbody>
</table>

Tenderer’s Initials ______________

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Tender Form
Page 4 of 9
TENDER FORM

TENDERER’S QUESTIONNAIRE

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

1. The size, model and make of the equipment which we will place on the project and use during the course of the work is as follows:

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>YEAR</th>
<th>SIZE</th>
<th>MODEL</th>
<th>MAKE</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

2. The average number of employees we will employ and maintain on the project is ______; of which an average number of _________ will be from the Nanaimo area.

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

Name: ____________________________________________________________

Qualifications: ____________________________________________________

______________________________________________________________

______________________________________________________________

Tenderer’s Initials ____________
TENDER FORM

TENDERER’S QUESTIONNAIRE

Years with Company: ___________ Years of Experience: ___________

Description of projects completed by the above personnel:

________________________________________________________

________________________________________________________

________________________________________________________

4. I, the Tenderer, have read and understood this agreement and safework procedures relating to this project. By signing this document, I am stating I have the necessary qualifications and accept the responsibilities as the Prime Contractor for this project as defined in the WorkSafeBC Occupational Health and Safety Regulations, Notice of projects, section 20.2, and Coordination of multiple employer workplaces, section 20.3; and in the Workers Compensation Act, Coordination at multiple-employer workplaces, sections 118, subsections (1) and (2).

I also acknowledge I understand the duties of the Owner as defined in the Workers Compensation Act, General duties of owner, section 119.

________________________________________________________

(Name & Title) (Signature)

5. The Contractor and all Subcontractors must have a current City of Nanaimo Business Licence. State Contractor’s Business Licence Number ______________. The Contractor’s business licence must be obtained before the contract is awarded. Subcontractors must obtain their business licence before their work commences.

Tenderer’s Initials ___________
TENDER FORM

LIST OF SUBCONTRACTORS

It is our intention that the following work will, subject to the Engineer's approval, be subcontracted to the firms indicated below. All other work will be performed by our forces, except as authorized in writing by the Engineer. NOTE: In accordance with the Instructions to Tender, list only one Subcontractor for each subtrade you propose to subcontract.

<table>
<thead>
<tr>
<th>TRADE</th>
<th>NAME &amp; ADDRESS OF SUBCONTRACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURVEY</td>
<td></td>
</tr>
<tr>
<td>TRAFFIC CONTROL</td>
<td></td>
</tr>
<tr>
<td>PAVING</td>
<td></td>
</tr>
</tbody>
</table>

Tenderer's Initials ____________________
TENDER FORM

PROPOSED ALTERNATE MATERIALS

We propose using the following materials as alternates to those specified and shown on the drawings. Should any of these proposed alternates be accepted, we will adjust our total Tender in accordance with the price variation shown below. These prices will represent the total cost difference to the Owner for supply and installation of the proposed alternate products in lieu of those specified.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PRODUCT BRAND NAME OF MANUFACTURER</th>
<th>SUPPLIER</th>
<th>PRICE VARIATION</th>
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<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Tenderer’s Initials _____________________________
TENDER FORM

This Tender is executed at ____________________________ this ______ day of ____________, 2018.

Name of firm:______________________________________
Address:__________________________________________
City/Postal Code:____________________________________
Email Address:______________________________________

SIGNED AND DELIVERED BY

_______________________________________________
Full Name of Company

_______________________________________________
Authorized Signing Officer Signature                  Print Name

_______________________________________________
Position/Title

_______________________________________________
Authorized Signing Officer Signature                  Print Name

_______________________________________________
Position/Title

NOTE: If the Tender is by joint venture, add additional forms of execution for each member of the Joint venture in the appropriate form or forms as above.
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Est Qty</th>
<th>Units</th>
<th>Unit Price</th>
<th>Total</th>
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</thead>
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<tr>
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</tr>
<tr>
<td>Section 2</td>
<td>General Conditions</td>
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</tr>
<tr>
<td>2.1</td>
<td>Location of Works - Project Layout (Article 7) (not to exceed 5% of the total contract price)</td>
<td>1</td>
<td>lump sum</td>
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Total Section 2

<table>
<thead>
<tr>
<th>Section 3</th>
<th>General Requirements</th>
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<tr>
<td>3.1</td>
<td>Existing Structures and Utility Works (Section 3.70)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>a)</td>
<td>Locate Existing Structures</td>
<td>3</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Support Existing BC Hydro Pole</td>
<td>1</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Support Existing TELUS/Hydro Ducts</td>
<td>1</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Control of Public Traffic (Section 3.73)</td>
<td>1</td>
<td>lump sum</td>
<td></td>
<td></td>
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<tr>
<td>3.3</td>
<td>Removal of Existing Pipe (Section 3.74)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>150mm PVC</td>
<td>125</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>200mm AC</td>
<td>5</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>300mm Concrete</td>
<td>10</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>Removal of Existing Structures (Section 3.75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Manholes</td>
<td>1</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Manholes (&gt; 2m deep)</td>
<td>6</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Sandbag Headwall</td>
<td>5</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>Abandon Existing Manhole (Section 3.77)</td>
<td>2</td>
<td>ea</td>
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</table>

Total Section 3

<table>
<thead>
<tr>
<th>Section 4</th>
<th>Trench Excavation, Bedding and Backfill</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Imported Granular Fill (Section 4.73)</td>
<td>4350</td>
<td>tonne</td>
<td></td>
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<tr>
<td>4.2</td>
<td>Surface Restoration (Section 4.76)</td>
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**UNTRAVELLED**

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<th></th>
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</thead>
<tbody>
<tr>
<td>a)</td>
<td>Seeding w/Topsoil (100mm Depth)</td>
<td>450</td>
<td>m²</td>
</tr>
<tr>
<td>b)</td>
<td>Bark Mulch</td>
<td>4</td>
<td>m²</td>
</tr>
<tr>
<td>c)</td>
<td>Ditch Re-grading</td>
<td>20</td>
<td>m²</td>
</tr>
</tbody>
</table>

**TRAVELLED**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>d)</td>
<td>Clean Crushed Gravel (100mm thick, 19mm minus)</td>
<td>50</td>
<td>m²</td>
</tr>
<tr>
<td>e)</td>
<td>Driveway Chips (50mm thick)</td>
<td>25</td>
<td>m²</td>
</tr>
<tr>
<td>f)</td>
<td>50mm Asphalt &amp; 100mm Base</td>
<td>515</td>
<td>m²</td>
</tr>
<tr>
<td>g)</td>
<td>Asphalt Curb (CS-12) 75mm</td>
<td>1.5</td>
<td>m</td>
</tr>
<tr>
<td>h)</td>
<td>Concrete Curb &amp; Gutter (CS-1)</td>
<td>115</td>
<td>m</td>
</tr>
<tr>
<td>i)</td>
<td>Asphalt Driveway, 50mm thick c/w 100mm base</td>
<td>10</td>
<td>m²</td>
</tr>
<tr>
<td>j)</td>
<td>Concrete Driveway, 150mm thick c/w 100mm base</td>
<td>6</td>
<td>m²</td>
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</tbody>
</table>

**TEMPORARY**

<p>| | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>k)</td>
<td>Cold Mix (50mm thick)</td>
<td>300</td>
<td>m²</td>
</tr>
<tr>
<td>l)</td>
<td>RAP (50mm thick)</td>
<td>215</td>
<td>m²</td>
</tr>
</tbody>
</table>

Total Section 4

Page 1 of 4

Tenderer's Initials _________
## TENDER T-2170-2018
WESTDALE ROAD SANITARY SEWER UPGRADE
SCHEDULE OF QUANTITIES AND PRICES

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Est Qty</th>
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<th>Unit Price</th>
<th>Total</th>
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<tbody>
<tr>
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<td>Water Distribution System</td>
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<td>Watermain Pipe (Section 5.70)</td>
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<td>a)</td>
<td>200mm PVC DR-18</td>
<td>1</td>
<td>LS</td>
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<td><strong>Total Section 5</strong></td>
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<tr>
<td><strong>Section 6</strong></td>
<td>Sanitary Sewer System</td>
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<tr>
<td>6.1</td>
<td>Piping (Section 6.70)</td>
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<tr>
<td>PIPING</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>a)</td>
<td>200mm dia. PVC DR 35</td>
<td>115</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>250mm dia. PVC DR 35</td>
<td>121</td>
<td>m</td>
<td></td>
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</tr>
<tr>
<td>c)</td>
<td>300mm dia. PVC DR 35</td>
<td>11</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPS &amp; PLUGS</td>
<td></td>
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</tr>
<tr>
<td>d)</td>
<td>100mm dia.</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>e)</td>
<td>200mm dia.</td>
<td>1</td>
<td>4</td>
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</tr>
<tr>
<td>f)</td>
<td>300mm dia.</td>
<td>1</td>
<td>12</td>
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<td>REDUCERS</td>
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<tr>
<td>g)</td>
<td>100mm dia. x 150mm dia. VC/PVC Eccentric Reduce</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>6.2</td>
<td>Service Junctions (Section 6.71)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>a)</td>
<td>100mm dia.</td>
<td>9</td>
<td>ea</td>
<td></td>
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<tr>
<td>b)</td>
<td>150mm dia.</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>6.3</td>
<td>Connections to Existing Piping and Appurtenances (Section 6.72)</td>
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<tr>
<td>a)</td>
<td>100mm dia.</td>
<td>10</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>150mm dia.</td>
<td>1</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>200mm dia.</td>
<td>5</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td>Tie-in to Existing Manhole</td>
<td>1</td>
<td>ea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>Precast Manhole Sections (Section 6.73)</td>
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</tr>
<tr>
<td>a)</td>
<td>1050mm dia.</td>
<td>17</td>
<td>vm</td>
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<tr>
<td>6.5</td>
<td>Concrete Bases, Frames, and Covers (Section 6.74)</td>
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<td></td>
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</tr>
<tr>
<td>a)</td>
<td>1050mm dia.</td>
<td>7</td>
<td>ea</td>
<td></td>
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<tr>
<td>6.6</td>
<td>Drop Structures (Section 6.75)</td>
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<td></td>
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</tr>
<tr>
<td>a)</td>
<td>100mm PVC DR 28</td>
<td>60</td>
<td>m</td>
<td></td>
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</tr>
<tr>
<td>b)</td>
<td>150mm PVC DR 28</td>
<td>41</td>
<td>m</td>
<td></td>
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<tr>
<td>6.8</td>
<td>Service Connection Inspection Assembly (Section 6.80)</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>a)</td>
<td>100mm dia.</td>
<td>14</td>
<td>ea</td>
<td></td>
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</tr>
<tr>
<td>b)</td>
<td>150mm dia.</td>
<td>1</td>
<td>ea</td>
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<tr>
<td><strong>Total Section 6</strong></td>
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</table>
## Section 7  Stormwater Management

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Est.Qty</th>
<th>Units</th>
<th>Unit Price</th>
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<tr>
<td>7.1</td>
<td>Piping, Fittings and Services (Section 7.70)</td>
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</tr>
<tr>
<td></td>
<td>a) 200mm dia. PVC DR 35</td>
<td>3</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) 375mm dia. PVC DR 35</td>
<td>18</td>
<td>m</td>
<td></td>
<td></td>
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NAME OF COMPANY: __________________________________________

SIGNATURE OF SIGNING OFFICER: ________________________________

DATE: _____________________________________________________
CONTRACT AGREEMENT

THIS AGREEMENT made this ______ day of April in the year 2018 by and between the City of Nanaimo, herein called the “Owner”, and __________________________ herein called the “Contractor”.

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

ARTICLE 1.

The Contractor shall:

(i) Provide all necessary materials, labour, supervision and equipment and perform all work, and fulfill everything as set forth and in strict accordance with the Contract Documents and Addenda numbered n/a for the project, entitled, "Westdale Road Sanitary Sewer Upgrade – Tender No. T-2170-2018”

(ii) Commence and proceed actively with the work of the Contract within a period of fourteen (14) days of receipt of the Notice to Proceed and complete all work under this Contract by 28th day of September in the year of 2018, subject to the provisions herein for the extension of Contract time, and shall guarantee all materials furnished and work performed, for a period of one (1) year from the date of acceptance contained in the Notice of Acceptance.

ARTICLE 2.

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

ARTICLE 3.

The Invitation to Tender, Instructions to Tenderers, executed Tender Form, Supplementary General Conditions, Specifications, Appendices, Drawings and all Addenda incorporated herein, are annexed hereto and form a part of this Agreement as fully to all intents and purposes as though recited in full herein, and the whole shall constitute the Contract between the parties, and it shall ensure to the benefit of and be binding upon them and their successors, executors, administrators, and assigns.

ARTICLE 4.

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

ARTICLE 5.

Subject to Article 3, this Agreement shall supersede all communications, negotiations and agreements, either written or verbal, made between the parties hereto in respect of matters pertaining to this Agreement prior to the execution and delivery hereof. The terms and conditions of this Agreement shall remain in force and effect notwithstanding the completion of the work to be performed by the Contractor under the Agreement.
CONTRACT AGREEMENT

ARTICLE 6.

All Communications in writing between the parties or between them and the Engineer shall be deemed to have been received by the addressee if delivered to the individual, or to a member of the firm, or to any officer of the corporation for whom they are intended, or if sent by mail or hand delivery addressed as follows:

The Contractor at

(Address)

The Owner at Engineering & Public Works Department, 2020 Labieux Road, Nanaimo, BC, V9T 6J9

(Address)

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

For Contractor:

Full Name of Company

Authorized Signing Officer Signature  Print Name

Position/Title

Authorized Signing Officer Signature  Print Name

Position/Title
CONTRACT AGREEMENT

For Owner:

CITY OF NANAIMO
Full Name of Company

Authorized Signing Officer Signature

Jane Rushton
Print Name

Manager of Purchasing and Stores
Position/Title

Authorized Signing Officer Signature

Print Name

Position/Title

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

No. $ 

Know All Men by These Presents That

as Principal, and 
hereinafter called the Principal, and a corporation created and existing under the laws of , and duly authorized to transact the business of Suretyship in , as Surety, hereinafter called the Surety, are held and firmly bound unto 

hereinafter called the Obligee, in the amount of 

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

Whereas the Principal has submitted a written tender to the Obligee, dated the day of 20__ , for in accordance with the Specifications and Drawings submitted therefor which contract, Specifications and Drawings, are by reference made part hereof and are hereinafter referred to as the Contract.

Now Therefore the Condition of This Obligation is such that if the Principal shall promptly and faithfully perform the Contract then this obligation shall be null and void; otherwise it shall remain in full force and effect.

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

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

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

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

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

In Witness Whereof the Principal and the Surety have Signed and Sealed this Bond this day of 20__

Signed and Sealed (SEAL)

In the presence of (SEAL)

Endorsed by
Insurance Bureau of Canada
The Royal Architectural Institute of Canada
The Association of Consulting Engineers of Canada
The Engineering Institute of Canada
The Specification Writers Association of Canada

Approved by
Insurance Bureau of Canada

Approved by Canadian Construction Association, 1972

Attorney-in-fact
LABOUR AND MATERIAL PAYMENT BOND
(Trustee Form)

No. $  

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

Know All Men by These Presents That

hereinafter called the Principal, and

a corporation created and existing under the laws of

, and duly authorized to transact the business of Suretyship in

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

as Trustee,

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

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

Whereas the Principal has entered into a written contract with the Obligee, dated the day of 20__, for

which contract, Specifications & Drawings are by reference made a part hereof, and is hereinafter referred to as the Contract.

No, Therefore, the Condition of This Obligation is such that if the Principal shall make payment to all Claimants for all labour and material used or reasonably required for use in the performance of the Contract then this obligation shall be null and void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

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

(2) The Principal, and the Surety hereby jointly and severally agree with the Obligee, as Trustee, that every Claimant who has not been paid as provided for under the terms of his contract with the Principal, before the expiration of a period of ninety (90) days after the date on which the last of such Claimant’s work or labour was done or performed or materials were furnished by such Claimant, may as a beneficiary of the trust herein provided for, sue on this Bond, prosecute the suit to final judgment for such sum or sums as may be justly due to such Claimant under the terms of his contract with the Principal and have execution thereon. Provided, that the Obligee is not obliged to do or take any act, action or proceeding against the Surety on behalf of the Claimants, or any of them, to enforce the provisions of this Bond. If any act, action or proceeding is taken either in the name of the Obligee or by joining the Obligee as a party to such proceeding, then such act, action or proceeding shall be taken on the understanding and basis that the Claimants, or any of them, who take such act, action or proceeding shall indemnify and save harmless the Obligee against all costs, charges and expenses or liabilities incurred thereon and any loss or damage resulting to the Obligee by reason thereof. Provided still further that, subject to the foregoing terms and conditions, the Claimants, or any of them, may use the name of the Obligee to sue on and enforce the provisions of this Bond.
(3) No suit or action shall be commenced hereunder by any Claimant:

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

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

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

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

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

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

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

(6) The Surety shall be liable for a greater sum than the specified penalty of this Bond.

In Witness Whereof, the Principal and the Surety have Signed and Sealed this Bond this day of 20__

Signed and Sealed (SEAL)
In the presence of (SEAL)

Endorsed by
The Royal Architectural Institute of Canada
The Association of Consulting Engineers of Canada
The Canadian Construction Association
The Engineering Institute of Canada
The Specification Writers Association of Canada

Approved by
Insurance Bureau of Canada

__________________________________________
Attorney-in-fact
Letter of Credit No. ____________________________  Amount $ __________
Initial Expiry Date: __________

City of Nanaimo
455 Wallace Street
Nanaimo, B.C.
V9R 5J6

Dear Sir:

We hereby authorize you to draw on the ____________________________ (Name of Bank)
for the account of ____________________________ (Address)
up to an aggregate amount of ____________________________ (Name of Customer)
available on demand.

Pursuant to the request of our customer, we hereby establish and give you an Irrevocable Standby Letter of Credit in your favour in the above amount which may be drawn on by you at any time and from time to time, upon written demand for payment made upon us by you, which demand we shall honor without inquiring whether you have the right as between yourself and the said customer to make such demand, and without recognizing any claim of our said customer, or objection by it to payment by us. All demands shall be delivered to: ____________________________, unless the City is notified of a change of address by ____________________________, registered mail at least 30 days prior to the present or future expiration date.

You may make partial drawings or full drawings at any time.

The Letter of Credit relates to those Municipal services and/or financial obligations set out in an Agreement between the customer and the Municipality and briefly described as:

____________________________________________________________

The amount of this Letter of Credit may be reduced from time to time as advised by notice in writing to the undersigned from time to time by the City of Nanaimo.

This Letter of Credit will continue in force for a period of 1 year, but shall be subject to the condition hereinafter set forth.

It is a condition of this Letter of Credit that it shall be deemed to be automatically extended without amendment from year to year from the present or any future expiration date hereof, unless at least 30 days prior to the present or any future expiration date, we notify you in writing by registered mail, that we elect not to consider this Letter of Credit to be renewable for any additional period.

Dated at ____________, British Columbia, this ______ day of
_______________, 20__.

____________________________
(Name of Bank)

____________________________
(Address of Bank)

____________________________
Per:

____________________________
(Authorized Signature)

____________________________
(Authorized Signature)
Attention: P. Rosen, Senior Manager of Engineering

RE: WESTDALE ROAD SANITARY SEWER UPGRADE

Please find attached our Final Invoice No. __________ for the sum of $ ____________ as being the full and final amount accruing to the undersigned by virtue of the said contract; said amount also covering full payment for the cost of all extra work and material furnished by the undersigned in the fulfillment of said work, and all incidentals thereto; and the undersigned hereby releases the said corporation from all claims whatsoever growing out of said contract.

And these presents are to certify that all persons doing work upon or furnishing materials for said work under the foregoing contract have been paid in full.

COMPANY NAME: ___________________________________________________________________

ADDRESS: _______________________________________________________________________

AUTHORIZED SIGNATORY: ___________________________________________________________________

POSITION: _______________________________________________________________________

DATED: ______________

cc Phil Stewart, Acting Construction Manager
STATUTORY DECLARATION
TO BE MADE BY CONTRACTOR TO EFFECT RELEASE OF THE HOLDBACK ACCOUNT

Province of British Columbia, Canada
In the matter of contract entered into with ________________________________, Owner by
____________________________________, Contractor

At Project _________________________________ Contract No. ______________________

TO WIT:

I, ______________________________________ of the _______________________ of __________________________
in the Province of ______________________________________________ do solemnly declare: -

1. That I am __________________________________________ of ______________________________________
   (President, Vice-President, Secretary, Treasurer, a Partner)
   the Contractor named in the contract above mentioned and as such have personal knowledge of the facts hereunder
   declared:

2. That all subcontractors, labour, and accounts for materials and equipment whatsoever entering into the construction of
   the project built under the said contract have been duly paid except for holdbacks on subcontracts which amount in
   total in all subcontracts to ____________________________________________ ($ _________________________);

3. That all assessment and levies under the Unemployment Insurance Acts, the Workers’ Compensation Acts or other
   social or labour legislation in respect of the said contract have been duly paid:

4. That the following is a list of subcontractors who have been employed under the said contract:

AND I MAKE THIS SOLEMN DECLARATION conscientiously believing it to be true and knowing that it is of the same force
and effect as if made under oath and by virtue of the Canada Evidence Act.

DECLARED before me at the ________________________________ of __________________________
in the ________________________________ of __________________________
this ________________________________ day of 2 ____________.

SIGNED: ______________________________________
     A Commissioner for Oaths, Notary Public, Justice of the Peace

Note 1. Where the Contractor is a corporation or a partnership, declarant’s position in the corporation partnership, and
   the corporation or partnership name should be clearly shown in No. 1. Where the Contractor is the person who
   makes the Declaration, strike out “of” in the first line of No. 1.

Note 2. Where the Contractor is an individual, they must make the Declaration themselves. Where the Contractor is a
   partnership the declaration must be made by one of the partners. Where the Contractor is an incorporated
   company, the declaration must be made by the President, Vice-President, Secretary, Treasurer or Director. If
   any other person makes this Declaration two copies of the bylaw issued under the Corporation seal, authorizing
   the individual to execute documents, must be submitted with the first declaration on each contract.
### SECTION 1 – SUPPLEMENTAL SPECIFICATIONS

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1.00 **SCOPE**

.1 In case of inconsistency or conflict, these Supplemental Specifications supersede the General Conditions, General Requirements, Specifications, Drawings, and all other Tender and Contract documents.

1.01 **AS-BUILT SUBMISSIONS**

.1 Drawings shall include all information as specified elsewhere for the construction drawings, but shall be corrected upon completion of construction to note all works removed or abandoned during construction. This information shall be retained in a digital point file.

.2 All dimensions, elevations and inverts shown shall reflect the As-Built conditions of the construction and all references to “Proposed” shall be removed. As-Built drawings shall be to scale in accordance with the As-Built dimensions shown. The Revision Table shall be completed indicating the drawings are As-Built. **All changes and notes marked in “red ink” on the IFC drawings.**

.3 All As-Built features shall be surveyed and survey points recorded in a digital point file with all changes marked on the IFC drawings in red ink. The As-Built drawing shall reflect the true elevation and location of all constructed features, in both the plan and profile views.

All As-Built drawings shall also include the following information:

(a) The location and elevation of all existing utilities and services encountered in the construction operation,

(b) The location and invert elevation at property line of all individual service connections, and the wye chainage, at the main for all constructed and existing works,

(c) A note on each drawing describing the type of trench material (sand, gravel, clay, hard pan, etc.) encountered during construction and the location and profile of all rock.

(d) A detail for each tie in point to existing utilities and locations where restrainers are required.
## SECTION 2 - GENERAL CONDITIONS

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SECTION 2 - GENERAL CONDITIONS
DRAWINGS, SPECIFICATIONS AND RELATED DATA

2.1 DRAWINGS, SPECIFICATIONS AND RELATED DATA

ARTICLE 1. DEFINITION OF TERMS

.1 "APPROVAL" shall mean the approval granted by the City Engineer unless otherwise noted.

.2 "CITY" shall mean a duly authorized representative of the City of Nanaimo.

.3 "CITY ENGINEER" shall mean the person appointed to the office of City Engineer, by Council, acting, either directly or through authorized staff acting severally within the scope of the particular duties entrusted to them.

.4 "CONSULTANT" shall mean a Professional Engineer acting either directly or through his/her authorized agents, acting severally within the scope of the particular duties entrusted to them.

.5 "CONTRACT DOCUMENTS" OR "CONTRACT" shall mean the complete set of documents, specifications, drawings, and addenda incorporated therein, as listed in the Table of Contents.

.6 "CONTRACTOR" shall mean the Contractor named in the Contract Agreement.

.7 "DIRECTOR OF ENGINEERING AND PUBLIC WORKS" shall mean the City Engineer.

.8 "ENGINEER" shall mean:

(a) the City Engineer acting either directly or through his/her properly authorized agents, Professional Engineers, Consultants, and authorized staff, acting severally within the scope of the particular duties entrusted to them or,
(b) notwithstanding Article 1.8 (a), for City construction contracts, the Manager of Construction acting either directly, or through his properly authorized agents, Professional Engineers, Consultants and staff, acting severally within the scope of the particular duties entrusted to them.
(c) notwithstanding Article 1.8 (a), for Private Developments, the Consultant acting on behalf of the developer. The City Engineer will monitor the Consultant and retains the right to direct the Consultant's application of the Engineer's responsibilities.

.9 "EQUIPMENT" shall mean anything and everything except persons used by the Contractor in performance of the work and except material as defined herein.

.10 "HEREIN" and "HEREOF" and similar expressions wherever used in the Contract Documents, shall relate to the whole of the Contract Documents and not to any one (1) paragraph alone, unless the context specifically requires it.

.11 "INSPECTOR" shall mean a person or company authorized by the Engineer or by the Owner to inspect the work or any part of it.

.12 "MATERIAL" or "MATERIALS" shall, unless otherwise specified, mean anything and everything other than persons or the Contractor's equipment which is manufactured, processed, or transported to the site, or existing on the site, and incorporated into the completed works.

.13 "OWNER" shall mean the City of Nanaimo.
.14 "PLANT" shall mean the same as EQUIPMENT.

.15 "PROFESSIONAL ENGINEER" shall mean a person registered with the Association of Professional Engineers of British Columbia as a Professional Engineer.

.16 "PROVIDE" shall mean the same as SUPPLY.

.17 "SUBCONTRACTOR" shall mean any person, engaged by the Contractor or another Sub-Contractor to perform or provide part or parts of the work or to supply material intended to be incorporated into the completed works, but does not include a worker or a person engaged by an architect, an engineer or a material supplier.

.18 "SUPPLY" shall mean supply and pay for or provide and payfor.

.19 "WORK" or "WORKS" shall, unless the context otherwise requires, mean the whole of the work, equipment, materials, labour, matters and things required to be done, furnished, and performed by the Contractor under this Contract.

ARTICLE 2.  INTENT OF CONTRACT

.1 The intent of the Contract is that the Contractor shall provide all materials, supervision, Labour, equipment, and all else necessary for, or incidental to, the proper execution of the work unless specifically noted otherwise. The Contractor shall do all the work shown on the drawings and/or described in the specifications and all other things necessary to complete the works.

ARTICLE 3.  DRAWINGS AND SPECIFICATIONS FURNISHED

.1 Except as provided for otherwise, a maximum of six (6) copies of drawings and specifications for the execution of the work shall be furnished to the Contractor without charge. Additional instructions may be issued by the Engineer during the progress of the work by means of drawings or otherwise for clarification of the drawings and specifications, or as may be necessary to explain or illustrate changes in the work to be done. One (1) complete set of all drawings and specifications shall be maintained at the jobsite by the Contractor and shall be available to the Engineer at all times.

ARTICLE 4.  DOCUMENTS CONFLICT

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

1.  Contract Agreement
2.  Supplementary General Conditions
3.  General Conditions
4.  Specifications
5.  Drawings
6.  Executed Tender Form
7.  Instructions to Tenderers
8.  Invitation to Tender
9.  All other documents
SECTION 2 - GENERAL CONDITIONS
DRAWINGS, SPECIFICATIONS AND RELATED DATA

.2 Figured dimensions on a drawing take precedence over measurements scaled from the drawing, and large scale drawings take precedence over those of smaller scale. Supplementary drawings and specifications supersede their antecedents. In case of conflict between figured dimensions on a drawing and the dimensions of a specified product, the dimensions of the specified product will govern. In case of conflict in materials and methods, the specifications govern. The drawings and specifications complement each other and anything called for by one will be as binding as if called for by both.

ARTICLE 5. DISCREPANCIES

.1 Any discrepancies found between the drawings and specifications or any errors or omissions in the drawings or specifications shall immediately be reported to the Engineer, who shall promptly correct such error or omission in writing. Any work done after discovery of such discrepancies, errors or omissions shall be done at the Contractor's risk.

ARTICLE 6. SHOP DRAWINGS

.1 The Contractor shall furnish to the Engineer, at proper times, all shop drawings including diagrams, illustrations, schedules, performance charts, brochures and other data necessary to clarify the work intended or to show its relation to adjacent work of other trades. The Contractor shall provide such additional drawings and shall make any changes or additions to such drawings or diagrams which the engineer may require consistent with the Contract and will submit sufficient copies of the revised prints for review, all but three (3) of which all be returned to the Contractor following review.

.2 Prior to submission to the engineer the Contractor shall review all shop drawings. By this submission, the Contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data and that he has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents.

.3 The Contractor shall submit shop drawings to the Engineer for his review with reasonable promptness and in orderly sequence so as to cause no delay in the work of other contractors. If either the Contractor or the Engineer so requests, they shall jointly prepare a schedule fixing the dates for submission and return of shop drawings. Shop drawings shall be submitted in the form of a reproducible transparency or prints as the engineer may direct. At the time of submission, the Contractor shall notify the engineer in writing of any deviations in the shop drawings from the requirements of the Contract Documents.

.4 The Engineer will review and return shop drawings in accordance with any schedule agreed upon, or otherwise with reasonable promptness so as to cause no delay. The Engineer's review shall be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Contract Documents unless a deviation on the shop drawings has been specifically approved in writing by the Engineer.

.5 The Contractor shall make any changes in shop drawings, which the Engineer may require consistent with the Contract Documents and resubmit unless otherwise directed by the Engineer. When resubmitting, the Contractor shall notify the Engineer in writing of any revisions other than those requested by the Engineer.
SECTION 2 - GENERAL CONDITIONS
DRAWINGS, SPECIFICATIONS AND RELATED DATA

ARTICLE 7. LOCATION OF THE WORKS

.1 Where location dimensions for the proposed works are not shown on the drawings or digital file, the locations are intended to be approximate.

.2 Unless otherwise specified, the Engineer will provide the contractor with a copy of the digital drawing file for the Contractor and/or his surveyor to create a point file to be used for layout to perform the construction works.

.3 The Contractor shall perform all layout as required from the digital drawing file and shall be responsible for all dimensions and elevations determined from the digital information.

.4 The Contractor shall satisfy himself, before commencing any work, as to the meaning, intent, and accuracy of the information in the digital drawing file as it relates to control points, control lines, benchmarks, and the construction drawings.

.5 Should the Contractor discover or suspect any errors in the digital drawing file provided by the Engineer, he shall at once discontinue the affected work until such errors are investigated by the Engineer and, if necessary, rectified.

.6 The Contractor shall carefully preserve bench marks, reference points and stakes. In case of willful or careless destruction or disturbance of such markers, he shall be charged with the expense of replacing them and shall be responsible for any mistakes that may be caused by their destruction, loss or disturbance.

.7 In any dispute between the Contractor and the Engineer on the correctness of grades, locations, elevations of the installations or constructed works, the Contractor shall be responsible for proving by means of cut sheets and undisturbed stakes, that he has made the installation or construction in accordance with the layout provided.

.8 The contractor shall be required to maintain an “as-constructed" drawing set for the project, with all changes and notes marked in red ink and an “as-constructed” digital survey file. This information shall be available to the Engineer for review on request, and shall be submitted to the Engineer prior to issuing the Notice of Acceptance.

.9 Legal survey markers, disturbed or removed by the construction operation that existed at a horizontal distance of 1.0 m or more from the maximum allowable trench width as shown on the standard drawings, shall be replaced at the Contractor’s expense. If it is necessary to remove or disturb existing legal survey markers that are within the above limits, the Engineer shall be so notified a minimum of three working days before such removal or disturbance and replacement will be at the Owner’s expense.

ARTICLE 8. LOCAL CONDITIONS

.1 The Contractor shall, by personal inspection, examination, calculations or tests, or by any other means, satisfy himself with respect to the local conditions to be encountered and the quantities, quality, and practicability of the work and of his methods of procedure. No verbal agreement or conversation with any officer, agent, or employee of the Owner, either before or after the execution of the contract, shall affect or modify any of the terms or obligations herein contained.
.2 Failure to properly assess the local conditions to be encountered and the quantities, quality and practicability of the work and his methods of procedure is a risk to be borne by the Contractor.
2.2 ENGINEER, OWNER, CONTRACTOR RELATIONS

ARTICLE 9. ENGINEER'S STATUS

.1 The Engineer will be the Owner's representative during the construction period and will observe work in progress on behalf of the owner. The Engineer will have the authority to stop the work whenever such stoppage may be necessary, in his opinion, to ensure the proper execution of the work in accordance with the provisions of the contract. The Contractor shall obey such order immediately. Neither the giving or carrying out of such orders shall thereby entitle the Contractor to any extra payment.

.2 The Engineer may delegate such of the powers of the Engineer to other persons, as the Engineer deems appropriate.

.3 The Engineer or the Owner may appoint any persons or company or the employee of any such person or company or of the Engineer to be an Inspector. Such Inspector shall have the authority of the Engineer to reject materials, procedures or workmanship as not complying with the provisions of the Contract and to order the Contractor to stop work until the materials, procedures or workmanship comply with such provisions.

ARTICLE 10. INSPECTION OF WORK

.1 The Contractor shall allow the Engineer and/or owner or their duly appointed Inspector access and provide adequate facilities for access to any part of the works at all times. If the specifications, Engineer's instructions, laws, ordinances or any public authority requires any work to be specially tested or approved, the Contractor shall give the Engineer advance notice of his preparedness for such inspection, and if the inspection is by an authority other than the Engineer, of the date fixed for such inspection. The Engineer will inspect the work promptly and without causing unreasonable delay to the Contractor. Extra payment will not be made to the Contractor for delay occasioned by an inspection, and extension of completion time will not be allowed for delay resulting therefrom.

.2 On request by the Engineer, the Contractor shall open for inspection any part of the work that has been covered up. If the Contractor refuses to comply with such request, the Owner may employ other persons to uncover the work. If the work is found to be in accordance with the Contract requirements then the cost of uncovering and recovering the work shall be borne by the Owner. If any of the work was covered by the Contractor in contravention of the Engineer's instructions, or if the uncovered work is found not to be in accordance with the Contract requirements, then the cost of uncovering and recovering the work shall be charged to the Contractor.

.3 The lack of comment on the part of the Engineer, on methods of construction by the Contractor shall not relieve the Contractor of his responsibility for any errors therein, and shall not be regarded as an acceptance of responsibility for work done by the Contractor.
SECTION 2 - GENERAL CONDITIONS
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ARTICLE 11. SUPERVISION AND LABOUR

.1 The Contractor shall keep on the work at all times during its progress a competent superintendent who is approved by the Engineer, which approval may be withdrawn at any time. The superintendent shall represent the Contractor in his absence and directions given to him shall be held as being given to the Contractor. The superintendent shall give efficient and effective supervision to the work until its completion.

.2 When competent personnel are available locally they shall, whenever possible, be employed by the Contractor.

ARTICLE 12. LANDS BY OWNER

.1 The Owner will provide the lands upon which the work is to be performed. Where work is to be performed on lands owned by others, the Owner, will obtain the necessary easements or rights-of-way. The Owner will endeavor to obtain the necessary easements or rights-of-entry in time to permit construction to proceed as scheduled by the Contractor. When this is not possible, the Contractor shall withhold work on property owned by others until such easements or rights-of-entry have been obtained. Delay in providing these lands, or in obtaining easements or rights-of-way which, in the opinion of the Engineer, delays the work or results in extra cost to the contractor, will be deemed proper cause for adjustment in the time of completion and adjustment of the Contract amount to cover the extra cost to the Contractor.

ARTICLE 13. LANDS REQUIRED BY CONTRACTOR

.1 Any lands other than those which are to be provided by the Owner and which may be required by the Contractor for temporary facilities, storage purposes, or access to the work site, shall be obtained by the Contractor at no cost to the Owner.

ARTICLE 14. PRIVATE LAND

.1 It shall be the Contractor's responsibility to ascertain the boundaries within which the work must be confined. The Contractor shall not enter lands other than those provided by the Owner for any purpose without obtaining prior written permission of the land owners and occupiers. The Contractor shall not enter upon lands owned by others on which the Owner has easements or rights-of-entry without having received the written authorization of the Owner for such entry. It shall be the Contractor's responsibility to ascertain from the Owner the conditions on which easements or right-of-entry have been granted on private lands and to abide by these conditions throughout the course of construction.

The Contractor shall notify the Owner and Engineer, in writing, of any supplementary construction agreements made between the Contractor and the Owner of private property in lieu of or in addition to the condition sheets provided by the Owner and forming part of this document.

.2 The Owner will not be responsible for any supplementary construction agreements other than those to which the Owner is a signed party.
ARTICLE 15. ASSIGNMENT OF CONTRACT

.1 Neither party shall sublet, sell, transfer, assign, or otherwise dispose of the Contract or any portions thereof, or his right, title, or interest herein, or his obligations thereunder without written consent of the other party, except for an assignment to a bank of the payments to be received hereunder.

ARTICLE 16. SUSPENSION OF WORK BY OWNER

.1 The Owner may at any time suspend the work, or any portion thereof, provided he gives the Contractor five (5) days written notice of suspension. The Contractor shall resume work upon written notice of the Owner within ten (10) days after the date set forth in such notice, or in a subsequent notice to resume work. The Owner will reimburse the Contractor for costs and expenses incurred by the Contractor necessitated by such suspension of work or portion thereof, but the Contractor shall not recover from the Owner payment for any loss of anticipated profits or damages.

ARTICLE 17. OWNER’S TERMINATION OF THE CONTRACTOR’S RIGHTS

.1 The Owner will have the right to terminate the Contractor’s right to continue with the work if the Contractor at any time becomes bankrupt, makes an assignment of his property for the benefit of the creditors, or if a receiver or liquidator should be appointed. Such termination shall be effective upon the Owner giving notice thereof.

.2 If at any time the Engineer is of the opinion and so states in writing to the Owner that the Contractor:

(a) has failed to commence work or to recommence work after a suspension within the time specified in the contract documents;
(b) has failed or is failing to furnish or to maintain a detailed work schedule and plan of operation as required by Article 38 - Schedule of Completion thereof;
(c) has failed or is failing to use diligence or has failed to comply with the instructions of the Engineer to expedite his work or is other wise failing to make such progress with the work as is necessary to ensure the completion of the work or any part thereof in the time specified in the contract documents;
(d) has failed or is failing to supply enough competent workmen, management, materials or suitable equipment; or
(e) has failed, or is failing to pay, the minimum rate of pay as described in Article 28 – Personnel and Rates of Pay;
(f) has become in any way unable to carry on the work or any part thereof;
(g) has failed to ensure the safety of the workers and public; (REVISED NOVEMBER 2016)
(h) has failed or refused to comply with a regulation or order issued pursuant to the Workers Compensation Act. (REVISED NOVEMBER 2016)

the Owner may give notice in writing to the Contractor of such opinion and requiring that such default or defaults be remedied forthwith. If, within five (5) days of such notice, such default or defaults are not remedied to the satisfaction of the Engineer, the Owner may terminate the Contractor’s right to perform further the work under the contract. Such termination shall be effective immediately.
.3 Upon such termination, the Owner may employ such means as he sees fit to complete the works. In such cases:

(a) The Contractor shall have no claim for any further payment in respect of work performed, but shall be liable for all damages and expenses which may be suffered by the Owner by reason of such default or delay, or the non-completion by the Contractor of the works;
(b) No objection or claim shall be raised or made by the Contractor by reason of or on account of the ultimate cost of the works so taken over for any reason proving greater than, in the opinion of the Contractor, it should have been;
(c) All materials and all rights, proprietary or otherwise, licenses, powers and privileges, whether relating to or effecting real or personal property, acquired, possessed or provided by the Contractor for the purposes of the work under the provisions of this Contract will become or remain and be the property of the Owner for all purposes incidental to the completion of the works and may be used, exercised, and enjoyed by the Owner as fully to all intents and purposes connected with the works as they might therefore have been used, exercised and enjoyed by the Contractor; and,
(d) The Owner may forthwith enter into possession of all the Contractor's equipment on the site of the work and may use the same in any way it sees fit in order to complete the works without the Owner being in any way liable for damage or any other cost in connection with such use by the Owner. Upon completion of the work, such equipment may be returned to the Contractor or may be sold by the Owner and the net proceeds of such sale credited to the Contractor's account.

.4 If the Contractor's right to perform the work is terminated in accordance with the provisions of this clause, the Contractor shall not be entitled to receive any further payment until the work is completed.

.5 Upon completion of the work the Engineer shall determine:

(a) The amount which would have been due to the Contractor under the Contract if all of the work had been performed by him;
(b) The costs and expenses borne by the Owner in completing the work and damages for delay in completion, if any.

.6 The Contractor shall be entitled to receive the balance of the contract price less such costs and expenses, or if such costs and expenses exceed such price, the Contractor shall pay the amount of such excess to the Owner on demand.

.7 The Owner shall have the option, under the provisions of this Article, to be exercised in its absolute discretion, to terminate the right of the Contractor to perform any part or parts of the work and to permit the Contractor to continue to perform the rest of the work. All the provisions of this article shall apply to such part or parts with such modifications as the circumstances may require.

ARTICLE 18. CONTRACTOR'S TERMINATION OF THE CONTRACT

.1 The Contractor shall have the right to terminate the Contract for any of the following reasons:

(a) In the event of any Order of any Court or other public authority, other than the Owner, causing the work to be stopped or suspended, and when the period of such stoppage
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or suspension exceeds ninety (90) days, and when such stoppage or suspension occurs through no act or fault of the Contractor, his agent, or servants.

(b) In the event that the Owner fails to pay, except as provided in the Contract documents, any sum certified by the Engineer within twenty (20) days from the due date of payment, and fails to remedy such default within ten (10) days of the Contractor's written notice to do so.

.2 In either event, the Contractor will receive from the Owner payment for all work performed and losses sustained in respect of any materials. For termination under (a) above, the Owner will not be liable for any loss of anticipated profits, damages, or expenses incurred by the Contractor as a result of such stoppage or suspension, but under (b) above, the Contractor will be paid for loss of profits, damages and expenses. Such termination shall be effective upon the Contractor giving notice hereof.

.3 The amount due to the Contractor for work performed and losses sustained shall be determined by the Engineer and certified by him to the Contractor and to the Owner.

ARTICLE 19. SEPARATE CONTRACTS

.1 The Owner reserves the right to let other contracts in connection with the work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.

.2 If any of the Contractor's work, as specified herein and shown on the drawings, depends upon the work of any other contractor, the Contractor shall inspect and measure the work in place and determine whether anything in such work renders it unsuitable for proper execution of his work. He shall promptly report the results of such inspection and measurement to the Engineer if anything in such work renders it unsuitable for proper execution of his work. His failure to inspect and report promptly shall constitute an acceptance of the other contractor's work and he shall have no claim against the Owner by reason of anything in such work rendering the same unsuitable for proper execution of his work.

ARTICLE 20. SUBCONTRACTS

.1 The subcontractor named in the Tender Form, and others as may be approved by the Engineer following execution of the Contract Agreement, shall not be changed nor shall additional subcontractors be employed except with the written approval of the Engineer. The Contractor is responsible to the Owner for the acts and omissions of his subcontractors and of their employees, to the same extent that he is responsible for the acts or omissions of persons employed by himself. Nothing in the Contract Documents shall create any contractual relation between any subcontractor and the Owner. The Contractor shall bind every subcontractor to the terms of the Contract Documents.

.2 Each Subcontract shall contain a provision that the Certificate of Completion of the work by the Subcontractor shall be binding on the Contractor and Subcontractor.

ARTICLE 21. ORAL AGREEMENTS

.1 No oral instruction, objection, claim or notice by any party to the other shall affect or modify any of the terms or obligations contained in any of the Contract Documents, and none of the provisions of the Contract Documents shall be held to be waived or modified by reason of
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any act whatsoever, other than by a waiver or modification thereof in writing and agreed to by the parties to the contract.

ARTICLE 22. NON-WAIVERS

.1 Any failure by the Owner or the Engineer at any time, or from time to time, to enforce or require the strict keeping and performance of any of the terms or conditions of the contract will not constitute a waiver of such terms or conditions and will not affect or impair such terms or conditions in any way or the right of the Owner or the Engineer at any time to avail itself or himself of such remedies as it or her may have for any breach or breaches of such terms or conditions.

.2 No provision in the Contract which imposes or may be deemed to imposes extra or specific responsibilities or liabilities on the Contractor shall restrict the general or other responsibilities or liabilities of the Contractor in any way.
2.3 MATERIALS AND WORKMANSHIP

ARTICLE 23. MATERIALS BY CONTRACTOR

.1 The Contractor shall supply all materials unless it is expressly specified to the contrary. Materials used in the work shall meet the requirements of the specifications, or where not detailed in the specifications, shall be to the Engineer's satisfaction. Unless otherwise specified, all materials shall be new.

.2 Unless otherwise specified, the Contractor shall provide all water, light, power, heating and equipment necessary for the execution of the work.

.3 Schedules of piping, fittings, reinforcing, or other materials indicating quantity and/or dimensions, which are shown on the drawings, or in the applicable sections of the specifications, are intended only to assist the Contractor in his quantity takeoff. Quantities and dimensions shown therein are not guaranteed to be accurate and the Contractor must satisfy himself as to the accuracy of the quantities and dimensions.

.4 No variations between the quantities shown on the schedules and those actually installed shall give rise to any claim by the Contractor or to any right for additional payment in a lump sum price contract or to a variation in unit price in a unit price contract.

.5 All materials provided by the Contractor shall remain in the custody and at the risk of the Contractor.

ARTICLE 24. MATERIALS BY OWNER

.1 The Owner will provide only such materials as are specifically listed as being supplied by the Owner.

.2 The Contractor shall be responsible for materials from the point of delivery to the jobsite. The Contractor shall verify the delivery dates of materials provided by the Owner and shall arrange work schedules to comply therein.

.3 The Owner shall not be liable in any way for a delay in such delivery arising out of any cause beyond the Owner's reasonable control.

ARTICLE 25. MATERIALS STORAGE

.1 The Contractor, at his own cost, shall store all materials provided for the work either by himself or the Owner until they have been incorporated into the completed works. Materials shall be so stored as to ensure the preservation of their quality and fitness for the work, and shall be so protected from vandalism and theft. Stored materials shall be located so as to facilitate prompt inspection. Faulty materials shall not be stored on the site, and any material found to be faulty shall promptly be removed from the site by the Contractor.
ARTICLE 26. TESTING, REJECTED WORK AND MATERIALS

.1 If, in the opinion of the Engineer, testing is required, the Engineer will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates inadequacies, additional testing may be required by the Engineer.

.2 The Contractor, as directed by the Engineer, shall supply specimens or samples for testing.

.3 All materials, which do not conform to the requirements of the Contract Documents, are not approved by the Engineer, or are in any way unsatisfactory or unsuited to the purpose for which they are intended, will be rejected. Any defective work, whatever the cause thereof, and without limiting the generality of the foregoing, whether the result of poor workmanship or use of defective materials, shall be removed within five (5) days after written notice is given by the Engineer, and the work shall be re-executed by the Contractor. The fact that the Engineer may have previously overlooked such defective work shall not constitute an acceptance. The removal of work and the re-execution thereof shall be at the expense of the Contractor, and he shall pay the cost of replacing the work which shall include materials of other contractors destroyed or damaged by the removal of the rejected work or materials and the subsequent replacement with acceptable work. The Contractor shall also reimburse the Owner for initial testing and any additional engineering, inspection, testing or other contractor's costs incurred in respect of rejected work or materials, whether such work or materials are replaced or not or are accepted at a lower price.

.4 If, in the opinion of the Engineer, it is not expedient to re-execute defective work the Owner may deduct from the Contract price, the difference in value between the work as done and that called for by the Contract, the amount of which shall be determined by the Engineer.

ARTICLE 27. OWNER'S RIGHT TO CORRECT DEFICIENCIES

.1 Upon failure of the Contractor to perform the work in accordance with the Contract Documents, and after five (5) days' written notice to the Contractor, or without notice if an emergency or danger to the work or public exists, the Owner may, without prejudice to any other remedy he may have, correct such deficiencies. The cost of work performed by the Owner in correcting deficiencies shall be paid by the Contractor.

ARTICLE 28. PERSONNEL AND RATES OF PAY

.1 All workers must have sufficient knowledge, skill, and experience to perform properly the work assigned to them. Any foreman or workers employed by the Contractor or subcontractor who, in the opinion of the Engineer, does not perform his work in a skillful manner, or appears to be incompetent or to act in a disorderly or intemperate manner shall, at the written request of the Engineer, be removed from the site of the work immediately and shall not be employed again in any portion of the work without the approval of the Engineer.

.2 In addition the minimum rate of pay to all workers for work performed under this Contract or under Sub-contract shall be as classified in the current Agreement between the City of Nanaimo and the Canadian Union of Public Employees, Local No. 401.
.3 Failure of the Contractor to pay the minimum rate of pay as described in Article 28.2, may result in the Owner:

(a) terminating the contract, in accordance with Article 17- Owner's Termination of the Contractor's Rights
(b) suspending payments to the Contractor, in accordance with Article 44 - Payment Withheld, until the Owner is satisfied the Contractor is complying with Article 28.2.
(c) holding back sufficient funds to cover the difference between what the Contractor or Sub-Contractor is paying and what they should be paying under Article 28.2.

ARTICLE 29. GUARANTEE PERIOD

.1 Neither the Notice of Acceptance nor a Notice of Partial Acceptance nor any payment by the Owner shall relieve the Contractor of responsibility for faulty materials or defective workmanship. The Contractor guarantees to maintain the work against any defects arising from faulty installation, faulty materials, supplied under the Contract or faulty workmanship which may appear within one (1) year of the date of the Notice of Acceptance. If a Notice of Partial Acceptance has been issued, the guarantee period shall begin from the date of such Certificate except for the work still to be performed and the defects and deficiencies still to be corrected which are listed on such Certificate. Faulty materials shall be replaced and defects discovered and failures which occur during the guarantee period shall be rectified to the satisfaction of the Engineer and in accordance with the Contract Documents, including, if deemed necessary by the Engineer, replacement of all or a portion of the work. The same guarantee as is here in provided and for the same period shall attach to such replacement materials or rectified work and the period shall begin on the date the Engineer accepts such replacement materials or rectified work.

.2 If the Owner observes through use of the works, or if it is discovered by tests or inspection of the works prior to the end of the guarantee period, that a deficiency or defect exists in the materials or workmanship in respect to the works, the Owner shall immediately notify the Contractor, by whatever means are available, of the defect or deficiency and instruct him to rectify the fault. Such notification shall be confirmed by the Owner in writing to the Contractor. In the event that this work, in the opinion of the Owner, must be done immediately to prevent serious damage, injury or loss of life, the Owner may perform, or cause to be performed, the necessary work, and shall notify the Contractor accordingly. Work required under guarantee shall, except as otherwise provided herein for emergencies, be carried out by the Contractor or his representative within ten (10) days of the Owner's written instruction to perform the work. In the event that this work is not done by the Contractor within the ten (10) day period, or such further period as may be approved by the Engineer, the Owner may take whatever action is necessary to have the work done.

.3 All costs relating from the necessity to do work under the guarantee requirement, whether it be done by the Contractor, his representative, or the Owner, as provided herein, shall be borne by the Contractor. The Contractor shall, in addition, be liable to the Owner for all expense, losses, or damages incurred by the Owner as a result of faulty materials and defective workmanship as are referred to in Article 29.1, or as a result of the Contractor's failure to meet the guarantee requirements as specified herein, including, but without limiting the generality hereof, all costs of engineering, inspection and testing. All costs will be deducted by the Owner from the guarantee amount described in Article 51 - Release of Guarantees.
The issuance of a Certificate of Completion in relation to a subcontract shall not relieve the Contractor of his obligation under this Article 29 - Guarantee Period.
2.4 LEGAL RESPONSIBILITY AND PUBLIC SAFETY

ARTICLE 30. DAMAGE TO WORK

.1 The Contractor shall be responsible for all loss and damage whatsoever which may occur on or to the works, completed or otherwise, until such time as the entire works have been completed and the Notice of Acceptance has been issued by the Owner. In the event of any loss or damage occurring, the Contractor shall, on notice from the Engineer, immediately put the works into the condition it was immediately prior to such loss or damage all at the Contractor’s expense, except where such loss or damage was caused solely by an act of the Owner.

ARTICLE 31. INDEMNITY

.1 The Contractor shall indemnify and save harmless the Owner from and against all losses and all claims, demands, payments, suits, actions, recoveries, and judgments of every nature and description brought or recovered against him, and/or the Owner, by reason of any act or omission or alleged act or omission of the Contractor, his agents, employees, or subcontractors in the execution of the work.

ARTICLE 32. BONDS

.1 To ensure the faithful execution and proper fulfillment of this Contract, the Contractor shall provide the Owner with the following bonds at the time of his execution of the Contract Agreement:

(a) a Performance Bond in the amount of fifty percent (50%) of the total contract amount covering the faithful performance of the Contract and maintenance of the Contract for one year after the Notice of Acceptance;
(b) a Labour and Material Payment bond in the amount of fifty percent (50%) of the total contract amount; and the above bonds must be issued by a Surety Company licensed to conduct business in the Province of British Columbia and shall be provided in quadruplicate on the forms contained within the Contract Documents.

.2 Notwithstanding anything contained elsewhere in the contract documents, the Owner shall not be required to make any payment whatever to the Contractor until the above bonds, duly executed, have been delivered to the Owner.

ARTICLE 33. PATENTS AND ROYALTIES

.1 The Contractor shall pay all royalties and license fees with respect to and shall assume the defense of and indemnify the Owner and the Engineer, their employees, officers and agents from all claims relating to inventions, copyrights, trademarks, or patents used in doing the work and in the subsequent use and operation of the work or any part thereof upon completion. The contractor shall not be liable hereunder with respect to any claims arising from a construction method, process or equipment specified by the Owner in the documents submitted to the Contractor before he submitted his tender.
ARTICLE 34. PERMITS AND REGULATIONS

.1 The Contractor shall, at his own expense, procure all permits, certificates and licensees required for the construction of the work and shall comply with all federal, provincial, and local laws, regulations and ordinances affecting the execution of the work, save insofar as the Contract Documents specifically provide otherwise.

.2 The Owner will obtain all necessary governmental approvals for the design of the completed work, and all permits and licenses required by law for the completed works.

ARTICLE 35. INJURY OR DAMAGE TO PERSONS OR PROPERTY

.1 The Contractor shall use due care and take all necessary precautions to ensure the protection of persons and property and shall comply with the provisions of the Workers' Compensation Act of the Province of British Columbia and any safe work procedures as listed in Section 3.10 – WorkSafe BC. The Contractor shall be liable for any and all injury or damage which may occur to persons or to property due to any act, omission, neglect or default of the Contractor, or of his employees, workmen or agents.

.2 The Contractor shall, without further order, provide and maintain at all times during the progress or suspension of the work, suitable barricades, fences, signs, signal lights and flagpersons as are necessary to ensure the safety of the public and those engaged in the work.

.3 Notwithstanding the provision of Article 9 – Engineer’s Status, in an emergency affecting the safety of life, or of the works, or of adjoining property, the Contractor, without the necessity of authorization from the Engineer, shall act in a reasonable manner to prevent loss or injury.

.4 The work shall be carried out in a manner that will cause the least interruption to vehicular and pedestrian traffic. Where work is to be carried out on highways or properties other than those of the Owner, the Contractor shall familiarize himself with the requirements of the owner or controllers of those highways or properties which pertain to traffic control and safety or which place limitations on the work and shall comply with such requirements.
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ARTICLE 36. NOTICE TO PROCEED

.1 Following the execution of the Contract Agreement by the Contractor and the provisions of the required bonds and insurance policies, written Notice to Proceed with the work will be given to the Contractor by the Owner. The Contractor shall begin work within fourteen (14) days following receipt of the Notice to Proceed and shall prosecute the work regularly and without interruption thereafter, unless otherwise directed in writing by the Engineer or Owner, in such a manner as to secure completion of the work within the time stated in the Contract Agreement. Time shall be of the essence of the Contract.

.2 If, however, when the Notice to Proceed is given, as strike or lockout affecting workers of a classification required to organize or begin performance of the work reasonably prevents the Contractor from beginning work promptly, the completion date stated in the Contract Agreement will be extended by the same number of days as the strike or lockout. If the strike or lockout affects workers of several classifications and such strike or lockout ends on different dates, the end of the strike or lockout will be deemed to occur when all workers of a classification required to organize or begin performance of the work are permitted to work for the Contractor. No extension of time herein provided, shall be grounds for any claim whatsoever by the Contractor for extra payment.

ARTICLE 37. FAILURE TO COMPLETE ON TIME

.1 If the work is not complete within the scheduled time, the Owner may extend the time of completion. If the time limit be so extended, the Owner shall have the right to charge to the Contractor and to deduct from the final payment for the work, the actual cost to the Owner of engineering, inspection, superintendence, and other overhead expenses which are directly chargeable to the contract and which accrue during the period of such extension, except that the cost of final surveys and preparation of final estimates shall not be included in such charges.

ARTICLE 38. SCHEDULE OF COMPLETION

.1 The Contractor shall prepare a detailed work schedule and plan of operation approved by the Engineer. The schedule and plan of operation, unless otherwise approved by the Engineer, shall be submitted to the Engineer not later than fourteen (14) days after the date of the Notice of Award. The schedule and plan of operation shall describe the proposed labour force and equipment, sequence and methods of operation, and projected weekly progress to show completion of all work within the Contract time for completion. Upon receipt of such schedule and plan of operation by the Engineer, the schedule shall become the approved construction schedule. Neither the plan of operation nor the approved construction schedule shall be changed without the prior approval of the Engineer.

.2 Unless otherwise approved by the Engineer, work shall be scheduled between the normal working hours of 8:00 a.m. and 4:30 p.m., Monday through Friday, excluding Statutory Holidays. For work scheduled outside the normal working hours, the owner shall have the right to charge to the contractor and to deduct from the Contractor's payments, the actual cost to the Owner for engineering inspection, superintendence and other overhead expenses which are directly chargeable to the contract and which accrue outside the normal working hours.
If the Engineer should be of the opinion, and so state in writing to the Contractor, that the rate of progress of the work is insufficient to enable the whole of the work or any part or parts thereof to be completed within the time or times specified for such completion in the approved construction schedule, the Contractor shall take whatever steps the Engineer may in his absolute discretion specify in writing to the Contractor to expedite the progress of the work. Such steps may include, but shall not be limited to adoption of shift work and/or the provision of additional men or equipment. The Contractor shall not be entitled to any extra payment by reason of such order of the Engineer.

ARTICLE 39. CHANGES IN THE WORK

The Owner, without invalidating the Contract, may make changes by altering, adding to, or deducting from the work. The Contractor shall proceed with the work as changed and the work shall be executed under the provisions of the Contract. No change shall be undertaken by the Contractor, without written order of the Engineer, except in an emergency endangering life or property, and no claims for additional compensation shall be valid unless the change was so ordered. No payment for extra work or changes in any contract will be entertained by the Owner unless a “Change Order Form” is completed prior to the change or commencement of the extra work.

If, in the opinion of the Engineer, such changes affect the time of Contract completion or the Contract amount, these will be adjusted at the time of ordering the changes. The value of the addition or deduction from the Contract amount, and the method of determining such value, shall be decided by the Engineer. The Engineer will use one (1) or more of the following methods in deciding such value:

(a) by unit prices or combinations of unit prices in the Contract Tender Form:
(b) by unit prices submitted by the Contractor and accepted by the Owner:
(c) by lump sum submitted by the Contractor and accepted by the Owner:
(d) on a force account basis as specified in the next succeeding Article.

If the Contractor and the Owner cannot agree on the method of determining such value, the Engineer shall decide and certify the unit prices or lump sum to be used which are or is in his opinion fair and reasonable to both parties and his decision shall be final.

The Contractor shall obey, perform and comply with the Engineer’s orders or instructions with respect to the work or concerning the conduct thereof promptly, efficiently and to the satisfaction of the Engineer. However, if the Contractor is of the opinion that such orders or instructions are not authorized under the provisions of the Contract or involve a change for which a Change Order should be issued as described in Article 39.1, he shall so notify the Engineer in writing before proceeding to carry them out and, in any event, within ten (10) days of the receipt of such orders or instructions. If the Contractor does not so notify the Engineer within the time so limited, he shall not claim at any time thereafter that the orders or instructions were not authorized or should have been subject to a Change Order. Nevertheless, the giving of such notice to the Engineer shall not relieve the Contractor of his obligations to carry out and obey such orders and instructions.
ARTICLE 40.  FORCE ACCOUNT WORK

.1 Force account rates for personnel shall be based on the direct cost to the Contractor. A markup of 20% of the total direct costs will be paid to cover overhead and profit. The total direct costs shall be calculated based on:

(a) The rate of pay as outlined in Article 28, or the employees actual rate of pay, if higher.
(b) All applicable employee benefits.
(c) All small tools and equipment, signage and transportation required by the employee to perform the duties of the listed occupation.
(d) All applicable Federal, Provincial and Municipal taxes, duties and charges.

.2 Force account rates for equipment shall be determined by the Engineer based on the B.C. Government Blue Book Equipment Rental Rate Guide as follows: (REVISED NOVEMBER 2016)

(a) For Contractor owned equipment, “all found” rates will be paid which include allowances for the equipment operator, small tools, overhead and profit.
(b) For Non-Contractor owned equipment, the lower of, Blue Book rates; or the actual rental costs, as evidenced by invoice, plus a 10% markup to cover overhead and profit.
(c) Attachments on equipment will only be paid when in use and not because the equipment has the attachment(s).

.3 Subcontractors will be paid the subcontractor’s proper bill for such work performed with a markup of 10% to cover overhead and profit.

.4 Materials will be paid based on the supplier’s invoice price with a markup of 10% to cover overhead and profit.

.5 The cost of the work done each day shall be submitted to the Engineer by the Contractor in a satisfactory form on each succeeding day after force account work is carried out and shall be approved or adjusted by the Engineer. No claim for compensation for extra work or materials shall be considered or allowed unless such report shall have been made, or the Engineer shall have extended the time for such reports or released the Contractor therefrom. The submission to, or acceptance or approval by, the Engineer of daily force account cost records shall not at any time be deemed to be an admission that the work is properly chargeable to force account.

.6 The Contractor will be required to demonstrate to the Engineer’s satisfaction the personnel force account rates are in fact the direct cost to the Contractor. The Contractor will also be required to provide any necessary information required by the Engineer to determine equipment rates.

ARTICLE 41.  DELAYS

.1 If the Contractor is delayed during the performance of the work, the time for completion of the work under the Contract may be extended by the owner in the event of one (1) or more of the following:

(a) Where extra work as herein provided is added to the work under this Contract.
(b) Where the work is suspended as provided for in Article 16 – Suspension of Work by Owner.

(c) Where the work is delayed on account of conditions which could not have been foreseen or which were beyond the control of the Contractor and which were not the result of the fault or negligence of the Contractor, his agents, or employees, provided, however, rain, wind, flood, or other natural phenomena of normal intensity for the area shall not be construed as cause for an extension of time for completion of the work.

(d) Where work is delayed on account of conditions that are beyond the reasonable control of the Engineer or the Owner.

(e) Where delay occurs in the progress of the work as a result of the negligent act of the Owner or his employees, in the administration of this contract.

(f) Where delay occurs as a result of an act of a public authority.

(g) Where the Engineer causes delay in furnishing of drawings or necessary information.

(h) Where strikes, lockouts, or labour disputes prevent or substantially interfere with the progress of the work.

(i) Where, in the opinion of the Engineer, the Contractor is entitled to an extension of time.

.2 A claim for extension of Contract time shall only be considered when submitted by the Contractor to the Engineer in writing within seven (7) days of the occurrence of the delay on which the claim is based, provided, however, that in the case of a continuing cause of delay only one (1) claim shall be necessary. Within a reasonable period after the Contractor submits a request for an extension of time, the Engineer will present his written recommendation to the Owner stating his opinion on whether or not the delay justifies an extension of time; and, if so, the number of days extension due to the Contractor. The Owner will make the final decision on all requests for extension of time.

.3 Delays, pursuant to Article 41, shall not entitle the Contractor to reimbursement for any additional costs, except as outlined in .1 (b) or (e) above.

ARTICLE 42. USE OF COMPLETED PORTIONS

.1 The Owner will have the right to take possession of and use any completed or partially completed portions of the work, whether the time for completing the entire work or such portions has or has not expired, but such taking possession and use will not be deemed an acceptance of any work so taken possession of or used. If such prior use increases the cost of, or delays the completion of uncompleted work or causes refinishing of completed work, the Contractor shall be entitled to such extra compensation or extension of time, or both, as the Engineer may determine.

ARTICLE 43. PROGRESS PAYMENT CERTIFICATES

.1 At the end of each calendar month the Contractor will estimate project quantities for that month and provide to the Engineer for review and approval. Where unit prices apply, payment will be calculated on the basis of the tendered prices and the units of work completed as determined by the Engineer. Where a lump sum price applies, payment will be calculated on the basis of the Engineer's estimate of the percentage of work completed. The Engineer will prepare final payment certificate for payment by the Owner.

.2 The payment certificate shall show as of the end of the last day of each calendar month the value of all labour and materials incorporated into the works, including extras, and all adjustments previously made whether additions or deductions. The certificate shall also
show the aggregate of previous payments, the amounts withheld to comply with the Builders Lien Act, and the amount, if any, of the holdback released in respect of completed subcontracts. Except in respect of the final progress payment, the gross amount shown on such certificate, less the aggregate of all previous payments, previous sums withheld, and the amount then required to be withheld to comply with the Builders Lien Act as set out below, shall become due and be payable by the Owner to the Contractor on or before the last day of the next month. In those cases where the work is such that the Builders Lien Act does not apply or does not require the retention of a holdback, the Owner will nevertheless retain holdbacks to the same extent as if such legislation applied to the work.

.3 Ten percent (10%) of each progress payment shall be retained by the Owner to comply with the Builders Lien Act until payment is due in accordance with the provisions of Article 50 – Release of Holdback.

.4 The monthly estimates shall not bind the Owner or Engineer in any manner in the preparation of the final estimate of the work done, but shall be construed and held to be approximate only, and shall in no case be taken as an acceptance of the work or as a release of the Contractor from his responsibility therefore.

ARTICLE 44. PAYMENT WITHHELD

.1 Upon receipt of a certificate in writing from the Engineer stating that, in his opinion, justification exists and stating the basis and the amount of such deduction, the Owner may withhold or nullify, on written notice to the Contractor specifying the ground or grounds relied on, the whole or part of any progress payment to the extent necessary to protect himself from loss on account of one (1) or more of the following:

(a) The Contractor is not making satisfactory progress in the opinion of the Engineer.
(b) That defective work is not being remedied at all or in a manner satisfactory to the Engineer.
(c) That there are claim of liens (or a lien) filed, against the holdback funds, lands and premises on which the work is done or is being done, or reasonable evidence of the probable filing of claim of lien or registration of liens (or a lien).
(d) That the Contractor is failing to make prompt payments as they become due to subcontractors or for material or labour.
(e) That there exist unsatisfied claims for damages caused by the Contractor to anyone employed on the site or in connection with the work.
(f) That the Contractor or any Sub-Contractor has failed, or is failing to pay the minimum rate of pay as outlined in Article 28.

.2 Where subcontractors or suppliers of materials are not receiving prompt payment, the Owner may make payment to such subcontractors or suppliers directly and deduct the amount of such payments from amounts otherwise due to the Contractor.

ARTICLE 45. BUILDER'S LIENS

.1 The Contractor shall remove or cause to be removed all claim of lien or liens filed or registered against the holdback funds, lands and premises on which the work is being performed which claim of lien or liens arise out of anything done or to be done under the Contract. Such removal shall be effected by the Contractor forthwith upon demand by the Owner or the Engineer.
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.2 Certificate of Completion shall have the interpretation assigned to it by the Builder's Lien Act.

.3 Application for the Certificate of Completion shall be in accordance with the Builder's Lien Act and shall include a written statement from the Contractor that all claims and demands of the Contractor for extra work or otherwise in connection with the Contract were presented in writing to the Engineer.

.4 The Owner shall release a holdback in respect of a completed subcontract if a Certificate of Completion has been issued in respect of that subcontract and the holdback period established under the Builder's Lien Act has expired without any claims of lien being filed that arose under that subcontract.

.5 Notwithstanding anything elsewhere contained in the contract documents, the Contractor shall indemnify and hold harmless the Owner from all demands, damages, costs, losses and actions arising in any way out of claims or lien or liens which arise out of anything done or to be done under the Contract whether the lien period binding on the Contractor has expired or not.

.6 The obligations imposed on the Contractor by the provisions of this Article 45 shall not extend to claims of lien or liens properly filed by the Contractor himself.

ARTICLE 46. COMPLETION

.1 When the Contractor is of the opinion that he has completely performed the work, he shall inspect the work to ensure that all work has in fact been performed, that it is in a clean and tidy condition and that it is ready in all respects for acceptance by the Owner. He shall then submit a written request to the Engineer that he make a final inspection.

.2 The Engineer will make an inspection and notify the Contractor in writing of any defects or deficiencies, which require correction by the Contractor. When the defects or deficiencies are corrected, and the Contractor has submitted to the Engineer the "as-constructed" drawings, digital survey file and a written statement that all claims and demands of the Contractor for extra work or otherwise in connection with the Contract were presented in writing to the Engineer, the Engineer will recommend to the Owner to issue a Notice of Acceptance to the Contractor. The Owner, subject to their acceptance of the Engineer's recommendation, will issue the Notice of Acceptance.

ARTICLE 47. PARTIAL COMPLETION

.1 If the Contractor considers that, by reason of climatic or similar problems beyond his reasonable control, not all the work can be performed or defects or deficiencies corrected promptly, he may in writing request the Engineer for a Notice of Partial Acceptance. Such request shall be accompanied by a written statement that all claims and demands of the Contractor for extra work or otherwise in connection with the work to be accepted have been presented in writing. If the Engineer considers such request to be reasonable, he will carry out an inspection and will notify the Contractor in writing of any defects or deficiencies which require correction before he will recommend partial acceptance. He will prepare an additional list of defects and deficiencies which in his opinion do not impair the usefulness to the Owner of the whole work and the correction of which may reasonably be deferred. This list shall show the amount, which the Engineer considers to be 200% of the cost of completing such work and correcting such defects and deficiencies. When all work has been performed and defects and deficiencies corrected other than those on this list, he will
recommend to the Owner that a Notice of Partial Acceptance be issued to the Contractor. If the owner accepts this recommendation, he will issue a Notice of Partial Acceptance which shall list the work to be performed and the defects and deficiencies to be corrected and 200% of the estimated cost thereof. The Notice of Partial Acceptance shall fix a date within which all such works shall be performed and the defects and deficiencies corrected.

.2 The Owner may make his acceptance conditional on the Contractor providing written consents of sureties under any Performance or Labour and Materials Payment Bonds or other evidence that no guarantor or surety will be relieved of his obligations.

.3 When all such work has been performed and the defects and deficiencies corrected, the Contractor shall call for final inspection in accordance with Article 46 - Completion.

.4 If all work is not performed and all defects and deficiencies are not corrected by the date set out in the Notice of Partial Acceptance, the Owner may have the work performed and the defects and deficiencies corrected by any means he thinks suitable, and may recover the costs thereof from any money withheld from the Contractor or from the Contractor if such money is insufficient.

ARTICLE 48. FINAL PROGRESS PAYMENT

.1 The final progress payment certificate will be prepared following the issuance of the Notice of Acceptance. The Engineer will review with the Contractor all work quantities and all claims and demands of the Contractor for extra work in connection with the Contract. The final progress payment certificate will show the total amount of the payment due to the Contractor less the amount required to be retained under the Builder’s Lien Act whether a lien can be filed or not and less a 2% guarantee amount or five thousand ($5,000) dollars, guarantee amount, whichever is greater.

.2 The final progress payment shall be made by the Owner within thirty (30) days of the date of the final progress payment certificate provided the Contractor supplies the Owner with a full and final payment receipt in respect of the work in the Contract, covering and including acknowledgment of full payment for the cost of all extra work and material furnished by the Contractor in the fulfillment of the works and all incidentals thereto and releasing the Owner from all claims whatsoever out of the Contract.

ARTICLE 49. PROGRESS PAYMENT AFTER PARTIAL COMPLETION

.1 If the Owner issues a Notice of Partial Acceptance, the Engineer will prepare a Progress Payment Certificate in the same detail as required for a Final Progress Payment Certificate. From the amount shown on such certificate to be due to the Contractor shall be deducted the amount required to be retained under the applicable lien legislation and twice the amount shown on the Notice of Partial Acceptance to be 200% of the estimated cost of performing the remaining work and correcting the defects and deficiencies. Payment of the net amount due to the Contractor shall be made by the Owner within thirty (30) days of the date of this progress payment certificate. If the amount to be withheld in respect of work still to be performed or defects and deficiencies still to be corrected exceeds the amount otherwise payable to the Contractor, the excess shall be withheld from the amount of the lien holdback to be paid under the provisions of Article 50 - Release of Holdback.
ARTICLE 50.  RELEASE OF HOLDBACK

.1 If applied for, the Certificate of Completion shall, in accordance with the Builder's Lien Act, start the period within which liens must be filed. Otherwise, a Notice of Partial Acceptance or where none is issued, a Notice of Acceptance shall be conclusively deemed between the Owner and the Contractor to start the period within which liens must be filed by the Contractor in accordance with the Builder's Lien Act.

.2 The Owner shall pay the holdback to the Contractor within fourteen (14) days of the expiry of the statutory time release of holdback, provided that:

(a) The Contractor has provided to the Owner a Certificate from the proper office to register liens to prove that, as of a date two days after the expiry of the statutory period, no notice of lien or liens has been filed or other matters recorded to make effective any lien.

(b) The Contractor has complied with any conditions imposed by the Owner in his acceptance of the recommendation of the Engineer to issue a Notice of Partial Acceptance.

(c) The Workers' Compensation Board has, at the request of the Contractor, filed with the Owner a certificate that all assessments due to the Board by the Contractor have been paid; such certificate shall be dated after the expiry of the statutory period for filing liens.

(d) If in accordance with the Builder's Lien Act, there is no person who can provide the certificate referred to in (a) above, the Contractor shall furnish to the Owner a Statutory Declaration, dated not earlier than seven (7) days after the expiry of the statutory lien period, stating that all materials, labour, work and services incurred directly or indirectly on account of the work have been paid for by the Contractor.

ARTICLE 51.  RELEASE OF GUARANTEES

.1 The Performance Bond and 2% of the final contract price, or five thousand dollars, ($5,000), whichever is greater, or a letter of credit in lieu of the 2% amount or five thousand dollars, ($5,000), whichever is greater, will be held by the Owner for one year from the date of Notice of Acceptance.

.2 The 2% guarantee amount, or five thousand dollars ($5,000), guarantee amount, held back during the one year guarantee period, or remaining portion thereof, will be released to the Contractor one year following Notice of Acceptance. No interest will be allowed.

3. Prior to the expiration of the one year guarantee period and subsequent release of guarantees, the Owner, Engineer and Contractor shall conduct an inspection to determine that all deficiencies have been corrected and that no new defects or deficiencies exist in the materials or workmanship in respect to the works. Any faults corrected at this time will be covered as set out in Article 29 – Guarantee Period and sufficient guarantees retained for an additional one year period from acceptance of the replacement materials or rectified work.

4. As an alternate to Article 51.1 and Article 51.2, a Contractor may deposit with the City an irrevocable letter of credit for $50,000 to cover the guarantee for all works undertaken for the City in any calendar year. This letter of credit would serve as an overall guarantee in place of individual guarantees for each project completed and would be renewed on its anniversary date each year. No interest will be allowed.
ARTICLE 52. INSURANCE

.1 The Contractor shall, at his own expense, provide the following insurance. Each policy shall contain a clause stating that: "This policy will not be cancelled or materially changed without the Insurer giving at least thirty (30) days written notice to the Owner." Certified copies of these policies shall be filed by the Contractor with the Owner prior to commencement of the work. Wherever the word "Owner" or "Engineer" is to appear in these policies, the legal name shall be inserted. The Contractor shall ensure all Subcontractors comply with these insurance requirements. (REVISED NOVEMBER 2016)

.2 Builder's Risk Course of Construction Insurance:

(a) The Contractor shall at all times during construction and until all conditions of this Contract (except guarantee provisions) have been fully complied with, keep all buildings, structures, works, equipment (other than Contractor's mobile equipment), and supplies, including materials which will form part of such building, works, or structure, which is the subject matter of this contract, insured in the name of the Owner and the Contractor for any amount not less than the Contract price against the following perils: "All risks of direct physical loss or damage from any cause whatsoever, including flood and earthquake. (REVISED NOVEMBER 2016)

(b) Such insurance shall be with Insurers and on forms acceptable to the Owner and shall contain the following clause:

"It is agreed that the right to subrogation against the Owner and the Engineer or any of their parent, subsidiary, or affiliated companies or corporations or any employee thereof is hereby waived."

(c) Coverage shall be on an "All Risks" basis, subject to a deductible provision not exceeding $2,500 for any one occurrence. The following exclusions shall be deemed permissible (additional or modified exclusions subject to permission of the Owner). (REVISED NOVEMBER 2016)

(i) Any loss or use of occupancy howsoever caused;
(ii) Penalties for non-completion of or delay in completion of Contract or non-compliance with Contract conditions;
(iii) Cost of making good faulty workmanship, construction, or design, but this exclusion shall not apply to damage resulting from such faulty workmanship, construction, or design;
(iv) Wear, tear, normal upkeep, and normal making good;
(v) Loss, damage, or liability occasioned by, happening through or in consequence of war, invasion, hostilities, acts of foreign enemies, civil war, rebellion, insurrection, military or usurped power or martial law or confiscation by order of any government or public authority;
(vi) Any weapon or war employing atomic fission or radioactive force whether in time of peace or war;
(vii) Claims or liability arising directly or indirectly from nuclear fission, nuclear fusion, or radioactive contamination;
(viii) Loss or damage caused by frost or freezing unless resulting from damage occasioned by fire and/or lighting and/or windstorm and/or hail and/or riot attending a strike and/or civil commotion and/or vehicles and/or smoke;
(ix) Loss due to disappearance or revealed by inventory shortage alone;
(x) Mechanical breakdown, but this exclusion shall not be deemed to exclude loss or damage arising as a consequence of mechanical breakdown;
(xi) Infidelity of the Assured's employees;
(xii) Loss or damage to material and/or equipment while in the course of ocean marine shipment, but this exclusion shall not apply to shipments by regular coast-wise vessels, regular ferry lines, or railway car transfer barges;
(xiii) Automobiles or Contractor’s equipment of every description.

.3 Liability Insurance:

(a) The Contractor shall buy and keep in force until twelve (12) months after the date of acceptance, and with respect to completed operations twenty-four (24) months, Comprehensive General Bodily Injury and Property Damage Liability Insurance. Such insurance shall be in the name of the Contractor, the Engineer and the Owner, and shall include a Cross Liability or Severability of Interest Clause. Such insurance shall be on a form and with an Insurer acceptable to the Owner. Both Personal Injury and Property Damage sections are to provide coverage on an “occurrence basis”. Any property damage deductible shall not exceed $2,500 for any one occurrence. *(REVISED NOVEMBER 2016)*

(b) Exclusion pertaining to the following operations are to be deleted, if such operations are to be performed by the Contractor or anyone on his behalf:

(i) Blasting or use of explosives;
(ii) Pile driving;
(iii) Excavation;
(iv) Underpinning, shoring or removal or rebuilding of support;
(v) Demolition.

(c) Such insurance shall indemnify the Contractor for claims arising out of all premises, operations, subcontracted operations, completed operations, products, and for all liability for personal injury or property damage assumed by the Contractor under any contract or agreement (including this Contract). *(REVISED NOVEMBER 2016)*

(d) Such insurance shall be for the following minimum limits:
Bodily Injury and Property Damage - $5,000,000 Inclusive. *(REVISED NOVEMBER 2016)*

.4 Owned and Non-Owned Automobile Insurance:

(a) The Contractor shall maintain, until all conditions of the Contract have been fully complied with, such insurance as required under the Insurance (Motor Vehicle) Act of British Columbia. Such insurance shall be for the following limits: *(REVISED NOVEMBER 2016)*

Bodily Injury and Property Damage $3,000,000 Inclusive. *(REVISED NOVEMBER 2016)*

(b) The Contractor shall provide a Certificate of Insurance, ICBC for No. APV47 for owned or leased vehicles as evidence of third party motor vehicle insurance coverage. *(REVISED NOVEMBER 2016)*

.5 Contractor’s Equipment Insurance:

(a) Notwithstanding anything contained elsewhere herein, it is understood and agreed that the Owner and/or Engineer will not be liable for any loss or damage to Contractor’s equipment including loss of use thereof. Each and every policy insuring Contractor’s equipment to be used on this project shall contain the following clause:
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"It is agreed that the right to subrogation against the Owner and the Engineer or any of their parent, subsidiary or affiliated companies or corporations or any employee thereof is hereby waived."

ARTICLE 53. ARBITRATION

.1 In the case of any dispute between the Owner or the Engineer on his behalf, and the Contractor, during the progress of the work or afterwards, or after the determination of breach of Contract, as to any matter arising thereunder, either party hereto shall be entitled to give to the other notice of such dispute and to demand arbitration thereof. Such notice shall be in writing and shall specify the matter to be submitted to arbitration, and in it said party shall name a person to act as arbitrator; thereupon within fifteen (15) days after receipt of such written notice the other party by written notice shall chose and name a second arbitrator; the two (2) arbitrators so chosen shall forthwith jointly select a third arbitrator, giving written notice to both parties of the choice so made, and fixing a place and time for meeting not later than thirty (30) days thereafter, at which both parties may appear and be heard, touching such controversy relating to the matters aforesaid. In case the two (2) arbitrators shall fail to agree upon a third arbitrator, or in case the party notified of the demand for arbitration shall fail to name the second arbitrator within the time stipulated, such third arbitrator (or such second arbitrator as the case may be) upon the application of either party, of which the other shall be given notice, shall be named by a Justice of a Superior Court of the Province of British Columbia. The parties may agree to submit the matter to one (1) arbitrator, whose award shall be as binding as that of three (3) arbitrators.

.2 The submission and the arbitration proceedings shall be under the provisions of the Arbitration Act of the Province of British Columbia provided nevertheless that any statutory limitation on the fees payable to the arbitrator or arbitrators shall be waived. The decision of the said arbitrator(s) shall be made in writing within thirty (30) days after the completion of hearings thereon, and when signed by a majority of them shall be final and conclusive upon the parties thereto.

.3 Arbitration proceedings shall not take place until after the completion or alleged completion of the work except; (a) on a question of certificate for payment; or (b) in a case where either party claims that the matter in dispute is of such a nature as to make immediate arbitration proceedings necessary while the evidence is available. The arbitrator(s) in their decision shall determine which party shall bear all or a portion of the costs and expenses of the arbitration including the fees of the arbitrator(s), and said arbitrator(s) may in any such decision allocate such costs and expenses between the parties in such amounts as they may deem fair and equitable by reason of such decision.
## STANDARD SPECIFICATIONS

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</tbody>
</table>

(REVISED NOVEMBER 2016)

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| Scope                                                        | 3.20        |
| Supply of Materials                                          | 3.21        |
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| Scope                                                        | 3.50        |
| Supply of Materials                                          | 3.51        |
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### SECTION 3 - GENERAL REQUIREMENTS

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</tbody>
</table>
3.1 SPECIFICATIONS, STANDARDS, OR METHODS

.1 When references to the following capitalized abbreviations are made, they refer to Specifications, Standards, or Methods of the respective Association. Abbreviations listed herein but not mentioned in the specifications shall be disregarded.

.2 The numbers and letters following the abbreviations denote the Association's serial designation for the Specification or Standard to which reference is made. All references to these Specifications, Standards or Methods shall, in each instance, be understood to refer to the latest adopted revision, including all amendments.

AASHTO American Association of State Highway and Transportation Officials
ACI American Concrete Institute
AGA American Gas Association
AIEEE American Institute of Electrical and Electronics Engineers
AISC American Institute of Steel Construction
AISI American Iron and Steel Institute
ANSI American National Standards Institute
ASCE American Society of Civil Engineers
ASME American Society of Mechanical Engineers
ASTM American Society for Testing and Materials
AWWA American Water Works Association
AWPA American Wood Preservers’ Association
AWS American Welding Society
BCLNA British Columbia Landscaping and Nursery Trades Association
BCNTA British Columbia Nursery Trades Association
BCSLA British Columbia Society of Landscape Architects
CEC Canadian Electrical Code
CEMA Canadian Electrical Manufacturers Association
CGA Canadian Gas Association
CGSB Canadian General Standards Board
CISC/ICCA Canadian Institute of Steel Construction
CMHC Canada Mortgage and Housing Corporation
CPCI Canadian Prestressed Concrete Institute
CRCA Canadian Roofing Contractors Association
CSA Canadian Standards Association
CIU Canadian Institute of Underwriters Association
CWB Canadian Welding Bureau
CSPI Corrugated Steel Pipe Institute
EEI Edison Electric Institute
IEC International Electrotechnical Commission
IET Institute of Engineers and Technology
IEEE Institute of Electrical and Electronics Engineers, I (formerly IRE and IEE)
IES Illuminating Engineering Society
ICEA Insulated Cable Engineers Association
ISA Instrument Society of America
IOS International Organization for Standardization
NEMA National Electrical Manufacturers Association
MOTI Ministry of Transportation and Infrastructure
NBC National Building Code of Canada
NEC National Electrical Code
### SECTION 3 - GENERAL REQUIREMENTS
#### STANDARD SPECIFICATIONS

| NEMA | National Electrical Manufacturers Association |
| NESC | National Electrical Safety Code |
| NLGA | National Lumber Grades Authority |
| TAC  | Transportation Association of Canada |
| SAE  | Society of Automotive Engineers |
| UL   | Underwriters’ Laboratories, Inc. |
| WORKSAFEBC | Workers’ Compensation Board |
| WCLIB | West Coast Lumber Inspection Bureau |

(REvised November 2016)

.3 All static and dynamic units on drawings and specifications are S.I. units, conforming to Can-3-Z234.2-73, the International System of Units (S.I.) and Can/CSAZ234.1, Metric Practice Guide.

.4 The S.I. Units accepted for the purpose of these standards, together with conversion factors relating them to equivalent imperial units are tabulated as follows:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>BASIC SI UNIT</th>
<th>(SIU) ABBREVIATION</th>
<th>EQUIVALENT IMPERIAL UNIT</th>
<th>CONVERSION FACTOR (CF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>metre</td>
<td>m</td>
<td>foot</td>
<td>0.3048</td>
</tr>
<tr>
<td>Length</td>
<td>millimetre</td>
<td>mm</td>
<td>inch</td>
<td>25.4</td>
</tr>
<tr>
<td>Area</td>
<td>square metre</td>
<td>m2</td>
<td>square foot</td>
<td>0.0929</td>
</tr>
<tr>
<td>Area</td>
<td>square metre</td>
<td>m2</td>
<td>square yard</td>
<td>0.836</td>
</tr>
<tr>
<td>Volume</td>
<td>cubic metre</td>
<td>m3</td>
<td>cubic foot</td>
<td>0.0283</td>
</tr>
<tr>
<td>Volume</td>
<td>cubic metre</td>
<td>m3</td>
<td>cubic yard</td>
<td>0.765</td>
</tr>
<tr>
<td>Volume</td>
<td>litre</td>
<td>L</td>
<td>imperial gallon</td>
<td>4.546</td>
</tr>
<tr>
<td>Mass</td>
<td>kilogram</td>
<td>kg</td>
<td>pound</td>
<td>0.454</td>
</tr>
<tr>
<td>Mass</td>
<td>tonne</td>
<td>t</td>
<td>ton (short)</td>
<td>0.907</td>
</tr>
<tr>
<td>Density</td>
<td>kilogram per</td>
<td>kg/m3</td>
<td>pound per cubic inch</td>
<td>27,680.0</td>
</tr>
<tr>
<td>Temperature</td>
<td>degree Celsius</td>
<td>C</td>
<td>degree Fahrenheit</td>
<td>(F-32) x 5/9 = C</td>
</tr>
<tr>
<td>ITEM</td>
<td>BASIC SI UNIT</td>
<td>(SIU) ABBREVIATION</td>
<td>EQUIVALENT IMPERIAL UNIT (EIU)</td>
<td>CONVERSION FACTOR (CF) (CF X EIU=SIU)</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------</td>
<td>-------------------</td>
<td>-------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Force</td>
<td>newton</td>
<td>N</td>
<td>pound force</td>
<td>4.448</td>
</tr>
<tr>
<td>Pressure*</td>
<td>kilopascal</td>
<td>kPa</td>
<td>pound per sq. inch</td>
<td>6.8948</td>
</tr>
<tr>
<td>Pressure*</td>
<td>kilopascal</td>
<td>kPa</td>
<td>inch water column</td>
<td>0.2491</td>
</tr>
<tr>
<td>Pressure, stress</td>
<td>megapascal</td>
<td>MPa</td>
<td>pound per sq. in.</td>
<td>0.0069</td>
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<tr>
<td>Volume flow</td>
<td>litre per second</td>
<td>l/s</td>
<td>imperial gallon per minute</td>
<td>0.07758</td>
</tr>
<tr>
<td>Volume flow</td>
<td>cubic metre per second</td>
<td>m3/s</td>
<td>cubic feet per second</td>
<td>0.0283</td>
</tr>
<tr>
<td>Volume flow</td>
<td>litre per second</td>
<td>l/s</td>
<td>cubic feet per second</td>
<td>28.316</td>
</tr>
<tr>
<td>Power</td>
<td>kilowatt</td>
<td>kW</td>
<td>horsepower (electric)</td>
<td>0.746</td>
</tr>
<tr>
<td>Energy</td>
<td>joule</td>
<td>J</td>
<td>British Thermal Unit</td>
<td>1055.06</td>
</tr>
<tr>
<td>Illuminance</td>
<td>lux</td>
<td>lux</td>
<td>footcandles</td>
<td>10.76391</td>
</tr>
<tr>
<td>Frequency</td>
<td>hertz</td>
<td>Hz</td>
<td>Cycles per second</td>
<td>1.0</td>
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</tbody>
</table>

*As used in these standards, pressure shall mean gauge pressure unless otherwise noted.
### Section 3 - General Requirements

#### Standard Sieve Sizes

<table>
<thead>
<tr>
<th>EIU</th>
<th>SI (mm)</th>
<th>EIU</th>
<th>SI (mm)</th>
<th>EIU</th>
<th>SI (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>100</td>
<td>1-1/2&quot;</td>
<td>37.5</td>
<td>3/8&quot;</td>
<td>9.5</td>
</tr>
<tr>
<td>3&quot;</td>
<td>75</td>
<td>1&quot;</td>
<td>25</td>
<td>1/4&quot;</td>
<td>6.3</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
<td>63</td>
<td>3/4&quot;</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2&quot;</td>
<td>50</td>
<td>1/2&quot;</td>
<td>12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>4.75</td>
<td>#20</td>
<td>0.85</td>
<td>#60</td>
<td>0.25</td>
</tr>
<tr>
<td>#8</td>
<td>2.36</td>
<td>#30</td>
<td>0.6</td>
<td>#80</td>
<td>0.18</td>
</tr>
<tr>
<td>#10</td>
<td>2</td>
<td>#40</td>
<td>0.425</td>
<td>#100</td>
<td>0.15</td>
</tr>
<tr>
<td>#16</td>
<td>1.18</td>
<td>#50</td>
<td>0.3</td>
<td>#200</td>
<td>0.075</td>
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</table>

#### Standard Pipe Sizes

<table>
<thead>
<tr>
<th>EIU</th>
<th>SI (mm)</th>
<th>EIU</th>
<th>SI (mm)</th>
<th>EIU</th>
<th>SI (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>12.5</td>
<td>4&quot;</td>
<td>100</td>
<td>15&quot;</td>
<td>375</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>19.0</td>
<td>6&quot;</td>
<td>150</td>
<td>18&quot;</td>
<td>450</td>
</tr>
<tr>
<td>1&quot;</td>
<td>25.0</td>
<td>8&quot;</td>
<td>200</td>
<td>21&quot;</td>
<td>525</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>37.5</td>
<td>10&quot;</td>
<td>250</td>
<td>24&quot;</td>
<td>600</td>
</tr>
<tr>
<td>2&quot;</td>
<td>50.0</td>
<td>12&quot;</td>
<td>300</td>
<td>42&quot;</td>
<td>1050</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
<td>65.0</td>
<td></td>
<td></td>
<td></td>
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</table>

#### Concrete Strengths

<table>
<thead>
<tr>
<th>EIU</th>
<th>SI</th>
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</thead>
<tbody>
<tr>
<td>2200 psi</td>
<td>15 MPa</td>
</tr>
<tr>
<td>2500 psi</td>
<td>18 MPa</td>
</tr>
<tr>
<td>2900 psi</td>
<td>20 MPa</td>
</tr>
<tr>
<td>3700 psi</td>
<td>25 MPa</td>
</tr>
<tr>
<td>4500 psi</td>
<td>30 MPa</td>
</tr>
<tr>
<td>5000 psi</td>
<td>36 MPa</td>
</tr>
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</table>
Reinforcing Steel

Comparison of Imperial and Metric Sizes
(Note: % difference based on area of bars in in²)

<table>
<thead>
<tr>
<th>IMPERIAL BAR</th>
<th>AREA in²</th>
<th>AREA mm²</th>
<th>METRIC BAR</th>
<th>AREA in²</th>
<th>AREA mm²</th>
<th>IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3</td>
<td>.11</td>
<td>71</td>
<td>10M</td>
<td>.16</td>
<td>100</td>
<td>45% L</td>
</tr>
<tr>
<td>#4</td>
<td>.20</td>
<td>129</td>
<td>10M</td>
<td>.16</td>
<td>100</td>
<td>20% S</td>
</tr>
<tr>
<td>#4</td>
<td>.20</td>
<td>129</td>
<td>15M</td>
<td>.31</td>
<td>200</td>
<td>55% L</td>
</tr>
<tr>
<td>#5</td>
<td>.31</td>
<td>200</td>
<td>15M</td>
<td>.31</td>
<td>200</td>
<td>SAME</td>
</tr>
<tr>
<td>#6</td>
<td>.44</td>
<td>284</td>
<td>20M</td>
<td>.47</td>
<td>300</td>
<td>6.8% L</td>
</tr>
<tr>
<td>#7</td>
<td>.60</td>
<td>387</td>
<td>20M</td>
<td>.47</td>
<td>300</td>
<td>22% S</td>
</tr>
<tr>
<td>#7</td>
<td>.60</td>
<td>387</td>
<td>25M</td>
<td>.78</td>
<td>500</td>
<td>30% L</td>
</tr>
<tr>
<td>#8</td>
<td>.79</td>
<td>510</td>
<td>25M</td>
<td>.78</td>
<td>500</td>
<td>1.3% S</td>
</tr>
<tr>
<td>#9</td>
<td>1.00</td>
<td>645</td>
<td>30M</td>
<td>1.09</td>
<td>700</td>
<td>9% L</td>
</tr>
<tr>
<td>#10</td>
<td>1.27</td>
<td>819</td>
<td>30M</td>
<td>1.09</td>
<td>700</td>
<td>14% S</td>
</tr>
<tr>
<td>#10</td>
<td>1.27</td>
<td>819</td>
<td>35M</td>
<td>1.55</td>
<td>1000</td>
<td>22% L</td>
</tr>
<tr>
<td>#11</td>
<td>1.56</td>
<td>1006</td>
<td>35M</td>
<td>1.55</td>
<td>1000</td>
<td>0.6% S</td>
</tr>
<tr>
<td>#14</td>
<td>2.25</td>
<td>1452</td>
<td>45M</td>
<td>2.33</td>
<td>1500</td>
<td>3.5% L</td>
</tr>
<tr>
<td>#18</td>
<td>4.00</td>
<td>2581</td>
<td>55M</td>
<td>3.88</td>
<td>2500</td>
<td>3.0% S</td>
</tr>
</tbody>
</table>

L = LARGER
S = SMALLER
3.1 A  REFERENCE

.1 The Manual of Engineering Standards and Specifications contains references to standard specifications for testing, materials, manufacturing installation and design procedures. This section provides the full descriptive title of referenced specifications.

.2 All references listed shall be understood to refer to the latest adopted revision, including all amendments.

.3 All references listed and referred to by the Manual of Engineering Standards and Specifications shall be part of the Manual as far as they are applicable to and not in consistent with the Manual.

<table>
<thead>
<tr>
<th>SPEC NUMBER</th>
<th>TITLE</th>
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<tbody>
<tr>
<td>ANSI A 300</td>
<td>Standard Tree Care Operations</td>
</tr>
<tr>
<td>ANSI B 16.1</td>
<td>Cast Iron Pipe Flanges and Flanged Fittings</td>
</tr>
<tr>
<td>ANSI B 16.5</td>
<td>Standard Specification for Pipe Flanges and Flanged Fittings</td>
</tr>
<tr>
<td>ANSI/ACI 315</td>
<td>Details and Detailing of Concrete Reinforcement</td>
</tr>
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<td>ANSI/ACI 315 R</td>
<td>Details and Detailing of Concrete Reinforcement</td>
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<tr>
<td>ANSI/IES RP-8</td>
<td>Roadway Lighting</td>
</tr>
<tr>
<td>ANSI/NSF 61</td>
<td>NSF/ANSI 61 Drinking Water System Components – Health Effects</td>
</tr>
<tr>
<td>ASTM A 153</td>
<td>Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware</td>
</tr>
<tr>
<td>ASTM A 354</td>
<td>Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners</td>
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<tr>
<td>ASTM A653/A653M</td>
<td>Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process</td>
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<tr>
<td>ASTM A 536</td>
<td>Standard Specification for Ductile Iron Castings</td>
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<tr>
<td>ASTM A 563</td>
<td>Standard Specification for Carbon and Alloy Steel Nuts</td>
</tr>
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<td>ASTM A 746</td>
<td>Standard Specifications for Ductile Iron Gravity Sewer Pipe</td>
</tr>
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<td>ASTM A 775</td>
<td>Standard Specification for Epoxy-Coated Reinforcing Steel Bars</td>
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<td>ASTM A 775 M</td>
<td>Standard Specification for Epoxy-Coated Reinforcing Steel Bars</td>
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<tr>
<td>ASTM B 42</td>
<td>Standard Specification for Seamless Copper Pipe, Standard Sizes</td>
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<tr>
<td>ASTM B 62</td>
<td>Standard Specifications for Composition Bronze or Ounce Metal Castings</td>
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<tr>
<td>ASTM B 766</td>
<td>Standard Specification for Electrodeposited Coatings of Cadmium</td>
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<td>ASTM B 88</td>
<td>Standard Specification for Seamless Copper Water Tube</td>
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<tr>
<td>ASTM C 14 M</td>
<td>Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)</td>
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<td>Standard Number</td>
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<tr>
<td>ASTM C 140</td>
<td>Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units</td>
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<td>ASTM C 144</td>
<td>Standard Specification for Aggregate for Masonry Mortar</td>
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<td>ASTM C 270</td>
<td>Standard Specification for Mortar for Unit Masonry</td>
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<td>ASTM C 33</td>
<td>Standard Specification for Concrete Aggregates</td>
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3.1 B SUPPLEMENTARY DOCUMENTS

The Manual of Engineering Standards and Specifications contains references to guidelines, governances, standards and strategies and reports. The intent of the supplemental documents is to provide additional information. Information provided in the supplemental documents does not replace or supersede the MoESS requirements.

(a) CNIB Position for Accessible Pedestrian Signals In Canada
www.cnib.ca/en/about/who/believe/documents/cnibAPSposition.doc

(b) City of Nanaimo, Steep Slope Development Permit Area Guidelines

(c) City of Nanaimo, Traffic and Highway Installation Guidelines

(d) FHWA, Manual of Uniform Control Devices

(e) NCHRP, Report 672 - Roundabouts an Informational Guide
http://www.trb.org/Main/Blurbs/164470.aspx

(f) Ministry of Transportation and Infrastructure, Manual of Standard Traffic Signs & Pavement Markings
http://www.th.gov.bc.ca/publications/eng_publications/electrical/MoST_PM.pdf

(g) Motor Vehicle Act Regulations - Division 23 – Traffic Control Devices

(h) BC Hydro, Street Light Information Management System (SLIM)
hhttps://www.bchydro.com/ex/streetlight/

(i) City of Nanaimo, Urban Forest Management Strategy
http://www.nanaimo.ca/assets/Departments/Parks~Rec~Culture/Publications~and~Forms/UFMS2010.pdf

(j) BCLNA, British Columbia Landscape Standards
http://bclna.com/bc-landscape-standards/

(k) City of Nanaimo, Invasive Plant Management Strategy

(l) Nanaimo Transportation Master Plan

(m) City of Nanaimo, Erosion and Sediment Control Guideline
https://www.nanaimo.ca/assets/Departments/Building~Inspection/Publications~and~Forms/erosion.pdf (REVISED NOVEMBER 2016)
3.1 C CITY BYLAW S (REVISED NOVEMBER 2016)

.1 The Manual of Engineering Standards and Specifications shall be used in conjunction with the most current City bylaws that impact construction.

(a) Building Bylaw No. 5693
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/B5693cons.pdf
(b) Crossing Control Bylaw No. 5174
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/B5174cons.pdf
(c) Development Parking Regulations Bylaw No. 7013
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/7013.pdf
(d) Elimination of Dust Emissions Bylaw No. 4896
http://www.nanaimo.ca/Bylaws/ViewBylaw/4896.pdf
(e) Flood Prevention Bylaw No. 5105
http://www.nanaimo.ca/Bylaws/ViewBylaw/5105.pdf
(f) Management and Protection of Trees Bylaw No. 7126
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/B7126.pdf
(g) Noise Control Bylaw No. 4750
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/4750.pdf
(h) Official Community Plan Bylaw No. 6500
(i) Soil Removal and Depositing Regulation Bylaw No. 1747
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/1747.pdf
(j) Sewer Regulation and Charge Bylaw No. 2496
http://www.nanaimo.ca/Bylaws/ViewBylaw/2496.pdf
(k) Storm Sewer Regulation and Charge Bylaw No. 3808
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/3808.pdf
(l) Traffic and Highways Regulation Bylaw No. 5000
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/5000.pdf
(m) Tree Protection Bylaw No. 7126
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/7126.pdf
(n) Waterworks Rate and Regulation Bylaw No. 7004
http://www.nanaimo.ca/UploadedFilesPath/Bylaws/B7004cons.pdf
(o) Zoning Bylaw No. 4500

(REVISED NOVEMBER 2016)
SECTION 3 - GENERAL REQUIREMENTS
STANDARD SPECIFICATIONS

3.2 CONSTRUCTION PROGRAM

.1 Prior to commencement of work specified herein, the Contractor shall submit to the Engineer for approval, a written construction program summarizing his proposed construction methods and sequences.

.2 This program shall contain sufficient information on the following points for the Engineer to assess the practicability of the proposed methods:

(a) Sources of aggregate
(b) Stripping methods
(c) Excavation and hauling methods
(d) Compaction equipment and methods for each type of fill and aggregate
(e) Watering and dewatering methods
(f) Waste material disposal locations
(g) Traffic control, if required
(h) Provision for access to adjacent properties, if required
(i) Hours of work

3.3 TEMPORARY CONSTRUCTION FACILITIES

.1 Access Road:

(a) Temporary roads shall be constructed as required for access to the working areas. Access to temporary roads from public roads shall require prior written approval from the City of Nanaimo. Adequate drainage facilities in the form of ditches, culverts, or other conduits shall be installed as found necessary to maintain these roads. In the construction of access roads, existing drainage facilities, natural or otherwise, shall not be disturbed to the detriment of properties outside the working area and such facilities shall, unless otherwise provided elsewhere in the specifications, be restored to their original condition as far as is practical to do so on completion of the work.

.2 Sanitary Facilities:

(a) Clean, sanitary, latrine accommodations shall be provided by the Contractor, and shall be located and maintained such that they are not offensive to any property owner or member of the public. The use of these facilities by persons engaged in the work shall be strictly enforced.

(b) These facilities shall be removed by the Contractor at the conclusion of the work or when instructed to do so by the Owner.

3.4 SPECIAL TOOLS, OPERATING MANUALS, AND SHOP DRAWINGS

.1 For installations which include mechanical and electrical equipment or machinery having wearing parts and requiring periodical repair and adjustment, all special tools, wrenches, and accessories required for removing worn parts, making adjustments, and carrying out maintenance shall be supplied. All gauges, indicators, and lubricating devices necessary for the proper operation of the equipment shall be furnished.
2. With each piece of equipment, 4 sets of operating manuals and as-constructed shop drawings shall be supplied. The manuals should give the manufacturer's recommended maintenance schedules with the grades of lubricants required and instructions as to how the equipment may be taken apart for periodic inspection and replacement.

3. The Contractor shall furnish all lubricating oils, greases, fuels, water, and power necessary to operate all equipment furnished under this Contract for a period of time sufficient to indicate its full acceptance to the Engineer.

3.5 EXPLOSIVES

1. The General method of storage, handling, use and character of all explosives shall be subject to the Accident Prevention Regulations covering explosives, pursuant to the Workers’ Compensation Act of British Columbia and must conform to local police requirements.

2. Explosives in excess of sixty-eight (68) kg shall be kept only in registered premises, which have been licensed under the Explosives Act (Canada).

3.6 BLASTING

1. Blasting will be permitted only after securing the approval of the Owner. Damage caused by blasting shall be repaired by the Contractor at his expense. The method and procedure employed for blasting shall be in accordance with Provincial and Municipal ordinances. The Contractor shall not do any blasting without first verifying that his insurance covers any loss of life or damage that may result from this work and includes a waiver of subrogation in favour of the Owner. The Owner, in granting approval for blasting, does not in any way assume responsibility for injury, loss of life, or damage that may result therefrom, and such approval shall not be construed as approval of the methods employed by the Contractor in blasting, the sole responsibility therefore being that of the Contractor.

3.7 SITE MAINTENANCE AND CLEANUP

1. The working areas shall be maintained in an orderly manner and shall not be encumbered with equipment, materials, or debris.

2. Cleanup shall be a continuing process from the start of the work to final acceptance of the project. The Contractor shall at all times, and without further order, keep property on which work is in progress free from accumulations of waste materials or rubbish caused by employees or by the work. Accumulations of waste materials which might constitute a fire hazard will not be permitted. Spillage from the Contractor's hauling vehicles on travelled public or private roads shall be promptly cleaned up. On completion of construction, the Contractor shall remove all temporary structures, rubbish, and waste materials resulting from his operations.

3.8 TIMING OF INSTALLATION

1. The Contractor shall schedule the work in a manner such that disruption of normal traffic and inconvenience to residents in the working area is kept to a minimum. Resurfacing of roads, testing of pipe, and cleanup of the site shall be completed no later than 30 days following commencement of construction on any street block.
.2 Departure from scheduling as specified above will be permitted only with the written consent of the Owner to a request made by the Contractor.

3.9 WORK WITHIN ROAD RIGHTS-OF-WAY

.1 All work within road rights-of-way shall be in strict conformance with, but shall not be limited to, the following requirements:

(a) Where one-way traffic cannot be avoided, adequate traffic control in the form of signs, lights, barricades and/or flagmen or pilot cars must be provided.
(b) Where detours are available, they must be adequately designated with proper signs.
(c) Traffic must be restored to as near normal as possible when work is not in progress.
(d) Surface runoff is to be prevented from seeping into trenches.
(e) Excavation across entrances, whether private or commercial, shall be backfilled and thoroughly compacted, within two hours unless otherwise approved in writing by the tenant or property owner.
(f) Open cut excavation shall not be left open overnight or on weekends unless there are workmen on duty and there is authorization by letter from the City of Nanaimo.
(g) Adequate signs, barriers, flares, etc., to ensure the safety of the public and traffic are to be provided at all times. Lights and flares are to be in good working order at all times and are to be checked daily. Lights that are not operational shall be removed from the worksite.
(h) Existing drainage courses and culverts are to be preserved and maintained as required.
(i) If the City of Nanaimo, at any time, deems it necessary, a workman from the Operations Division, City of Nanaimo, will be stationed at the work site to ensure that no damage is done to existing services.

.2 The Contractor shall make allowance in his tendered prices for all additional costs likely to be incurred in conforming with the Ministry of Transportation and Infrastructure regulations when working on or near a highway or right-of-way under the jurisdiction of the Ministry of Transportation and Infrastructure.

3.10 WORKSAFEBC

.1 The Contractor shall comply, at all times, with the current Workers Compensation Act and the WorkSafeBC Occupational Health and Safety Regulation.

.2 The Contractor shall have a current Occupational, Health & Safety Program and provide a copy of this program to the Owner.

.3 Prior to commencing work, the Contractor shall forward a copy of their WorkSafeBC Notice of Project, Clearance Letter and Safety Program to the Owner.

.4 If the Contractor is designated as the Prime Contractor, they shall fulfill the Prime Contractor responsibilities as defined in: (REVISED NOVEMBER 2016)

(a) WorkSafeBC Occupational Health and Safety Regulation, Notice of project, Section 20.2, and Coordination of multiple employer workplaces, Section 20.3. (REVISED NOVEMBER 2016)
SECTION 3 - GENERAL REQUIREMENTS
STANDARD SPECIFICATIONS

(b) Workers Compensation Act (BC), Coordination at multiple-employer workplaces, Section 118, Subsections (1) & (2) and, (REVISED NOVEMBER 2016)
(c) General Requirements, Section 3.10 WorkSafeBC. (REVISED NOVEMBER 2016)

.5 If the Contractor is designated as the Prime Contractor, they shall follow current WorkSafeBC regulations.

.6 The workplace may have the following known operations and/or site conditions that could present a potential hazard to workers and other persons at the workplace. Other hazards may exist:

Example:

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<td>Underground Utilities</td>
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.7 The City of Nanaimo has developed Safework Procedures for the guidance of Municipal Employees in addressing the aforementioned potential hazards. These procedures can be made available to the Contractor as reference in developing their own site specific safework procedures that will be utilized to protect the health and safety of all workers and persons on this project.
SECTION 3 - GENERAL REQUIREMENTS
EXISTING STRUCTURES AND UTILITY WORKS

3.20 SCOPE

.1 This specification refers to the location, protection, removal, and replacement of existing structures and utility works.

.2 Existing structures shall mean all existing pipes, ducts, ditches, or other works forming a part of sewerage, drainage, water, telephone, electrical, gas or other utility systems as well as sidewalks, curbs, poles, fences, buildings, and other man-made things that may be encountered during construction.

3.21 SUPPLY OF MATERIALS

.1 The Contractor shall supply all materials required for the specified location, protection, removal, and replacement of existing structures.

.2 Unless specified otherwise, materials supplied for replacement of existing structures shall be at least equal to those being replaced.

3.22 LOCATION OF STRUCTURES

.1 Prior to commencing any excavation the Contractor shall be responsible for locating existing surface and underground structures that may affect the work or may be damaged during construction.

.2 Drawings or descriptions, verbal or otherwise, of existing structures or their location that are given to the Contractor are intended only as an aid to his location of these structures. Measurements and location of the existing underground structures shown on the drawings are not guaranteed to be accurate, and must be verified by the Contractor prior to proceeding with construction.

.3 On request from the Engineer, the Contractor shall excavate and uncover underground structures for the purpose of establishing line or grade for proposed installation of piping or other works.

3.23 PROTECTION, ADJUSTMENT, AND SALVAGE OF STRUCTURES

.1 Unless authorization from the Engineer is received for their removal, underground and surface structures encountered during construction shall be protected from damage. In the event of damage resulting from the construction operation, they shall be repaired or replaced at the contractor's sole expense to a condition which is at least the equivalent of that which existed prior to construction. On instructions from the Engineer certain works shall be salvaged and delivered to the City of Nanaimo Works Yard on Labieux Road.

.2 All asbestos cement pipe damaged or disturbed during construction shall be removed and disposed of in accordance with WorkSafeBC regulations using proper safework practices. (REVISED NOVEMBER 2016)
SECTION 3 - GENERAL REQUIREMENTS
EXISTING STRUCTURES AND UTILITY WORKS

3.24 EMERGENCY SITUATIONS

.1 In emergency situations resulting from the construction operation, where life or property are endangered, the Contractor shall immediately take whatever action is required to eliminate the danger and shall also notify the appropriate authorities of the situation.

.2 In the specific case of a water or sewer break, the contractor shall immediately notify the Public Works Department at 250-758-5222.

.3 During periods when the Contractor's personnel are not on the job (after hours and weekends) at least one of the three Contractor's representatives in Nanaimo shall be available by phone contact. The names, addresses and phone numbers of the three Contractor's representatives shall be filed with the Engineer prior to commencement of construction and this list shall be updated by the Contractor as is necessary.

.4 If the Contractor cannot be contacted to remedy the situation the Owner will take whatever action deemed necessary to eliminate the danger and all costs incurred shall be borne by the Contractor.

3.25 ACCESS MAINTAINED

.1 Existing hydrants, valve or manhole covers, valve boxes, curb stop boxes, fire or police call boxes, and all other utility controls, warning systems, and appurtenances thereof shall not be obstructed or made inaccessible at any time by the construction work. Bridges, walks, or other temporary facilities shall be provided as may be necessary to ensure that these controls or warning systems are free for use in their normal manner at all times during construction.

3.26 CURTAILMENT OF UTILITY SERVICE

.1 Where existing utilities such as water, sanitary sewer, storm sewer, electricity, telephone, and gas are serving the public, work shall be planned and executed such that there is no curtailment of service provided by these utilities without prior receipt of approval of the authorities responsible for provision and maintenance of these utilities. The Contractor shall obtain the above approvals from the recognized authorities controlling these utilities. If approval for such disruption of utility service is not granted, the Contractor may be able to establish temporary facilities to provide continuous utility service during the course of construction. Such temporary facilities shall only be implemented after receiving the approval of the utility authority and all costs relating to the establishment of temporary services shall be borne by the Contractor.

.2 If the Contractor, after receiving approval of the responsible authorities, is to temporarily close off an existing utility, he shall, unless otherwise authorized by the Engineer, notify individual users of the utility at least twenty-four (24) hours prior to the time of shut-off.

3.27 SUPPORT OF STRUCTURES

.1 Existing structures other than pipes shall be protected against damage from settlement by means of support or compaction of backfill as required. Support shall remain in place following backfill of excavations.
.2 Backfill which is placed under or adjacent to existing structures which have been undermined during excavation shall be compacted in a manner which will prevent damage of the structure from settlement. Such backfill shall be of approved granular material suitable for compaction.

.3 For support of existing piping, other than asbestos cement or cast iron piping, refer to Standard Drawing T-11 in Section 4 – Trench Excavation, Bedding and Backfill.

.4 Where excavations for works cross underneath existing asbestos cement or cast iron piping the existing pipe shall be replaced by the Contractor with PVC pipe approved by the Engineer or supported with a concrete grade beam refer to Standard Drawing No. T-11, Section 4 – Trench Excavation, Bedding and Backfill as determined by the Engineer.

3.28 DRAINAGE FACILITIES

.1 Existing culverts, enclosed drains, flumes and ditches, and other drainage structures affected by the work but left in place, shall be kept clear of excavated material at all times during construction. When it is necessary to temporarily remove an existing drainage structure, the Contractor shall provide suitable temporary ditches or other approved means of handling the drainage during construction.

.2 Culverts and drain pipes shall be replaced on line and grade at the time of trench backfilling, in accordance with City of Nanaimo Standards and Specifications.

.3 No chlorinated water shall be discharged into storm drainage facilities without prior approval from the City Engineer.

.4 Prior to, and during construction, the Contractor shall take full responsibility for controlling erosion and sediment transfer by utilizing the guidelines contained in the handbook entitled, “Land Development Guidelines for the Protection of Aquatic Habitat”, by the Department of Fisheries and Oceans and the Ministry of Environment, to prevent discharge of sediment into City stormwater management systems and environmentally sensitive areas. It is incumbent for the contractor to acquire and be familiar with these guidelines.

3.29 WORK WITHIN RAIL RIGHTS-OF-WAY

.1 Where construction occurs within Railway rights-of-way the Owner will obtain the necessary permit for installation. The Contractor shall provide written notice to the local Superintendent of the Railway company at least 48 hours prior to commencement of work, with copies to the Engineer.

.2 The Contractor shall coordinate timing of installation, rail removal and replacement with the Railway District Superintendent.
3.30 HIGHWAY CROSSING

.1 Where construction occurs on Provincial Highway rights-of-way the Owner will obtain the permit for Permission to Construct Works within Crown Lands. The Contractor shall be responsible for obtaining any other necessary construction permits and shall determine the complete requirements of the Ministry of Transportation and Infrastructure (MOTI). Installation within the right-of-way shall be strictly in conformance with MOTI requirements and regulations. If there is any conflict between MOTI requirements and these specifications, the MOTI requirements shall govern within the highway rights-of-way. The Contractor shall provide written notice to the MOTI at least 7 days prior to commencement of work with copies to the Engineer.

3.31 ELECTRICAL POWER, TELEPHONE, TELEVISION, CITY AND PRIVATE OWNED FIBRE OPTICS, CABLES AND CONDUITS

.1 Electrical power, telephone, television, city and private owned fibre optics, cables and conduits may exist throughout the work area. B.C. Utility Companies shall be notified by the Contractor prior to excavation in the vicinity of any buried cables or ducts.

3.32 GAS PIPELINES

.1 High pressure gas pipelines may exist throughout the area. The Contractor shall familiarize themselves with the requirements and regulations of the Standard Practice Instruction of the Gas Utility Company, the Gas Act, and the Pipe-Line Act of the Province of British Columbia with regard to work carried out in the vicinity of these pipelines, and shall comply with such requirements and regulations.

.2 The local gas company shall be notified prior to excavation in the vicinity of buried gas mains.

3.33 POWER LINE CROSSING

.1 Where construction crosses British Columbia Hydro and Power Authority (BCH&PA) rights-of-way, the Owner will obtain necessary permission beforehand. Construction within the right-of-way shall be strictly in conformance with BCH&PA requirements and regulations.

3.34 WORK IN VICINITY OF OVERHEAD POWER LINES

.1 Equipment shall not be operated where it is possible to bring such equipment or any part of the equipment within 3 metres of any energized electrical conductor unless the following safety precautions are taken by the Contractor:

(a) The utility company is notified, the line de-energized, or effectively guarded against contact, or displaced or re-routed from the work area.

(b) The Workers' Compensation Board prior to commencement of construction is notified in accordance with their required procedure.

(c) For high-voltage transmission lines, a greater clearance is provided, as determined by the utility company.
3.35 **RELOCATION OF EXISTING PIPING**

.1 Where existing underground piping parallels the centreline of the trench, or crosses the trench centreline and intersects the pipe to be installed and must, in either case, be relocated, the Contractor shall make arrangements for the relocation of existing piping or shall, having received the approval of the authority responsible for maintenance of the existing pipe, remove and relocate existing piping with his own forces. Where existing pipes cross the centreline of the trench but do not intersect the pipe to be installed, the Contractor will not disturb the existing pipes.

3.36 **WATERCOURSE CROSSING**

.1 Where a watercourse crossing is required as part of the construction, the crossing construction shall be in accordance with the Ministry of Environment, Provincial Fish and Wildlife regulations and Federal Fisheries regulations where applicable.

.2 The Owner will obtain the necessary initial permission from the authority having jurisdiction to construct works where a water course crossing is required. The Contractor shall provide written notice to the authority having jurisdiction at least seven (7) days prior to commencement of work, with copies to the Engineer.

3.37 **DETOURS**

.1 All road closures and detours require approval from the City of Nanaimo. Applications for detours shall be made by the Contractor to the City of Nanaimo in writing at least seven (7) days in advance of the detour going into effect. Where detours are permitted the City of Nanaimo will notify the fire, police and ambulance departments as well as the bus service prior to the detour going into effect.

.2 The Contractor shall notify the City of Nanaimo immediately following the resumption of normal traffic flow.
3.50 **SCOPE**

.1 This specification refers to clearing and grubbing of the site for construction in the areas delineated on the drawings or described in the specifications.

3.51 **SUPPLY OF MATERIALS**

.1 The Contractor shall supply all materials required for clearing and grubbing.

3.52 **CLEARING AND GRUBBING**

.1 The area shall be cleared and grubbed within the limits designated by the Engineer on the site.

.2 All trees and brush except those selected for preservation shall be cut, and along with all stumps, logs, roots, rotten wood, and other organic materials shall be removed from the site.

.3 The above material shall be removed from the ground surface and to a minimum depth of 0.30 metres below.

.4 All other rubbish and debris existing on the site shall be removed and disposed of. No burning will be allowed.

.5 Where selective clearing is required, trees or groups of trees as designated on the drawings or marked by the Engineer in the field shall be preserved.

.6 Trees shall be felled within the designated clearing area and those falling outside this area shall be cut up and returned to the clearing area for disposal.

.7 Individual leaning or dangerous trees or snags adjacent to, but outside the designated clearing area, shall be cut and disposed of. Written permission shall be obtained from the Owner by the City of Nanaimo for this work.

.8 Excavations resulting from removal of tree trunks, roots, or other material shall be filled and leveled by the Contractor as a part of the clearing and grubbing operation.

3.53 **BURNING**

.1 No burning of wood waste, rubbish or debris is allowed in the City of Nanaimo.

3.54 **MERCHANTABLE TIMBER**

.1 Merchantable timber cut during the clearing operation shall be trimmed of all branches and stockpiled on the site at a location designated by the Engineer. Such timber will remain the property of the Owner unless otherwise noted in the contract documents.

.2 Removal of timber from dedicated road rights-of-way will be subject to permission from the Ministry of Forests, Lands and Natural Resource Operations. *(REVISED NOVEMBER 2016)*
SECTION 3 - GENERAL REQUIREMENTS
CONTROL OF PUBLIC TRAFFIC

3.60 SCOPE

.1 This specification refers to the control of public traffic in construction areas.

3.61 CONTROL OF PUBLIC TRAFFIC - GENERAL

.1 The following general principles shall be maintained when performing construction or maintenance work upon Municipal streets and thereby affecting traffic through movement, access to properties and/or parking.

.2 All control of public traffic will be carried out in accordance with the Ministry of Transportation and Infrastructure Traffic Control Manual for Work on Roadways and WorkSafeBC regulations.

.3 Work on streets shall be completed as quickly as possible so as to only disrupt normal street operation for the shortest possible time.

.4 Proposed projects shall be planned in such a way as to keep work areas and interference with traffic to a minimum.

.5 Initial inspection of the site shall include observations of traffic intensity, property use and extent of no parking.

.6 All job equipment not in use shall be sorted in such a manner as not to create view obstructions or unnecessary obstructions to vehicular or pedestrian traffic.

.7 In certain instances, it may be required to perform construction jobs between traffic peaks, which will be noted as a condition on the permit to construct works on the Public Road Allowance, i.e. 9:00 a.m. to 4:00 p.m.

.8 Emergency works shall have priority over traffic inconvenience insofar as is necessary to correct the problem. Nevertheless, every effort must be made to provide protection for the public and workers.

.9 Partial or complete closure of major and collector roads requiring traffic detouring in at least one direction must be approved by the City of Nanaimo at least seven days prior to the start of construction.

.10 No loose material like dirt, mud and debris should be allowed to accumulate or remain upon any sidewalk, street or driveway.

.11 At any time, a Police Officer can override these provisions.
3.62 USE OF FLAG PERSONS

.1 Although the need for flag persons will be determined by the Engineer, it is generally expected that they will be required in the following situations:

(a) When public traffic is required to pass working vehicles or equipment which may block all or part of the travelled roadway.
(b) When it is necessary to institute a one-way traffic system through a construction area or other blockage where traffic volumes are heavy, approach speeds are high, and a traffic signal system is not in use.
(c) Where workers and/or equipment are employed on the travelled way over the brow of a hill, around a sharp curve or at any other location where oncoming traffic would not otherwise have adequate warning of their presence.
(d) In high speed, high volume areas where temporary protection is required while other traffic control devices (barricades, cones, signs, etc.) are being erected or taken down.
(e) For emergency protection when other traffic control devices are not readily available.
(f) In all situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.
(g) At the entrance to road closures and along detour routes where required.

.2 Courtesy is of prime importance as many motorists tend to become irritable when held up by road work for any length of time. Each flagperson shall be fully conversant with all aspects of the situation requiring the delay and shall be ready to explain the hold-up, and its approximate duration, if required.

.3 All flag persons must be trained and certified in a Traffic Control course acceptable to WorkSafeBC.

.4 Flag persons and their equipment shall conform to WorkSafeBC regulations.

3.63 USE OF TRAFFIC CONTROL DEVICES

.1 Traffic control devices shall be placed immediately before the work commences, except "parking restriction" signs which will be installed a minimum of 12 hours in advance.

.2 Traffic control devices shall remain in place only as long as they are needed, and shall be removed immediately thereafter.

.3 Any traffic control device not required at any time during the work shall be removed from view.

.4 Traffic control devices used outside work hours (overnight, holidays and weekends) shall be maintained to produce a safe effect and be minimal obstructions to traffic, parking or access. Flashing beacons will be used to completely and properly identify all sites at night.

.5 Traffic control devices shall at all times be in good repair.

.6 Misapplication and excessive use of traffic control devices shall be avoided. This may cause confusion and result in disrespect for the instruction.
.7 Detoured traffic shall be afforded maximum practical protection, convenience and guidance by the proper use of traffic control devices.

.8 Signs shall be mounted on weighted bases or folding frames, ensuring that they are held rigidly and maintained in a proper position.
MEASUREMENT AND PAYMENT

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3.70 **EXISTING STRUCTURES AND UTILITY WORKS**

Extra payment will not be made to the Contractor for expense incurred as a result of the presence of existing structures except as follows:

(a) **Location of Existing Structures:** Section 3.22.3

Where he is specifically instructed by the Engineer to locate, by excavating, underground structures for the purpose of establishing line or grade, the Contractor will be paid on the basis of the payment items shown on the Tender Form.

(b) **Support Existing BC Hydro Pole:**

Where required payment for the temporary support of BC Hydro poles shall be made at the unit price quoted in the Tender Form.

(c) **Support of Existing TELUS/BC Hydro Ducts**

Payment for work to provide for the temporary support of existing TELUS/BC Hydro service ducts being crossed support shall be made at the unit price quoted in the Tender Form. This price shall include supply of materials, installation, maintenance, removal, and all work incidental thereto.

3.71 **CLEARING AND GRUBBING** Section 3.52

Payment for clearing and grubbing will be made at the lump sum price shown in the Tender Form. This price shall include materials, and all work incidental thereto.

3.72 **SALVAGED MATERIALS** Section 3.23

This item covers the cost of salvage and delivery of salvaged items to the City of Nanaimo Works Yard on Labieux Road. This work shall be paid for on a per unit basis as shown in the Tender Form. No payment will be made for items damaged due to the act of removal or delivery.
3.73 **CONTROL OF PUBLIC TRAFFIC**  Section 3.60, 3.61, 3.62, and 3.63

Payment will be made as a lump sum as shown in the Tender Form.

3.74 **REMOVAL OF EXISTING PIPE**

Payment for pipe removal will be made at the unit price per linear metre shown in the Tender Form for the various sizes of pipe. Measurement will be made horizontally along the centre line of the existing culverts.

This item covers the removal and disposal of all existing pipe, culverts, and headwalls designated on the drawings for removal including backfill of the trench with suitable native material. Where imported granular fill is required, it shall be paid for at the unit price quoted in the tender form.

3.75 **REMOVAL OF EXISTING STRUCTURES**  Section 3.23

Payment for the removal and disposal of structures, as designated on the drawings, will be made at the unit price shown in the Tender Form.

a) **Manholes** – This price shall include the removal and disposal of the manhole base, barrels, lid, grade rings, frame and cover, and all work incidental thereto.

b) **Manholes greater than 2m deep** – This price shall include the removal and disposal of the manhole base, barrels, lid, grade rings, frame and cover, and all work incidental thereto.

c) **Sandbag Headwall** – This price shall include the removal and disposal of the headwall and all work incidental thereto.

For these pay items, import granular backfill where required, and surface restoration will be paid separately under the applicable unit rate in the Tender Form.

3.76 **PLUG/CAP EXISTING PIPE**

Payment for plugging or capping of existing pipe is to be made at the unit price per proposed pipe size shown in the Tender Form. This item covers the supply and installation of a manufactured cap or concrete plug as specified on the drawings for abandonment of existing pipe and includes backfill of the trench with suitable native material. Where imported granular fill is required, it shall be paid for at the unit price quoted in the tender form.

3.77 **ABANDON EXISTING MANHOLE**

Payment for abandoning manholes is to be made at the unit price as shown in the Tender Form. This item covers the supply and installation of drain rock, geotextile, removal and disposal of frame, cover, grade rings, manhole lid, including all labour, equipment, and work incidental thereto to complete the work as specified on Drawing 22476.
# SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL

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4.1 SCOPE

.1 This specification refers to trench excavation, bedding, backfill and all work pertaining thereto.

.2 Trenches shall be excavated only as far in advance of the pipe laying operation as safety, traffic, and weather conditions permit. Caution shall be exercised with respect to structures, piping, or other man-made obstacles that may exist within the working area and due consideration given to the protection and support of such properties and structures.

.3 Only those products approved by the City Engineer or listed in the City of Nanaimo Approved Products List will be accepted for installation.

4.2 TESTING

.1 The Engineer will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates non-compliance with the specifications, additional testing shall be required at the Contractor's expense.

.2 The Contractor, as directed by the Engineer, shall supply specimens or samples for testing.

.3 The types of tests listed below are the minimum testing requirements. The Engineer shall determine if additional testing is required.

(a) Regular sieve analysis of aggregate gradation on materials to be incorporated in the works.

(b) Determination of optimum moisture content and Modified Proctor Density (ASTM D1557) on all materials to be used for import bedding and backfill.

(c) Field density tests taken on the compacted backfill.

(d) Other tests as may be required.

4.3 NOT USED

4.4 PRECUTTING PAVED SURFACES

.1 When trenching along or across a paved surface, pavement shall first be sawn or cut by methods approved by the Engineer in straight lines parallel to the trench centreline. The total cut width of pavement shall not be greater than the specified maximum trench width at the ground surface shown on the drawings. Concrete curbs and sidewalks shall be sawn at existing joints.

.2 Where, in the opinion of the Engineer, existing pavement is in poor condition, pavement may be cut by hand, mechanical means, or trenching equipment.

.3 When asphalt cutting around a manhole is required to repair the manhole frame and cover, it shall be done in accordance with Standard Drawing No. T-4B.

.4 Pavement that has been cut and removed to permit trenching shall be disposed of as waste material and shall not be placed in the trench backfill. Pavement that has been removed by grinding may be re-used as backfill if approved by the Engineer.
.5 Pavement Restoration shall be done in accordance with Section 4.28 - Pavement Restoration.

4.5 SITE PREPARATION

.1 Remove all brush, weeds, grasses and accumulated debris from the trench width and working area.

.2 Where directed by the Engineer for trenchwork in existing lawns, carefully cut and remove sod prior to excavation.

.3 For trenchwork in landscaped statutory rights-of-way, carefully remove fences, shrubs, small trees and other items for replacement after backfilling is completed. If, in the opinion of the Engineer, removed trees are too large to be replaced, the contractor shall not be responsible for their replacement unless otherwise noted on the construction drawings.

.4 For trenchwork in landscaped boulevards, the Contractor shall provide 14 days notice to all property owners for the removal of all fences, shrubs, small trees or other structures or plantings within the road rights-of-way that the property owner wishes to retain. Plantings and structures listed above, not removed by the property owner upon expiration of the 14 day notice, shall be removed and disposed of by the Contractor.

.5 Remove all top soil within the trench width and where required in the working area, and stockpile for replacement at locations approved by the Engineer. Stumps, boulders and other deleterious material shall be removed from the top soil and disposed of as specified in Section 4.11 - Disposal of Excavated Material. Do not handle top soil while it is wet or frozen.

.6 Cut pavement, sidewalks and curbs in accordance with Section 4.04 – Precutting Paved Surfaces.

.7 Provide temporary drainage control to protect construction area and adjacent properties. Provide siltation controls to protect natural watercourse or existing storm drainage systems.

4.6 TRENCH ALIGNMENT AND DEPTH

.1 The trench shall be excavated so that pipe can be laid to the established alignment and depth with allowance made for specified trench wall clearances and bedding as required.

.2 Prior to, or at the commencement of construction, the contractor shall check existing mains for line and elevation at the point of connection. If they are different than what is shown on the construction drawings, the contractor shall immediately report the difference to the Engineer and cease construction pending direction from the Engineer.
4.7  TRENCH EXCAVATION

.1 Trench excavation shall be classified as common or rock excavation.

.2 Trenches shall be excavated to the section and dimensions as shown on the drawings. Trench stability and safety procedures shall conform to WorkSafeBC Regulations.

.3 Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 150mm around all sides of pipe, fittings and appurtenances.

.4 In road rights-of-way, the trench width shall be kept to a minimum and the trench width be such that at least one-way traffic can be maintained at all times unless otherwise approved by the City Engineer.

.5 To prevent damage to existing utilities, excavate the last 300mm above the utility by hand.

.6 If, in the opinion of the Engineer, trench width exceeds the maximum allowable for pipe support, the contractor may be required to provide a higher class of bedding, a pipe with a higher strength class or concrete encasement at no extra cost to the owner.

.7 Excavation for manholes shall be to dimensions which will permit assembly of the sections in accordance with these specifications. (REVISED NOVEMBER 2016)

.8 Excavate trenches only as far in advance of pipe laying operation as safety, traffic and weather conditions permit. In no case shall open trenches exceed 30 metres.

.9 All excavations left unattended shall be adequately protected with approved fencing and barricades and with flashing lights where required.

4.07A  COMMON EXCAVATION

.1 Common excavation is the excavation and removal of all material encountered which is not classified as rock.

4.7 B  ROCK EXCAVATION

.1 Rock excavation is:

(a) The removal of detached masses of rock including single boulders, and pieces of concrete or masonry having individual volumes in excess of 1 cubic metre, or solid rock which requires drilling and blasting or breaking with a power-operated tool for its removal.

(b) Removal of soft or disintegrated rock which can be removed with a hand pick or power-operated excavator or shovel, or previously blasted or broken stone in rock fills or elsewhere with individual volumes less than one cubic metre, or boulders or pieces of fractured rock which do not occur naturally within the excavated volume but fall into the excavation from the adjacent area, shall not be classified as rock excavation. Hardpan (glacial till) shall not be classified as rock excavation.
SECCTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL
SPECIFICATIONS AND INSTALLATION

(c) Overbreak, is that portion of solid rock which is excavated, displaced or loosened outside the limits used to calculate the volume of rock excavation and will be classified as unauthorized overexcavation.

(d) Authorized overexcavation is that excavation required by the Engineer as a result of unsuitable foundation conditions not resulting from the Contractor's operation.

(e) Unauthorized overexcavation is that excavation required as a result of the Contractor’s operation as determined by the Engineer. Replacement of unauthorized overexcavation shall be at no additional cost to the Owner.

.2 Rock excavation for trenches:

(a) Where rock is encountered in the trench or pit, the method of removal shall be agreed with the Engineer before its removal.

(b) When blasting is required during excavation, the Contractor shall exercise extreme care and shall limit the use of explosives to such charges that shall not cause damage to existing pipelines, other utilities or private property. Blasting shall be done by experienced persons, qualified for the work. The compliance with regulations regarding the use and storage of explosives shall be the responsibility of the Contractor and he shall be responsible for any accidents or injury, loss and/or damage which might occur as a result of his blasting.

(c) Overbreak shall be removed as directed by the Engineer and replaced with imported granular fill, placed and compacted as specified herein at no additional cost to the Owner.

4.8 -NOT USED-

4.9 HAND EXCAVATION

.1 Mechanical trenching and backfilling equipment shall be used except where by so doing, damage to trees, buildings, sidewalks, curbs, piping, or other existing structures or man-made obstacles above or below ground cannot be avoided. Trenches shall be hand excavated and backfilled where such obstacles prevent the use of mechanical equipment.

.2 Authorized hand excavation shall be restricted to trench excavation in statutory rights-of-way and only in those locations which, in the opinion of the Engineer, necessitate hand excavation methods.

.3 The following and similar circumstances shall not be considered as authorized hand excavation:

(a) Crossing of existing structures and utility works;
(b) Where lighter or smaller mechanical equipment could be used;
(c) Where, by the use of close sheeting, timber support, equipment pads, or other facilities, mechanical equipment could be used; or
(d) Where the presence of timbering, sheeting, well pointing equipment, or other Contractor placed obstacles restrict the use of mechanical equipment.
4.10 PILING OF EXCAVATED TRENCH MATERIAL

.1 Common excavation approved by the Engineer as approved native backfill, may be piled along the trench in accordance with WorkSafeBC regulations and provided the working space is adequate for this purpose and provided that by so doing the backfill material does not spill onto private properties adjacent to the line of the trench thereby disturbing fences, buildings, shrubs, lawns, or other items of value.

.2 Piling of excavated material along the trench shall not unduly restrict cross traffic at road intersections. Material shall be cleared from road intersections and provision made for use of the cross road by traffic as soon as possible after excavation has taken place. Pedestrian traffic to individual properties shall be maintained at all times and timber bridges shall be provided where it is necessary to cross open trenches. Roadways, driveways, and drainage facilities shall not be blocked unnecessarily. The spoil pile shall be located such that hindrance to local traffic is minimal.

.3 In order that excavated material may be piled along the trench, roads may be temporarily closed to traffic with the permission of the City of Nanaimo and providing that adequate detour traffic routes can be established to move traffic around the construction area, and providing also that street entrances to driveways are not blocked from vehicular traffic for periods in excess of one day. One lane shall be kept open at all times for emergency vehicles unless otherwise approved by the City Engineer.

.4 Where excavated material cannot be piled along the trench in compliance with the above restrictions, it shall be trucked to locations where backfilling is taking place or trucked to stockpile for return to the trench at the time of backfilling. Alternatively, subject to approval of the Engineer, excavated material may be wasted and replaced with approved material at the time of backfilling.

.5 The contractor shall retain sufficient approved native backfill material for the backfilling of the trench. Surplus approved native backfill material shall be taken to and used at other locations within the project site suitable for material placement.

.6 The contractor shall take all measures required to protect approved native backfill from contamination, segregation and weather.

4.11 DISPOSAL OF EXCAVATED MATERIAL

.1 Surplus or waste excavated material shall be removed from the trench area during the excavation or backfilling operations and shall not be left along the trench following the completion of backfilling the trench.

.2 Surplus excavated material which is not required for the works, as shown on the drawings or specified elsewhere herein, shall be disposed of at sites obtained by the Contractor. Waste material shall not be dumped on private property without the written permission of the owner of the property and a fill permit obtained from the City of Nanaimo.

.3 The Contractor shall exercise particular care to avoid spillage on paved roadways over which excavated material is hauled, and any such spillage shall be cleaned up promptly by sweeping.
.4 Failure to immediately begin cleanup of spillage from roadways when required by the City of Nanaimo will result in the Contractor being charged all costs accrued by the City of Nanaimo to do the cleanup work.

.5 Care shall also be exercised to avoid spreading the excavated material over a wide area and rutting or otherwise damaging unnecessarily adjacent property when side casting of excavated material is permitted.

4.12 BRACING AND SHEETING

.1 Trenches shall be excavated, sheeted and braced in accordance with WorkSafeBC regulations or as may be necessary to protect life, property, and structures adjacent to the work, the work itself, or to maintain trench widths within the specified limits. Trench sheeting and bracing shall be located no closer than 150mm to the widest section of any installed pipe.

.2 Whenever possible, vertical trench timber or sheeting shall be placed so that it does not extend below the springline of the pipe being installed. When it is necessary to place sheeting or timber below the pipe springline, as in the case of overexcavation for trench bottom stabilization, sheeting shall be raised in 600mm lifts and all backfill placed below the level of the pipe springline shall be thoroughly compacted on each lift to fill the void left by the raised sheeting.

.3 Trench sheeting and bracing shall be removed, except in situations where the removal of trench sheeting and bracing will result in damage to adjacent structures. When sheeting and bracing is left in place, it shall be cut off above springline.

.4 Where sheeting or timber is removed from a trench in which backfill is to be compacted, it shall be removed in a manner which permits compaction of the backfill in the manner specified.

.5 WorkSafeBC approved cages may also be used in place of sheeting.

4.13 DEWATERING

.1 During construction, ground and surface water shall be controlled to the extent that excavation and pipe installation can proceed in the specified manner and such that the trench bottom is not disturbed to the detriment of the pipe installation. Trench water shall not be permitted to enter the pipe being installed unless approval is received from the Engineer.

.2 Pumps, well points, or other equipment shall be employed to keep excavations free of water. Caution shall be exercised to make sure that foundation problems with existing structures and works under construction do not result from the selected method of dewatering excavations.

.3 Discharge from pumps, well points, or other dewatering equipment shall be located and controlled such that loss, damage, nuisance, or injury does not result.
.4 The contractor shall be responsible for any claims or actions resulting from the dewatering operation.

4.14 TRENCH BOTTOM CONDITIONS

.1 Trenches shall be maintained such that pipe can be installed without allowing water, muck, silt, gravel, or other foreign material into the pipe. Material remaining in the trench bottom on completion of machine excavating which has been disturbed or softened by workmen or trench water shall be removed before bedding material is placed. The trench bottom shall be firm and capable of supporting the pipe to be installed.

.2 When, in the opinion of the Engineer, the material in the trench bottom is found to be unstable or otherwise unsuitable for pipe support or the support of appurtenant structures, the Engineer shall direct the contractor to utilize the most suitable of the following stabilization methods:

(a) Overexcavate to suitable subgrade and backfill with base gravel and compact to 95% Modified Proctor Density (ASTM D1557). Use of import granular fill, subbase gravel, drainrock or bedding material shall be at the discretion of the Engineer.

(b) Use of concrete bedding as directed by the Engineer.

(c) Other methods as proposed by the Engineer and approved by the City Engineer.

4.15 AUGERING

.1 Augering shall be performed with hand- or power-operating equipment, subject to the approval of the Engineer.

.2 Auger holes shall terminate in open trench.

.3 Augering shall be performed such that undermining or displacement of the roadway structure does not result and the completed auger hole is not more than 50mm larger in diameter than the maximum outside diameter of the casing pipe or pipe to be augered.

.4 The augered hole shall be to the correct line and grade. If an obstruction is encountered that will cause deviation from the correct line and grade, a new hole shall be augered.

4.16 CASING PIPES

.1 Casing pipes shall be as shown in the construction drawings and shall be laid to the grade and alignment shown.

.2 The same bedding and backfill criteria shall be used for casing pipe as required for main piping.

.3 All pipe joints within the pipe casing shall be fully restrained with approved mechanical restrainers and shall be approved by the Engineer.
4.17 BEDDING WITHIN PIPE ZONE

.1 Bedding materials shall be granular in nature, free of organic material, silt or clay, and shall conform to the following gradation limits when tested in accordance with ASTM C136:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.0 mm</td>
<td>100</td>
<td>90 - 100</td>
</tr>
<tr>
<td>12.5 mm</td>
<td></td>
<td>65 - 85</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>85 - 100</td>
<td>50 - 75</td>
</tr>
<tr>
<td>4.750 mm</td>
<td>70 - 100</td>
<td>25 - 50</td>
</tr>
<tr>
<td>2.36 mm</td>
<td></td>
<td>10 - 35</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>20 - 65</td>
<td></td>
</tr>
<tr>
<td>0.850 mm</td>
<td></td>
<td>5 - 20</td>
</tr>
<tr>
<td>0.6 mm</td>
<td></td>
<td>0 - 45</td>
</tr>
<tr>
<td>0.425 mm</td>
<td></td>
<td>0 - 15</td>
</tr>
<tr>
<td>0.180 mm</td>
<td></td>
<td>0 - 8</td>
</tr>
<tr>
<td>0.15 mm</td>
<td></td>
<td>0 - 10</td>
</tr>
<tr>
<td>0.075 mm</td>
<td></td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

.2 Type 1 is the standard acceptable bedding material. Type 2 shall be used where specified by the Engineer.

.3 Other acceptable bedding materials, for use only where shown on the construction drawings or as approved by the Engineer, are drainrock or native material.

.4 The bedding material shall cover the full width of the trench bottom and have a minimum depth of 100mm on completion of compaction. In rock excavation the minimum depth of bedding below the pipe shall be 150mm after completion of compaction.

.5 Bedding material shall be compacted in maximum 150mm lifts to 95% of Modified Proctor Density (ASTM D1557).

.6 Bedding material shall be placed in such a manner that the pipe is evenly supported throughout its length by the pipe bedding material.

.7 Placement and compaction of the bedding material shall not damage or displace the pipe.

.8 Bedding material shall be leveled across the full width of the trench to an elevation of 300mm above the crown of the pipe.
SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL SPECIFICATIONS AND INSTALLATION

4.18 TRENCH DAMS

.1 Trench dams shall be constructed on all utility main lines where grades are ten percent (10%) or greater, or when indicated on the construction drawings. *(REVISED NOVEMBER 2016)*

.2 All trench dams on utility mains shall be constructed in accordance with Standard Drawing No. T-8. Trench dams on storm sewer gravity mains as per Standard Drawing No. T-8A requires approval by the City Engineer.

.3 All trench dam drain pipes shall be capped at the highest end of the run.

.4 Trench dam spacing shall be as follows:

<table>
<thead>
<tr>
<th>SLOPE</th>
<th>MAX. SPACING</th>
<th>SLOPE</th>
<th>MAX. SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANITARY AND STORM GRAVITY SEWERS</td>
<td>WATERMAINS AND FORCMAINS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10% - 15%</td>
<td>30m</td>
<td>10% - 29%</td>
<td>10m (upon approval of City Engineer)</td>
</tr>
<tr>
<td>15% - 20%</td>
<td>25m</td>
<td>20% - 35%</td>
<td>See Section 4.18.5</td>
</tr>
<tr>
<td>20% - 35%</td>
<td>20m</td>
<td>35% - 50%</td>
<td></td>
</tr>
<tr>
<td>35% - 50%</td>
<td>15m</td>
<td>50% - Over</td>
<td></td>
</tr>
<tr>
<td>50% - Over</td>
<td>10m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(REVISED NOVEMBER 2016)*

.5 Where the slope of the watermain is 30% or greater, a geotechnical study shall be submitted to assess slope stability. Geotechnical studies shall be completed in accordance with the “Guidelines for Legislated Landslide Assessments for Proposed Residential Development in British Columbia” published by APEGBC. Additionally, the City Engineer may request a geotechnical study regardless of the pipe grade if the stability of the adjacent slope is in question. *(REVISED NOVEMBER 2016)*

.6 If approved by the Engineer, concrete trench dams may be constructed of wetted sandbag sacks filled with wet pre-mixed concrete for areas inaccessible by construction equipment. Sacked concrete shall be laid in courses such that joints in succeeding courses are staggered. Courses shall be a minimum of nine (9) per vertical metre and shall be placed around the pipe and keyed into the trench walls to form a water tight dam.

.7 Relief drains shall be installed on all trench dams to an acceptable watercourse or storm sewer system.
4.19 BACKFILL AND COMPACTION

.1 Backfill material shall be:

(a) Imported granular fill (Section 4.20 – Imported Granular Fill)
(b) Approved native material (Section 4.23 – Approved Native Backfill)
(c) Controlled density fill (Section 4.24 – Controlled Density Fill)

.2 General:

(a) Placement and compaction of backfill material shall not damage or displace the pipe.
(b) Remove shoring or cages in such a manner as to allow proper compaction and to prevent trench walls from collapsing.
(c) Place backfill in lifts suitable to the soil type and compaction equipment being used as determined by the Engineer.
(d) Import granular fill shall be used for backfill unless native soils are suitable and approved by the Engineer, and are specified on the construction drawings.
(e) Deficiencies in the quantities of approved native backfill material which are the result of the Contractor’s operation shall be replaced with imported granular fill at no additional cost to the Owner.
(f) Trenches shall be backfilled to a depth to allow for surface restoration in accordance with Section 4.27 – Surface Restoration.

.3 Traveled Surfaces:

(a) Traveled surfaces are roadways, lanes, driveways, road shoulders, sidewalks, walkways or other surfaces on which vehicular or pedestrian traffic normally travels. The ultimate extent of the traveled surface must be considered.
(b) Under no circumstances shall a trench in a traveled area be left in a hazardous condition.
(c) Trenches in traveled surfaces shall be backfilled with imported granular fill in accordance with Section 4.20. Approved native backfill shall be used when directed by the Engineer in accordance with Section 4.23. Trenches located in existing arterial, collector or commercial/industrial roads shall be backfilled with controlled density backfill in accordance with Section 4.24.
(d) Approved native backfill shall be compacted to 95% Modified Proctor Density (ASTM D1557).

.4 Untraveled Surfaces:

(a) Untraveled surfaces are all other surfaces not classified as traveled surfaces.
(b) Untraveled surfaces shall be backfilled with approved native backfill and compacted to 90% Modified Proctor Density (ASTM D1577).
4.20  IMPORTED GRANULAR FILL

.1 The Contractor shall import granular fill for trench backfill, unless the material excavated from the trench is suitable and approved by the Engineer.

.2 All imported granular fill for trench backfill shall consist of well graded granular material, with not more than 8% passing the 0.075 mm sieve, which contains no stones larger than 150mm in diameter and contains no stumps, roots, organic or other deleterious material.

.3 All imported granular fill shall require approval by the Engineer prior to placement.

(a) A wet sieve analysis (ASTM C117) may be required by the Engineer to confirm the fines content of the imported granular fill material.

.4 The use of quarried or blast rock as import granular fill for trenches requires specific approval by the City Engineer unless listed in the City of Nanaimo Approved Product List. Quarried or blast rock shall be hard and durable, well graded, with not more than 8% passing the 0.075 mm sieve, which contains no stones larger than 150 mm in diameter and no stumps, roots, organic or other deleterious material.

4.21  CONCRETE

.1 Concrete for pipe base, encasement or backfill shall have a minimum compressive strength of 20MPa at twenty-eight (28) days and be in accordance with Section 11.31 – Concrete.

.2 Backfill material shall not be placed over the concrete until the concrete has obtained its initial set but in no case shall time be less than one hour.

4.22  ROAD SUB-BASE GRAVEL COURSE

.1 The road sub-base gravel shall be in accordance with Section 9.29 - Road Sub-Base Gravel Course.

4.22A  ROAD BASE GRAVEL COURSE

.1 The road base course gravel shall be in accordance with Section 9.30 - Road Base Gravel Course.

4.23  APPROVED NATIVE BACKFILL

.1 Approved native backfill shall be soils native to the excavation and suitable for backfilling to the required compaction densities as determined by the Engineer.

.2 The maximum size rock in approved native backfill shall be 200mm in any dimension.

.3 Approved native backfill material placed within 600mm of the finished surface shall have a maximum rock size of 75mm measured in any dimension.
4 Unsuitable native materials, i.e. rock, clay or silt may be mixed with granular material for use as approved native backfill if approved by the Engineer. In no case shall the silt and clay content exceed 30% by volume.

4.24 CONTROLLED DENSITY FILL

.1 All materials and methods shall conform to CAN/CSA A23.1 and A23.2.

.2 Materials:

(a) Portland cement: Type 10 to CAN/CSA A3000, for winter conditions Type 30 may be used. *(REVISED NOVEMBER 2016)*
(b) Fly Ash: Type F to CAN/CSA A23.5.
(c) Water: To CAN/CSA A23.1.
(d) Aggregate: To CAN/CSA A23.1.
(e) Air entraining admixture: To CAN3 - A266.2. *(REVISED NOVEMBER 2016)*
(f) Chemical admixtures: To CAN3 - A266.2. Use of admixtures to accelerate or retard curing as directed by the Engineer. *(REVISED NOVEMBER 2016)*

.3 Mix Design:

(a) Compressive strength: 0.5MPa at twenty-eight (28) days.
(b) Cement content: 25kg per m³.
(c) Slump: 150 - 200mm
(d) Air entrainment: 4 - 6%

.4 Formwork:

(a) Formwork, if required, shall conform to CSA S269.3.

.5 Placement:

(a) Provide the Engineer with twenty-four (24) hours notice prior to placing controlled density backfill.
(b) Segregation of the material during placement shall not be permitted. Pumping of controlled density fill is permitted if approved by the Engineer.
(c) Internal vibrators or other methods of consolidation may be used to ensure undercut areas of pavement are fully supported.
(d) When using controlled density fill to bed and surround the pipe, material shall be placed so as not to damage or displace the pipe.
(e) Begin placement of controlled density fill at the high end of sloping trenches.
(f) Do not place load on the controlled density backfill until authorized by the Engineer.
(g) Steel road plates or other approved means of supporting traffic shall be used until surface restoration can proceed.

4.25 VARIATION IN SPECIFICATION REQUIREMENTS FOR TRAVELED SURFACES

.1 Requirements under Section 4.19 - Backfill and Compaction, Section 4.27 - Surface Restoration and Section 4.28 - Pavement Restoration may be modified or deleted as determined and authorized by the Engineer depending on soil conditions, the condition of
the existing pavement and road structure, traffic control, future planned construction or other reasons, that affect work outlined under the aforementioned specification sections.

4.26 FISH HABITAT GRAVEL

1. Gravel shall be composed of inert, non-fractured smooth washed aggregate.

2. Gradation:

<table>
<thead>
<tr>
<th>US STANDARD SIEVE SIZE</th>
<th>GRADATION LIMITS (PERCENT BY WEIGHT PASSING)</th>
<th>PERCENT BY VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mm</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>75 mm</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>50 mm</td>
<td>80</td>
<td>15</td>
</tr>
<tr>
<td>37.5 mm</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>19 mm</td>
<td>25-30</td>
<td>30-35</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>10-15</td>
<td>10-20</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>0 - 15</td>
<td>0 - 15</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>0 - 5</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

4.27 SURFACE RESTORATION

1. General:

   (a) Surface restoration shall be completed immediately following the backfilling operation.
   (b) Restore all disturbed surfaces to a condition equal to or better than the condition that existed prior to construction to the satisfaction of the Engineer unless otherwise specified.
   (c) Repair any damage to adjacent lands or improvements.
   (d) Damage to paved surfaces shall be seal coated, patched or replaced in an approved manner to the satisfaction of the Engineer.
   (e) Damage to graveled surfaces shall be restored by scarifying, regrading and compacting the surface, or if required, regravelling the surface with base gravel or approved equivalent to the satisfaction of the Engineer.
.2 Traveled Surfaces:

(a) Restoration of traveled surfaces shall conform to the following minimum requirements, or to the existing road structure, whichever is greater, unless otherwise noted on the construction drawings.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SUB-BASE</th>
<th>BASE</th>
<th>TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel Roads</td>
<td>300mm</td>
<td>50mm</td>
<td>-</td>
</tr>
<tr>
<td>Gravel Shoulders</td>
<td>300mm</td>
<td>50mm</td>
<td>-</td>
</tr>
<tr>
<td>Asphalt Roads (Existing)</td>
<td>250mm</td>
<td>100mm</td>
<td>50mm Asphalt</td>
</tr>
<tr>
<td>Asphalt Roads (With CDF)</td>
<td>CDF</td>
<td>100mm</td>
<td>50mm Asphalt</td>
</tr>
<tr>
<td>Gravel Driveways</td>
<td>-</td>
<td>100mm</td>
<td>-</td>
</tr>
<tr>
<td>Asphalt Driveways</td>
<td>-</td>
<td>100mm</td>
<td>50mm Asphalt</td>
</tr>
<tr>
<td>Concrete Driveways*</td>
<td>-</td>
<td>100mm</td>
<td>100mm Concrete</td>
</tr>
<tr>
<td>Asphalt Sidewalks</td>
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<td>100mm</td>
<td>50mm Asphalt</td>
</tr>
<tr>
<td>Concrete Sidewalks</td>
<td>250mm</td>
<td>100mm</td>
<td>100mm Concrete</td>
</tr>
<tr>
<td>Asphalt Walkways</td>
<td>150mm</td>
<td>50mm</td>
<td>50mm Asphalt</td>
</tr>
</tbody>
</table>

* Concrete driveways within the road rights-of-way shall be restored in accordance with the asphalt driveway requirements where the abutting street is not constructed with concrete curb and gutter or where future road widening will be required.

(b) Place and compact sub-base, and base to 95% Modified proctor Density (ASTM D1557).
(c) Restore asphalt road surfaces in accordance with Section 4.28 – Pavement Restoration.
(d) If approved by the Engineer, excavated road gravel may be reused for the sub-base course.
(e) Concrete shall be in accordance with Section 8 – Curbs, Sidewalks and Walkways.

.3 Ditches:

(a) Reshape ditches to the original lines, grades and sections as existed prior to construction unless otherwise shown on the construction drawings.
(b) Restore ditch with a minimum of 300mm of import granular fill, or other material specified by the Engineer where stability of ditch slopes and bottom cannot be maintained.
(c) Compact to 95% Modified Proctor Density (ASTM D1557).

.4 Boulevards, Statutory Rights-of-way and Private Property:

(a) Surface restoration in untraveled boulevard areas shall be limited to the replacement of topsoil, grass, gravel, rock chips or bark mulch (subject to drainage conditions) unless otherwise stated in the construction drawings or contract documents.
(b) Surface restoration shall be a minimum depth of 100mm, or to meet pre-construction conditions, whichever is greater, unless otherwise noted on the construction drawings.
(c) Restore unimproved areas with materials equivalent to the surface conditions prior to construction.
(d) Restore gardens with materials approved by the Engineer including top soil, bark mulch, rock chips or other materials required to match pre-construction conditions.
(e) Restore lawns with sod removed prior to construction, otherwise restore lawn with top soil approved by the Engineer and seed or sod to match existing lawn.
(f) Restore gravel surfaces with equivalent granular materials.
(g) Restore driveways in accordance with Section 4.27.2.
(h) Restore landscaped areas in accordance with Section 4.27.5.
(i) Surface restoration in statutory rights-of-way shall also be in accordance with the rights-of-way condition sheet.
(j) Prior to acceptance of the work, the contractor shall obtain and submit, in duplicate to the Engineer, a written release from each owner of property, where works were constructed or damaged, certifying that the owner is satisfied with the completed works.

.5 Landscaped Areas:

(a) Top soil, shrubs, small trees, fences and other items removed prior to, or during construction shall be replaced to the satisfaction of the property owner.
(b) Replacement shrubs, trees and plants shall be planted at a suitable time of the year in accordance with good horticultural practice to provide a maximum assurance of survival.
(c) During the maintenance period, any trees, shrubs or plants which show signs of dying as a result of the Contractor's operation shall be replaced with new plantings of a similar variety, age and size at no extra cost to the owner.

4.28 PAVEMENT RESTORATION

.1 All pavement restorations with a minimum 75mm asphalt thickness shall be constructed in accordance with Standard Drawing No. T-4A or as directed by the Engineer. All pavement restorations with less than 75mm asphalt thickness shall be constructed in accordance with Standard Drawings No. T-4 or as directed by the Engineer.

.2 All pavement restorations where asphalt cutting around a manhole is required, shall be done in accordance with Standard Drawing No. T-4B.

.3 All excavations in traveled paved areas shall be patched on the same day as the excavation with a temporary or permanent patch, or with approved steel plates, unless otherwise directed by the Engineer.

.4 Temporary Pavement Patching:

(a) All temporary patching and steel road plates shall be installed and maintained to ensure safe and smooth conditions.
(b) Temporary patching shall consist of cold or hot mix asphaltic concrete as approved by the Engineer and placed to a minimum compacted thickness of 50mm.
(c) Use of steel road plates shall require approval from the Engineer and shall only be used where the specifications or drawings require the trench to be left open. (i.e. to allow curing of concrete or controlled density fill.) Steel plates shall be rated to meet traffic loading requirements.
.5 Permanent Asphaltic Concrete Pavement Patching:

(a) Install permanent pavement patch within 15 days of the excavation unless otherwise approved by the Engineer.
(b) Remove and dispose of all broken, cracked, damaged or temporary pavement as well as paved areas showing settlement.
(c) All pavement outside the allowable trench width, as shown on Standard Drawing No. T-1, that is damaged as a result of the contractor’s operation shall be removed; all backfill beneath the damaged pavement recompacted; and the pavement reinstated in accordance with these specifications at no additional cost to the Owner.
(d) If required, re-cut existing pavement so that the location and alignment of the patch is in accordance with Section 4.29 – Final Cutting Paved Surfaces, and so that the pavement edge is a minimum of 300mm from the trench wall.
(e) Excavate patch, as required, to ensure placement of the specified thickness of road base. Road base material and placement shall be in accordance with Section 9 - Streets, Traffic Signs and Markings.
(f) Pavement edges shall be thoroughly cleaned. Tack coat, in accordance with Section 12.27, shall be applied to completely cover all pavement edges. *(REVISED NOVEMBER 2016)*
(g) Minimum compacted pavement thickness shall be equal to the existing pavement thickness or 50mm, whichever is greater.
(h) Material and placement of pavement shall be in accordance with Section 12 - Asphaltic Concrete Paving.
(i) Finished permanent pavement patch shall be smooth and match adjacent pavement grades and be free of humps, depressions or ridges and within 6mm of the existing pavement grades when measured with a 3.0m straightedge, but not uniformly high or low.
(j) The contractor shall maintain all pavement patches in complete repair during the warranty period. Should a dangerous situation arise, the pavement patch shall be repaired immediately upon notification by the Engineer, unless otherwise directed by the Engineer.

.6 Temporary RAP Patching: *(REVISED NOVEMBER 2016)*

(a) The RAP specifications shall be in accordance with Section 12.23.3(a) – Recycled Asphalt Pavement. *(REVISED NOVEMBER 2016)*
(b) Minimum compacted RAP thickness shall be 50mm or as specified in the contract documents. *(REVISED NOVEMBER 2016)*
(c) RAP patches shall be compacted to 95% modified proctor, (ASTM D1557) in one lift so the finished grade is at or above the existing pavement surface. *(REVISED NOVEMBER 2016)*
(d) If the finished grade is below the existing pavement surface, the RAP shall be scarified, additional RAP material added, and recompacted so the finished grade is at or above the existing pavement surface. *(REVISED NOVEMBER 2016)*
(e) If the finished grade is above the existing pavement surface, it shall be trimmed flush with the existing pavement surface. *(REVISED NOVEMBER 2016)*
(f) Temporary RAP patches are to be used only on low volume roads unless directed otherwise by the City Engineer. *(REVISED NOVEMBER 2016)*
SECTION 4 - TRENCH EXCAVATION, BEDDING AND BACKFILL
SPECIFICATIONS AND INSTALLATION

4.29   FINAL CUTTING PAVED SURFACES

.1 All final pavement cuts shall be sawn in accordance with Section 4.28 – Pavement Restoration.

.2 All final cuts shall be a minimum of 300mm from the trench wall.

.3 All longitudinal pavement cuts in streets shall lie outside a vehicle wheel path, unless otherwise directed by the Engineer.

4.30   TRENCH SETTLEMENT DURING GUARANTEE PERIOD

.1 The Contractor shall replace materials and rectify all failures that occur as a result of settlement of trench backfill or collapse of trench walls during the guarantee period as specified in Section 2.03 – Materials and Workmanship, Article 29.

.2 Trenches in which backfill settles shall be refilled with the specified backfill material, and paved surfaces that are adjacent to trenches or on trench backfill, which fail during this period, shall be replaced or repaired in an approved manner.

4.31   PRIVATE UTILITIES IN CITY RIGHTS-OF-WAY

.1 Private utilities within City of Nanaimo road rights-of-way generally shall follow the alignments shown on Standard Drawings No. T-9 and T-10.

.2 All private utilities shall be traceable electronically.

.3 Installation of private utilities shall require prior approval by the City Engineer.
NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
NOTES:
1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
NOTES:
1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DIMENSIONS AND DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
NOTES:
1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DIMENSIONS AND DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
CUT ASPHALT 300 (MIN.) BACK FROM TRENCH WALL.

FOR BACKFILLING AND COMPACTION REFER TO SECTION 4.19

HOT-MIX ASPHALT TO MATCH EXISTING OR 75 (MIN.) WHICHER IS GREATER.

300 (MIN.)

300 (MIN.)

FOR ROAD STRUCTURE RESTORATION REFER TO SECTION 4.27

WHERE THICKNESS OF EXISTING A.C. PERMITS, GRIND, TACK COAT AND OVERLAY OR APPROVED ALTERNATIVE

PERMANENT RESTORATION

NOTES:
1. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DIMENSIONS AND DETAILS.
2. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
NOTES:
1. COVER MANHOLE WITH BUILDING PAPER AND CONSTRUCTION ASPHALT CONCRETE BASE COURSE AND WEARING COURSES.
2. SAW CUT SQUARE EXCAVATING AROUND MANHOLE 300mm MIN FROM MANHOLE FRAME.
3. RAISE MANHOLE COVER AND FRAME TO FINISH GRADE.
4. APPLY TACK COAT TO EDGES OF EXISTING PAVEMENT BEFORE INSTALLING PATCH.
5. FINISH JOINT WITH ASPHALT SEAL AND SAND.
6. REFER TO STANDARD DRAWINGS AS PER RELEVANT SECTIONS 5, 6, OR 7 FOR OTHER MANHOLE REQUIREMENTS.
7. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCT LIST WILL BE ACCEPTED FOR INSTALLATION.
8. REFER TO STANDARD DRAWING T-1 FOR ADDITIONAL TRENCH DIMENSIONS AND DETAILS.
9. ALL DIMENSIONS IN MILLIMETRES UNLESS SHOWN OTHERWISE.
ELEVATION

SECTION A-A

PLAN

NOTES:
1. USE OF CONCRETE ENCASEMENT WHERE MINISTRY OF HEALTH’S MINIMUM WATER/SEWER SEPARATION OFFSET CANNOT BE MET, REQUIRES APPROVAL BY THE MINISTRY OF HEALTH.
2. FOR PIPE PROTECTION WITH CONCRETE REFER TO STANDARD DRAWING T-6.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

CONCRETE 20 MPa AT 28 DAYS

DESCRIPTION:
- WATERMAIN BELL
- TYPE COUPLING

WHERE POSSIBLE, NO WATERMAIN PIPE JOINTS WITHIN CONCRETE ENCASEMENT.
NOTES:

1. THE REQUIREMENT FOR CONCRETE PIPE PROTECTION SHALL BE DETERMINED BY THE
   ENGINEER. DIMENSIONS SHOWN ARE MINIMUM REQUIREMENTS AND SHALL
   BE MODIFIED TO SUIT PIPE LOADING CONDITIONS.
2. USE OF CONCRETE BEDDING OR HAUNCHING SHALL NOT BE PERMITTED
   ON PVC OR OTHER FLEXIBLE PIPE MATERIALS.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.

ALTERNATIVE 1 - ENCASEMENT

CONCRETE 20 MPa AT 28 DAYS

FLEXIBLE COUPLING

ALTERNATIVE 2 - PROTECTIVE SLAB

CONCRETE (20 MPa AT 28 DAYS MIN.)
REBAR (15M @ 200 c/c MIN.)

300 (MIN.) OF UNDISTURBED SOIL
COMPACTED GRANULAR BEDDING
NOTES:
1. SANITARY AND STORM SEWER SERVICES TO BE INSTALLED ON THE LOWER SIDE OF THE LOT, AND WHERE POSSIBLE, SHALL BE FROM THE THE FRONT PROPERTY LINE.
2. POLE RESERVE, IF REQUIRED, TO BE AT ALTERNATE LOT CORNER TO WATER SERVICES.
3. GAS SERVICES SHALL BE 1.0m MINIMUM SEPARATION FROM SANITARY, STORM AND WATER UTILITIES.
4. ALL DIMENSIONS IN METERS UNLESS OTHERWISE SHOWN.
5. CAPPED UTC/UGH STUBS MUST BE PLACED WITHIN A STANDARD CONCRETE SERVICE BOX TYPE 66.
TRENCH DAMES - TYPE 1
FOR ALL UTILITY MAINS

NOTES:
1. IF APPROVED BY THE ENGINEER, IN AREAS INACCESSIBLE BY CONSTRUCTION EQUIPMENT, WET, PRE-MIXED CONCRETE FILLED SANDBAGS MAY BE USED.
2. REFER TO SECTION 4.18 FOR TRENCH DAM SPACING.
3. PROVIDE TRENCH DRAINAGE TO AN ACCEPTABLE WATERCOURSE OR STORM COLLECTION SYSTEM FROM EVERY TRENCH DAM. HIGHEST END OF THE TRENCH DAM DRAIN PIPE SHALL BE CAPPED.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
5. ALL PIPE TO BE SDR-28 PVC.
ALTERNATIVE 1
FOR USE IN TILLS AND OTHER STABLE, WELL COMPACTED NATIVE MATERIALS.

ALTERNATIVE 2
FOR USE IN CLEAN GRAVELS, SANDS AND OTHER LOOSE, PERMEABLE NATIVE MATERIALS.

NOTE: MAINLINE PIPE & FILTER CLOTH NOT SHOWN FOR CLARITY.

NOTES:
1. IF APPROVED BY THE ENGINEER, IN AREAS INACCESSIBLE BY CONSTRUCTION EQUIPMENT, WET, PRE-MIXED CONCRETE FILLED SANDBAGS MAY BE USED.
2. REFER TO SECTION 4.18 FOR TRENCH DAM SPACING.
3. PROVIDE TRENCH DRAINAGE TO AN ACCEPTABLE WATERCOURSE OR STORM COLLECTION SYSTEM FROM EVERY TRENCH DAM. HIGHEST END OF THE TRENCH DAM DRAIN PIPE SHALL BE CAPPED.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
5. ALL PIPE TO BE SDR-28 PVC.

Scale: NTS
Created: OCT 2012
Rev Date: NOV 2016
Dwg No: T-8A
NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.
2. REFER TO UTILITY CONSTRUCTION DRAWINGS FOR DUCT SIZE AND OTHER CONSTRUCTION REQUIREMENTS.
3. ALL UTILITIES SHALL BE TRACEABLE ELECTRONICALLY.
APPRAISABLE DIMENSIONS (mm)

HYDRO BOX: 750Ø
TEL BOX: 750x1000
CABLE BOX: 750x1000

UNDERGROUND ELECTRICAL SERVICE AREA
(2.00 x 3.50 MIN.)

NOTE:
1. REFER TO SECTION 9 - STREETS FOR STREET LIGHT AND SIDEWALK OFFSETS.
2. FOR STREET LIGHT OFFSETS LESS THAN 3.00m, HYDRANTS AND STREET LIGHT POLES SHALL NOT BE LOCATED WITH UNDERGROUND ELECTRICAL SERVICES.
3. SERVICE BOXES SHALL HAVE MINIMUM SEPARATION OF 300mm.
4. REFER TO UTILITY CONSTRUCTION DRAWINGS FOR FURTHER DETAILS.
5. ALL UTILITIES SHALL BE TRACEABLE ELECTRONICALLY.
6. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN.
PLAN

FINISHED GRADE

SECTION A-A

EXISTING PIPE
'

'D' + 300 MIN

BEDDING

PROPOSED PIPE OR CONDUIT

CONTROLLED DENSITY FILL

SECTION B-B

TRENCH WIDTH VARIES

EXISTING PIPE

PROPOSED PIPE OR CONDUIT WRAPPED WITH BOND BREAKER

CONTROLLED DENSITY FILL

NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS SHOWN OTHERWISE.
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4.70 **AUTHORIZED HAND EXCAVATION** Section 4.09

Payment for authorized hand excavation will be made at the unit price per linear metre if shown in the Tender Form and will be based on the trench depth. This price shall include supply of materials, hand excavation, hand backfilling, and all work incidental thereto.

4.71 **TRENCH ROCK EXCAVATION** Section 4.07B

Payment for trench rock excavation will be made as shown in the Tender Form:

(a) **By Volume Measurement:**

Payment will be made for excavation of single boulders, pieces of concrete, or masonry having individual volumes exceeding one cubic metre in volume.

Measurement for trench rock excavation will be calculated based on:

1. The depth from the top of the rock surface to 150 mm below the bottom of the pipe barrel.
2. The maximum allowable trench dimensions as per T-1, or for common trenches, as per T-2.
3. The length measured horizontally along the centre line of the trench.
4. Cross sectional measurements will be made at 3 m intervals or as required.
5. In the event that the average rock width is less than 600 mm in any 3 m interval, payment will be based on a 600 mm minimum rock width.

This price shall include excavation, disposal of rock, and all work incidental thereto.

(b) **By Linear Metre:**

The City will provide a rock profile along the trench centreline showing rock elevations at 10 m intervals.

Payment will be made per linear metre of trench where rock is excavated irrespective of depth. This price shall include excavation, disposal of rock, and all work incidental thereto.

(c) **By hourly rates:**

Rates for personnel and equipment shall be in accordance to Section 2 – Article 40 Force Account Work. The contractor shall schedule his workforce in such a manner that the Trench Rock Excavation will not interfere substantially with progress of other work. Only personnel and equipment required for the excavation and disposal of the rock will be paid under force account rates. No payment will be made for delays or standby time.
4.72 **OVEREXCAVATION AND PLACEMENT OF BASE GRAVEL MATERIAL**  Section 4.07B (d) (e) and 4.14

Payment for authorized overexcavation and placement of base gravel material or other material specified will be made at the unit price per tonne of material placed as shown in the Tender Form. This price shall include supply of materials, overexcavation and disposal of the unsuitable material, placement and compaction of the specified base gravel material, special bracing and sheeting as may be required, and all work incidental thereto. Payment for this work will only be made when, in the opinion of the Engineer, it is necessitated by the natural existence of unsatisfactory soil conditions. No payment will be made for unauthorized over excavation which has resulted from acts, neglects, or delays of the Contractor.

4.73 **IMPORTED GRANULAR FILL**  Section 4.20

Payment for imported granular fill will be made at the price per cubic metre or tonne as shown in the tender form (conversion of tonnes to cubic metres compacted will be 2.43 tonnes/cubic meter). This price shall include supplying, loading, hauling, placing, compacting imported granular material, disposal of excavated material and all work incidental thereto. Payment by weight will be based on weigh certificates for material actually incorporated into the work unless otherwise approved by the Engineer.

Tender quantities are based on the allowable trench width limits as shown on Standard Drawings T-1 or T-2, with allowances for site soil conditions. Placement of import granular fill beyond these limits will be at the Contractor's expense where the Contractor employs methods that excavate beyond these limits without prior authorization from the Engineer.

4.74 **CONCRETE AND CONTROLLED DENSITY FILL**

(a) Concrete Fill Section 4.21 - Standard Drawing T-5 and T-6  
(b) Controlled Density Fill - Section 4.24 - Standard Drawing T-3

Payment for concrete or controlled density fill for pipe base, encasement, or backfill in the trench will be made at the unit price per cubic metre shown in the Tender Form. Measurement will be based on the design dimensions of the concrete placed. This price shall include supply of materials, concrete work, form work, curing and protection and all work incidental thereto.

4.75 **TRENCH DAMS**  Section 4.18  Standard Drawing T-8

Payment for trench dams will be made at the unit price per trench dam shown in the Tender Form. This price shall include supply of materials, installation and all work incidental thereto.
**SURFACE RESTORATION** Section 4.27, 4.28 & 4.29

Payment for surface restoration will be made at the price per square metre as shown on the Tender Form for the various types of surface restoration.

a) For surface restoration of untraveled areas, (boulevards, rights-of-way and private property), price shall include all labour, equipment and materials necessary to restore untraveled areas, to a condition equal to or better than existed prior to construction and in accordance with the specifications and drawings.

b) For surface restoration of traveled areas, (roads, shoulders, driveways, sidewalks, curbs and walkways), price shall include all labour, equipment and materials necessary to restore the traveled areas, to a condition equal to or better than existed prior to construction and in accordance with the specifications and drawings. **This price shall include surface cutting and removal, supply and installation of gravel materials, and restoration of the travelled surface.**

c) For temporary surface restoration of traveled areas, (roads, driveways, sidewalks, curbs and walkways), price shall include all labour, equipment and materials necessary to restore and maintain the traveled surface, as directed by the Engineer, using the materials as shown on the Tender Form.

Tender quantities are based on the allowable trench width limits as shown on Standard Drawings T-1 or T-2. Surface restoration beyond these limits will be at the Contractor’s expense where the Contractor employs methods that damage areas beyond these limits without prior authorization from the Engineer.

**ASBESTOS CEMENT PIPE REMOVAL**

Payment for the handling, cutting and removal of asbestos cement pipe will be made at the unit price per linear metre of pipe removed as shown in the Tender Form. This price shall include all labour, equipment and materials required for the proper removal and disposal of asbestos cement pipe as required by the WorkSafeBC Regulations and City of Nanaimo Asbestos Cement Pipe Safe Work Procedures (Jan 30, 2015) provided in Appendix 2.
SECTION 5 - WATER DISTRIBUTION SYSTEM

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SECTION 5 - WATER DISTRIBUTION SYSTEM
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(REVISED NOVEMBER 2016)
### SECTION 5 - WATER DISTRIBUTION SYSTEM

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<td>W-21</td>
</tr>
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*(REVISED NOVEMBER 2016)*
5.01 **SCOPE**

.1 Waterworks design shall follow accepted engineering principles, the Provincial Health Branch requirements, the Fire Underwriters Survey Guidelines and the following design criteria:

5.1 A **WATER DEMAND**

.1 The water distribution system shall be designed according to the following minimum demands:

(a) **Residential:**

- Average daily per capita: 455 L
- Maximum daily per capita: 1135 L
- Maximum peak per capita: 1820 L

(b) **Commercial and Industrial:**

Commercial and other non-residential water demands are normally included in the per capita design consumptions for the overall Community. Heavy industrial, industry parks, and shopping centers must be accounted for separately in any proposed development which includes such zoning.

(c) **Fire:**

Watermains servicing fire hydrants shall be sized to provide Fire Flows in accordance with the recommendations of the Fire Underwriters Survey publication 'Water Supply for Public Fire Protection' 1999 edition. Calculations supporting the theoretical fire flow available are to be submitted with the design drawings. *(REVISED NOVEMBER 2016)*

Fire flow requirements for a development with a sprinklered building under the Building Code shall be determined in accordance with the water supply requirements in National Fire Protection Association (NFPA) 13. *(REVISED NOVEMBER 2016)*

All fire hydrants shall be installed on a looped water system unless otherwise approved by the City Engineer. Water distribution systems shall also be designed to ensure that fire flow, as required by the Insurers' Advisory Organization (IAO), is available for the required duration. *(REVISED NOVEMBER 2016)*

The maximum allowable reduction to a calculated fire flow for a sprinkler system, as determined in Part 3 of Appendix H3 - Fire Flow Calculation Sheet shall be fifty percent (50%).

Design for fire flows shall consider present available flow and anticipated ultimate available fire flow from the City of Nanaimo's water system.

New water distribution piping shall be capable of delivering the required fire flows with a minimum of 75l/s during Maximum Day Demand and a residual pressure at all flowing hydrants of 150kPa. The hydrant fire flow for new piping shall be the value in Table W-1 “Hydrant Fire Flows by Land Use Zone” for all properties served by the new piping.
SECTION 5 - WATER DISTRIBUTION SYSTEM
DESIGN CRITERIA

For new developments, a balance of pipe size, water quality and existing fire flows at the main will be considered. If the fire flow requirements, as calculated above, cannot be supplied by the existing water distribution system at time of development, available fire flows shall be reviewed with the City Engineer. The developer will be required to either upgrade portions of the system at their own cost or modify the proposed development to match existing fire flows at the main.
**SECTION 5 - WATER DISTRIBUTION SYSTEM DESIGN CRITERIA**

**TABLE W-1: HYDRANT FIRE FLOWS BY LAND USE ZONE**

<table>
<thead>
<tr>
<th>LAND USE ZONE (BYLAW 4500)</th>
<th>Hydrant Flows at main (ℓ/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 - 3 Single Dwelling Residential</td>
<td>75</td>
</tr>
<tr>
<td>R4 Duplex Residential (not sprinklered)</td>
<td>150</td>
</tr>
<tr>
<td>R5 Three &amp; Four Unit Residential</td>
<td>110</td>
</tr>
<tr>
<td>R6 Townhouse Residential</td>
<td>130</td>
</tr>
<tr>
<td>R7 Row House Residential ((s) for larger buildings)</td>
<td>90</td>
</tr>
<tr>
<td>R8 Medium Density Residential</td>
<td>240</td>
</tr>
<tr>
<td>R9 * High Density (High Rise) Residential</td>
<td>300</td>
</tr>
<tr>
<td>R10 Steep Slope Residential (SFD / (s) for Multi)</td>
<td>75 / 175</td>
</tr>
<tr>
<td>R11 Recreational Vehicle Park</td>
<td>120</td>
</tr>
<tr>
<td>R12 Mobile Home Park Residential</td>
<td>120</td>
</tr>
<tr>
<td>R13 Old City Duplex Residential</td>
<td>180</td>
</tr>
<tr>
<td>R14 Old City Low Density (Four plex) Residential</td>
<td>115</td>
</tr>
<tr>
<td>R15 Old City Medium Density Residential</td>
<td>140</td>
</tr>
<tr>
<td>AR1 Rural Resource</td>
<td>75</td>
</tr>
<tr>
<td>AR2 Urban Reserve</td>
<td>75</td>
</tr>
<tr>
<td>COR1 Residential Corridor</td>
<td>230</td>
</tr>
<tr>
<td>COR2 * Mixed Use Corridor</td>
<td>300</td>
</tr>
<tr>
<td>COR3 * Community Corridor</td>
<td>300</td>
</tr>
<tr>
<td>CC1 Local Service Centre</td>
<td>105</td>
</tr>
<tr>
<td>CC2 Neighbourhood Centre</td>
<td>200</td>
</tr>
<tr>
<td>CC3 * City Commercial Centre</td>
<td>300</td>
</tr>
<tr>
<td>CC4 * North Nanaimo Urban Centre</td>
<td>300</td>
</tr>
<tr>
<td>CC5 Hospital Urban Centre</td>
<td>240</td>
</tr>
<tr>
<td>CC6 Commercial Recreation Centre (s)</td>
<td>----</td>
</tr>
<tr>
<td>DT1 Core ((s) for high rise)</td>
<td>230</td>
</tr>
<tr>
<td>DT2 Fitzwilliam</td>
<td>300</td>
</tr>
<tr>
<td>DT3 * Wallace</td>
<td>300</td>
</tr>
<tr>
<td>DT4 Terminal Avenue</td>
<td>210</td>
</tr>
<tr>
<td>DT5 Chapel ((s) for high rise)</td>
<td>240</td>
</tr>
<tr>
<td>DT6 * Port Place ((s) for high rise)</td>
<td>300</td>
</tr>
<tr>
<td>DT7 Quennell Square</td>
<td>225</td>
</tr>
<tr>
<td>DT8 Old City Mixed Use</td>
<td>140</td>
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<tr>
<td>DT9 Old City Central</td>
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<tr>
<td>PRC1/2/3 Parks, Recreation and Culture One, Two, Three(s)</td>
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<tr>
<td>I1 Highway Industrial</td>
<td>225</td>
</tr>
<tr>
<td>I2 * Light Industrial</td>
<td>300</td>
</tr>
<tr>
<td>I3 * High Tech Industrial</td>
<td>300</td>
</tr>
<tr>
<td>I4 * Industrial</td>
<td>300</td>
</tr>
<tr>
<td>CS1/2/3 Community Service One, Two, Three(s)</td>
<td>----</td>
</tr>
<tr>
<td>W1 Waterfront</td>
<td>75</td>
</tr>
<tr>
<td>W2 * Harbour Waterfront</td>
<td>300</td>
</tr>
<tr>
<td>W3 Newcastle Waterfront</td>
<td>285</td>
</tr>
<tr>
<td>W4 * Industrial Waterfront</td>
<td>300</td>
</tr>
<tr>
<td>CD1 - CD6 Comprehensive Development (s)</td>
<td>----</td>
</tr>
</tbody>
</table>

Land uses marked * require limitation to 300ℓ/s
Land uses marked (s), and all high rises require site specific calculations

*(REVISED NOVEMBER 2016)*
SECTION 5 - WATER DISTRIBUTION SYSTEM
DESIGN CRITERIA

5.2 WATER PRESSURE

.1 Minimum design distribution pressure in all areas at peak hour demand is 275kPa based on
design low reservoir level. With the combination of maximum daily demand and the
specified fire flow, the minimum residual water pressure at the fire hydrant is 138kPa.
Where these minimum design pressures cannot be maintained due to an increase in
elevation or distance from the point of connection, a booster pump station and/or
emergency storage shall be provided as part of the distribution system. *(REVISED
NOVEMBER 2016)*

.2 The maximum allowable distribution line pressure is 860kPa static, except where individual
connections are permitted directly from trunk mains and where special precautions are
taken. Otherwise, where distribution pressures will exceed 860kPa static due to a drop in
elevation, a pressure reducing station shall be installed as part of the distribution system.
Where distribution pressures exceed 550kPa, occupants of existing houses in the area
shall be advised to install individual pressure reducing valves.

5.2A VELOCITY

.1 The maximum desirable velocity at maximum peak hour flow shall not exceed 2.0m/s.
*(REVISED NOVEMBER 2016)*

.2 The maximum desirable velocity during fire flow conditions plus the maximum day rate shall
not exceed 3.0m/s. *(REVISED NOVEMBER 2016)*

5.3 DESIGN POPULATION

.1 Design populations used in calculating water demands shall be computed in accordance
with the City of Nanaimo’s population predictions or with the planned development in the
area to be served, whichever is larger. In the absence of detailed design population
information, the following minimum design population densities shall be used.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Population Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>36 persons per hectare</td>
</tr>
<tr>
<td>Low density multi-family</td>
<td>48 persons per hectare</td>
</tr>
<tr>
<td>High density multi-family</td>
<td>120 persons per hectare</td>
</tr>
<tr>
<td>Industrial &amp; Commercial</td>
<td>36 persons per hectare</td>
</tr>
</tbody>
</table>

5.4 HYDRAULIC NETWORK

.1 Depending on the complexity and extent of the proposed distribution system, the City may
require, for new developments, a hydraulic network analysis diagram showing maximum
design flows and pressures. If this information is required, it shall be stated at the time of
the feasibility review and shall be submitted by the applicant with the detailed design
application. The hydraulic network shall be designed to distribute the maximum design
flows in accordance with Section 5.02 – Water Pressure and Section 5.02A – Velocity.

.2 Field testing of design flows and existing network capacity may be required by the City
Engineer.
5.5 WATER DISTRIBUTION PIPING

.1 The general requirements for the distribution piping are as follows:

(a) Numerous trunk lines and secondary feeders shall be installed throughout the system. Mains must be adequate to deliver consumption and fire flow demands for the area served, and should be spaced not more than 1000m apart and looped. For extensions to the distribution network, all water distribution piping shall be looped. When looping is not feasible, temporary or permanent dead ends shall be approved at the discretion of the City Engineer.

(b) Pipes on a grid system in residential areas shall be a minimum of 200mm diameter, except that 150mm diameter may be allowed for short interconnecting streets, or short dead ends not over 100m long. Where dead ends or poor grids are likely to last over two years, greater pipe diameters may be required and shall be evaluated for peak hour and fire flow requirements.

(c) Lines furnishing domestic supply only, and not serving hydrants, may be 100mm in diameter. Where a watermain ends in a dead-end or a valve is normally closed, a fire hydrant or flushout shall be provided for flushing purposes. No flushout shall be connected to a sewer.

(d) The distribution piping and all the ancillary components of the water system work together to provide the service. The longevity and reliability of this overall system is critical to the sustainability of the service. To ensure longevity of the systems, including all of the components from the pipe and fittings to curb stop, there are two options: (REVISED NOVEMBER 2016)

(i) Provide a soils corrosivity report prepared by a professional engineer based on field samples covering the entire alignment with spacing no greater than 150m apart, a minimum of 2 samples shall be provided. The report must outline the required protective measures for all buried metallic components from pipe and fittings, to appurtenances. This report is to be prepared based on the methodology outlined in AWWA C105 Appendix A. (REVISED NOVEMBER 2016)

(ii) Material selection and corrosion protection measures that assume the soils are corrosive (corrosive is defined as a soil exceeding 10 points based on AWWA C105 Appendix A) shall be provided. For all buried metallic components, specific measures may include cathodic protection, petroleum tape application, or non corrosive material choice such as stainless steel. (REVISED NOVEMBER 2016)

(e) All pipes shall be designed for the maximum pressures and earth loading to which the pipe will be exposed. For PVC pipe, in no case shall the design working pressure or Dimension Ratio be less than DR18 and 1030kPa. In areas where static pressures are greater than 860kPa, the Dimension Ratio shall be DR14.

(f) Design criteria for any watermain piping 350mm or greater in diameter requires City Engineer approval. (REVISED NOVEMBER 2016)

5.6 SERVICE CONNECTIONS

.1 Design drawings shall show the arrangement for water service connections. The minimum size of service connection to be specified is 25mm diameter for polyethylene service tubing and 19mm diameter for copper. All components shall be the same size as the service pipe to which they are connected, except for 25mm diameter polyethylene service tubing, the
SECTION 5 - WATER DISTRIBUTION SYSTEM DESIGN CRITERIA

Corporation stop, curb stop and water meter shall be 19mm diameter. All lots shall be provided with their own water service. *(REVISED NOVEMBER 2016)*

.2 The maximum length of water service connections from the watermain to the property line shall be 30m unless otherwise approved by the City Engineer.

.3 For all services greater than 50mm diameter, a gate valve c/w valve box shall be provided at the watermain tee. There shall also be a gate valve at the property line. *(REVISED NOVEMBER 2016)*

.4 Water service connection locations shall be coordinated with gas, cable, hydro and telephone utilities to avoid any conflict with their installations at the property lines of lots.

.5 Each lot shall be serviced by one only service connection for domestic water.

.6 Domestic and fire services shall be separate. The domestic water meter shall be downstream from the separation point. Combined lines may be considered with the approval of the City Engineer. *(REVISED NOVEMBER 2016)*

.7 The City of Nanaimo Water Meter Sizing Calculation Sheet in Appendix H4 shall be used for sizing of water meters. *(REVISED NOVEMBER 2016)*

5.7 HYDRANTS

.1 The minimum hydrant connection size shall be 150mm. The minimum depth of cover shall be 1.20m. Drain outlets shall be provided.

.2 Hydrants shall be constructed in accordance with Standard Drawing No. W-5 - Hydrant Connection. The bottom flange of the hydrant shall be located between 150mm to 200mm above final grade. *(REVISED NOVEMBER 2016)*

.3 Hydrant spacing shall be the most conservative of the following:

(a) B.C. Building Code requirements for sprinkler systems and the Fire Underwriters Survey Guide.

(b) The maximum lineal distance between hydrants shall be 140m in single family and duplex land use zones where sprinklers are not required.

(c) The maximum spacing of hydrants in commercial, industrial, institutional and multi-family residential zones shall be 90m. *(REVISED NOVEMBER 2016)*

.4 Two gate valves shall be provided at a hydrant assembly:

(a) A gate valve, flanged to a flanged tee on the hydrant lead. Hydrants shall not be flanged to the main or gate valve.

(b) A gate valve flanged to the flanged tee at the main. The location of this valve shall be on the upstream side of a dead-end main. *(REVISED NOVEMBER 2016)*

.5 Hydrant access crossings shall be provided for hydrant installations adjacent to open ditches as per Standard Drawing No. W-7.

.6 Hydrants shall be located as per the offsets shown on the Standard Drawings in Section 9 - Streets, Traffic Signs and Markings, and where possible at property corners. Hydrants shall
SECTION 5 - WATER DISTRIBUTION SYSTEM DESIGN CRITERIA

be located 2.0m (minimum) from the edge of present and future vehicular traveled areas; a minimum of 3.0m from lamp standards, hydro poles, or other obstructions; and shall not be constructed closer than 1.0m from front property line. (REVISED NOVEMBER 2016)

.7 The maximum design flow per hydrant shall be 100l/s. Where greater flows are required, additional hydrants shall be provided within a distance approved by the Fire Department.

.8 Preferably, hydrants shall be located on low points in the pipe system in conjunction with hydrant spacing for fire control.

5.8 VALVES

.1 In general, valves shall be located as follows: (REVISED NOVEMBER 2016)

(a) In intersections either in a cluster at the pipe intersection or at projected property lines to avoid conflicts with curbs, gutters and sidewalks. Normally, 3 valves will be required at an “X” intersection of mains, and 2 valves at a “T” intersection of mains. (REVISED NOVEMBER 2016)

(b) Distance between valves shall not be more than 150m. (REVISED NOVEMBER 2016)

.2 Unless otherwise permitted, valves shall be the same size and class as the pipe in which they are installed. Resilient seat gate valves shall be used up to and including 300mm diameter. Valves may be rubber seated butterfly valves if approved by the City Engineer. (REVISED NOVEMBER 2016)

.3 Thrust blocking or other restraints shall be provided on valves.

.4 Use of butterfly valves requires approval by the City Engineer. Butterfly valves shall not be direct buried. Chambers shall be provided for all butterfly valves.

5.9 THRUST BLOCKS AND JOINT RESTRAINTS (REVISED NOVEMBER 2016)

.1 Provide concrete thrust/reaction blocks or restraints on all tees, bends (>5 degrees), valves, caps and fittings. For pipes equal to or less than 300mm nominal diameter, refer to Standard Drawing No. W-8 for the minimum thrust/reaction block dimensions. Thrust/reaction and restraint calculations shall be completed by the Design Engineer and details shall be shown on the design drawings in the following cases: (REVISED NOVEMBER 2016)

(a) For sizes larger than 300mm diameter.
(b) Where pressures exceed 1034kPa.
(c) Where allowable soil bearing is less than 96kPa.
(d) Where vertical thrust/reaction blocking is required. (REVISED NOVEMBER 2016)
(e) Where joint restraints are used.

.2 Thrust calculations for joint restraints shall be done in accordance with the manufacturer's specifications. The type of joint restraint and length of pipe to be restrained shall be clearly indicated on the design drawings. All tie rods and joint restraints shall be protected with an approved petrolatum protection coating meeting AWWA Standards. (REVISED NOVEMBER 2016)
SECTI0N 5 - WATER DISTRIBUTION SYSTEM
DESIGN CRITERIA

.3 Tie rods and joint restraints shall be provided, as a minimum for the following locations:

(REVISED NOVEMBER 2016)

(a) Hydrants
(b) Blow-offs
(c) Temporary caps
(d) Fittings or pipes larger than 300mm
(e) Carrier pipe in casings
(f) Connections to valves outside PRVs and other chambers
(g) Any other location required by the Design Engineer or City Engineer.

(REVISED NOVEMBER 2016)

5.10 WATERMAIN LOCATION, DEPTH AND GRADE

.1 The minimum depth of cover shall be 1.20m unless otherwise permitted by the City Engineer. Minimum cover over watermain pipe crossings under ditches shall be 0.5m.

(REVISED NOVEMBER 2016)

.2 Unless otherwise approved by the Engineer, tolerances for pipe alignment and grade shall be:

Alignment ±50mm
Grade ±25mm

(REVISED NOVEMBER 2016)

.3 Watermains shall be located not less than 3.0m clear distance horizontally and 0.45m clear distance vertically from all sewer lines, unless otherwise permitted by the City Engineer and the Provincial Health Department. Normal watermain offsets are shown in the standard drawings for roadways.

(REVISED NOVEMBER 2016)

.4 If pipe alignment is not feasible as a means of establishing required separations due to conflict with existing services, crossings shall be arranged such that the crossover occurs on nominal pipe length centers and all joints within 3m of the crossing shall be secured with concrete encasement (as per Standard Drawing No. T-5), petrolatum tape, shrink wrap or approved equivalent in accordance with the Ministry of Health permit requirements.

.5 Watermains shall be designed with a rising grade (minimum 0.1%) wherever possible, to minimize high points in the main. Where a high point is unavoidable, an air release valve shall be installed in accordance with Section 5.14.

(REVISED NOVEMBER 2016)

.6 For trench dam design, refer to Section 4.18 - Trench Dams.

(REVISED NOVEMBER 2016)

5.10A UTILITIES IN PRIVATE LANDS

The following shall be considered in the design of utilities crossing private lands:

.1 The design of utilities shall avoid crossing private lands as much as possible.

.2 Utilities following property boundaries across private lands shall generally be offset a minimum 2.0m from the property boundary.

(REVISED NOVEMBER 2016)

.3 Appurtenances such as valves, etc., shall not be located on property boundaries.
SECTION 5 - WATER DISTRIBUTION SYSTEM
DESIGN CRITERIA

.4 Utilities shall not cross private parcels in such a manner that they render the property unusable. Special consideration must be given to ensure the location of the utility crossing minimizes the limitations on the future use of the property.

.5 For minimum widths of statutory right-of-way and working widths refer to Appendix D.

.6 For a sample statutory right-of-way condition sheet, refer to Appendix C, Standard Drawing No. RW-2.

.7 For an Easement Release and Inspection Form Following the Construction of the Utility, refer to Appendix C.

5.11 PRESSURE REDUCING STATIONS

.1 A pressure reducing station shall be required where the static pressure in the proposed distribution system will exceed 860kPa. In general, the pressure reducing station shall be located at the elevation where the static pressure initially exceeds 860kPa.

.2 General requirements for pressure reducing stations shall be as follows:

(a) A valved bypass shall be provided.
(b) A downstream surge relief valve shall be provided to release pressure in the event of a failure of the pressure reducing valve(s). The surge relief valve may be incorporated into the pressure reducing station or may be located at some other suitable location within the distribution system. The surge relief valve shall drain to an adequate storm drainage facility, as approved by the City Engineer. Upstream surge relief valves shall be provided as required.
(c) Pressure reducing valves shall be sized to provide adequate pressure control through all ranges of design flows. If necessary, two or more pressure reducing valves of varying sizes shall be provided in the one station. Pressure reducing valves shall be equipped with valve stem position indicators.
(d) Each pressure reducing and surge relief valve shall be provided with isolating valves and shall be installed so that individual components may be easily removed for repair or replacement.
(e) The pressure reducing station equipment shall be enclosed in a watertight reinforced concrete vault designed to CS600 loading with a standard manhole cover or other opening large enough to remove the largest single piece of equipment in the station. Station floors shall be sloped at 2.0% towards a floor drain assembly in accordance with Section 5.16 – Floor Drain Assembly Chamber Design.
(f) Pressure gauges complete with snubbers and isolating valves shall be installed to register both upstream and downstream pressure. Gauges shall be mounted so they may be read from the manhole access lid without entering the chamber.
(g) Adequate strainers shall be supplied on the water used for controlling the regulating valves and on the main intake.
(h) Pressure reducing stations shall be located outside of the travelled portion of any street and must be vented to promote air circulation.
(i) Inside walls, floors and ceilings of stations to be painted with a white water soluble cement base paint manufactured for the purpose of sealing concrete.
(j) Exterior walls below grade shall be black damp-proofed (tar coated) to prevent leakage.
SECTION 5 - WATER DISTRIBUTION SYSTEM
DESIGN CRITERIA

5.12 -NOT USED- (REVISED NOVEMBER 2016)

5.13 METER CHAMBERS

.1 All water services must be metered and all meters must be contained in an approved chamber or meter box normally located in:

(a) the road right-of-way at the property line of the lot served for services 50mm in diameter or less.
(b) a statutory right-of-way on private property for services larger than 50mm in diameter. Chamber shall be as close to property line as possible.
(c) Alternate locations may be considered with the approval of City Engineer. (REVISED NOVEMBER 2016)

.2 Larger strata developments are to have a single meter at the property line with a privately owned watermain. A City owned watermain with individually metered units may be considered for small strata developments with the approval of the City Engineer. (REVISED NOVEMBER 2016)

.3 For small services, 50mm in diameter or less, manufactured meter service boxes in accordance with Section 5.30 – Water Service Connections, clause 5.30.4 are adequate. For larger services, the meter shall be contained in a chamber designed to accommodate the meter arrangement including associated piping, isolation valves, and bypasses and shall be in accordance with Section 5.34.

.4 The meter shall be installed in a horizontal plane.

(a) Avoid locating meter boxes, Hydro, telephone, cable vaults and junction boxes in sidewalks.
(b) If sidewalk location unavoidable, situate box to maximize unobstructed walking corridor.

.5 Isolation valves shall be provided on both sides of meters 50mm diameter and larger. Valves for fire line services shall be in accordance with NFPA regulations.

.6 The following requirements are to be applied in the design of meter chambers.

(a) The chamber shall be sized so that the meter and associated piping are accessible for meter reading, servicing and inspecting. A minimum of 600mm clearance shall be provided between the walls and the meter including associated piping. At least 600mm of head space shall be provided from the highest point on the meter including associated piping to the bottom of the vault cover, and a minimum of 450mm of clearance provided above the chamber floor. Overall inside height of the chamber shall not be less than 1.8m.
(b) The meter shall be protected against freezing, mechanical damage and tampering.
(c) Bypass and isolation valves may be located in approved valve boxes outside the chamber to minimize chamber size.
(d) The chamber shall be constructed of reinforced concrete designed to withstand CS600 loading with a standard manhole cover or other approved opening large enough to remove the largest single piece of equipment.
(e) The meter chamber shall be designed as a vault in accordance with Standard Drawing No. W-11. The meter chamber can be designed as a manhole with a precast circular manhole barrel only when the meter and associated piping can be
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installed allowing for the required clearances to the chamber wall and approved by the City Engineer.

(f) Chambers, either vaults or manholes, that contain valves, flushouts, meters or other appurtenances shall allow for adequate room for maintenance including headroom and side room. Access openings must be suitable for removing valves and equipment.

(g) The chamber shall not be located or constructed such that it is an obstacle or hazard to the customer or public safety.

(h) The lid of the chamber shall be flush with the surrounding grade and the ground surface shall be graded to direct drainage away from the chamber.

(i) An adequate floor drain assembly shall be provided and designed in accordance with Section 5.16 – Floor Drain Assembly Chamber Design.

(j) A safe permanent access ladder shall be provided which meets the WorkSafe BC requirements for fixed ladders.

(k) Exterior walls below grade shall be watertight.

(l) Interior surfaces of chambers for meters 50mm diameter and larger to be painted with white, waterproof masonry wall coating that penetrates and seals pores in masonry surface.

.7 A valved bypass shall be provided for meters 38mm diameter and larger to avoid service shutdown during meter maintenance. For combination fire service and domestic meters, the bypass shall be sized for the largest flow rate. In the absence of the flow rate, the bypass shall be the same diameter as the service. *(REvised November 2016)*

.8 The City has a Cross Connection Control program that requires all new developments to install Premise Isolation. The Premise Isolation will be privately owned. Refer to CSA B64.10, BC Building Code and appropriate City of Nanaimo bylaws. *(REvised November 2016)*

5.14 AIR VALVES

.1 Combination air valves shall be provided at all high points of the watermain or where a closed valve creates a high point (i.e. closed valve to isolate pressure zone) and located off the travelled portion of the road. *(REvised November 2016)*

.2 Combination air valves shall be a minimum of 25mm diameter. *(REvised November 2016)*

.3 For mains 300mm diameter and larger, the air valve type, (combination, release or vacuum) and size shall be determined by the Design Engineer and the details shall be on the design drawings. *(REvised November 2016)*

.4 Combination air valve chambers shall be drained to ensure that the chamber does not flood. *(REvised November 2016)*

.5 Combination air valves must be vented to an appropriate above-grade location to eliminate potential cross-connection in a flooded or contaminated chamber. *(REvised November 2016)*

5.15 FLUSHOUTS

.1 Flushouts shall be provided at the ends of all dead end mains whether permanent or temporary. *(REvised November 2016)*
.2 On all mains greater than 350mm diameter, flushouts shall be installed at the lowest points in the watermain network. *(REVISED NOVEMBER 2016)*

.3 Above-ground flushouts shall only be installed in areas where high ground water tables prohibit the installation of below-grade flushouts.

.4 Above-ground flushouts shall be located as per the offsets shown for hydrants on the Standard Drawings in Section 9 - Streets, Traffic Signs and Markings. Flushouts shall be located 2.0m (minimum) from the edge of present and future vehicular traveled areas and shall not be constructed closer than 0.6m from front property line.

.5 Where practical, and with the approval of the City Engineer, hydrants may also be used in a secondary role as a flushout. *(REVISED NOVEMBER 2016)*

5.16 FLOOR DRAIN ASSEMBLY CHAMBER DESIGN

.1 Chambers are to be designed to include a drain to a storm sewer or ditch.

.2 Floor drain assemblies shall be designed in accordance with Section 7 – Stormwater Management System with adequate capacity to keep the chamber dry at all times.

.3 Floor drain systems shall provide no risk of flooding of the chamber.

.4 Sumps shall be provided at the low point of the meter chamber for all floor drain assemblies.

.5 The design of floor drain assemblies shall consider the following options in the order presented:

(a) Sump drain to an adequately sized and normally dry rock pit or gravity flow to daylight. *(REVISED NOVEMBER 2016)*

(b) Where ground water tables permit, a perimeter drain around the base of the meter chamber with gravity connection to storm sewer mains. The City Engineer may approve raising the perimeter drain to the bottom of the water pipe to provide sufficient grade for a gravity connection.

(c) Alternatives require approval by City Engineer. *(REVISED NOVEMBER 2016)*
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5.20 SCOPE

.1 This specification refers to pressure pipe and appurtenant fittings for water distribution piping and water service connections. Only those products approved by the City Engineer and listed in the City of Nanaimo Approved Products List will be accepted for installation.

5.21 MATERIALS TESTING

.1 If, in the opinion of the Engineer, testing is required, the Engineer will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates inadequacies, additional testing may be required by the Engineer.

.2 The Contractor as directed by the Engineer shall supply specimens or samples for testing.

5.22 WATERMAIN PIPE

.1 The sizes and types of pipe to be used shall be shown on the drawings. *(REVISED NOVEMBER 2016)*

.2 Ductile Iron Pipe:

(a) **Standard Specifications:**

Ductile iron pipe shall conform to AWWA C151 and AWWA C150.

(b) **Supplementary Data:**

Unless otherwise specified on the construction drawings, all pipe shall have a minimum pipe class as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 - 300</td>
<td>350</td>
</tr>
<tr>
<td>350 - 500</td>
<td>250</td>
</tr>
</tbody>
</table>

An affidavit of compliance with the standard specifications and supplementary data shall be submitted from the supplier.

All pipe supplied shall bear the underwriter's label.

Joints shall be a mechanical type conforming to AWWA C111 or shall be rubber gasket, bell and spigot, Tyton joint, or as approved.

(c) **Protective Coatings:**

Ductile iron pipe shall be cement-lined conforming to AWWA C104.

A cathodic protection system shall be provided where warranted by soil conditions.

Polyethylene Encasement to ANSI/AWWA C1054/A21.5 and ASTM A674 where warranted by soil conditions. *(REVISED NOVEMBER 2016)*
.3 STEEL PIPE

(a) Standard Specifications:

Steel pipe, fittings and specials, shall conform to the following standard specifications:

- ASTM A36 – Standard Specification for Carbon Structural Steel
- AWWA C200 - Standard for Steel Water Pipe 150mm and larger ASTM A36
- AWWA C205 – Standard for Cement – Mortar Protective Lining and Coating for Steel Water Pipe 4 in. (100mm) and Larger-Shop Applied *(REVISED NOVEMBER 2016)*
- AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service Sizes 4 in. through 144 in. (100mm through 3,600mm) *(REVISED NOVEMBER 2016)*
- AWWA C208 - Standard for dimensions for Steel Water Pipe Fittings
- AWWA C606 – Standard for Grooved and Shouldered Joints *(REVISED NOVEMBER 2016)*

(b) Supplementary Data:

- An affidavit of compliance with the standard specifications and supplementary data shall be submitted from the supplier.

- Hydrostatic mill test reports for each length of pipe shall be submitted from the supplier.

- Wall thicknesses shall be determined in accordance with AWWA Manual M11 Steel Pipe Design and Installation and the following criteria:
  
  Minimum wall thickness shall be 6.3mm.

Pipe shall be electric resistance welded or fusion welded, with spiral or longitudinal seams. Pipe shall have 1 or 2 longitudinal seams with no girth seam, or one longitudinal seam with girth seams 1.5m - 2.75m apart, or spiral seams. If girth seams are used, adjacent cans within a pipe length shall be arranged so that their longitudinal seams do not form a continuous line. Seams shall be staggered on alternate cans on each side of top centreline so that each seam is approximately 100mm from the top centreline.

Pipes, fittings and special sections shall be complete with all materials necessary to complete a watertight joint by methods other than welding equipment, or coal-tar enamel.

The joints shall be plain ends for mechanical couplings.

(c) Protective Coatings:

The interior surface of the steel pipe fittings and specials shall be cleaned and lined with an epoxy paint, in conformance with AWWA C210 or C213 and ANSI/NSF61. Epoxy paint shall be applied such that there is a minimum thickness of 406 micro-meters. The maximum coating thickness shall be of 508 micro-meters built up after two or more coats, or as recommended by the individual product supplier. Note, for 100% solids, chemically cured epoxies, the maximum thickness may be increased.
above 508 micro-meters. This coating shall also apply to the interior of steel reservoirs.

The exterior surface of buried steel pipe, fittings and specials shall be coated in accordance with AWWA C203 and AWWA C209 and finished with a coal tar epoxy or coal tar enamel and a Kraft paper outer wrap, or; the exterior surface of the pipe shall be coated with extruded polyethylene. Heat shrink sleeves shall be provided for all welded pipe joints. Special sections and fittings shall be coated with a primer and wrapped with polyethylene tape to provide a corrosion resistant coating equal to the extruded pipe coating.

The exterior protective coating for fittings and pipe inside underground chambers shall consist of 2 coats of coal tar epoxy, as per AWWA C210 and painted with marine enamel in colours approved by the City Engineer.

.4 POLYVINYL CHLORIDE (PVC) PIPE

(a) **Standard Specifications:**

100 to 300mm dia to AWWA C900 and CSA B137.3
350 to 1200mm dia to AWWA C905 and CSA B137.3 *(REVISED NOVEMBER 2016)*

(b) **Supplementary Data:**

Unless otherwise stated in the drawings, all pipe shall be as stated in Section 5.05(e) – Water Distribution Piping. An affidavit of compliance with the standard specifications and supplementary data shall be submitted from the supplier. All pipe shall be ULC Listed and be CIP size equivalent. Joints for PVC pipe shall have a mechanical seal formed by a preformed rubber gasket in a bell or coupling. It is mandatory that the push-on integrally thickened bell and spigot type conform to ASTM D3139 Clause 6.2 with single elastomeric gasket to ASTM F477. Couplings shall be of a class and strength equivalent to the pipe. *(REVISED NOVEMBER 2016)*

All PVC water pipe shall be blue in colour.

.5 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

(a) **Standard Specifications:**

HDPE pipe to be used for watermains only, at the discretion and approval of the City Engineer. (HDPE pipe shall not be used for services.)

Projects in which HDPE pipe is proposed shall be accompanied by complete HDPE specifications for approval.

HDPE pressure pipe shall conform to AWWA C906 (Standard for Polyethylene Pressure Pipe & Fittings, 100mm through 1575mm for Water Distribution and Transmission). *(REVISED NOVEMBER 2016)*

Iron pipe size equivalent outside diameter.
(b) **Fittings:**

Fabricated HDPE mitered fittings shall be AWWA C906 suitable for pressure rating as specified in Contract Documents.

Molded HDPE fittings shall be ASTM 3261 suitable for pressure rating specified and fusion to main pipe with dimensions as specified in Contract Documents.

(c) **Supplementary Data:**

An affidavit of compliance with the standard specifications and Section 5.05 – Water Distribution Piping shall be submitted from the supplier. All pipe shall bear the underwriters label.

Joints for HDPE pipe shall be heat butt fusion to ASTM D2657 and in accordance with manufacturer’s recommendations.

Fittings to be compatible with approved mechanical joint fittings and valves without special adapters. See City of Nanaimo Approved Product List.

Couplings shall be of a pressure rating and strength equivalent to the pipe.

5.23 **WATERMAIN FITTINGS**

.1 All fittings for ductile iron and PVC pipe shall be:

(a) Cast iron fittings manufactured to AWWA C110 designed for a minimum working pressure of 1035kPa, and cement mortar lined to AWWA C104.

(b) Asphalt coated ductile iron compact fittings manufactured to AWWA C153, designed for a minimum working pressure of 2415kPa, and cement mortar lined to AWWA C104.

(c) Asphalt coated ductile iron fittings manufactured to AWWA C110, designed for a minimum working pressure of 2415kPa and cement mortar lined to AWWA C104.

.2 The design pressure rating of all fittings shall meet or exceed the pressure class of the pipes they are connected to.

.3 Mechanical seal joints on fittings to pipe shall be formed by a bell equipped with closed tie-rod lugs and preformed rubber gasket suitable for the pipe to which the joint is made.

.4 Flanged joints on fittings shall be flat faced conforming in dimension and drilling to ANSI B16.1.

.5 Ends shall be flanged or belled to suit pipe ends.

.6 Thrust blocks or joint restraints shall be provided as shown in the drawings.

.7 In areas where the static pressure exceeds 1380kPa, fittings shall be as approved by the City Engineer.
5.24 WATERMAIN VALVES

.1 Refer to Section 5.08 - Valves.

.2 Unless otherwise permitted, only valves conforming to the following specifications shall be installed in the distribution system:

(a) Gate Valves:

Gate valves shall be in accordance with AWWA C500 and the following supplementary data:

(i) Gate valves shall have a cast iron or ductile iron body, bronze mounted.
(ii) Gate valves shall be solid wedge gate or double-disc parallel seat, with a non-rising stem.
(iii) Valve ends shall be provided to fit the pipe.
(iv) The position of the valve in line shall be vertical.
(v) Stem seals shall be o-ring.
(vi) Valves shall open to the left (counter-clockwise).
(vii) Extension pieces complete with valve riser guide shall be used where valve bury is deeper than 1.2m below finished grade. Valve nut extension rods shall be a minimum 600mm below finished grade. Refer to Standard Drawing No. W-16.
(viii) Gears will be required on valves 400mm in diameter and larger. Gear cases shall be totally enclosed.
(ix) Valves shall be flanged to fittings.
(x) Bypasses will be provided on valves 510mm in diameter and larger. Ends shall be bell or mechanical at junctions with pipe. Joints shall be formed with a mechanical seal which is the equivalent of that used in jointing the pipe.
(xi) Valves shall have a 50mm square operating nut.

(b) Rubber Seated Butterfly Valves:

Butterfly valves for water service shall be short body flanged type or wafer body type conforming to AWWA C504, suitable for a maximum non-shock shut-off pressure of 1035kPa. Valve construction shall be as follows, or as approved.

(i) Body material shall be ductile or cast iron.
(ii) Disc material shall be ductile or cast iron.
(iii) Valve seats shall be of new natural or synthetic rubber.
(iv) Valve shaft material shall be 18-8 stainless steel type 304 or 316. Shaft shall be pinned to the disc. Shaft sizing shall be in accordance with AWWA C504.
(v) Body shall be complete with shaft bushing and locating lugs for flange bolts.
(vi) Valve operators shall be worm gear type totally enclosed and waterproofed and equipped with adjustable stops. All valves shall be equipped with a standard 50mm square operating nut and the operator shall be located on the side of the valve with the spindle in a vertical position.
(vii) Valve shall be designed for the extreme maximum flows for both opening and closing.
(viii) Valve ends shall suit the pipe.
(ix) Valves shall open to the left (counter-clockwise).
(x) Shaft seals shall be of the o-ring type.
(xi) A reinforced concrete chamber (designed to meet CS600 loading requirements) shall be provided for each butterfly valve as shown on the drawings. Valves shall not be direct buried.

(c) Resilient Wedge Gate Valves:

(i) Valves shall conform to the latest revision of AWWA Standard C509 Resilient Seated Gate valves and shall be UL listed and FM approved

(ii) Valves shall be non-rising stem, open left (counter-clockwise) and have a 50mm square operating nut.

(iii) The wedge shall be ductile or cast iron completely encapsulated with urethane rubber.

(iv) The rubber shall be permanently bonded to the wedge and meet ASTM D429 for test for rubber metal bond.

(v) Stems for non-rising assemblies shall be cast bronze with integral collars or stainless steel in full compliance with AWWA. The non-rising stem stuffing box shall be the O-ring seal type with two rings located above the thrust collar; the two rings shall be replaceable with the valve fully open and subjected to full rated working pressure.

(vi) There shall be two low torque thrust washers located above and below the stem collar. The stem nut shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area.

(vii) The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior. Each valve shall have the manufacturer’s name, pressure rating and the year of manufacture cast on the body. Prior to shipment, each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure.

(viii) Every valve will have a positive stop to prevent distortion to the wedge.

(ix) Valve operating nuts greater than 1.2m below finished grade require a valve nut extension rod complete with valve riser guide. Valve nut extension rods shall be a minimum 600mm below finished grade. Refer to Standard Drawing No. W-16.

5.25 WATERMAIN VALVE BOXES

.1 Where valves are located in the roadway, valve boxes shall be MR Type of cast iron and telescoping so that surface loads are not transmitted to the valve body or pipeline. A minimum of 450mm of adjustment shall be available on all valve boxes. PVC C900/C905 valve hoods shall be used on all 200mm and larger underground valve installations.

.2 Valve box lids shall have a non-rocking fit and extend 75mm into the valve box from the lid seat as shown on Standard Drawing W-16.

.3 Minimum requirements for valve box risers in traveled and untraveled areas shall be DR18 pipe.

5.26 WATERMAIN VALVE MARKERS

.1 Valve markers are required to indicate the locations of the valves.
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.2 Where valve boxes are located outside the paved portion of a road, these markers shall be constructed of 50mm steel pipe painted blue and set in a concrete base. They shall extend one 1.0m above the ground surface. The markers shall be located on site at a location determined by the Engineer opposite the valve and the distance to the valve is to be painted in black figures on a flattened upper portion of the marker.

.3 Where valve boxes are located in the paved portion of the road, valve tag markers shall be installed in a nearby reasonable location. (REVISED NOVEMBER 2016)

5.27 HYDRANTS

.1 Installed fire hydrants shall meet the following specifications:

(a) Hydrants shall be compression type complying fully with AWWA standard C502.
(b) Hydrants shall be clockwise opening and have a standard pentagonal operating nut with a circle diameter of 44.5mm.
(c) The inlet connection shall be 150mm diameter and made of the same material as the mainline piping. The hydrant shall have a bell and preformed rubber gasket suitable for connection to the pipe being used.
(d) Hydrants shall have two nominal 65mm diameter hose outlets without independent cut-off. The 65mm diameter hose outlets shall conform to the B.C. Fire Hose Thread Standards, nominal 65mm I.P., 75mm O.D. male, 8 threads per 25mm, tapering from 75.72mm minimum O.D. to 82.63mm maximum O.D.

There shall also be one nominal 100mm diameter (120mm O.D.) pumper outlet. The 100mm diameter pumper outlet shall conform to the B.C. Fire Hose Thread Standards, nominal 100mm I.P., 117.5 mm O.D. male, 6 threads per 25mm.

(e) Hydrant bodies shall be painted with red rust paint above the bury line. Hydrant ports and bonnets shall be painted with a base coat of aluminum rust paint and a top coat of bright yellow rust paint.
(f) Drain outlets shall be provided.
(g) Depth of bury shall be as required to provide the specified minimum cover on the connecting pipe and the required position of the hydrant flange relative to the finished ground elevation.
(h) For new installations, fire hydrant extensions will require approval from the Engineer.
(i) Subject to the discretion of the City Engineer, hydrant flow test on all new hydrants, in accordance with NFPA 291, may be required. (REVISED NOVEMBER 2016)

.2 Tie Rods and Nuts:

(a) Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B766. Tie rod sizes to be minimum 19mm diameter or greater as shown on the Contract Drawings.
(b) Nuts and internally threaded couplings to be heavy hex finish to ASTM A563. Washers to be flat hardened steel to ASTM F436. All to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.
(c) All tie rods, nuts and washers shall be coated with approved petrolatum corrosion protection. (REVISED NOVEMBER 2016)
.3 **Hydrant Access Crossings:**

(a) Culvert headwalls shall be as specified in Section 7.35B - Culvert Headwalls.
(b) Culverts shall be as specified in Section 7.35A - Culverts.
(c) Gravel surfacing shall be as specified in Section 9.30 – Road Base Gravel Course.

### 5.28 Flushout

.1 All piping and fittings shall be 65mm diameter iron pipe thread, galvanized steel pipe.

.2 Shutoff valve shall be a 65mm cast iron gate valve meeting all specifications for main line valves.

.3 Vertical section of flushout above ground shall be supported by a 100 x 100mm cedar post, painted white with a red top and extending 1.20m above finished grade.

.4 Above ground flushout bodies shall be painted with red rust paint above the grade line. Flushout caps shall be painted with a base coat of aluminum rust paint and a top coat of bright yellow rust paint.

.5 The valve box shall be a MR type of cast iron and telescoping so that surface loads are not transmitted to the valve body or piping. A minimum of 300mm of adjustment shall be available. The 65mm diameter fire hose connection and cap shall meet standard B.C. Fire Hose Thread Requirements.

.6 Below grade flushouts shall conform to Standard Drawing No. W-2B.

### 5.29 Air Valves and Fittings

.1 All air valves shall be combination air release valves. Bushings, reducers and unions to be used in the valve connection shall be brass manufactured to ASA specification A 40.2 using ASTM B62 bronze. Nipples shall be standard brass and threaded at both ends.

.2 Service valves for use in air valve assemblies shall have screw ends and shall be brass or bronze. All packing shall have each ring cut to fit, with staggered joints. Continuous (spiraled) packing shall not be used. Gate valves 100mm or less in diameter shall be wedge disc type with non-rising stem, hand wheel and stuffing box glands, as specified for 1375kPa water (860kPa steam) service.

.3 All air valves shall have two 12mm ball-type drain valves as shown on Standard Drawing No. W-4.

.4 Air valves for watermains greater than 300mm diameter shall be as approved by the City Engineer.

### 5.30 Water Service Connections

.1 **Pipe:**

(a) Tubing for underground services 75mm diameter and smaller shall be:

   (i) type K annealed copper conforming to ASTM B88M or
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(ii) class 200 Polyethylene tubing to AWWA C901.

(b) Service supply lines larger than 75mm diameter shall be as specified for the watermain pipe.
(c) Tracer wire shall be installed with polyethylene tubing and shall be blue in colour and be 14 gauge wire.  

(REVISED NOVEMBER 2016)

.2 Corporation Stops:

(a) Corporation stops shall be bronze conforming to ASTM B62 and conform to AWWA C800 with AWWA standard threaded inlet and compression copper outlet.
(b) Shutoff head shall be solid tee head type.
(c) All pipe for installation inside the meter chamber up to 75mm diameter shall be copper or brass. Only compression, or threaded joints shall be permitted.
(d) All pipe for installation inside the meter chamber over 75mm diameter shall be ductile iron or epoxy coated steel pipe. (REVISED NOVEMBER 2016)

.3 Curb Stops:

(a) Curb stops shall be bronze conforming to ASTM B62 and be supplied with compression and female iron pipe thread outlets. (REVISED NOVEMBER 2016)
(b) Shutoff head shall be solid tee head type.

.4 Meter Service Boxes, Box Extensions and Lids:

(a) Service boxes for water services 25mm diameter and smaller shall be 300mm x 500mm concrete meter boxes complete with cast iron traffic cover marked “water”. Where approved by the City Engineer, plastic meter service boxes may be used in existing landscape areas. They are not to be used in existing, proposed or future driveway locations. (REVISED NOVEMBER 2016)
(b) Service boxes for 38 - 50mm diameter water services shall be 425 x 750mm concrete boxes complete with steel traffic covers marked "Water". (REVISED NOVEMBER 2016)
(c) Service boxes or chambers for water services larger than 50mm diameter shall be specified as per Section 5.34 - Meter Chambers.
(d) Meter box lid shall be suitable for mounting of a “touch pit read” register unit. (REVISED NOVEMBER 2016)

.5 Couplings and Joints:

(a) Couplings for jointing copper shall be compression type. Sweated joints shall not be permitted. (REVISED NOVEMBER 2016)

.6 Pipe Saddles:

(a) Tapping threads to be tapered to AWWA C800. (REVISED NOVEMBER 2016)
(b) Saddles shall be compliant with NSF61. (REVISED NOVEMBER 2016)
(c) Gasket shall be styrene butadiene rubber (SBR) to ASTM D2000 specifications or other approved gasket material. The Design Engineer shall specify the appropriate gasket material. (REVISED NOVEMBER 2016)
(d) Saddles for ductile iron pipe: (REVISED NOVEMBER 2016)
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(i) Saddles for 19mm to 50mm services to have a ductile iron body to ASTM A536. *(REVISED NOVEMBER 2016)*

(ii) Anti-corrosive coating to AWWA C219, AWWA C210, or AWWA C213. *(REVISED NOVEMBER 2016)*

(iii) Two high strength low alloy steel straps to AWWA C111, or Type 304 stainless steel U-bolt straps, with minimum width per strap of 50mm. *(REVISED NOVEMBER 2016)*

(e) Saddles for PVC pipe to AWWA C900/905:

(i) To provide full support around circumference of pipe, saddles with lugs or U-bolt straps that may gouge or deform the pipe are not allowed. *(REVISED NOVEMBER 2016)*

(ii) Saddles for 19mm to 50mm services shall be:

1. Bronze body to ASTM B62 and two stainless steel straps to ANSI T304 with minimum width per strap of 50mm.
2. All-stainless steel broadband saddle to ANSI T304; for services less than 37mm diameter, saddle shell must be a minimum of 125mm wide and have double bolts; for services 37mm to 50mm, saddle shell must be a minimum of 190mm wide and have double bolts. Saddles to come with donut style gasket and stainless steel shell must be minimum 18 gauge thickness. All stainless steel to be fully passivated to ASTM A240. *(REVISED NOVEMBER 2016)*

(f) Pipe saddles shall be installed on all PVC pipe service junctions. *(REVISED NOVEMBER 2016)*

.7 Meters:

(a) Meters shall be compatible with "Sensus Touch Read" automated meter reading and billing system. Meters installed in meter chambers shall be equipped with a Touch Read Pit Lid register mounted on a bracket as per Standard Drawing No. W-12.

(b) All meters shall be equipped with encoder type remote – registers and provide at least 8 digit visual and encoded registration. *(REVISED NOVEMBER 2016)*

(c) For single family servicing, meters shall be 19mm minimum positive displacement meters.

(d) For duplex servicing, meters shall be 25mm positive displacement meters.

(e) All meters larger than 25mm require approval from the City Engineer.

(f) All meters 100mm and larger shall be equipped with a test port or test tee and be plumbed with the appropriate isolation valves and bypass to facilitate in-situ testing of the meter. *(REVISED NOVEMBER 2016)*

(g) All meters used for a fire line service shall be UL listed and FM approved. *(REVISED NOVEMBER 2016)*

(h) All meters shall read in cubic meters.

.8 Gate Valves Domestic Service:

(a) Gate valves shall be as per Section 5.24 – Watermain Valves, clause 5.24.2(a) and (c). *(REVISED NOVEMBER 2016)*
.9 Gate Valves Fire Line Service:
   (a) All valves shall be in conformance with NFPA regulations.
   (b) Solid wedge and parallel seat valves shall be in conformance with Section 5.24 – Watermain Valves, clause 5.24.2(a) and shall be UL listed and FM approved.
   (c) Resilient wedge valves shall be in conformance with Section 5.24 – Watermain Valves, clause 5.24.2(c). (REVISED NOVEMBER 2016)
   (d) Valves installed in chambers shall be OS&Y type or shall be supplied with indicator posts.

5.31 PRESSURE REDUCING STATIONS

.1 Valves:
   (a) Pressure reducing valves shall be hydraulically operated, pilot controlled diaphragm-type globe or angle valves.
   (b) The main valve shall have a resilient disc and a removable seat ring.
   (c) The main valve trim shall be stainless steel.
   (d) The valve stem on 50mm and larger valves shall be guided at both ends.
   (e) All repairs shall be possible without removing valve from main line.
   (f) All wetted surfaces on main valve shall be coated with an epoxy protective coating.
   (g) All PR valves shall have a position indicator.
   (h) All PR valves shall have Y strainers or basket strainers installed upstream of the main valve and upstream of the control pilot.
   (i) All PR valves shall have speed controls between pilot and main valve body.
   (j) All PR valves used for fire line service shall be UL Listed and FM approved (REVISED NOVEMBER 2016)

.2 Gauges, pressure snubbers, isolation valves for gauges:
   (a) All pressure gauges shall have a 90mm minimum dial size with a 6.5mm NPT bottom connection.
   (b) All gauges shall be installed with a piston-type snubber.
   (c) All gauges shall be installed with a brass gate valve for isolation.
   (d) All gauges in pressure reducing chambers shall be mounted so they can be read from the manhole lid access.
   (e) Small diameter piping up to 60mm shall be copper, or brass.
   (f) Piping over 75mm shall be flanged steel pipe.

5.32 FLANGE ADAPTERS AND JOINT RESTRAINTS

.1 Flange adapters and joint restraints shall conform to AWWA C219 and be UL listed and/or FM approved. Flanged joints shall conform to AWWA C110 and ANSI B16.1, Class 125.

.2 Flange adapters and joint restraints shall be ductile iron conforming to ASTM A536 with an anti-corrosion coating on the interior and exterior rings conforming to AWWA C219.

.3 Bolts and nuts shall be high strength low alloy steel conforming to AWWA C111, or stainless steel conforming to ASTM F593 and F594. Rolled threads, fit and dimensions shall be to AWWA C111. (REVISED NOVEMBER 2016)
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.4 Tie rods shall be continuous threaded, quenched and alloyed steel conforming to ASTM A354, Grade BC and hot-dipped galvanized in accordance with ASTM A153. Coarse threads shall have Class 2A tolerance before galvanizing.

.5 Compression gaskets shall conform to AWWA C219.

.6 Flange adapters and joint restraints shall be designed to be suitable for the type pipe for which they are installed.

5.33 FLOOR DRAIN ASSEMBLIES

.1 Pipe and fittings for gravity connections shall conform to Section 7.22A – Piping, Fittings and Services, clause 7.22A.5.

.2 Pipe and fittings for 19mm to 100mm diameter sump pump connections shall conform to Section 5.30 – Water Service Connections.

.3 Services junctions at the storm main, where permitted, shall conform to Section 7.23 – Service Junctions.

.4 Sump drainer assemblies, if required, shall consist of a backflow preventer, ejector pump, foot valve, strainer and float assembly connected to the watermain with a saddle and corporation stop conforming to Section 5.30 – Water Service Connections.

.5 Sumps shall have minimum dimensions of 300 x 300 x 150mm.

.6 Perimeter drains shall consist of:

   (a) 100mm diameter PVC certified to CSA B182.1. Includes drain rock and geotextile wrap.  (REVISED NOVEMBER 2016)

5.34 METER CHAMBERS

.1 Precast Manhole Sections

   (a) Unless otherwise approved, all manholes sections shall be precast reinforced concrete conforming to ASTM C478.
   (b) All precast sections shall be complete with ladder rungs.
   (c) O-ring rubber gaskets shall conform to ASTM C443.

.2 Precast Manhole Bases

   (a) Precast manhole bases shall be reinforced concrete in accordance with ASTM C76 Class III or better.

.3 Manhole Tops

   (a) Manhole tops shall be flat slab, precast concrete. Tops shall be reinforced to meet CS600 loading requirements. Precast tops shall conform to ASTM C478 with approved offset opening for frame and cover.
.4 Manhole Covers and Frames

(a) Covers and frames shall be cast iron and certified to meet CS600 loading requirements with the bearing faces of the cover to be frame machined for a non-rocking fit.
(b) Patterns, dimensions and weights shall be in accordance with the Standard Drawings. Covers shall have "CITY OF NANAIMO WATER" permanently embossed on the covers.
(c) Standard manhole frame and cover shall conform to Standard Drawing No. W-19 – Manhole Frame and Cover.
(d) Utility chamber manhole frame and cover shall conform to Standard Drawing No. W-20 – Utility Chamber, Manhole, Frame, Ring and Cover.
(e) A watertight manhole frame and cover, if required, shall conform to Standard Drawing No. W-21 - Watertight Manhole Frame and Cover.
(f) Covers located in statutory rights-of-way shall be permanently embossed with the additional wording "DO NOT COVER".
(g) Refer to Section 5.58 for frame and cover installation.

.5 Manhole Steps

(a) Steps shall conform to ASTM C478 for manhole steps and ladders and shall be a 19mm diameter aluminum alloy conforming to CSA S157.
(b) All steps shall be complete with approved polyethylene anchor insulating sleeves and installed in 25mm to 26mm diameter precast or drilled holes in a manhole section.
(c) Refer to Section 5.58 for manhole steps installation.

.6 Concrete

(a) The compressive field strength of concrete for manhole bases shall be not less than 20MPa at 28 days.
(b) All concrete work shall conform to Section 11 – Reinforced and Plain Concrete Works.

.7 Precast Concrete Grade Ring

(a) A precast concrete grade ring conforming to ASTM C478 shall be used.

.8 Touch Read Meter Bracket

(a) Touch read meter bracket shall conform to Standard Drawing No. W-12.

5.35 -NOT USED-

(REVISED NOVEMBER 2016)
SECTION 5 - WATER DISTRIBUTION SYSTEM INSTALLATION

5.40 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4 - Trench Excavation, Bedding and Backfill for installation requirements.

5.41 PIPE ALIGNMENT (REVISED NOVEMBER 2016)

.1 The pipe shall be laid on line and grade in accordance with the construction drawings. Each pipe shall be checked for line and grade as it is installed. Methods to maintain pipe alignment and grade shall be approved by the Engineer. (REVISED NOVEMBER 2016)

.2 The following methods shall be used when a main is to be installed on a curve to maintain a constant offset within the road allowance:

(a) Deflection of Joints as per Section 5.46 – Deflection.

   For: Ductile Iron Pipe, as per AWWA C600/82
   For: PVC Pipe, as specified in the Uni-Bell Handbook of PVC Pipe

(b) Manufactured 5° PVC bends.

   Arcing or bending of the pipe is not permitted.

.3 Refer to Section 5.10 – Watermain Location, Depth and Grade for design criteria.

5.42 PIPE CUTTING

.1 Pipe cutting shall be done in the manner recommended by the pipe manufacturer employing tools designed for this purpose.

.2 Cutting of asbestos cement pipe shall conform to WorkSafe BC requirements.

5.43 PIPE INSTALLATION

.1 Pipe shall be installed in strict accordance with the manufacturer’s recommended practice.

.2 Pipe shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer’s defects, or cracks exist that might prevent the proper jointing of the pipe or its operation.

.3 The open end of the pipe in the trench shall be suitably covered to prevent entrance of trench water and other material during periods when pipe is not being installed.

.4 Precautions shall be taken to ensure that displacement of the pipe in the trench does not occur through soil displacement or floatation due to the presence of trench water. Pipe that has been displaced shall be removed from the trench and re-laid.
SECTION 5 - WATER DISTRIBUTION SYSTEM
INSTALLATION

5.44 JOINTS AT RIGID STRUCTURES

.1 A flexible joint shall be provided at locations where the pipe is held in fixed position by a rigid support or structure. The distance from the support or structure shall depend on the diameter and type of pipe being installed and shall be in accordance with the pipe manufacturer’s recommended practice. The purpose of the flexible joint is to prevent pipe failure due to uneven support under the pipe. Approved flexible joints include rubber gasket bell and spigot connections and dresser couplings.

5.45 HORIZONTAL AND VERTICAL CURVES

.1 Pipe on horizontal and vertical curves shall be laid true to the curve of the radius shown on the drawings and in accordance with field lines and grades for each curve supplied by the Engineer. Variations in vertical curves and grades within the allowable joint deflection may be allowed where approved by the Engineer.

5.46 DEFLECTION

.1 Unless otherwise specified, the amount of pipe deflection at joints and couplings shall not exceed the limit as specified by the manufacturer. (REVISED NOVEMBER 2016)

5.47 PIPE RESTRAINT

.1 All fittings shall be restrained either by concrete thrust blocks as per Standard Drawing W-8 or joint restraints as indicated on the construction drawings, as directed by the Engineer.

.2 Concrete thrust blocking shall be placed between undisturbed ground and the fitting to be anchored. The area of thrust block bearing on pipe and on ground shall be as shown on the Standard Drawings or as otherwise indicated on the construction drawings. Concrete shall be so placed that pipe and fitting joints are accessible for repair. Bolts on flanged fittings shall not be encased in concrete. A polyethylene plastic barrier shall be provided between all fittings and concrete for thrust blocking. Concrete specifications shall be as per Section 11 – Reinforced and Plain Concrete Works.

.3 Joint restraints shall be installed in accordance with the manufacturer’s specifications. The length of pipe to be restrained shall be as shown on the construction drawings.

5.48 FITTINGS

.1 Fittings shall be installed at the locations shown on the drawings or as directed by the Engineer. Fittings shall be flanged to valves unless otherwise directed by the Engineer.

5.49 CONNECTIONS TO EXISTING PIPING

.1 All connections to existing piping services, and appurtenances shall be made by the City of Nanaimo forces unless otherwise authorized by the City Engineer.

.2 All connections to existing piping and services shall utilize a manufactured rubber gasket bell and spigot joint or dresser coupling designed for types of pipes to be connected.
SECTION 5 - WATER DISTRIBUTION SYSTEM
INSTALLATION

5.50 VALVES

.1 All valves shall be set plumb directly on the centreline of the pipe and installed in accordance with Standard Drawing No. W-16.

.2 Valve boxes in unpaved areas shall have a 1.0m wide, 50mm thick asphalt apron around the valve box. (REVISED NOVEMBER 2016)

.3 Abandoned Valve Box Removal

(a) Cut asphalt around valve box. Remove valve extension, mud and debris from valve riser box prior to filling with pea gravel. Valve box shall not be pulled prior to filling with pea gravel.

(b) Existing riser pipe must be minimum 300mm below final grade. Riser pipe shall be cut down where necessary so that the existing riser pipe is a minimum 300mm below finished grade.

(c) The minimum 300mm grade difference shall be backfilled with 25mm crush gravel and compacted to City of Nanaimo standards. Temporary cold mix asphalt to be used where necessary.

5.51 VALVES MARKERS

.1 All valve markers shall be installed in accordance with Standard Drawing No. W-9.

5.52 HYDRANTS

.1 All hydrants shall be installed in accordance with Standard Drawing No. W-5.

.2 Hydrant Installation:

(a) Hydrants shall be installed at the locations shown on the construction drawings and as specified in Section 5.07 - Hydrants, clause 5.07.6.

(b) Hydrant installation shall be in general accordance with AWWA manual M17.

(c) Tie rods shall be in accordance with Section 5.27 – Hydrants, clause 5.27.2.

(d) Hydrants shall be set plumb and such that the pumper nozzle faces, and is at right angles to, the road centreline unless otherwise directed by the Engineer.

(e) Hydrants shall be set with the ground flange 150 - 200mm above finished ground or sidewalk surface unless otherwise directed by the Engineer. (REVISED NOVEMBER 2016)

(f) Care shall be taken in installing the connection pipe from the main to the hydrant to ensure that the hydrant is set at the specified level.

(g) Drain rock shall be placed as shown on the Standard Drawing for a hydrant connection to a level above the hydrant drain openings. The drain rock shall be covered with filter cloth before backfilling to prevent plugging up of the drainage pit.

(h) After installation, hydrants shall be covered with firmly secured black plastic bag until they are put into service. (REVISED NOVEMBER 2016)
.3 **Hydrant Thrust Blocking:**

(a) Hydrant thrust blocking shall only be used in situations where installation of tie rods is not acceptable as determined by the Engineer.
(b) Care shall be taken to ensure that concrete for thrust blocking does not interfere with the operation of flange bolts and nuts or prevent proper operation of hydrant drains.
(c) Thrust block bearing areas shall be as shown on the drawings.

.4 **Hydrant Access Crossings:**

(a) Culverted hydrant access crossings shall be constructed as shown on the Standard Drawings.
(b) Culvert headwalls shall be constructed in accordance with Section 7.66 - Culvert Headwalls.
(c) Culverts shall be constructed in accordance with Section 7.65 - Culvert Installation.
(d) Gravel surfacing shall be constructed in accordance with Section 9.54 - Placing and Compacting Sub-base and Base Course.

5.53 **FLUSHOUT INSTALLATION**

.1 All flushouts shall be installed in accordance with Standard Drawing No’s. W-2A and W-2B and located as directed by the Engineer.

.2 Flushouts shall be set plumb.

.3 Care shall be taken in installing the piping, drain hole and drain rock to ensure that the flushout will drain when the 65mm diameter gate valve is closed.

5.54 **AIR VALVE INSTALLATION**

1. All air valves shall be installed in accordance with Standard Drawing No. W-4 and located as directed by the Engineer.

5.55 **FLOOR DRAIN ASSEMBLY INSTALLATION**

.1 Drain assemblies shall be installed as shown on the construction drawings.

.2 Drain assembly connections to storm sewer mains, where approved by the City Engineer, shall be in accordance with Section 7.61 – Service Connection Installation.

5.56 **WATER SERVICE CONNECTION INSTALLATION**

.1 All water service connections up to and including 50mm diameter shall be installed in accordance with Standard Drawing No. W-1. *(REVISED NOVEMBER 2016)*

.2 All water service connections greater than 50mm diameter shall be installed as shown on the drawings.

.3 **Location of Water Service Connections:**

(a) Install service connections to the locations and depths as shown on the drawings or as specified by the Engineer.
(b) Water service connections to each individual property shall have their own independent connection to the watermain.

.4 Water Service Connection Installation:

(a) Trenches shall be excavated where possible so that the pipe can be installed at right angles to, and in a direct line from, the main pipe to the terminus of the service.
(b) The trench shall be excavated to provide a minimum cover of 1.2m over the service connection pipe and raised for the curb stop as shown on Standard Drawing No. W-1 for services up to and including 50mm diameter in size. (REVISED NOVEMBER 2016)
(c) In rock, the trench is to be extended 3.0m into the property to facilitate future extension of the service connection. (REVISED NOVEMBER 2016)
(d) The trench bottom shall be graded to form a continuous support along the service pipe. All rocks or projections within 150mm of the service tubing shall be removed. (REVISED NOVEMBER 2016)
(e) When the service box is to be installed in a driveway, a 150mm wide x 150mm deep concrete apron shall be installed around the concrete service box in addition to the 25mm minus crush gravel base structure. (REVISED NOVEMBER 2016)
(f) For services up to and including 50mm diameter, the pipe shall be connected to the corporation stop and a gooseneck formed as shown on the drawings. (REVISED NOVEMBER 2016)
(g) When polyethylene tubing is installed and squeezers are used, the area squeezed shall be marked with yellow electrical tape so that the location is not squeezed again to prevent damage. (REVISED NOVEMBER 2016)
(h) Copper pipe shall be cut with square ends and reamed with the proper tools. Care shall be taken to prevent the pipe from kinking or buckling on short radius bends. Joints shall be made using the specified couplings. Sweated joints shall not be made. (REVISED NOVEMBER 2016)
(i) Pipe installed in an augered hole shall be protected with a cap or plug to prevent the entrance of foreign material into the pipe.
(j) A gate valve c/w valve box shall be provided at the main on all services over 50mm diameter. (REVISED NOVEMBER 2016)
(k) After installation, water service connection locations shall be marked with a 50 x 100mm pressure treated wood marker stake painted blue and located at the terminus of the water service next to the service box. The stake shall extend from a point approximately 600mm above ground to 600mm below ground except in locations where the extension of the stake above ground surface would be hazardous, in which case the stake shall be placed at a location satisfactory to the Engineer.

.5 Tapping Main Pipe:

(a) Taps shall be made in the main pipe by workmen using tools in good repair with the proper adapters for the size of main being tapped. Pipe shall be tapped while under internal water pressure unless otherwise approved by the Engineer. The minimum distance of a tapping shall be 1.0m from a pipe end or joint, or 2.0m from a pipe end equipped with a flushout and a minimum of 1.0m from an adjacent tapping unless a greater distance is specified by the pipe manufacturer.
(b) Service connections tapped to 100mm diameter main pipes and AC and PVC main pipes (all diameter) shall have approved pipe saddles for hot tapping. (REVISED NOVEMBER 2016)
SECTION 5 - WATER DISTRIBUTION SYSTEM INSTALLATION

.6 Curb Stop and Service Box Installation:

(a) The curb stop shall be installed as shown on the drawings or in the locations directed by the Engineer and shall be provided with a plastic plug to prevent the entrance of foreign material.

(b) The service box shall be installed when the service is installed from the main to the property line. The service box shall be installed plumb with the center of the top of the lid 25mm above finished grade in untraveled areas and 0 - 6mm below finished grade in travelled areas as shown on Standard Drawing No. W-1. (REVISED NOVEMBER 2016)

5.57 WATER METERS

.1 Water meters shall be installed by City of Nanaimo forces unless otherwise authorized by the City Engineer.

.2 Install meters in accordance with the manufacturer’s recommendations.

5.58 METER CHAMBERS

.1 All meter chambers shall be constructed in accordance with Standard Drawing No. W-11 unless otherwise shown on the construction drawings.

.2 The floor drain system shall be installed in accordance with Section 5.55 – Floor Drain Assembly Installation.

.3 Install valves, fittings and meters according to the manufacturer’s recommendations at the locations shown on the construction drawings.

.4 Support valves, fittings and meters by means of steel pipe supports.

.5 Install touch read meter bracket between the first and second ladder rung in accordance with Standard Drawing No. W-12.

.6 If required by the Engineer, meter chambers shall be tested for leakage after the installation of equipment by filling the chamber to the underside of the roof slab with water. The test duration shall be a minimum of three hours. No leakage will be allowed.

.7 Precast Manhole Sections

(a) Precast manhole barrel sections shall be placed plumb.

(b) Joints between the top riser and the cover slab shall be made watertight with cement mortar. Prior to placing sections, the mating faces shall be thoroughly soaked with water and a layer of cement mortar shall be spread on the lower face. After sections are placed, excess mortar which has been squeezed out shall be removed and the joint made flush inside and out.

(c) Joints between precast manhole barrels must utilize O-ring gaskets and shall conform to the manufacturer’s specifications. The inside surface of the precast barrel at the O-ring joints shall be filled with cement grout to a smooth finish.

(d) Damaged O-ring manhole joints require removal and replacement of damaged manhole section. Mortar patching of damaged area if approved by the Engineer, shall require the removal of the O-ring gasket and installation as per Section 5.58.7(b).
(e) Refer to Section 5.34 for precast manhole section specifications.

.8 Manhole Concrete Bases

(a) All water shall be removed from the excavation prior to placing base concrete. The base shall be constructed such that the first section of a precast section can be set plumb with uniform bearing throughout its full circumference.

(b) If material in the bottom of the trench is unsuitable for support, the bottom shall be over excavated to firm base as determined by the Engineer and backfilled to the required grade with thoroughly compacted base gravel as specified for trench bottom stabilization under the applicable item included in Section 4 - Trench Excavation Backfill and Bedding.

(c) Where overexcavation and backfill with base gravel is not practical, special structural support shall be provided as specified for trench bottom stabilization under the applicable item included in Section 4 - Trench Excavation, Backfill and Bedding.

(d) Concrete manhole bases shall be constructed as shown on the drawings.

(e) Refer to Section 5.34 for precast manhole bases section specifications.

.9 Precast Manhole Bases

(a) Installation of precast manhole bases shall conform to 5.58.8.

(b) Precast manhole bases shall be placed on 150mm thick base of 40mm drain rock.

(c) Use of precast concrete bases requires approval by the Engineer.

.10 Concrete

(a) Concrete work shall be as specified under the Section 11 - Reinforced and Plain Concrete Works.

.11 Frames and Covers

(a) Frames shall be set on precast concrete grade rings to bring the cast iron manhole frame up to grade as shown on the Standard Drawings. Contractor to install a minimum of two (2) 62.5mm thick concrete grade rings to a maximum of four (4) 62.5mm thick grade rings. The concrete grade rings shall be laid in common bond with raked mortar joints and shall be mortared inside and outside of the manhole.

(i) Fine grade elevation adjustments of frames shall be done with a minimum of 3, steel only, shims equally spaced.

(b) Manhole covers shall be installed:

(i) for unpaved areas, covers shall have a 1.5m x 1.5m, 50mm thick asphalt apron. Covers shall be set flush with the asphalt surround.

(ii) for paved areas, covers shall be flush with finished pavement grade with a maximum allowed variance of 6mm lower than the finished pavement grade. Covers shall not protrude above the finished pavement.

(c) Steel manhole riser rings shall be used in easements only.

(d) Refer to Section 5.34 for manhole covers and frames specifications.
.12 Manhole Steps
(a) Manhole steps shall be installed in manhole sections by the manufacturer unless circumstance dictates otherwise, in which case approval must be received from the Engineer.
(b) The distance from the top of the chamber manhole, to the first manhole step shall conform to WorkSafe BC requirements.
(c) Refer to Section 5.34 for manhole step specifications.

5.59 NOT USED.

5.60 PRESSURE REDUCING STATIONS

.1 Pressure reducing stations shall be installed in accordance with the construction drawings and supplementary specifications.

5.61 PRESSURE AND LEAKAGE TESTING

.1 Pressure and leakage tests shall be performed on all installed pipes, hydrants, valves, fittings and service connections.

.2 Pressure and leakage tests can be commenced upon completion of all underground utility installation. Prior to testing, concrete thrust blocking shall be sufficiently cured to restrain fittings, valves and hydrants.

.3 Testing procedures shall be submitted to the City Engineer for approval prior to commencement of testing. (REVISED NOVEMBER 2016)

.4 Hydrant lead valves and service corporation stops shall be fully opened during the test. As a preliminary step, the entire system may be pressure and leakage tested at once. Pressure and leakage tests shall be carried out between valved sections of the installation such that every valve in the system is tested for leakage in the shut-off position.

.5 Pressure and leakage testing shall be conducted in the presence of the Design Engineer, and the City of Nanaimo Works Inspector. (REVISED NOVEMBER 2016)

.6 Pressure and leakage tests for ductile iron piping shall be in accordance with AWWA C600.

.7 Testing of welded steel piping shall be in accordance with AWWA C206. No leakage shall be allowed.

.8 Pressure and leakage tests for PVC pipe shall be performed in the following manner:
(a) Fill the section to be tested slowly with water and expel all the air from the section.
(b) If air relief valves are not required at the high points of the test section, the pipe shall be tapped to release all air and approved plugs inserted upon completion of testing.
(c) Pump water into the test section until the static pressure reaches 1035kPa or 1.5 times the average system operating pressure at the point of test, whichever is greater.
(d) Maintain the test pressure in the pipe to ± 70kPa throughout the duration of the test by the addition of a measured quantity of water. The duration of the test shall be a minimum of one hour.
SECTION 5 - WATER DISTRIBUTION SYSTEM INSTALLATION

(e) The quantity of water required to maintain the test pressure shall be considered to be the leakage.

(f) The allowable leakage shall be determined from the following formula: (REVISED NOVEMBER 2016)

\[
L = \frac{SD \times \text{square root of } P}{715,317}
\]

in which:
- \( L \) = allowable leakage (liters/hour)
- \( S \) = length of the test section, in meters
- \( D \) = nominal diameter of the pipe run in mm
- \( P \) = average test pressure during the leakage test in kPa

(REVISED NOVEMBER 2016)

(g) Should testing disclose leakage above the maximum allowable leakage, the contractor shall locate and repair or replace the defect and retest the section until test results are satisfactory.

(h) A copy of the leakage and test pressure report shall be forwarded to the City Works Inspector.

(i) Prior to accepting the work, all valves shall be checked to ensure they fully open.

5.62 FLUSHING, CHLORINATION AND BACTERIAL SAMPLING (REVISED NOVEMBER 2016)

.1 Prior to chlorination, all piping and appurtenances shall be flushed with a minimum velocity of 1.0 m/s. Dispose of flushing water only to drainage works capable of carrying the flows. When flushing the watermain into a sanitary sewer, the downstream capacity shall be reviewed with City of Nanaimo Operations staff.

.2 The Design Engineer shall arrange, undertake and ensure all piping and appurtenances are flushed, chlorinated, flushed of chlorinated water and tested for bacteria according to the latest edition of AWWA C651. (REVISED NOVEMBER 2016)

On completion of chlorination, the entire piping system shall be thoroughly flushed and filled with potable water prior to bacterial sampling. (REVISED NOVEMBER 2016)

Flushing chlorination and bacterial sampling shall be conducted in the presence of the Design Engineer and the City of Nanaimo Works Inspector. (REVISED NOVEMBER 2016)

.3 Chlorinated water shall be disposed of in a way that will not cause harm or damage to vegetation or aquatic life in bodies of water or water courses. Points of discharge are to be approved by the Engineer.

5.63 NOTIFICATION TO ENGINEER - SYSTEM TESTS AND FINAL CONNECTION (REVISED NOVEMBER 2016)

.1 The City Engineer and the City of Nanaimo Works Inspector shall be given 48 hours written notice in advance of all system tests and pipe chlorination by the Contractor.
.2 On new water systems no physical connection (tie-in) to the public system shall be made until the new system passes: (REVISED NOVEMBER 2016)

(a) flushing, (REVISED NOVEMBER 2016)
(b) pressure testing, (REVISED NOVEMBER 2016)
(c) disinfection, (REVISED NOVEMBER 2016)
(d) satisfactory bacterial testing results by an accredited certified lab. (REVISED NOVEMBER 2016)

.3 Upon satisfactory passing, the Design Engineer shall submit copies of all the above noted test results to the City Engineer with their written recommendation on connection to the Public Water Supply. (REVISED NOVEMBER 2016)

.4 The City Engineer will review the provided test results and recommendation from the Design Engineer and if acceptable may grant Approval to Connect to the Public Water Supply. Under no circumstances shall a connection to the Public Water Supply be undertaken without an Approval to Connect issued by the City Engineer. (REVISED NOVEMBER 2016)

.5 Once Approval To Connect is granted, the time to connect (tie-in) to the Public Water Supply shall be no greater than 7 calendar days, otherwise bacterial testing results will be invalid and will need to be redone. The short spool pieces, fittings and couplers required to complete the connection shall be cleaned and disinfected to AWWA standards. All final connections (tie-ins) shall be reviewed by the Design Engineer. Once final tie-in is complete and the system is in operation, the tie-in shall be reviewed by the Design Engineer for water leaks prior to backfilling and covering up. (REVISED NOVEMBER 2016)

.6 Tie-in and connection shall be conducted in the presence of the Design Engineer and the City of Nanaimo Works Inspector. (REVISED NOVEMBER 2016)

.7 Final Connections: (REVISED NOVEMBER 2016)

(a) If Connection is 1 pipe length or less (6m or less) spray or swab disinfect all parts just prior to connection. (REVISED NOVEMBER 2016)
(b) If connection is greater than 1 pipe length (plus 6m), pipe must be set up above ground, disinfected and bacterial samples taken as described in AWWA C651 Section 5. Ends of pipe must be sealed watertight until installed. (REVISED NOVEMBER 2016)
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 5.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. NOMINAL TRENCH WIDTH FOR SERVICE CONNECTION TO BE 600mm.
4. FOR 19mm and 25mm DIA. WATER CONNECTION, SERVICE BOXES SHALL BE CONCRETE WITH TOUCH READ CAST IRON LIDS.
5. FOR 38mm AND 50mm DIA. WATER CONNECTION, SERVICE BOXES SHALL BE CONCRETE WITH STEEL TOUCH READ TRAFFIC LIDS.
6. WHEN SERVICE BOX IS WITHIN A CONCRETE DRIVEWAY, CONCRETE ADJACENT TO THE SERVICE BOX MUST BE A MINIMUM OF 150mm THICK FOR A MINIMUM DISTANCE OF 150mm AROUND THE OUTSIDE EDGES OF THE SERVICE BOX.
7. TRACER WIRE SHALL BE 14 GAUGE AND BLUE IN COLOUR AS PER SECTION 5.30.1. TRACER WIRE SHALL BE INSTALLED AS PER THE MANUFACTURER’S RECOMMENDATIONS AND BE ATTACHED TO THE THE CORPORATION STOP AND RUN ON TOP OF THE SERVICE PIPE TO THE CURB STOP WHERE IT SHALL BE COILED NEATLY WITHIN THE BOX WITH 600mm OF SURPLUS LENGTH. TRACER WIRE SHALL BE SECURED TO THE SERVICE PIPE AT 1.0m INCREMENTS USING ELECTRICAL TAPE. WIRE SHALL NOT BE WRAPPED AROUND THE SERVICE PIPE.
8. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
9. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:

1. NOMINAL TRENCH WIDTH FOR FLUSHOUT IS 600mm
   VALVE BOX NOT TO CONFLICT WITH CURB AND GUTTER CURB AND GUTTER NOT SHOWN

2. 150Ø x 200 PIPE TO BE PLACED AROUND PIPE AT DRAIN HOLE TO PREVENT EROSION.

3. ABOVE GROUND FLUSHOUT TO BE RESTRAINED AS PER THRUST BLOCK OR RESTRAINER METHOD AT THE DISCRETION OF THE ENGINEER.

4. WHEN RESTRAINER METHOD IS USED, RESTRAIN AS PER MANUFACTURER'S RECOMMENDATIONS.

5. ONLY PRODUCTS APPROVED BY CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION

6. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN
NOTES:

1. NOMINAL TRENCH WIDTH FOR FLUSHOUT IS 600mm
   VALVE BOX NOT CONFLICT WITH CURB AND GUTTER
   CURB AND GUTTER NOT SHOWN.

2. LETTERING ON MANHOLE COVER SHALL REFER TO
   "CITY OF NANAIMO WATERWORKS"
   LETTERING SHALL BE 25 FLATTENED FACE GOTHIC
   LETTERING WITH FACE OF LETTERS RAISED TO THE
   SAME ELEVATION AS THE TOP OF THE RIBS.

3. NOT TO BE USED IN AREAS WHERE WATER TABLE
   COULD BE ABOVE FIRE HOSE CONNECTION.

4. SURROUNDING GRADE TO DRAIN AWAY FROM COVER.

5. 150Ø x 200 PIPE TO BE PLACED AROUND PIPE
   AT DRAIN HOLE TO PREVENT EROSION.

6. FLUSHOUTS LOCATED ON GRAVEL ROADS OR SHOULDERS
   REQUIRE A 1.5m X 1.5m HOT MIX ASPHALT APRON,
   50mm THICK.

7. BELOW GRADE FLUSHOUT TO BE REstrained AS PER
   THRUST BLOCK OR RESTRAINER METHOD AT THE
   DISCRETION OF THE ENGINEER.

8. WHEN RESTRAINER METHOD IS USED, RESTRAIN AS PER
   MANUFACTURER'S RECOMMENDATIONS.

9. ONLY PRODUCTS APPROVED BY CITY ENGINEER AND
   LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS
   LIST WILL BE ACCEPTED FOR INSTALLATION.

10. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE
    SHOWN.
NOTES:
1. CHAMBERS LOCATED ON GRAVEL ROADS OR SHOULDERS REQUIRE A 1.5m x 1.5m HOT MIX ASPHALT APRON, 50 THICK
2. PLACE FILTER CLOTH OVER DRAIN ROCK PRIOR TO BACKFILL.
3. ABOVE GROUND VENT PIPING TO BE PAINTED FOREST GREEN.
4. PRECAST CB BARREL SHALL BE AN ACCEPTABLE ALTERNATIVE TO MANHOLE BARREL AND Poured IN PLACE BASE
5. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION
6. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
NOTES:
1. FOR HYDRANT OFFSETS REFER TO DESIGN DRAWINGS. AT NO TIME SHALL HYDRANTS BE CONSTRUCTED CLOSER THAN 1.0 METERS TO THE PROPERTY LINE.
2. HOSE AND PUMPER NOZZLE MUST FACE CURB.
3. HYDRANT FLANGES SHALL BE SET 150 - 200mm ABOVE A POINT 2% UP FROM THE TOP OF THE CURB OR FROM THE TOP OF THE EDGE OF THE ASPHALT WHERE THERE IS NO CURB UNLESS OTHERWISE DIRECTED BY THE CITY ENGINEER.
4. VALVE BOXES LOCATED OUTSIDE PAVED AREAS REQUIRE A 1.5m X 1.5m HOTMIX ASPHALT APRON, 50mm THICK.
5. FOR VALVE NUT EXTENSION REQUIREMENTS REFER TO STD. DWG. NO. W-16.
6. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR CONSTRUCTION.
7. OUT OF SERVICE HYDRANTS SHALL BE BAGGED AS PER 5.52.2(h).
THE SANDBAG BULKHEADS REQUIRE CURVED WING WALLS TO FUNNEL THE FLOW.

IF THE HORIZONTAL DIRECTION OF FLOW AT CULVERT INLETS AND OUTLETS EXCEEDS 30°, THE

1. IF THE HORIZONTAL DIRECTION OF FLOW AT CULVERT INLETS AND OUTLETS EXCEEDS 30°, THE
THE SANDBAG BULKHEADS REQUIRE CURVED WING WALLS TO FUNNEL THE FLOW.

2. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO
APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

NOTES

STANDARD SANDBAGS
FILLED WITH 15 MPa
WET PRE-MIXED CONCRETE

TYPICAL DITCH SECTION AT CULVERT INLETS AND OUTLETS.

15M REBAR TIES BENT OVER ON TOP

CULVERT 300mm Ø MIN.
OR AS DIRECTED

FINISHED GRADE

STANDARD SANDBAGS FILLED WITH 15 MPa
WET PRE-MIXED CONCRETE

Scale:
NTS
Created:
MAY 1999
Rev Date:
NOV 2016
Dwg No:
W-7

Engineering Standards & Specifications
November 2016 Edition
**Notes:**

1. All dimensions are in millimetres.
2. Dimensions apply to the larger diameter end of the fitting.
3. For concrete specifications see Section 11.
4. Concrete minimum compressive strength shall be 20MPa @ 28 days.
5. Where ground cannot be excavated to free standing undisturbed soil, small plank sheet piling shall be driven to provide undisturbed thrust area. Piling to be driven prior to excavating for thrust block. Piling should be used only below the permanent water table.

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<th>Fitting Size</th>
<th>Outside of Fitting to Bearing Face</th>
<th>Length</th>
<th>Height</th>
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<th>Fitting Size</th>
<th>Outside of Fitting to Bearing Face</th>
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</table>
NOTES:

1. FOR USE ONLY WHERE VALVE BOXES ARE LOCATED OUTSIDE THE PORTION OF A STREET.

2. THE VALVE MARKER SHALL BE LOCATED ON SITE BY THE ENGINEER, WITH THE FLATTENED END AND MARKED DISTANCE FACING THE VALVE BOX.

3. VALVE BOXES IN UNPAVED AREAS REQUIRE A 1.5m x 1.5m HOTMIX ASPHALT APRON, 50mm THICK.

4. FOR VALVE NUT EXTENSION REQUIREMENTS REFER TO STD. DWG. NO. W-16

5. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
**NOTES:**

1. USE THIS DRAWING ONLY AS A GUIDE. DETAIL DESIGN SHALL CONSIDER EXISTING SITE AND SOIL CONDITIONS AND INCLUDE STEEL REINFORCEMENT.
2. CONCRETE AND REINFORCING STEEL SHALL CONFORM TO SECTION 11.
3. DESIGN VAULT TO WITHSTAND CS600 LOADING.
4. SIZE VAULT TO PROVIDE MINIMUM CLEARANCES AS PER SECTION 5.13.
5. CHAMBERS LOCATED ON GRAVEL ROADS OR SHOULDERS REQUIRE A 1.5m X 1.5m HOT MIX ASPHALT PERIMETER APRON, 50mm THICK.
6. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SHOWN.
8. MINIMUM 200mm CLEAR DISTANCE FROM FLANGE OR BOLTED CONNECTION TO THE INSIDE WALL.

**MINIMUM INTERVAL DIMENSION FOR THE PRECAST VAULT METER CHAMBER**

<table>
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<th>DOMESTIC/FIRE METER</th>
<th>LENGTH</th>
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</tr>
<tr>
<td>150-250Ø</td>
<td>2600</td>
<td>1200</td>
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</table>
NOTES:

1. CHAMBERS LOCATED IN UPAVED AREAS REQUIRE 1.5m x 1.5m GRAVEL OR PAVED SURFACE AROUND COVER. PROJECT COVER 0mm IN PAVEMENT OR 25mm IN UPAVED AREAS.

2. CHAMBER MANHOLES LOCATED IN UPAVED AREAS REQUIRE A 1.5m X 1.5m, 50mm THICK HOT MIX ASPHALT APRON.

3. ONLY PRODUCTS APPROVED BY THE DIRECTOR OF ENGINEERING AND PUBLIC WORKS AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.

5. MINIMUM 200mm CLEAR DISTANCE FROM FLANGE OR BOLTED CONNECTION TO THE INSIDE WALL.

6. WATERTIGHT MANHOLE FRAME AND COVER WHEN SPECIFICALLY APPROVED BY THE ENGINEER.
NOTES:

1. BRACKETS TO BE CONSTRUCTED OUT OF 3mm ALUMINUM PLATE

2. BRACKETS TO BE MOUNTED WITH TWO 6mm STAINLESS STEEL BOLTS WITH LEAD ANCHORS

3. IN PRECAST MANHOLE METER CHAMBERS THE BRACKET SHALL BE MOUNTED BETWEEN THE FIRST AND SECOND LADDER RUNG

4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN
**NOTE:**
1. THRUST BLOCKING TO BE INSTALLED AS REQUIRED.
2. METER ASSEMBLY TO BE SUPPORTED BY STEEL PIPE SUPPORTS AS REQUIRED
3. FABRICATED STEEL PIPE AND FITTING TO BE SCHEDULE 40 SANDBLASTED, EPOXY LINED, AND COATED TO AWWA C-210 & ANSI/NSF-61 SPECIFICATION
4. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER OR LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION. ONLY UL LISTED/FM APPROVED PRODUCTS SHALL BE APPROVED FOR FIRELINE SERVICE.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.

**MATERIAL LIST**
1. WATER METER (FIRE)
2. FLANGE COUPLING ADAPTER FOR STEEL PIPE
3. GALVANIZED STEEL ADJUSTABLE PIPE SUPPORT
4. PIPE SEAL ASSEMBLY
5. THRUST-SEAL PLATE C/W BOLTS
6. REINFORCED CONCRETE THRUST BLOCK TO SPAN ENTIRE WIDTH
7. COUPLING
8. SUMP JET (OPTIONAL)
9. STRAINER DRAIN ASSEMBLY
10. GATE VALVE
11. VALVE BOX C/W LOCKING LID
12. TEE
13. 90° ELBOW
14. COUPLING
NOTES:
1. METER ASSEMBLY TO BE SUPPORTED BY STEEL PIPE SUPPORTS AS REQUIRED.
2. THRUST BLOCKING TO BE INSTALLED AS REQUIRED.
3. METER BY-PASS MAY BE INSTALLED OUTSIDE THE CHAMBER. VALVES OUTSIDE THE
4. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO
   APPROVED PRODUCT LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.
MATERIAL LIST

1. GATE VALVE
2. WATER METER - DOMESTIC
3. CURB STOP
4. METER BOX
5. COUPLING
6. VALVE BOX

NOTES:

1. METER BY-PASS MAY BE INSTALLED OUTSIDE THE METER BOX. VALVES OUTSIDE THE METER BOX SHALL BE AS PER SECTION 5.30.8
2. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCT LIST WILL BE ACCEPTED FOR INSTALLATION
NOTES:

1. METER ASSEMBLY TO BE SUPPORTED BY STEEL PIPE SUPPORTS AS REQUIRED
2. THRUST BLOCKING TO BE INSTALLED AS REQUIRED
3. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCT LIST WILL BE ACCEPTED FOR INSTALLATION. ONLY UL/FM LISTED PRODUCTS SHALL BE APPROVED FOR FIRE LINE SERVICE.

MATERIAL LIST

1. GATE VALVE (OS&Y)
2. CHECK VALVE
3. BY-PASS METER
4. LOCKING BALL VALVE
5. DETECTOR CHECK
6. THRUST RING, c/w REINFORCED CONCRETE THRUST BLOCK TO SPAN ENTIRE WIDTH
7. FLANGED COUPLING ADAPTOR
8. TEE
9. 90° ELBOW
10. COUPLING

SEE DRAWING W-11 FOR METER CHAMBER DETAILS

FLOW

DETECTOR CHECK FIRE LINE SERVICE
PIPING LAYOUT (1000Ø - 2500Ø)
NOTES:

1. VALVE RISER PIPE IN TRAVELED AREAS SHALL BE 150Ø DR-18 PVC AND IN UNTRAVELED AREAS SHALL BE 150Ø DR-35 PVC AT THE DISCRETION OF THE ENGINEER.

2. VALVE BOX SHALL BE MR TYPE AS PER STD. DWG. NO. W-16A. NELSON-TYPE VALVE BOX SHALL BE USED IN NON-PAVED AREAS AT THE DISCRETION OF THE ENGINEER.

3. ALL MR AND NELSON BOX LIDS SHALL BE PARSONS LONG NECK.

4. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR CONSTRUCTION.

5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.

6. NO TIE-DOWNS REQUIRED IF VALVE FLANGED TO RESTRAINED TEE.
SECTION A - A

NOTES:

1. FINISH COATING TO BE BITUMINOUS DIP.

2. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCT LIST WILL BE ACCEPTED FOR CONSTRUCTION.

3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.
LOCATE GOOSE NECK OUTLET AS CLOSE TO CENTER OF CB GRATE AS POSSIBLE

SLOPE GROUND TO CB GRATE FOR SURGE AND EJECTOR DRAINS (STD. DWG. SW-1 & SW-6)

180° BEND WELDED TO PIPE

BIRD SCREEN WELDED TO END OF BEND

AIR GAP MUST BE THREE PIPE DIAMETERS OR 450mm WHICH EVER IS GREATER

CB OUTLET TO STORM DRAINAGE SYSTEM

SURGE OUTLET OR EJECTOR DRAIN OUTLET

APPROVED TRANSITION COUPLING

THRUST BLOCK TO UNDISTURBED GROUND

NOTE:

1.) CONCRETE NO POST BARRIER PROTECTION REQUIRED FOR VENTS WITHIN 4.0m OF ROADWAY

2.) ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

3.) ALL DIMENSION IN MILLIMETERS UNLESS OTHERWISE SHOWN.
REFERRING TO "CITY OF NANAIMO WATER", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

MANUFACTURER'S SYMBOL 90 MAXIMUM DIMENSION CIRCLE OR SQUARE

2-21Ø HOLES

FRAMES INSTALLED ON 600Ø BARRELS SHALL NOT HAVE RIB

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 5.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. ALL BEARING SURFACES BETWEEN FRAME, COVER AND RISER RINGS SHALL BE MACHINED FOR NON-ROCKING FIT IN ALL POSITIONS. ALLOW 1.5mm RAISED FACE IN CASTINGS FOR MACHINING.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 5.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. THIS MANHOLE FRAME AND COVER IS TO BE USED FOR ACCESS TO UNDERGROUND UTILITY CHAMBERS, INCLUDING PUMPS STATIONS AND PRVs, WHERE A LARGER ACCESS DIAMETER IS REQUIRED.
4. FOR COVER LETTERING AND BOLTING REQUIREMENTS REFER TO STD. DWG. W-19 OR W-21.
5. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
6. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
APPLICATION: UNITS ARE FOR USE IN AREAS WHERE FLOODING OR HIGH TIDES ARE POSSIBLE. THIS UNIT SHALL HAVE A POSITIONING LUG IN COVER FOR EASY REPLACEMENT OF CAP SCREWS AND SHALL BE EQUIPPED WITH FOUR ONLY 19Ø HOLES IN FRAME FOR ANCHOR BOLTS AS SHOWN.

REFERRING TO "CITY OF NANAIMO WATER", LETTERING SHALL BE 25 FLATTENED FACE GOThic WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

WEIGHT OF UNIT SHOWN IS
FRAME = 113.4 kg
COVER = 56.7 kg

FURNISHED WITH:
A) FOUR 13x57 PENTA HEAD STAINLESS STEEL CAP SCREWS TO DISCOURAGE VANDALISM.
B) A 6mm THICK NEOprene GASKET FULLY ENCOMPASSING BOLT HOLES.
C) METAL SURFACES BETWEEN FRAME AND COVER MACHINED TO ENSURE NON ROCKING FIT IN ALL POSITIONS. ALLOW 1.5 RAISED FACE IN CASTING FOR MACHINING.
D) MANUFACTURE BOLT HOLES TO PERMIT INTERCHANGING OF COVERS BETWEEN FRAME UNITS.

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 5.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. FRAME SHALL BE SET IN MORTAR AND BOLTED TO THE MANHOLE SLAB WITH 19Ø STAINLESS STEEL BOLTS, WASHERS AND NUTS.
4. THIS DRAWING TO BE READ IN ACCORDANCE WITH DRAWING W-11A.
5. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
6. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
## SECTION 5 - WATER DISTRIBUTION SYSTEM
### MEASUREMENT AND PAYMENT

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<tr>
<td>Water Main Fittings</td>
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<td>Flange Adaptors and Joint Restraints</td>
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<td>Water Main Gate Valves</td>
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<td>Meter Service Boxes, Box Extensions, and Lids</td>
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<tr>
<td>Meter Chambers (Section 5.58) Booster Pump Stations (Section 5.59) and Pressure Reducing Stations (Section 5.60)</td>
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The contractor will note that the tendered price for all items specified in this section will include but not be limited to the following: Please refer to Section 4 – Trench Excavation, Bedding and Backfill for further clarification of these items.

(a) materials  
(b) excavation  
(c) dewatering  
(d) bracing & sheeting  
(e) bedding  
(f) pipe installation  
(g) backfill with native material  
(h) maintenance  
(i) wrapping of joints

The Contractor will note that payment for surface restoration and asphalt removal is paid in accordance with Section 4.76.

5.70 PIPE Section 5.43

Payment for water main pipe will be made at the lump sum price shown in the Tender Form for the size and class of pipe specified. Measurement will be made horizontally along the centreline of the installed pipe including all fittings. This price shall include materials, excavation, dewatering, bracing & sheeting, bedding, pipe installation, couplings, connection to existing system, wrapping of joints, backfill with native material, and maintenance, test points, disinfection, and testing as specified, and all work incidental thereto.

5.71 FITTINGS Section 5.48

Payment for fittings will be made at the unit price per fitting shown in the Tender Form. This price shall include supply of materials, installation of the fitting, thrust blocking, and all work incidental thereto. Payment will be in addition to that of 5.70.

5.72 FLANGE ADAPTORS AND JOINT RESTRAINTS Section 5.47

Where noted on the drawings or specifically requested by the Engineer, payment for flange adaptors and joint restraints shall be made at the unit prices shown in the Tender Form. This price shall include supply of materials, bolts, installation, and all work incidental thereto. Payment will be in addition to that of 5.70.

5.73 GATE VALVES Section 5.50 Standard Drawing W-16

Payment for valves will be made at the unit prices shown in the Tender Form for gate valves. This price shall include supply of materials, installation of the valve and valve box, valve hood, riser pipe, asphalt apron and thrust blocking if required, and all work incidental thereto. Payment will be in addition to that of 5.70.
5.74 **VALVE MARKERS**  Section 5.51  Standard Drawing W-9

Payment for water main valve markers will be made at the unit price shown in the Tender Form. This price shall include supply of materials, excavation, fabrication, painting, installation, backfilling, and all work incidental thereto. Payment will be in addition to that of 5.70.

5.75 **HYDRANT ASSEMBLIES**  Section 5.52.1, 5.52.2, 5.52.3  Standard Drawings W-5

Payment for hydrant assemblies will be made at the unit price shown in the Tender Form as follows:

a) **Hydrant Assemblies**
   This price shall include supply of materials, installation of the hydrant, hydrant lead, valve, valve box riser pipe, tie rods, drain rock, and all work incidental thereto. Payment will be in addition to that of 5.70.

b) **Relocating Existing Hydrants**
   Payment for relocating existing hydrants will be made as per 5.75 a) except work includes relocating an existing hydrant to the new location as specified on the drawings.

c) **Connect to Existing Hydrants**
   Payment for connecting to existing hydrants will be made as per 5.75 a) except work includes connecting to an existing hydrant as specified on the drawings.

5.76 **HYDRANT ACCESS CROSSING**  Section 5.52.4  Standard Drawing W-7

Payment for hydrant access crossings will be made at the unit price shown in the Tender Form. This price shall include all supply of materials, excavation, dewatering, backfill and compaction and all work incidental thereto. Payment will be in addition to that of 5.70.

5.77 **FLUSHOUTS**  Section 5.53  Standard Drawing W2A - W2B

Flushouts will be paid at the unit price shown in the Tender Form for the specified type of flushout.

a) For above ground flushouts, this price shall include supply and installation of flushouts in accordance with the specifications and drawings including all pipes, fittings, valves, valve boxes, thrust blocking, drain rock, bedding, backfill, cedar post, painting and all work incidental thereto. Payment for the iron cap or plug will be paid separately under Section 5.71. Payment will be in addition to Section 5.70.

b) For below grade flushouts, this price shall include supply and installation of flushouts in accordance with the specifications and drawings including all pipes, fittings, valves, valve boxes, thrust blocking, drain rock, bedding, backfill, concrete barrel, brickwork, frame and cover, grouting, adjustment to grade, asphalt apron and all work incidental thereto. Payment for the iron cap or plug will be paid separately under Section 5.71. Payment will be in addition to Section 5.70.
5.78 AIR VALVES AND FITTINGS Section 5.54 Standard Drawing W4

Air valves and fittings will be paid for at the unit price shown in the Tender Form. This price shall include excavation, supply of materials, piping, pipe saddle, vent piping, gate valve, air valve, manhole, manhole frame and cover, adjustment to final grade, asphalt apron and all work incidental thereto. Payment will be in addition to that of 5.70.

5.79 FLOOR DRAIN ASSEMBLIES Section 5.55

Floor drains will be paid at the unit price shown in the Tender Form for the various types of floor drain assemblies. Payment for the storm service connection will be paid separately under Section 7 - Storm Sewers.

a) For perimeter drains, price shall include supply and installation of materials including pipe, fittings, drain rock, filter cloth and all work incidental thereto.

b) For sump pumps, price shall include supply and installation of materials including sump drainer assembly, piping, fittings, piping to surface discharge, and all work incidental thereto.

5.80 CONNECTION TO EXISTING MAIN PIPING Section 5.49

Payment for connections to existing piping will be made at the unit price per connection shown in the Tender Form. This price shall include supply of couplings, materials, and all work incidental thereto. Payment will be made in addition to that of 5.70.

5.80A CONNECTIONS TO EXISTING SERVICES Section 5.49

Payment for connections to existing services will be made at the unit price per connection shown in the Tender Form regardless of existing service depth. This price shall include supply of materials, and all work incidental thereto.

5.81 SERVICE CONNECTION PIPE Section 5.56

Payment for water service connection pipe will be made at the unit price per linear metre shown in the Tender Form. Measurement will be made horizontally along the centreline of the installed pipe from the centre of the main pipe to the curb stop. This price shall include supply of materials, pipe installation, testing, flushing, chlorination, and all work incidental thereto, except those items for which payment is specified additional to that for water connection pipe.

5.82 CORPORATION STOPS AND SADDLES Section 5.30.2, 5.30.6, 5.56.4 (f)

Payment for corporation stops and saddles will be made at the unit price shown the Tender Form. This price shall include supply of materials, drilling and tapping the main pipe, installation, and all work incidental thereto. Payment will be in addition to that of 5.81.
5.83 **CURB STOPS**  Section 5.56.6 (a)

Payment for curb stops will be made at the unit price shown in the Tender Form. This price shall include supply of materials, installation of curb stop, and all work incidental thereto. No additional payments will be made for supply and installation of test points. Payment will be in addition to that of 5.81.

5.84 **METER SERVICE BOXES, BOX EXTENSIONS, AND LIDS**  Section 5.56.6 (b)

Payment for meter service boxes, box extension, and touch read lids will be made at the unit price shown in the Tender Form. This price shall include supply of materials, installation of service boxes and all work incidental thereto. Payment will be in addition to that of 5.81.

5.85 **TOUCH READ METERS**  Section 5.57

Payment for touch read meters will be made at the unit price shown in the Tender Form. This price shall include completion of meter cards, supply of materials, installation of meter, touch read sensor and all work incidental thereto. This pay item includes installing new meters in both existing and new meter boxes. Payment will be made in addition to that of 5.81.

5.86 **METER CHAMBERS (Section 5.58) and PRESSURE REDUCING STATIONS (Section 5.60)**

Payment for meter chambers, booster pump stations and pressure reducing stations will be made at the lump sum price in the Tender Form and shall include supply and installation of valves, chamber, piping and asphalt apron all as detailed on the drawings and all work and materials incidental to construction of the station.
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SECTION 6 - SANITARY SEWER SYSTEM
DESIGN CRITERIA

6.01 SCOPE

.1 All design and construction of sanitary sewers shall conform in general to these criteria and to the standard drawings and construction specifications. Changes may be authorized by the City of Nanaimo for specific projects. The following criteria shall be used in preparing construction drawings.

6.1 A SEWAGE FLOWS

.1 Sanitary sewer systems shall be designed to accommodate peak sewage flows with an allowance for inflow and infiltration. The discharge of storm water into the sanitary sewer system will not be allowed.

.2 Design contributory populations shall be computed in accordance with the City of Nanaimo population predictions or with the planned development in the tributary area based on the Official Community Plan, whichever is the larger.

.3 In the absence of detailed design population information, the following minimum design population densities shall be used:

<table>
<thead>
<tr>
<th>AREAS</th>
<th>POPULATION DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Dwellings</td>
<td>2.8 ppu or 36 pph</td>
</tr>
<tr>
<td>Low Density Multiple Family Dwellings</td>
<td>1.7 ppu or 48 pph</td>
</tr>
<tr>
<td>High Density Multiple Family Dwellings</td>
<td>1.7 ppu or 120 pph</td>
</tr>
<tr>
<td>Industrial equivalent of</td>
<td>36 pph</td>
</tr>
<tr>
<td>Commercial equivalent of</td>
<td>90 pph (incl. parking)</td>
</tr>
<tr>
<td>Institutional equivalent of</td>
<td>50 pph (incl. parking, but not greenspace)</td>
</tr>
</tbody>
</table>

ppu = persons per unit
pph = persons per hectare

.4 Peak sewage flow shall be established by multiplying an average dry weather flow (ADWF) rate of 230 litres per capita per day by a peaking factor (PF) to obtain peak dry weather flow (PDWF). The peaking factor shall be based on the Harmon formula:

\[ PF = 1 + \frac{14}{(4+P^{0.5})} \]  
(shown graphically on drawing SAN-1)

Where P is the design contributory population, in thousands. *(REVISED NOVEMBER 2016)*

In cases of large populations, greater than 1000, and trunk sewer designs, a sanitary sewer model approved by the City Engineer shall be used.

.5 Peak Inflow and Infiltration (I&I)

(a) Peak inflow and infiltration (I&I) shall be calculated based on a minimum rate of 25,000 litres per hectare of design tributary area per day, or at rates approved by the City Engineer for the general tributary area, for I&I from a 1:25 year, 24 hour storm.
.6 Design sewage rates of flow shall be computed by adding peak sewage flow to peak inflow and infiltration.

.7 Sanitary sewage design calculations shall be prepared in a format in accordance with Appendix H1 – Sanitary Sewer Flow Analysis – Calculation Sheet.

6.2 SEWAGE CHARACTERISTICS

.1 Sewage quality criteria shall be as follows:

<table>
<thead>
<tr>
<th>Sewage Quantity (ADWF) in the</th>
<th>Constituent</th>
<th>Normal Average</th>
<th>Maximum Short Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 50,000 L/d</td>
<td>BOD (Biological Oxygen Demand) 5 day 20°C</td>
<td>1000 mg/L</td>
<td>2000 mg/L</td>
</tr>
<tr>
<td></td>
<td>TSS (Total Suspended Solids)</td>
<td>800 mg/L</td>
<td>2000 mg/L</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>4 – 10.5</td>
<td>3.5 – 11</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>79°C</td>
<td>95°C</td>
</tr>
<tr>
<td>50,000 to 450,000 L/d</td>
<td>BOD (Biological Oxygen Demand) 5 day 20°C</td>
<td>400 mg/L</td>
<td>1000 mg/L</td>
</tr>
<tr>
<td></td>
<td>TSS (Total Suspended Solids)</td>
<td>300 mg/L</td>
<td>1000 mg/L</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>5 – 9.5</td>
<td>4 – 10.5</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>66°C</td>
<td>80°C</td>
</tr>
<tr>
<td>Over 450,000 L/d</td>
<td>BOD (Biological Oxygen Demand) 5 day 20°C</td>
<td>200 mg/L</td>
<td>500 mg/L</td>
</tr>
<tr>
<td></td>
<td>TSS (Total Suspended Solids)</td>
<td>200 mg/L</td>
<td>500 mg/L</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>5.5 – 9.0</td>
<td>5 – 9.5</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>54°C</td>
<td>65°C</td>
</tr>
</tbody>
</table>

.2 Regulations governing the quality of wastes acceptable for admission to Regional District of Nanaimo facilities shall be followed.
.3 For industrial and commercial developments, flow sampling and pre-treatment may be required prior to discharge to City of Nanaimo facilities.

6.3 HYDRAULICS

.1 No gravity sewer shall be less than 200mm in diameter except that in residential areas 150mm diameter may be approved by the City Engineer in the final section of a gravity sewer, providing the pipe has the required capacity and extension in the future, is precluded by physical barriers or there is existing alternate pick-up of adjacent areas. Unless otherwise approved by the City Engineer downstream pipe diameter shall be greater than or equal to upstream pipe diameter.

.2 Except under special circumstances, gravity sewers shall be designed to achieve a minimum daily self-cleansing velocity of 0.75m/s.

.3 A Mannings roughness co-efficient of 0.013 shall be used for design of gravity sewers and service connections.

.4 Design of gravity sewers to flow at less than 70% of diameter.

.5 Service connections shall be 100mm in diameter minimum. Service connections to other than single family dwellings shall be minimum 150mm diameter in accordance with design flows and available grades. Water and sewer services in a common trench shall be in accordance with the requirements of the Ministry of Health.

.6 Minimum grade of gravity sewers are as required to obtain the minimum velocity of 0.75m/s, except for terminal sewers which are to be as follows: (REVISED NOVEMBER 2016)

(a) Sewers servicing less than 10 houses 1.0% minimum grade
(b) Sewers servicing less than 25 houses 0.6% minimum grade

6.4 PIPING

.1 Depths:

(a) Depths of all gravity sewer mains and service connections shall be such that all basements in the area the sewer is intended to serve can be drained by gravity. Where properties cannot be serviced by a gravity connection, an explanation of the reasons shall be submitted to the City Engineer for approval. Pump stations from individual properties, shall have a gravity connection from the property line to the main sewer pipe.
(b) Minimum cover on gravity sewers shall be 1.5m in travelled roads and 1.0m in untravelled areas. Unless otherwise approved by the City Engineer, the maximum cover depth over gravity sewers is 4.5m.
(c) Minimum cover on service connections shall be 750mm from finished grade.
(d) Where minimum cover cannot be provided, an explanation of the reasons and pipe loading calculations shall be submitted with the proposed method of pipe protection to the City Engineer for approval. Design services shall meet the minimum building elevation based on the lot topography in order to avoid excessively deep service inspection assemblies.
.2 Curved Sewers:

(a) Horizontal curves will be permitted where the configuration of the property lines requires curvature for a constant offset and where the design velocity exceeds 1m per second.

(b) Radius of curvature shall be uniform throughout the curves and shall not be less than 60m radius, or the manufacturer's minimum pipe radius, whichever is greater. Miter bends shall not be used unless otherwise approved by the City Engineer.

(c) Vertical curves may be approved where excessive depths or rock cuts are to be avoided or where energy dissipation is required.

(d) Only one vertical and/or horizontal curve shall be permitted between manholes.

.3 Location of Sewers:

(a) Wherever possible, sewers shall be located on the high side of the street centre line where only the high side is served by the sewers and on the low side of the street where both sides are served by the sewers. Normal sanitary sewer main offsets are shown in the standard drawings for roadways. Wherever possible, the sewer shall be located on the opposite side of the street centre line from the watermain and at a constant offset from the property line.

(b) Sanitary sewers and service connections shall be located not less than 3.0m horizontally and 0.45m vertically distant from all water pipes, unless otherwise approved by the Provincial Department of Health.

(c) Sanitary sewer mains may be installed in a common trench with storm sewers provided the minimum outside pipe separation is 300mm.

(d) All lots shall be provided with a sanitary sewer service connection unless otherwise approved by the City Engineer. Service connections shall be located to the offsets as shown on Standard Drawing No. T-7.

.3A Utilities in Private Lands

The following shall be considered in the design of utilities crossing private lands:

(a) The design of utilities shall avoid crossing private lands as much as possible.

(b) Utilities following property boundaries across private lands shall generally be offset a minimum 2.0m from the property boundary. *(REVISED NOVEMBER 2016)*

(c) Appurtenances such as manholes, valves, etc., shall not be located on property boundaries.

(d) Utilities shall not cross private parcels in such a manner that they render the property unusable. Special consideration must be given to ensure the location of the utility crossing minimizes the limitations on the future use of the property.

(e) For minimum widths of statutory right-of-way and working widths refer to Appendix D.


(g) For an Easement Release and Inspection Form Following the Construction of the Utility, refer to Appendix C.
.4 Service Connection Lengths, Grade and Alignment:

(a) The maximum length of a sanitary sewer service connection as measured horizontally between the sanitary sewer and the property line shall be 30m. Sanitary sewer services longer than 30m shall require approval by the City Engineer. All inspection assemblies required for service connections in excess of 30m in length shall be shown on the design drawings.

(b) Service connections shall be designed at a grade of not less than two percent (2%) unless otherwise directed by the Engineer. *(REVISED NOVEMBER 2016)*

.4A Number of Service Connections per Lot

(a) Each lot shall be serviced by one only service connection for sanitary sewer.

.5 Selection of Pipe Material and Class:

(a) For determination of pipe material and class, the Engineer shall consider earth and live loading, depth of bury, soil conditions and design life of the installation. Pipe selection requires approval by the City Engineer.

(b) High Density Polyethylene (HDPE) pipe (Smooth Profile) is for special applications and shall only be considered in special situations where other types of pipe are not suitable.

6.4 A MANHOLES

.1 Distances between manholes shall not exceed 120m, unless otherwise approved by the City Engineer.

.2 Manholes shall be located at grade and alignment changes, at pipe size changes, at the upstream end of all gravity sewers, and at the junctions of all gravity sewers.

.3 Cleanouts may not be substituted for manholes at the upstream end of gravity sewers. Temporary cleanout structures may only be used at the discretion of the City Engineer where there is development phasing. *(REVISED NOVEMBER 2016)*

.4 Where the difference in elevation between incoming and outgoing sewers exceeds 600mm, standard drops for pipe sizes 375mm or less shall be used as shown in the standard drawings. Differences in elevation between 150mm and 600mm shall be avoided where possible. Inside drops into an existing standard diameter manhole may be permitted at the discretion of the City Engineer, only under exceptional circumstances. The inside drop manhole shall accommodate the incoming sewer without compromising working space within the manhole. *(REVISED NOVEMBER 2016)*
.5 Precast manhole barrels shall be sized according to nominal inside pipe diameter and depth as detailed below:

<table>
<thead>
<tr>
<th>Pipe Size (Nominal)</th>
<th>Depth of Manhole (Top of Cover to Inv.)</th>
<th>Barrel Size (Inside Dia.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 - 375mm</td>
<td>0 - 5.9m</td>
<td>1050mm</td>
</tr>
<tr>
<td>150 - 375mm</td>
<td>6.0 - 9.0m</td>
<td>1200mm</td>
</tr>
<tr>
<td>150 - 600mm</td>
<td>9.0 m or greater</td>
<td>1500mm</td>
</tr>
<tr>
<td>400 - 600mm</td>
<td>0.0 - 8.9m</td>
<td>1200mm</td>
</tr>
<tr>
<td>675 - 1050mm</td>
<td>All Depths</td>
<td>1500mm</td>
</tr>
</tbody>
</table>

.6 Where cast-in-place type manholes are proposed, design and construction details shall be submitted to the City Engineer for approval.

.7 Manholes shall be located to avoid any conflict with curb and gutter or sidewalks.

.8 A watertight manhole frame and cover shall be required for all sewer manholes located in areas where flooding can occur or in areas subject to vandalism (i.e. Parks, undeveloped rights-of-way, etc.).

### 6.5 PUMPING STATIONS

.1 This section applies to all municipal owned and operated sanitary sewer pumping stations. Properties serviced by individual sewer pumps shall be connected to the municipal sewer system by a gravity service connection from the property line to the municipal sewer system. Non-municipal owned sewer pumps shall conform to the Provincial Health Branch requirements and the City of Nanaimo Building By-laws.

.2 Sanitary sewer pumping stations shall be permitted only at locations where gravity connections from an existing or proposed trunk sewer cannot be provided. Pump stations require approval from the City Engineer. The extent of the works and technical specifications shall be determined on a site specific basis at the discretion of the City Engineer. (REVISED NOVEMBER 2016)

### 6.6 FORCE MAINS

.1 All forcemains shall be designed for a 1m/s minimum velocity and a detention time at minimum design ADWF not exceeding 12 hours.

.2 Forcemains shall be designed without high points unless otherwise approved by the City Engineer. If approved, an air-relief valve shall be provided at high points in the line.

.3 The top of the forcemain shall be below the hydraulic grade line at minimum pumping rate.
6.7 SIPHONS

.1 Where a siphon (i.e., inverted sewer, depressed sewer) is required to carry flow under an obstruction such as a stream, the following criteria shall be applied to the design:

(a) All siphons shall be multiple-pipe structures.
(b) A cleansing velocity of 0.6 to 0.9m/s shall be reached at least once a day in the primary pipe even during the first years of operation.
(c) The total system shall be sized to accommodate the ultimate design peak flow.
(d) A 1200mm diameter manhole shall be provided on both ends of the siphon.
(e) Each manhole on the siphon shall be provided with a suitable vent.
(f) There shall be no high points in the siphon between manholes.
(g) There shall be no acute bends in the siphon.
(h) There shall be no change of pipe diameter between manholes.
(i) The primary pipe shall be minimum 200mm in diameter wherever possible.
(j) All siphons shall have a separate debris sump manhole upstream of the siphon. The debris sump shall be designed to allow easy access for maintenance and cleaning and shall be suitably vented.
SECTION 6 - SANITARY SEWER SYSTEM
SPECIFICATIONS

6.20 SCOPE

.1 This specification refers to gravity sewer pipe and appurtenant fittings for sanitary sewers. Only those products approved by the City Engineer and listed in the City of Nanaimo Approved Products List will be accepted for installation.

.2 Refer to Section 4 - Trench Excavation, Bedding and Backfill for related specifications.

6.21 MATERIALS TESTING

.1 If, in the opinion of the Engineer, testing is required, the Engineer will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates inadequacies, additional testing may be required by the Engineer.

.2 The Contractor as directed by the Engineer shall supply specimens or samples for testing.

.3 The types of tests listed below may be required by the Engineer unless in the opinion of the Engineer other testing is required.

.4 Joints for sanitary sewer main pipe and fittings and service connection pipe and fittings shall be capable of meeting the following exfiltration tests. The Engineer may require that these tests be carried out by the Contractor or his supplier prior to acceptance of pipe on the project.

(a) **Pipes in Proper Alignment:**

Not fewer than 3, or more than 5, pipes selected from stock by the Engineer shall be assembled according to standard installation instructions issued by the manufacturer. With ends bulkheaded and restrained against internal pressure, the section shall be subjected to 70kPa internal hydrostatic pressure. Pressure shall be maintained for a period of 24 hours. There shall be no leakage at the joints.

(b) **Pipes in Maximum Deflected Position:**

At least 2 of the joints of the assembly shall be deflected to the maximum amount recommended by the manufacturer. 35kPa internal hydrostatic pressure shall then be applied to the test section and maintained for a period of 24 hours. Joints shall show no leakage.

(c) **Pipes in Maximum Lateral Misalignment:**

The test section shall be supported on blocks or otherwise so that one of the pipes is suspended freely between adjacent pipes and bears only on the jointing material. The suspended pipe shall then be loaded on the bell or coupling by a load equal to one-third of the ultimate 3-edge bearing strength required by the applicable ASTM specification, except that pipe having a laying length of more than 1.2m shall be loaded no more than the amount computed for a 1.2m length. While under this load, stressed joints shall show no leakage under 35kPa internal hydrostatic pressure.
6.22 PIPING, FITTINGS AND SERVICES

.1 The sizes and types of pipe to be used are shown on the drawings.

.2 Concrete Pipe:
   (a) Non-reinforced concrete pipe and fittings shall conform to ASTM C14M, Class 3, to a maximum diameter of 600mm and shall be designed with flexible rubber gasket joints conforming to ASTM C443M.
   (b) Reinforced circular concrete pipe and fittings shall conform to ASTM C76M, Class III or higher, for all pipe greater than 600mm diameter and shall be designed with flexible rubber gasket joints conforming to ASTM C443M.
   (c) Pipe with chips, cracks, porous concrete or any other defects which impair joint sealing or durability will not be accepted.

.3 Polyvinyl Chloride (PVC) Pipe (Smooth Profile):
   (a) Pipe and fittings up to 675mm diameter shall be DR35. Pipe and fittings shall have a minimum pipe stiffness of 320kPa at 5.0% deflection when tested in accordance with ASTM D2412.
   (b) Pipe and fittings shall be manufactured to the following specifications:
       100mm - 375mm dia. to ASTM D3034 and CSA B182.2
       450mm - 675mm dia. to ASTM F679 and CSA B182.2
   (c) Pipe and fittings shall include integral bell and spigot ends with stiffened wall section and a formed groove for a rubber gasket conforming to ASTM F477.
   (d) All PVC sanitary gravity main pipes shall be green in colour.

.4 Ductile Iron Pipe:
   (a) Pipe and fittings shall conform to ASTM A746 or as approved by the City Engineer.

.5 Polyvinyl Chloride (PVC) Service Pipe:
   (a) All sanitary service inspection assemblies shall be white in colour.
   (b) Sanitary service connections of 100mm diameter shall be DR28 and conform to CSA B182.1. Pipe and fittings shall have elastomeric seal joints, locked in gasket and integral bell joint features.
   (c) Sanitary service connections greater than 100mm diameter shall be as specified for PVC (smooth profile) mainline pipe.

.6 High Density Polyethylene (HDPE) Pipe (Smooth Profile):
   (a) Pipe shall conform to CGSB 41-GP-25M. Pipe material shall conform to ASTM D1248 Type III, Class C, Category 5, Grade PE35-10.
   (b) Minimum acceptable pipe class shall be DR26 with a hydrostatic design stress of 10MPa.
   (c) All pipe shall bear the pipe series designation and manufacturers name.
(d) Fittings for polyethylene pipe, if required, shall be detailed and manufactured by the pipe manufacturer. Miter bends shall be fiberglass reinforced. Pipe deflected up to manufacturer's recommended minimum radius may be used in place of fabricated miter bends and to form the required vertical and horizontal curves. Polyethylene fittings shall have a pressure rating at least equal to that of the pipe being joined.

6.22A FORCE MAINS

.1 The sizes and types of pipes to be used are shown on the drawings.

.2 Ductile Iron Pipe:

(a) Pipe shall conform to AWWA C150 and C151 and shall be cement mortar lined in accordance with AWWA C104.
(b) Joints shall be a mechanical type conforming to AWWA C111 or shall be rubber gasket, bell and spigot tyton joint.

.3 Polyvinyl Chloride (PVC) Pressure Pipe:

(a) Pipe shall be ULC approved and have cast iron pipe equivalent outside diameter.
(b) Pipe shall be manufactured to the following specifications:

- 100mm - 300mm dia. to AWWA C900 and CSA B137.3
- 350mm - 900mm dia. to AWWA C905 and CSA B137.3
(c) Pipe shall be compatible with mechanical and push-on joint fittings and valves without the use of special adapters.
(d) Pipe shall include push-on integrally thickened bell and spigot type joints conforming to ASTM D313.9 with single elastomeric gasket conforming to ASTM F477.
(e) All PVC sanitary force main pipe shall be white in colour. (REVISED NOVEMBER 2016)

.4 High Density Polyethylene (HDPE) - Smooth Profile:

(a) High Density Polyethylene (HDPE) pipe shall conform to Section 6.22.6, except that the minimum acceptable pipe class shall be DR21.

6.23 JOINTS

.1 Sanitary sewer main pipe and fittings and service connections pipe and fittings shall be jointed with a rubber gasket or other preformed, factory-manufactured gasket or approved material designed for use with the specified pipe. Solvent connected joints and fittings will not be permitted.

.2 High Density Polyethylene (HDPE) Pipe (Smooth Profile) Joints:

(a) Joints shall be by thermal butt-fusion and constructed in accordance with the manufacturer’s specifications.
(b) Flange joints shall be used to join long sections of butt-jointed pipe or as shown on the construction drawings.
(c) Flanges for polyethylene pipe shall be slip-on type installed in conjunction with stub ends supplied by the pipe manufacturer. The flanges shall be Class 150 meeting ANSI B16.5 drilling dimensions. Flanges shall be carbon steel.
(d) All flanged joints shall be separated by a neoprene gasket bonded to one of the flange faces. Neoprene for flange gaskets shall be 3mm thick with holes drilled for flange bolts and size equal to flange diameter.
(e) Flanged joints and flange bolts shall be stainless steel, complete with isolation washers.
(f) Refer to Section 6.46 for fitting and joint installation.

6.24 SERVICE JUNCTIONS

.1 Concrete Pipe (non-reinforced and reinforced):
   (a) Service connections shall be manufactured using a sanded PVC male and stub pipe with integral bell.
   (b) Stub orientation shall be at 45° to the centreline of the mainline pipe for pipe diameters less than 1050mm (between 1 o’clock and 2 o’clock or 10 o’clock and 11 o’clock orientation).
   (c) Stub orientation may be at 90° to the centreline of the mainline pipe for pipe diameters of 1050mm or larger (at 3 o’clock or 9 o’clock orientation).
   (d) Field break-in and mortar patch joints shall not be used unless approved by the City Engineer. Refer to Section 6.48 for service connection junction installation.

.2 PVC Pipe (Smooth Profile):
   (a) Service connections to PVC mainline pipe shall be made with extrusion molded PVC or fabricated PVC fittings manufactured to ASTM D3034, CSA B182.1 and CSA B182.2.
   (b) The use of saddles instead of manufactured wye fittings shall require approval by the City Engineer. Refer to Section 6.48 for service connection junction installation.

.3 PVC Pipe (Ribbed Profile):
   (a) Ribbed pipe shall only be used if repairing an existing ribbed pipe section.
   (b) Service connections to PVC mainline pipe shall be made with extrusion molded or fabricated PVC fittings manufactured to ASTM D3034, CSA B182.1 and CSA B182.2.
   (c) For connections more than two pipe sizes smaller than the mainline, prefabricated service saddle connections may be approved.

.4 High Density Polyethylene (HDPE) Pipe (Smooth Profile):
   (a) Service connections to HDPE mainline pipe shall be made with manufactured fittings, electro-fused, or heat welded to the main. Mechanical connections, if used, shall be water-tight.
   (b) Refer to Section 6.48 for service connection junction installation.
.5 High Density Polyethylene (HDPE) Pipe (Open Profile):

(a) Service connections to HDPE mainline pipe shall be made with extrusion molded or fabricated fittings manufactured to CSA B182.1, B182.2 and B182.4.

(b) For service connections more than two pipe sizes smaller than the mainline, prefabricated service saddle connections may be approved.

(c) Refer to Section 6.48 for service connection junction installation.

6.25 PRECAST MANHOLE SECTIONS

.1 Unless otherwise approved, all manhole sections shall be precast reinforced concrete in accordance with ASTM C478.

.2 All precast sections shall be complete with ladder rungs.

.3 O-ring rubber gaskets shall conform to ASTM C443.

.4 Refer to Section 6.51 for precast manhole sections installation.

6.25A PRECAST MANHOLE BASES

.1 Precast manhole bases shall be reinforced concrete in accordance with ASTM C76 Class III or better.

.2 All dimensions, specifications and installations shall conform to the requirements for cast-in-place manhole bases in accordance with Section 6.49 – Cast-In-Place Manhole Concrete Bases, Section 6.49A - Precast Manhole Bases and the Standard Drawings.

.3 Pipe alignment, grade and invert elevations in the precast manhole bases shall conform to the construction drawings.

6.26 MANHOLE TOPS

.1 Manhole tops shall be flat slab, precast concrete. Tops shall be reinforced to meet CS600 loading conditions. Precast tops shall conform to ASTM C478 with approved offset opening for frame and cover.

6.27 MANHOLE COVERS AND FRAMES

.1 Covers and frames shall be cast iron and certified to meet CS600 loading requirements with the bearing faces of the cover to be frame machined for a non-rocking fit.

.2 Patterns, dimensions and weights shall be in accordance with the Standard Drawings. Covers shall have “CITY OF NANAIMO SANITARY SEWER” permanently embossed on the cover.

.3 Standard manhole frame and cover shall conform to Standard Drawing No. S-9 - Sanitary Manhole Cover and Frame.

.4 Utility chamber manhole frame and cover shall conform to Standard Drawing No. S-10.
.5 A watertight manhole frame and cover, if required shall conform to Standard Drawing No. S-15 - Watertight Sanitary Manhole Frame and Cover.

.6 Covers located in statutory rights-of-way shall be permanently embossed with the additional wording "DO NOT COVER".

.7 Refer to Section 6.53 for frames and covers installation.

6.28 MANHOLE STEPS

.1 Steps shall conform to ASTM C478 for manhole steps and ladders and shall be: 19mm diameter aluminum alloy conforming to CSA S157.

.2 Refer to Section 6.54 for manhole steps installation.

6.29 -NOT USED-  *(REVISED NOVEMBER 2016)*

6.30 CONCRETE

.1 The compressive strength of concrete for manhole bases shall be not less than 20MPa at 28 days.

.2 All concrete work shall conform to Section 11 - Reinforced and Plain Concrete Works.

6.31 PRECAST CONCRETE GRADE RING

.1 Precast concrete grade rings conforming to ASTM C478 shall be used.

6.32 TEMPORARY CLEANOUT FRAMES AND COVERS

.1 Temporary cleanout structures may only be used at the discretion of the City Engineer where there is development phasing.

.2 Temporary cleanout frames and covers shall be as specified for sanitary manhole frames and covers. *(REVISED NOVEMBER 2016)*

6.33 PIPE AND FITTINGS FOR DROP MANHOLE STRUCTURES

.1 Pipe and fittings for drop manhole structures shall be as specified under Section 6.22 – Piping, Fittings and Services and Section 6.23 - Joints.

.2 Refer to Section 6.55 for drop manhole structure installation.
6.34 - NOT USED -

6.35 MANHOLE AND TEMPORARY CLEANOUT LID MARKERS

.1 Markers are required, where manhole and temporary cleanout lids are not located within developed road rights-of-way or residential properties, to indicate the location of the manholes and temporary cleanouts. These markers shall be constructed of 50mm galvanized steel pipe painted with a minimum of two coats of yellow exterior duty paint applied in accordance with the manufacturer's recommendations and set in a concrete base. The markers shall extend one (1) metre above the ground surface. The markers shall be located on site at a location determined by the Engineer opposite the manhole or temporary cleanout lid and the distance to the lid is to be marked in black figures on a flattened upper portion of the marker. See Standard Drawing No. S-14.

6.36 SERVICE BOXES

.1 Service boxes for single sanitary sewer services shall be 300 x 500mm concrete boxes complete with cast iron traffic cover marked "Sewer" and concrete extension sections as required.

.2 Service boxes for twin sanitary sewer services shall be 425 x 750mm concrete boxes complete with steel traffic cover marked "Sewer" and concrete extension sections as required.

6.37 PUMPING STATIONS

.1 The specifications shall be determined on a site specific basis at the discretion of the City Engineer. *(REVISED NOVEMBER 2016)*
SECTION 6 - SANITARY SEWER SYSTEM INSTALLATION

6.40 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4 - Trench Excavation, Bedding and Backfill for installation requirements.

6.40A PIPE ALIGNMENT AND GRADE

.1 The pipe shall be laid on the alignment and grade in accordance with the construction drawings. Methods to maintain pipe alignment and grade must be approved by the Engineer. Each pipe shall be checked for line and grade as it is installed.

.2 Unless otherwise directed by the Engineer, tolerances for pipe alignment and grade shall be:

Alignment = ± 50mm
Grade = ± 10mm

6.41 PIPE CUTTING

.1 Pipe cutting shall be done in the manner recommended by the pipe manufacturer employing tools designed for this purpose.

6.42 PIPE INSTALLATION

.1 Pipe shall be installed in strict accordance with the manufacturer's recommended practice.

.2 Pipe shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer's defects, or cracks exist that might prevent the proper jointing of the pipe or its operation.

.3 The open end of the pipe in the trench shall be suitably covered to prevent entrance of trench water and other material during periods when pipe is not being installed.

.4 Precautions shall be taken to ensure that displacement of the pipe in the trench does not occur through soil displacement or floatation due to the presence of trench water. Pipe that has been displaced shall be removed from the trench and re-laid.

.5 Lifting holes in concrete pipe shall be plugged with prefabricated plugs in non-shrink grout, or other plugs recommended by the pipe manufacturer.

.6 The contractor shall use methods for installing pipe in an auger hole or casing pipe as described on the construction drawings.

6.42A FORCE MAIN INSTALLATION

.1 Force mains shall be installed according to installation requirements in Section 6.42 – Pipe Installation.

.2 Thrust blocking to be installed in accordance with Section 5.47 - Pipe Restraint.
SECTION 6 - SANITARY SEWER SYSTEM INSTALLATION

6.43 JOINTS AT RIGID STRUCTURES

.1 A flexible joint shall be provided at locations where the pipe is held in fixed position by a rigid support or structure. The distance from the support or structure shall depend on the diameter and type of pipe being installed and shall be in accordance with the pipe manufacturer's recommended practice. The purpose of the flexible joint is to prevent pipe failure due to uneven support under the pipe. Approved flexible joints include rubber gasket bell and spigot connections and dresser couplings.

6.44 HORIZONTAL AND VERTICAL CURVES

.1 Pipe on horizontal and vertical curves shall be laid true to the curve of the radius shown on the drawings. Variations in vertical curves and grades within the allowable pipe deflection may be allowed where approved by the Engineer.

6.45 DEFLECTION

.1 The amount of pipe deflection at joints and couplings shall be the limit as specified by the manufacturer. PVC pipe shall not be deflected at joints or couplings.

6.46 FITTINGS AND JOINTS

.1 Fittings shall be installed at the locations shown on the construction drawings or as directed by the Engineer. Fittings shall be installed in accordance with the manufacturer's specifications.

.2 High Density Polyethylene (HDPE) Pipe (Smooth Profile):

(a) Pipe shall be joined by the thermal butt fusion method.
(b) The contractor shall make arrangements to have the pipe jointing carried out by the pipe manufacturer or certified personnel, familiar with the jointing technique, using equipment and techniques specifically designed for the pipe diameter and material being jointed.
(c) Where required, flanged joints shall be used for connecting long pipe sections.
(d) The joint shall consist of a polyethylene stub end butt fused to the end of pipe and a carbon steel slip-on flange.
(e) Refer to Section 6.23 for joint specifications.

.3 Sewage Force Mains:

(a) Install thrust blocking in accordance with Section 5.47 – Pipe Restraint.

6.47 CONNECTIONS TO EXISTING PIPING AND APPURTEANCES

.1 All connections to existing piping, services, and appurtenances shall be made by City of Nanaimo forces unless otherwise authorized by the City Engineer.

.2 All connections to existing piping and services shall utilize a manufactured rubber gasket bell and spigot joint or dresser coupling designed for the types of pipes to be connected.

.3 The use of field joints or rubber repair couplings shall require the approval of the Engineer.
.4 Rubber repair couplings must have 4 stainless steel clamps complete with stainless steel anti shear band. Only those products approved by the City Engineer will be accepted for installation.

.5 Slip couplers shall be used on PVC pipes. Rubber repair couplings are not to be used on PVC pipes.

6.48 SERVICE CONNECTION JUNCTIONS

.1 Locations of service connection junctions to the sewer shall be installed as shown on the construction drawings or as directed by the Engineer during construction.

.2 Where service connections are not constructed in conjunction with the mains, fittings shall be provided with approved caps or plugs and markers as specified in Section 6.59 – Service Connection Installation, clause 6.59.3(i). Caps or plugs for sanitary sewers shall be watertight and suitably blocked to withstand test pressures.

.3 Concrete Pipe (Reinforced and Non-reinforced):

(a) Field break-in and mortar patch joints shall not be used unless approved by the City Engineer. If approved, the following shall apply:

(i) Service connections shall be manufactured using a sanded PVC male and stub pipe with integral bell.
(ii) Break into the pipe by coring to within 40mm of the outside diameter of the service stub. All exposed reinforcing steel shall be removed.
(iii) Insert the stub into the core ensuring that no portion of the service stub protrudes past the inside of the concrete pipe wall, and the stub length shall be equivalent to the thickness of the concrete pipe wall and the length of the stub's integral bell.
(iv) Prepare non-shrink, fast setting cementitious grout with a 3:1 sand/cement mix to a "dry pack" consistency. Pack grout tightly into the void between the stub and the pipe and mound around the stub for lateral support.
(v) Hand finish interior and exterior grout surfaces to a smooth finish.
(vi) In order to prevent damage to the field joint, allow sufficient time for grout to develop strength prior to installation of connecting pipe or backfilling.
(vii) Installation shall be inspected by the Engineer prior to backfilling.

(b) Refer to Section 6.24 for service junction specifications.

.4 PVC Pipe (smooth profile):

(a) Service saddle connections shall not be used unless approved by the City Engineer.
(b) If approved, installation of service saddle connections shall conform to the following:

(i) Drill hole into mainline pipe to the exact dimension of the new connection.
(ii) The use of saddles instead of manufactured wye fittings shall require approval by the City Engineer. Saddles shall be cast iron with alignment rings complete with stainless steel bands.
(iii) Attach service saddle in accordance with the manufacturers specifications.
SECTION 6 - SANITARY SEWER SYSTEM
INSTALLATION

(c) Refer to Section 6.24 for service junction specifications.

.5 PVC Pipe (ribbed profile):
(a) Installation of service saddle connections shall conform to Section 6.48.4

.6 High Density Polyethylene (HDPE) Pipe (Smooth Profile):
(a) Service connections to mainline pipe using manufactured fittings shall be in strict accordance with manufacturer's instructions.
(b) Connection of HDPE service junctions to non-pressurized PVC service pipe shall be with flexible couplings. Flexible couplings shall be manufactured from elastomeric PVC, and be held in place with series 300 stainless steel worm gear clamps.
(c) Refer to Section 6.24 for service junction specifications.

.7 High Density Polyethylene (HDPE) Pipe (Open Profile):
(a) Installation of service saddle connections shall conform to Section 6.48.4.
(b) Refer to Section 6.24 for service junction specifications.

6.49 CAST-IN-PLACE MANHOLE CONCRETE BASES (REVISED NOVEMBER 2016)

.1 All water shall be removed from the excavation prior to placing base concrete. The base shall be constructed such that the first section of a precast section can be set plumb with uniform bearing throughout its full circumference.

.2 If material in the bottom of the trench is unsuitable for support, the bottom shall be over excavated to firm base as determined by the Engineer and backfilled to the required grade with thoroughly compacted base gravel as specified for trench bottom stabilization under the applicable item included in Section 4 – Trench Excavation, Backfill and Bedding.

.3 Where over excavation and backfill with base gravel is not practical, special structural support shall be provided as specified for trench bottom stabilization under the applicable item included in Section 4 – Trench Excavation, Backfill and Bedding.

.4 Concrete manhole bases shall be constructed as shown on the drawings. Pipes and fittings through the manhole shall be supported on concrete blocks and the concrete base poured around the pipe to a depth of at least 150mm below the bottom of the pipe and up to the springline of the pipe. Install rubber manhole adapter rings on all plastic pipe installed in the manhole base.

.5 Invert elevations of pipes at the manhole shall be checked by the Contractor prior to and following placement of base concrete around the pipe to ensure that all pipes are installed at the design elevation.

.6 Variations in manhole inverts from established grade or elevation shall be corrected.

.7 Manhole channeling shall be constructed as shown on Standard Drawing S-1 or as shown on the construction drawings. Channeling shall be constructed to have a minimum 0.3m straight section before the change in direction within the manhole. (REVISED NOVEMBER 2016)
.8 The channels in the base of manholes shall be shaped and finished to provide smooth passage for the sewage in order to minimize head losses and deposits at bends and at junctions of channels. *(REVISED NOVEMBER 2016)*

.9 Channels shall be accurately formed. The practice of forming channels roughly to shape and finishing with cement mortar will not be permitted. The channels shall be steel trowel finished. *(REVISED NOVEMBER 2016)*

.10 Benching in manholes shall be sloped to drain. While green, the concrete benching shall be given a broom finish to produce a non-skid surface. *(REVISED NOVEMBER 2016)*

6.49A PRECAST MANHOLE BASES

.1 Installation of precast manhole bases shall conform to Section 6.49 – Cast-In-Place Manhole Concrete Bases.

.2 Precast manhole bases shall be placed on 150mm thick base of 38mm drainrock. *(REVISED NOVEMBER 2016)*

.3 Plastic and concrete pipes installed in the precast manhole base shall utilize rubber manhole adapter rings to seal the connection.

.4 Refer to Section 6.25A for precast manhole bases specifications.

6.50 -NOT USED- *(REVISED NOVEMBER 2016)*

6.51 PRECAST MANHOLE SECTIONS

.1 Precast manhole barrel sections shall be placed plumb.

.2 Joints between the top riser and the cover slab shall be made watertight with cement mortar. Prior to placing sections, the mating faces shall be thoroughly soaked with water and a layer of cement mortar shall be spread on the lower face. After sections are placed, excess mortar which has been squeezed out shall be removed and the joint made flush inside and out.

.3 Joints between precast manhole barrels must utilize O-ring gaskets and shall conform to the manufacturer’s specifications. The inside surface of the precast barrel at the O-ring joints shall be filled with cement grout to a smooth finish.

.4 Damaged O-ring manhole joints require removal and replacement of damaged manhole section. Mortar patching of damaged area if approved by the Engineer, shall require the removal of the O-ring gasket and installation as per Section 6.51.2.

.5 Refer to Section 6.25 for precast manhole sections specifications.

6.52 CONCRETE

.1 Concrete work shall be as specified under the Section 11 - Reinforced and Plain Concrete Works.
SECTION 6 - SANITARY SEWER SYSTEM
INSTALLATION

6.53 FRAMES AND COVERS

.1 Frames shall be set on precast concrete grade rings to bring the cast iron manhole frame up to grade as shown on the Standard Drawings. Contractor to install concrete grade rings to a minimum of 50mm thick and to a maximum of 100mm thick. The concrete grade rings shall be laid in common bond with raked mortar joints and shall be mortared inside and outside of the manhole. *(REVISED NOVEMBER 2016)*

(a) Fine grade elevation adjustments of frames shall be done with a minimum of 3 steel only, shims equally spaced.

.2 Manhole covers shall be installed:

(a) for unpaved areas, covers shall have a 1.5m x 1.5m, 50mm thick asphalt apron. Covers shall be set flush with the asphalt surround.
(b) for paved areas, covers shall be flush with finished pavement grade or a maximum of 6mm lower than finished pavement grade. Covers shall not protrude above the finished pavement.

.3 Steel manhole riser rings shall be used in easements only.

.4 The inside surface of the manhole frame shall be painted yellow with an enamel rust paint in accordance with the manufacturer's specifications.

.5 Refer to Section 6.27 for manhole covers and frames specifications.

6.54 MANHOLE STEPS

.1 Manhole steps shall be installed in manhole sections by the manufacturer unless circumstance dictates otherwise in which case approval must be received from the Engineer.

.2 The distance from the top of the manhole cover, to the first manhole step, shall conform to WorkSafe BC requirements.

.3 All steps shall be complete with approved polyethylene anchor insulating sleeves and installed in 25mm to 26mm diameter precast or drilled holes in a manhole section.

.4 Refer to Section 6.28 for manhole steps specifications.

6.55 DROP MANHOLE STRUCTURES

.1 Drop manhole structures shall be constructed as shown on Standard Drawing No. S-3.
SECTION 6 - SANITARY SEWER SYSTEM INSTALLATION

6.56 STUBS

.1 Blind stub sections for connection of future sewers and service connections to the manholes shall be installed where shown on the construction drawings and as directed by the Engineer. Stubs shall be as long as the vertical depth from finish grade to the invert of each stub. Each stub shall be plugged with a removable, watertight plug as shown on the construction drawings. Where stubs are installed, the bottom of the manhole shall be channeled to the stub entrance.

6.57 TEMPORARY CLEANOUTS

.1 Temporary cleanouts shall be constructed as shown on Standard Drawing No. S-12.

6.58 -NOT USED- (REVISED NOVEMBER 2016)

6.58A PUMPING STATIONS

.1 Pump stations shall be constructed in accordance with the approved construction drawings, the installation requirements shall be determined on a site specific basis at the discretion of the City Engineer. (REVISED NOVEMBER 2016)

6.59 SERVICE CONNECTION INSTALLATION

.1 Location of Service Connections:

(a) Service connections are to be installed at the locations and depths as specified by the Engineer. For new connections, where the depth of the service connection exceeds 2m, the service shall be extended into the property the same distance as the depth of the service, up to a maximum distance of 4m. This shall be done during the installation of the service connection from the main to the property.

(b) At no time shall two or more sanitary services be coupled into one lead crossing the street or right-of-way. Each service shall have its own independent connection into the main sewer.

.2 Grade and Alignment of Service Connections:

(a) Trenches shall be excavated so that pipe can be installed in a direct line from the service connection fitting at the sewer or from a manhole to the terminus of the service. Service pipe shall be installed at a uniform grade between the terminus at the property line and the junction fitting (or upper end of a service drop) at the sewer. (REVISED NOVEMBER 2016)

.3 Sanitary Sewer Service Connection Installation:

(a) Pipe shall be installed in strict accordance with the manufacturer’s recommended practice.

(b) Pipe shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer’s defects, or cracks exist that might prevent the proper jointing of the pipe or its operation.

(c) The Contractor shall use methods for installing pipe in an auger hole or casing pipe as described in Section 4 - Trench Excavation, Bedding and Backfill.
SECTION 6 - SANITARY SEWER SYSTEM INSTALLATION

(d) The trench shall be excavated to provide a minimum cover of 0.75m over the service connection pipe at property line.

(e) In rock, the trench is to be extended 3m into the property to facilitate future extension of the service connection.

(f) The trench bottom shall be graded to form a continuous support along the service pipe. All rocks or projections which might prove detrimental to the pipe shall be removed.

(g) Joints shall be made using the specified couplings. Glued joints shall not be made.

(h) Approved watertight caps suitably supported by sandbags to prevent leakage shall be installed on sewer services at the terminus of each service.

(i) A 38mm x 89mm pressure treated wood marker stake shall be placed at the service terminus as shown on the drawings to facilitate future location of the service pipe. This stake shall extend from a point approximately 600mm above ground to 600mm below ground except in locations where the extension of the stake above ground surface would prove hazardous, in which case the stake shall be cut off flush with the ground surface. The stake shall be marked in an approved manner to show the depth of the service pipe invert below the top of the stake. The stake shall be unpainted to visually identify the sanitary sewer service connections. The Engineer will record the invert elevation of the service connection assembly prior to placement of the cap by the Contractor. (REVISED NOVEMBER 2016)

(j) Inspection assemblies shall be installed as shown on the standard drawings.

(k) The service box shall be installed plumb with the lid 25mm above finished grade in unpaved areas, and 0 - 6mm below finished grade in paved areas.

.4 Riser Service Connections:

(a) Riser service connections shall be installed as shown on Standard Drawing No.’s S-5 or S-7 in locations shown on the construction drawings. (REVISED NOVEMBER 2016)

6.60 CLEANING AND FLUSHING

.1 On completion of the sewer pipe installation, the pipes shall be cleaned to the satisfaction of the Engineer and the City of Nanaimo Public Works Inspector by power flushing with water to remove all foreign matter.

.2 Ensure that snow chains are installed at the downstream manhole so that no foreign material passes beyond downstream manhole. Flow through the system shall remain unimpeded at all times while snow chains are installed.

.3 Begin cleaning from the upstream pipe in the system and proceed downstream. Under no circumstances is the pipe cleaning process to proceed downstream until all contributing upstream pipes have been successfully cleaned and approved by the Engineer, the City of Nanaimo Public Works Inspector or by the City of Nanaimo CCTV contract administrator.

.4 Manholes shall be cleaned after the upstream section of pipe has been successfully cleaned and approved by the Engineer, the City of Nanaimo Public Works Inspector or by the City of Nanaimo CCTV contract administrator.
.5 Pipes shall be cleaned in the direction of flow and shall not be flushed in a backflush direction unless approved by the City Engineer, by the City of Nanaimo Public Works Inspector or by the City of Nanaimo CCTV contract administrator.

.6 Under no circumstances shall debris pass beyond the downstream manhole. Active vactoring shall remove all debris at the snow chains installed at the downstream manhole.

.7 Dispose of debris at approved dump site such as the Regional District of Nanaimo’s landfill or by the CCTV contract administrator’s approved alternative.

.8 Decanting of liquid waste accumulated during debris removal is permitted at a controlled release rate, to a maximum of 8 litres per second, at a location approved by the City of Nanaimo CCTV contract administrator.

.9 Timeframe between cleaning and video inspection of pipeline shall not exceed 24 hrs unless approved by the City Engineer.

6.61 NOTIFICATION TO CITY OF NANAIMO

.1 The City Inspector shall be given 48 hours notice of all tests.

6.62 LEAKAGE TESTING OF GRAVITY SEWERS

.1 Leakage tests shall be performed by the Contractor on all sanitary sewers and sewer service connections, manholes and appurtenances.

.2 Type of Test:

   (a) Tests on gravity sewers and manholes shall be either exfiltration or infiltration water tests as directed by the Engineer. Manholes shall be tested separately from gravity sewers.
   (b) In lieu of leakage testing with water, the Engineer may permit testing with low pressure compressed air.
   (c) Testing shall only be carried out after all underground work is complete.
   (d) Copies of all test results must be forwarded to the City Inspector.

.3 Testing Equipment:

   (a) The Contractor shall furnish all the necessary testing equipment, including suitable removable watertight plugs and test balls, and shall perform the tests in a manner satisfactory to the Engineer. Testing equipment must provide readily observable and reasonably accurate measurements of leakage under the specified conditions. The Contractor must comply with all WorkSafe BC regulations covering the use of air testing, and ensure that safe working practices are used in the application of the test.
.4 Water Exfiltration Test:

(a) On an exfiltration test, the test section shall be sealed at its lower extremity by means of a watertight plug. The test section shall be filled with water such that a minimum hydrostatic head of 600mm is placed on the pipe at its upper extremity. The head of water on the pipe shall be taken as the distance from the top of the pipe being tested to water surface at the point of measurement. The test pressure shall be maintained above the 600mm minimum head for a period of not less than one hour, and unless excess exfiltration requires further testing, not greater than 8 hours. Pressures in excess of 3m water head are not recommended. Damage resulting to pipe as a result of testing shall be repaired by the Contractor at no cost to the owner.

(b) Manholes shall be tested independent of the sewer pipe for leakage by filling the chamber to the underside of the roof slab with water. The test duration shall be a minimum of three hours. No leakage shall be permitted in manholes.

(c) In areas where the groundwater table is above the sewer invert level, the test shall be increased by a height equal to the distance from the sewer invert level to the water table elevations.

(d) Exfiltration test sections shall normally have a manhole at both extremities. If, however, sewer grades are such that a test section cannot be terminated at a manhole without placing excess pressure on the pipe or joints, apparatus shall be provided to enable testing without having manholes at the upper and lower ends of a test section.

(e) Gravity sewers, service connections and appurtenant structures thereon shall be constructed such that leakage, as evidenced by exfiltration tests, is less than that calculated using the following formula:

\[
\text{Allowable leakage in litres} = \frac{HDL}{5200}
\]

where \( H \) = duration of test in hours,
\( D \) = inside diameter of the pipe in millimetres, and
\( L \) = length of pipe in the test section in metres

(f) The above leakage limit will constitute the total maximum allowable leakage of any test section of gravity sewer. Where service connections exist along the test section, the allowable leakage from service pipe calculated by the use of the formula in Section 6.62.4 (e) will be added to that of the main sewer to arrive at the total allowable leakage unless the elevation of the service connection pipe is greater than the maximum water elevation. No additional leakage allowance will be made for manholes existing along the test section.

(g) The maximum allowable leakage for an exfiltration test will be that calculated by the formula in Section 6.62.4 (e) regardless of the test head of water employed. Where a section of sewer is found to have leakage exceeding the allowable limit, replacement or repairs shall be made to reduce the amount of leakage to or below the allowable limit. Repaired sections shall be retested until they meet the allowable limit.

(h) All point sources of leakage exceeding 1.2 litres per minute (from poor joints, improper connections, etc.) shall be made watertight by the Contractor to the satisfaction of the Engineer.

(i) The Contractor shall dispose of the water used for testing in a manner approved by the Engineer.
.5 Water Infiltration Tests:

In areas of high groundwater table, the Contractor shall, if instructed by the Engineer, measure the amount of infiltration into the sewer over a period of 8 hours. The infiltration rate shall not exceed the leakage as calculated for exfiltration testing.

.6 Air Test:

(a) Air test shall not be used with concrete sewers.
(b) On an air test, the section to be tested shall be plugged at each end and all service laterals, stubs and fittings properly capped or plugged.
(c) Air shall be supplied to the test section slowly, filling the line to a constant pressure of 24.0 kilopascal (kPa). The air pressure inside the pipe shall not exceed 28kPa except in the case where the groundwater level is above the sewer line being tested. In the event of the groundwater level being above the invert, the air test pressure must be increased by 1.0kPa for each 100mm of groundwater above the invert.
(d) The air supply is throttled to maintain the internal pressure above 20kPa for a minimum of 5 minutes to stabilize the temperature in the pipe. After stabilization, the air pressure is adjusted to 24.0kPa and the air supply shut off or disconnected. Timing commences and the time required for the line pressure to drop to 20.5kPa is noted.
(e) If the time required to drop from 24.0 to 20.5kPa is greater than allowable, the test section shall have passed.
(f) For the air test the minimum time allowable is calculated from the following tables:

<table>
<thead>
<tr>
<th>(Millimetres)</th>
<th>Min</th>
<th>Sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>150</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>200</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>250</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>300</td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>375</td>
<td>9</td>
<td>35</td>
</tr>
<tr>
<td>450</td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td>525</td>
<td>13</td>
<td>30</td>
</tr>
<tr>
<td>600</td>
<td>15</td>
<td>24</td>
</tr>
</tbody>
</table>

(g) Where multi pipe sizes are to undergo the air test, the average size shall be used.

6.63 TESTING OF FORCE MAINS

.1 Sewage force mains shall be tested in accordance with Section 5.61 – Pressure and Leakage Testing.
SECTION 6 - SANITARY SEWER SYSTEM INSTALLATION

6.64 VIDEO INSPECTING MAINS AND SERVICE CONNECTIONS

.1 All pipe video inspection including methods of cleaning, equipment and rates of camera travel, shall be in accordance with the UK Water Research Centre’s (WRc), Sewage Rehabilitation Manual, most current edition.

.2 For gravity sewers and service connections, the contractor shall arrange for video inspection to check alignment, grade, and condition of the main sewer pipe including service connection leads.

(a) Illumination depth of field shall be no less than 3 joints for standard joint and spigot pipe types to allow for pipe deflection assessments (9m). No dark/opaque circle shall be visible in the middle of this depth of field viewing area.

(b) Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.

(c) Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.

(d) Pan and tilt view each service connection (junction) such that the camera looks down the centreline of the service, pause for a minimum of five (5) seconds and note condition of the joint and/or pipe/service interface.

(e) Camera guides (Skids) shall not be visible at either side of the pipe during normal camera travel or during Pan & Tilt operation. Configuration of camera/guides shall be altered to alleviate this problem.

(f) CCTV push camera work shall be video captured (complete with skids for centering) from the main wye pulling back to entrance point to avoid an invert only view.

(g) A winch line shall be provided to support camera travel in steep, slippery or relined pipe sections.

(h) Position camera lens centrally in the pipeline with a positioning tolerance of ±10% off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.

(i) Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

(j) Instantaneous travelling speed of the camera in the pipeline to be as follows:

i) 0.1m/s for pipeline of diameter less than 200mm.

ii) 0.15m/s for diameters 200mm and larger but not exceeding 310mm; and

iii) 0.20m/s for diameters exceeding 310mm.

.3 The inspection shall include the preparation of:

(a) a 4.7GB DVD MPEG4 video data disk. Picture size: NTSC 640x480 pixels, aspect ratio 4:3, 29.97 frames per second @ 8 megabits per second capture rate. Individual MPEG4 video files shall not exceed 1.7GB in size. DVD data disk shall be finalized afterburn.

(b) a Microsoft Access database CD of the Header and Observation codes as specified by City Engineer.

(c) a pipe condition assessment paper report.

All submitted to the Engineer.
SECTION 6 - SANITARY SEWER SYSTEM INSTALLATION

.4 The Engineer shall review the, DVD and CD and pipe condition report and provide certification that the condition of the installed pipe is accurately recorded and the pipe installation meets the City of Nanaimo Standards and Specifications.

.5 The DVD and CD, pipe condition report and certification shall become the property of the City of Nanaimo.

.6 Variations in line or grade of pipe, from that established by the Engineer prior to installation, and any jointing, pipe cleaning, or other deficiencies discovered during the inspection, shall be rectified. Reinspection of the pipe may be required by the Engineer at the contractor’s expense.

.7 During this test, manhole construction and invert elevations shall be checked and any variations from the established grade, drawings, or specifications, shall be rectified.

.8 If directed by the Engineer, the contractor shall arrange for a reinspection of the pipe at the contractor’s cost, for the warranty inspection one month prior to the end of the maintenance period.

.9 Video inspection and pipe condition coding shall be undertaken only by personnel with current Canadian certification by a City approved agency.

6.65 SMOKE TESTING

.1 The Engineer shall arrange for smoke testing of all installed gravity sanitary mains in the presence of the City of Nanaimo Works Inspector.

.2 The Engineer shall provide as-built service location information to the City of Nanaimo Works Inspector prior to smoke testing.

.3 Cross-connections noted during the smoke testing shall be corrected and the as-built service location information revised.

6.66 TESTING OF PUMPING STATIONS

.1 Wet well chambers shall be tested for exfiltration by filling the chamber to the underside of the roof slab with water. The test duration shall be a minimum of three hours. No leakage shall be permitted.

.2 In areas of high groundwater tables, the engineer may require an infiltration test. No leakage shall be permitted.

.3 Pumping stations shall be tested using water. Station shall be tested through its operating range to confirm float operation, pumps, controls, alarms, backup power, manual operation and operation with the City of Nanaimo’s portable power unit.

.4 A noise level test shall be required to confirm pumping station and standby power are within specified acceptable limits.
**SECT ION 6 - SANITARY SEWER SYSTEM INSTALLATION**

6.67 **PIPE VIDEO AND MANHOLE CONDITION REPORT FORMAT**

.1 Reference plans shall accompany reports with manholes labeled and inspected sections highlighted. Manhole and pipe numbering shall conform with the construction drawings, or if available, City of Nanaimo pipe and manhole numbers. Reports shall be submitted in both digital and hardcopy formats.

.2 All sewer defects shall be photographed and included with the report and referenced by numbers accordingly.

.3 The video pipe condition rating report format shall be in accordance with the UK Water Research Centre’s (WRc), Sewerage Rehabilitation Manual, most current edition.

Structural defects shall be properly weighted with the appropriate scores assigned to them as shown in the following table:

**WRc GRADING SYSTEM**

<table>
<thead>
<tr>
<th>DEFECT CODE NO.</th>
<th>TYPE OF DEFECTS</th>
<th>POINT SCORES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open Joints</td>
<td>1 to 2</td>
</tr>
<tr>
<td>2</td>
<td>Displaced Joints</td>
<td>1 to 2</td>
</tr>
<tr>
<td>3</td>
<td>Cracks</td>
<td>10 to 40</td>
</tr>
<tr>
<td>4</td>
<td>Fracture</td>
<td>40 to 80</td>
</tr>
<tr>
<td>5</td>
<td>Broken</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>Hole</td>
<td>80 to 165</td>
</tr>
<tr>
<td>7</td>
<td>Collapsed</td>
<td>165</td>
</tr>
<tr>
<td>8</td>
<td>Spalling</td>
<td>5 to 120</td>
</tr>
<tr>
<td>9</td>
<td>Wear</td>
<td>5 to 120</td>
</tr>
<tr>
<td>10</td>
<td>Deformation</td>
<td>20 to 165</td>
</tr>
</tbody>
</table>
Every video inspected sewer will be assigned a composite score when it scores under each defect category which are added as per the following table:

**WRc - SEWER RATING COMPOSITE SCORES**

<table>
<thead>
<tr>
<th>COMPUTER COMPOSITE GRADE</th>
<th>PEAK SCORE RANGE (SUM OF THE SCORES FROM THE ABOVE TABLE)</th>
<th>TYPICAL DEFECT DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (least defective)</td>
<td>1 to 9</td>
<td>No observable structural defects</td>
</tr>
<tr>
<td>2</td>
<td>10 to 39</td>
<td>Circumferential crack. Moderate joint defects, i.e. open joint (medium) or joint displaced (medium), spalling slight and wear slight.</td>
</tr>
<tr>
<td>3</td>
<td>40 to 79</td>
<td>Fracture with deformation &lt;5%. Longitudinal cracking or multiple cracking. Minor loss of level. More severe joint defects, i.e. open joint (large) or joint displaced (large). Spalling medium. Wear medium.</td>
</tr>
<tr>
<td>4</td>
<td>80 to 164</td>
<td>Broken, deformation up to 10% and broken fracture with deformation 5 - 10%. Multiple fractures. Serious loss of level. Spalling large. Wear large.</td>
</tr>
<tr>
<td>5 (most defective)</td>
<td>165+</td>
<td>Already collapsed. Deformation &gt;10% and broken. Extensive areas of fabric missing. Fracture with deformation &gt;10%.</td>
</tr>
</tbody>
</table>

The following additional information shall be included for each sewer section as the CCTV Title Page:

(a) Date of survey.
(b) Contractor Project Index No. (i.e. Tape No. V2-1234)
(c) Survey No.
(d) Start MH No.
(e) Finish MH No.
(f) Line ID No.
(g) Direction of Camera Travel.
(h) Street Location (Road Name or RW No.).
(i) Distance from the manhole rim to pipe invert.
(j) Length of Capture.
(k) Total of Captured CCTV.
(l) Current weather information.
.4 All pipe video inspections shall include an annotated map with the following information:

(a) Manhole and catchbasin locations with labels.
(b) City of Nanaimo drawing numbers.
(c) Manhole ID numbers (as per the City of Nanaimo GIS numbering system).
(d) Catchbasin ID numbers (as per the City of Nanaimo GIS numbering system).

.5 Computer database file to contain identical survey report information as the printed report exclusive of photographs. Index numbers and distance of survey information shall numerically increase. For an individual survey, whether the information is sorted by index or distance, the result will be in the same order.

.6 All pipe video inspection operators shall be thoroughly trained with current Canadian certification by a City approved agency.

.7 Manhole video inspection is not required. Manholes shall be rated as per the following table and form part of the video inspection report.

**MANHOLE RATING SYSTEM**

<table>
<thead>
<tr>
<th>INTERNAL CONDITION GRADE</th>
<th>TYPICAL DEFECT DESCRIPTION</th>
</tr>
</thead>
</table>
| 1 (least defective)      | -no observable structural defects  
                           | -no observable signs of infiltration |
| 2                        | -minor cracks, chips, spalling.  
                           | -signs of minor staining, but no infiltration |
| 3                        | -fractures, medium spalling, defective pipe/MH joints  
                           | -some staining, mineral build-up and seeding infiltration. Possible infiltration through manhole cover |
| 4                        | -broken manhole wall, channel or riser assembly, multiple fractures, medium wear  
                           | -moderate staining, mineral build-up and running infiltration  
                           | -infiltration through manhole cover  
                           | -manhole frame and cover cracks or broken |
| 5 (most defective)       | -failure in manhole wall, channel or riser assembly, multiple fractures with deformation, large wear  
                           | -heavy staining, mineral build-up and gushing infiltration  
                           | -surface ponding and infiltration through manhole cover  
                           | -manhole frame and cover cracks or broken |
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR MANHOLE CHANNELING, REFER TO SECTION 6.49.
3. ALL CHANNELS SHALL BE FINISHED WITH A STEEL TROWEL. BENCHING (HATCHED AREAS), SHALL BE BROOM FINISHED.
4. MANHOLE COVER AND RUNG LOCATIONS SHALL BE AS SHOWN, UNLESS NOTED OTHERWISE.
5. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
6. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR MANHOLE BENCHING, SEE STD DWG S-1.
3. FOR FRAME AND COVER DETAILS, SEE STD DWG S-9.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

MANHOLES INSTALLED IN GRAVEL SURFACES SHALL HAVE A 50mm THICK x 1.5mØ ASPHALT APRON ON 100mm OF COMPACTED CRUSHED GRAVEL.

PRECAST GRADE RINGS, 2 MIN: 4 MAX

PRECAST MANHOLE LID

Rungs cast into wall of barrel to conform to Worksafe BC requirements.

Rubber manhole adapter ring for PVC pipes.

TYPICAL SECTION
1:25

150mm of 38mm drain rock on approved sub-grade.

TYPICAL SECTION
1:25

Precast manhole barrel, see design for size.

Backfill with imported granular fill.

Precast pre-benched manhole base.

Use short manhole barrel as form. Ensure top is level prior to pouring concrete.

Concrete block to set manhole barrel height.

Cast-in-place manhole base on undisturbed soils.

Cast-in-place manhole base on undisturbed soils.

Use short manhole barrel, see design for size.

Slope benching 1:10.

Cast-in-place manhole base.

Where possible, use half pipe sections, or break-out top half of pipe.

Pre-cast manhole barrel, see design for size.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR MANHOLE DETAILS, SEE STD DWG S-2.
3. FOR MANHOLE BENCHING, SEE STD DWG S-1.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

DROP MANHOLE TYPE 1
1:25

DROP MANHOLE TYPE 2
1:25
BRACKET DETAIL

NOTES:
1. INSIDE DROP TO BE USED ONLY WHERE PERMITTED BY THE CITY ENGINEER.
2. MAXIMUM SIZE OF DROP PIPE TO BE 150Ø DR28 PVC.
3. THIS DRAWING SHOWS INSIDE DROP ONLY. SEE DRAWING S-2 FOR ALL OTHER DETAILS PERTAINING TO MANHOLE REQUIREMENTS.
4. ALL DIMENSIONS IN MILLIMETERS UNLESS SHOWN OTHERWISE
5. ALL MOUNTING & BRACKET HARDWARE, (STRAPS & BOLTS) SHALL BE STAINLESS STEEL
6. DROP PIPE SHALL BE TIGHT TO THE INSIDE FACE OF THE MANHOLE BARREL.

DROP MANHOLE - TYPE III

CONCRETE SURROUND TO FIRST JOINT, BENching TURNED TO FLOW OF MAIN PIPE

STAINLESS STRAPPING WITH STAINLESS HILTI FASTENERS AT 500 SPACING (SEE DETAIL)

45° BEND

PVC TEE

RUBBER MANHOLE ADAPTOR RING

6 x 40 STAINLESS PIPE STRAP

STAINLESS ANCHOR BOLTS

DROP PIPE TIGHT TO WALL

1200 MINIMUM

900 MINIMUM

2000 MAXIMUM
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. WHERE DEPTH OF SERVICE AT PROPERTY LINE IS GREATER THAN 2.0m, EXTEND THE SERVICE PAST THE PROPERTY LINE EQUAL TO ITS DEPTH, TO MAXIMUM OF 4.0m.
3. WHERE SERVICE IS INSTALLED IN ROCK, THE TRENCH IS TO EXTEND 3.0m PAST THE PROPERTY LINE.
4. SANITARY SEWER INSPECTION ASSEMBLY, INCLUDING PROPERTY SIDE STUB TO BE WHITE.
5. SERVICE PIPE DEPTH TO BE INSTALLED TO PROVIDE SUFFICIENT DEPTH TO SERVICE THE BASEMENT PLUMBING BY GRAVITY IN ACCORDANCE WITH THE BC PLUMBING CODE. MINIMUM COVER OF SERVICE PIPE AT PROPERTY LINE TO BE 0.75m.
6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

GENERAL SANITARY SERVICE CONNECTION DETAIL
RISER AND NON-RISER TYPES

Engineering Standards & Specifications
November 2016 Edition
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. WHERE DEPTH OF SERVICE AT PROPERTY LINE IS GREATER THAN 2.0m, EXTEND THE SERVICE PAST THE PROPERTY LINE EQUAL TO ITS DEPTH, TO A MAXIMUM OF 4.0m.
3. WHERE SERVICE IS INSTALLED IN ROCK, THE TRENCH IS TO EXTEND 3.0m PAST THE PROPERTY LINE.
4. SANITARY SEWER INSPECTION ASSEMBLY, INCLUDING PROPERTY SIDE STUB TO BE WHITE.
5. SERVICE PIPE DEPTH TO BE INSTALLED TO PROVIDE SUFFICIENT DEPTH TO SERVICE THE BASEMENT PLUMBING BY GRAVITY IN ACCORDANCE WITH THE BC PLUMBING CODE. MINIMUM COVER OF SERVICE PIPE AT PROPERTY LINE TO BE 0.75m.
6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

NOTE:
WHERE CONNECTION TO EXISTING SERVICE PIPING IS SMALLER THAN 150Ø, AN ECCENTRIC REDUCER SHALL BE INSTALLED.
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.

2. WHEN SERVICE BOX IS WITHIN A CONCRETE DRIVEWAY, CONCRETE ADJACENT TO THE SERVICE BOX MUST BE A MINIMUM OF 150mm THICK FOR A MINIMUM DISTANCE OF 150mm AROUND THE OUTSIDE EDGES OF THE SERVICE BOX.

3. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

4. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
3. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
REFERRING TO "CITY OF NANAIMO SANITARY SEWER", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

MANUFACTURER'S SYMBOL 90 MAXIMUM DIMENSION, CIRCLE OR SQUARE

2-21Ø HOLES

160 x 65 GALVANIZED STEEL CARRIAGE BOLT AND NUT

5/8" GALVANIZED WASHER REQUIRED ON CARRIAGE BOLT WHEN NUT PENETRATES INTO CASTING.

IMPORTANT: CARRIAGE BOLT TO EXTEND EXACTLY 18mm ABOVE CASTING.

CARRIAGE BOLT DETAIL

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. ALL BEARING SURFACES BETWEEN FRAME, COVER AND RISER RINGS SHALL BE MACHINED FOR NON-ROCKING FIT IN ALL POSITIONS. ALLOW 1.5mm RAISED FACE IN CASTINGS FOR MACHINING.
4. PAINT THE INSIDE SURFACE OF THE MANHOLE FRAME IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATION WITH ENAMEL RUST PAINT. COLOUR TO BE YELLOW.
5. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
6. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. FOR COVER LETTERING AND BOLTING REQUIREMENTS REFER TO STD. DWG. S-9 OR S-15.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
CLEANOUT CAP (RUBBER GASKET REMOVED)

ASPHALT APRON C/W 100mm BASE (OFF ROADWAY AREAS)

CONCRETE SURROUND FRAME TO 50 BELOW BARREL (MIN.)

2 - 45° LONG RADIUS BENDS

JUTE WRAPPED

STANDARD MANHOLE COVER AND FRAME. PROJECT FRAME 25mm IN UNPAVED AREAS AND 0mm IN PAVED AREAS

PRECAST CONCRETE GRADE RINGS. MORTAR INSIDE AND OUT. BUILD TO SUIT GRADE. TWO GRADE RINGS (125 MIN.) FOUR GRADE RINGS (250 MAX.)

600Ø C76 CL II CONCRETE BARREL

CONCRETE IN ACCORDANCE WITH SECTION 6.30 FOR CONCRETE BASE

COMPACTED SELECT BACKFILL

Scale:
Rev Date: NTS
Created: JUNE 2013
Rev Date: NOV 2016
Dwg No: S-12

NOTES:

1. TEMPORARY CLEANOUT STRUCTURES MAY ONLY BE USED AT THE DISCRETION OF THE CITY ENGINEER WHERE THERE IS DEVELOPMENT PHASING.

2. USE WHERE NO SERVICE EXTENSION IS REQUIRED.

3. FRAME AND COVER TO STANDARD DRAWING S-9 (SANITARY MANHOLE FRAME AND COVER), OR STANDARD DRAWING S-15 (WATERTIGHT SANITARY MANHOLE FRAME AND COVER).

4. CLEAN OUT STRUCTURES LOCATED ON GRAVEL ROADS OR SHOULDERS REQUIRE A 1.5m X 1.5m HOT MIX ASPHALT APRON, 50 mm THICK.

5. ONLY PRODUCTS APPROVED BY THE CITY ENGINEER AND LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION

6. ALL DIMENSIONS IN MILLIMETERS UNLESS SHOWN OTHERWISE
1. The marker shall be located on site by the engineer.

2. The marker shall be located outside the paved portion of a street.

3. All dimensions in millimeters unless shown otherwise.

NOTES

MANHOLE OR TEMPORARY CLEANOUT LID MARKER
WITH UPPER PORTION FLATTENED AND DISTANCE TO
LID MARKED IN BLACK FIGURES.

50Ø STEEL PIPE
PAINTED YELLOW

CONCRETE BASE SET IN 300Ø
SECTION OF PVC PIPE.
APPLICATION: UNITS ARE FOR USE IN AREAS WHERE FLOODING OR HIGH TIDES ARE POSSIBLE. THIS UNIT SHALL HAVE A POSITIONING LUG IN COVER FOR EASY REPLACEMENT OF CAP SCREWS AND SHALL BE EQUIPPED WITH FOUR ONLY 19Ø Holes IN FRAME FOR ANCHOR BOLTS AS SHOWN.

REFERRING TO "CITY OF NANAIMO SANITARY SEWER", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

WEIGHT OF UNIT SHOWN IS
FRAME = 113.4 kg
COVER = 56.7 kg

FURNISHED WITH:
A) FOUR 13x57 PENTA HEAD STAINLESS STEEL CAP SCREWS TO DISCOURAGE VANDALISM.
B) A 6mm THICK NEOPRENE GASKET FULLY ENCOMPASSING BOLT HOLES.
C) METAL SURFACES BETWEEN FRAME AND COVER MACHINED TO ENSURE NON ROCKING FIT IN ALL POSITIONS, ALLOW 1.5 RAISED FACE IN CASTING FOR MACHINING.
D) MANUFACTURE BOLT HOLES TO PERMIT INTERCHANGING OF COVERS BETWEEN FRAME UNITS.

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 6.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. PAINT THE INSIDE SURFACE OF THE MANHOLE FRAME IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATION WITH ENAMEL RUST PAINT. COLOUR TO BE YELLOW.
4. FRAME SHALL BE SET IN MORTAR AND BOLTED TO THE MANHOLE SLAB WITH 19Ø STAINLESS STEEL BOLTS, WASHERS AND NUTS.
5. THIS DRAWING TO BE READ IN ACCORDANCE WITH DRAWING S-2.
6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
PEAKING FACTOR BASED ON HARMON FORMULA:

$$PF = 1 + \frac{14}{4 + Pf^2}$$

HARMON PEAKING FACTOR CURVE

DESIGN CONTRIBUTORY POPULATION IN THOUSANDS
# SECTION 6 - SANITARY SEWER SYSTEM

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The contractor will note that the tendered price for all items specified in this section will include but not be limited to the following: Please refer to Section 4 - Trench Excavation, Bedding and Backfill for further clarification of these items.

(a) materials  
(b) excavation  
(c) dewatering  
(d) bracing & sheeting  
(e) bypass pumping  
(f) bedding  
(g) pipe installation  
(h) backfill with native material  
(i) video inspection  
(k) maintenance

The Contractor will note that payment for surface restoration and asphalt removal is paid in accordance with Section 4.76.

6.70 PIPING AND FITTINGS Section 6.42 - 6.46

Payment for piping and fittings will be made at the unit price per linear metre shown in the Tender Form for the various sizes and class of pipe. Measurement will be made horizontally along the centreline of the installed pipe, including fittings, from centre-to-centre of manholes or to the end of the pipe, whichever is applicable. This price shall include materials, excavation, dewatering, bracing & sheeting, bypass pumping, bedding, pipe installation, backfill with native material, video inspection and maintenance, testing as specified, and all work incidental thereto except those items for which payment is specified additional to that for gravity sewer pipe.

6.71 SERVICE JUNCTIONS Section 6.48

Payment for service junctions installed in the gravity sewers will be made at the unit price shown in the Tender Form. This price shall include materials, and placement of the wye and plug or cap as required.

6.72 CONNECTIONS TO EXISTING PIPING Section 6.47

(a) Payment for connections to existing main piping will be made at the unit price per proposed pipe size per connection shown in the Tender Form. This price shall include materials, and all work incidental thereto.

(b) Payment for connections to existing service connections will be made at the unit price per pipe size per connection shown in the Tender Form. This price shall include materials, and all work incidental thereto.
6.73 **PRECAST MANHOLE SECTIONS** Section 6.51 and 6.54

Payment for manholes will be made at the unit price per vertical metre per diameter of manhole barrel shown in the Tender Form. Measurement will be made from the lowest channel invert in the manhole to the bottom of the manhole cover slab. This price shall include materials, installation, grouting, and all work incidental thereto except those items for which payment is specified additional to that for manholes.

6.74 **CONCRETE BASES, FRAMES AND COVERS** Sections 6.49, 6.49A, 6.52, 6.53

Payment for concrete bases or tee manholes, cover slabs, and frames and covers will be made at the unit price per manhole shown in the Tender Form. This price shall include materials, installation, brickwork, concrete, channeling, grouting, adjustment to grade, asphalt apron and all work incidental thereto. Payment will be in addition to that of 6.73 above.

6.75 **DROP STRUCTURES** Section 6.55

Payment for drop structures on manholes will be made at the unit price per vertical metre of drop shown in the Tender Form. Measurement will be made between pipe inverts at the top and bottom of the drop section. This price shall include materials, installation, concrete, asphalt apron and all work incidental thereto.

6.76 **STUBS** Section 6.56

Payment for stubs in manholes will be made at the unit price per linear metre for the various sizes of pipe shown in the Tender Form. This price shall include materials, grouting, installation, cap, and all work incidental thereto. Payment will be in addition to that of 6.73 above.

6.77 **CLEANOUTS** Section 6.57 Standard Drawing S12

Payment for cleanouts will be made at the unit price shown in the Tender Form for the specified type of cleanout. This price shall include excavation, materials, installation, concrete base, concrete barrel, grouting, brickwork, frame and cover, pipe, fittings, adjustment to grade and all work incidental thereto.

6.78 **ADDITIONAL EXCAVATION AND BACKFILL**

Payment will not be made as a separate item for excavation, backfill and work applicable thereto required at any structure specified in this section. The cost of such work shall be included in the applicable prices for the various structures shown in the Tender Form.
6.79 **SEWER SERVICE CONNECTION PIPING** Section 6.59

Payment for sewer service connection pipe will be made at the unit price per linear metre shown in the Tender Form for the various sizes of pipe. Measurement will be made horizontally along the centreline of the installed pipe from the centre of the gravity sewer to the terminus of the service pipe or from the bend fitting in the case of riser service connections. This price shall include materials, excavation, dewatering, bracing & sheeting, bedding, pipe installation, backfill with native material, and maintenance, testing as specified, bends, caps, and other fittings, and all work incidental thereto except those items for which payment is specified additional to that for sewer service connection pipe.

6.80 **SERVICE CONNECTION INSPECTION ASSEMBLY** Section 6.59.3 (j) & (k) and 6.59.4

Standard Drawing S-5

Payment for service connection inspection assemblies will be made at the unit price shown in the Tender Form. This price shall include installation of pipe, fittings, marker posts, concrete service box, other materials and all work incidental thereto.

6.81 **MANHOLE AND CLEANOUT LID MARKERS** Section 6.35 Standard Drawing S-14

Payment for manhole and cleanout lid markers will be made at the unit price shown in the Tender Form. This price shall include supply of materials, excavation, fabrication, painting, installation, backfilling and all work incidental thereto. Payment will be in addition to that of 6.73 and 6.77.
## SECTION 7 - STORMWATER MANAGEMENT

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SECTION 7 - STORMWATER MANAGEMENT
DESIGN CRITERIA
(REVISED NOVEMBER 2016)

7.1 INTRODUCTION

.1 Scope:

Stormwater management is the term traditionally used when referring to managing rainfall using design storms and sizing drainage facilities. Rainwater management refers to frequently occurring events. In this section, the term stormwater management is used and is intended to include the scope of rainwater management.

.2 Objectives:

(a) Overall – To provide flood protection, drainage, and minimize impacts on the aquatic environment. Achieve a balance between protecting property from flood hazards and protecting the aquatic environment in terms of both water quality and quantity.
(b) Major System – To safely convey the 1:100 year storm event with overland and piped flow to a suitable receiving body.
(c) Minor System – To safely contain the 1:5 year storm within the minor system.
(d) Rainwater Best Management Practices – To emulate the natural conditions of undeveloped land by capturing or retaining small rainwater events and infiltrating the water into the ground.
(e) Existing Watercourses – To ensure that the quality and quantity of flows do not adversely affect the receiving waters.

.3 City Bylaws:

This manual should be used in accordance with the most recent version of other City policies and bylaws including, but not limited to those listed below:

(a) Stormwater Management in Nanaimo
(b) Official Community Plan
(c) Other bylaws pertaining to stormwater as listed in Section 3.01(c) City Bylaws

.4 Other Applicable Government Initiatives:

In addition, this manual should be used in accordance with other applicable government policies, guidelines and documents, including, but not necessarily limited to the following:

(a) Federal Fisheries Act
(b) Provincial Fish Protection Act
(c) Fish-Stream Crossing Guidebook, Revised Edition, Ministry of Forests, Lands and Natural Resource Operations, Ministry of Environment
(d) Stormwater Source Control Guidelines 2012 – Metro Vancouver
(e) Stormwater Planning: A Guidebook for British Columbia

.5 Previous Design Criteria:

City of Nanaimo utility systems have been constructed over many years using design criteria and practices that were in place at the time. The current criteria is to be used when designing all new infrastructure and when assessing the adequacy of existing systems. Existing systems which do not meet current design criteria will be evaluated on a case-by-case basis and upgraded as resources permit. When replacing existing infrastructure,
should the existing system not meet current criteria, the Design Engineer will be responsible to ensure the design is appropriate and founded on solid engineering principles and practices.

.6 Development Requirements:

(a) Responsibilities:

Development proponents shall be responsible for designing stormwater systems which consider watershed management, flood protection, drainage, riparian area, and watercourse protection.

Post-development run-off release rates must be designed to consider the capacity of the downstream drainage system and the erosion of any downstream watercourses. The design must ensure that the frequency and magnitude of erosion events do not increase when compared to the pre-development conditions. These requirements are further detailed in Section 7.03.7 - Peak Flow and Runoff Volume Control.

For new developments and re-developments that drain to watercourses, frequently occurring post-development run-off volumes and rates must be designed to emulate pre-development conditions. These requirements are further detailed in Section 7.03.7 - Peak Flow and Runoff Volume Control.

For developments and re-developments that do not drain into a creek or river system, but discharge directly into pipes, ditches or overland flow paths which discharges directly into the Strait of Georgia, hydraulic control facilities may not be required as for discharge to watercourses. These requirements are further detailed in Section 7.03.7 - Peak Flow and Runoff Volume Control.

The stormwater system must be designed in a manner which prevents pollutants and sediment from entering watercourses and ocean from the development both during and after construction. These requirements are further detailed in Section 7.14 Water Quality.

Construction activities must be managed to minimize the impact to adjacent watercourses as set out in the “Storm Sewer Regulation and Charge Bylaw No. 3808” and Erosion and Sediment Control Guideline.

It is the Design Engineer’s responsibility to ensure that all applicable guidelines, standards, bylaws, and other regulations and policies are strictly followed.

(b) Reporting:

Development proponents shall prepare a Stormwater Management Plan for developments of more than three lots single or duplex residential lots and for all multi-family, commercial, industrial, and institutional developments, or at the discretion of the City Engineer. All Stormwater Management Plans shall be presented in a report which includes:
SECTION 7 - STORMWATER MANAGEMENT
DESIGN CRITERIA
(REVISIED NOVEMBER 2016)

(i) A tributary area plan outlining all areas included in the stormwater calculations, tributary to the rainwater management measures and minor and major systems.

(ii) An overall plan showing major and minor systems and rainwater management measures (quantity and/or quality control as required). The plan shall, at minimum, include reference to street names and the legal addresses of adjacent lots; it is encouraged to include references to City of Nanaimo GIS pipe and manhole ID numbers for existing infrastructure. The design flows shall be marked on the drawing at all discharge points from the property.

(iii) Detailed design drawings for the proposed minor and major systems and rainwater management measures. The drawings should show the routing of flows and the hydraulic grade line of all piped flows.

(iv) A plan showing the pre and post-development topography that adequately describes the terrain.

(v) Summary tables that provide the following key design information:

(a) Total catchment area
(b) Pre and post-development catchment area runoff coefficients used, if used.

(vi) Design calculations including:

(a) Where applicable as described in Section 7.03.7 - Peak Flow and Runoff Volume Control, a review of the downstream infrastructure to the nearest trunk storm sewer or ocean. Where it is found that the discharge from the development alters the flows entering the downstream pipe to a point where the pipes no longer have sufficient capacity, the report shall include specific recommendations on downstream improvements to be made to accommodate the additional drainage.

(b) Hydraulic and Hydrologic design calculations for the pipe network using either the Rational Method and Manning’s Equation or computer modeling.

(c) Design calculations for storage facilities including the storage volume, facility size and flow control considerations.

(d) Design calculations for rainwater management best practices including the rainwater design volume and facility size.

(e) Time of concentration design calculations including a rationale explaining which method was chosen and why that method was chosen.

(vii) The report shall include details regarding the provisions included to address water quality leaving the site and entering the minor system.

(viii) For systems which include works or facilities which require ongoing maintenance, an operation and maintenance plan shall be provided detailing the inspection and maintenance requirements.

(ix) All Stormwater Management Plans are to be signed and sealed by a Professional Engineer licensed in British Columbia.
SECTION 7 - STORMWATER MANAGEMENT
DESIGN CRITERIA
(REVISED NOVEMBER 2016)

7.2 SUMMARY OF STORMWATER AND ENVIRONMENTAL PROTECTION DESIGN CRITERIA

.1 This section provides a summary of all the design criteria to be used for the planning and design of stormwater management infrastructure. The planning and design for Stormwater Management Plans must meet the following criteria:

(a) A minor system conveyance capacity up to the 1:5-year return period storm to minimize inconvenience of frequent surface runoff.
(b) A major system conveyance capacity up to the 1:100-year return period storm to provide safe conveyance of flows to minimize damage to life and property.
(c) For areas draining to watercourses: Provide volume reduction, detention, and water quality treatment to minimize erosion and protect aquatic habitat and water quality.
(d) For areas draining directly to the ocean: Volume reduction is not required; however, detention for the protection of downstream infrastructure may be required and water quality treatment.
(e) Volume reduction: Retain, infiltrate, or reuse the 6-month, 24-hour (50% of the 2-year, 24-hour) post development runoff volume. For Nanaimo, this equates to approximately 31mm of rainfall depth.
(f) Detention: Detain post-development flows to pre-development levels for the 6-month, 24-hour (50% of the 2-year, 24-hour) event for areas draining to watercourses to minimize erosion. If downstream drainage system cannot accommodate the 5-year post-development flows, detain them to pre-development levels.
(g) Provide water quality treatment for 90% of the average annual runoff (the 6-month, 24-hour storm or 50% of the 2-year, 24-hour storm) for impervious surfaces exposed to vehicle traffic as described in Section 7.14 - Water Quality. Remove 80% of Total Suspended Solids over 50µm particle size.
(h) Account for climate change in stormwater management designs as described in Section 7.15 - Climate Change.

7.3 STORMWATER RUNOFF

.1 Scope:

This section describes the rationale, methodology and parameters for determining the hydrologic variables such as rate and amount of stormwater runoff in the design of drainage flow conveyance and storage facilities.

.2 Catchment Areas:

Ultimate land use for the purpose of stormwater calculations shall be determined by referring to the current “Official Community Plan” and the current Official Regional District Community Plans for the area outside the City.

The contributing catchment area shall be governed by the natural contours of the land and any changes to the topography caused by the development. The catchment shall also consider any overall catchment areas which have been established by the City of Nanaimo.
.3 Rainfall Data:

(a) IDF Curves:

Intensity/Duration/Frequency data has been compiled into the IDF Curves shown on Standard Drawing No. SW-25 for the applicable design year return period rainfall.

(b) Rainfall Gauges:

The City of Nanaimo has several rainfall gauges with historical rainfall data. This rainfall data is available for reference if desired; however, it is up to the individual engineer to verify the quality of the data. In the future, specific data sets may become available.

.4 Time of Concentration:

(a) Definition:

Time of Concentration is the time required for stormwater runoff to travel from the most remote point of the drainage basin to the point of interest and having the greatest impact on downstream flows.

(b) Method:

There are several methods available to calculate time of concentration such as the Upland Method, Kinematic Wave Equation, Kirby Equation, Kirpich Equation, and others. The Design Engineer shall determine the most appropriate method of calculating the time of concentration. Overland flow times in undeveloped areas may be estimated using the Upland Method of Estimating Time of Concentration as shown on Standard Drawing No. SW-26 if the slope and land use of the area is known.

(c) Minimum and Maximum Time of Concentration:

The minimum time of concentration for all calculations shall be 5 minutes. The maximum time of concentration shall be 10 minutes for the overland flow component into the stormwater system in fully developed areas. Time of concentration with large areas of land which will remain undeveloped shall be determined by one of the above mentioned methods.

.5 Rational Method:

(a) Application:

The use of the Rational Method for final design calculations is to be limited to the design of minor or major systems where detention storage and/or other runoff controls do not exist or are not required, and where the catchment is not larger than 20 hectares.
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(b) Formula:

\[ Q = CIA \times 2.78 \]

Where:

\[ Q = \text{storm runoff flow in litres/second} \]
\[ C = \text{the coefficient of runoff} \]
\[ I = \text{the rainfall intensity in mm per hour} \]
\[ A = \text{contributing catchment area in hectares} \]

(c) Coefficient of Runoff (C):

The choice of coefficient of runoff “C” shall be based on ground slope, type of ground or surface cover, soil conditions, size of drainage area and the expected ultimate land use of the properties within the drainage areas. Selection of the runoff coefficient for existing areas shall include a review of the orthographic photo to determine the impervious area.

The choice of the coefficient shall be guided by the expected characteristics of the proposed development and fall within the following ranges for new development:

<table>
<thead>
<tr>
<th>TYPE OF DEVELOPMENT</th>
<th>COEFFICIENT OF RUNOFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>0.80 to 1.00</td>
</tr>
<tr>
<td>Commercial Business Areas, Multi-Family</td>
<td>0.65 to 0.90</td>
</tr>
<tr>
<td>Single Family Residential and Low Density Multi-Family</td>
<td>0.50 to 0.80</td>
</tr>
<tr>
<td>Rural Areas, Parks, Golf Courses</td>
<td>0.25 to 0.55</td>
</tr>
</tbody>
</table>

(d) Presentation:

Where the rational formula is used, two copies of the storm sewer design calculations, in a format in accordance with Appendix H2, Stormwater Management Flow Analysis – Calculation Sheet shall be submitted.

.6 Computer Simulation Methodology:

(a) Application:

For all stormwater calculations which include detention storage or other runoff controls and/or a catchment greater than 20 hectares, a computer simulation model shall be used. The model results must be used for design and sizing of all pipes and storage facilities.

(b) Stormwater Modeling Software:

The City of Nanaimo supports the use of any interface that supports the SWMM modeling engine for the creation of hydrologic and hydraulic computer models. The use of the other types of software requires the prior approval of the City Engineer.
(c) Hydrology Methods:

There are several hydrology methods available in modeling software. Infiltration methods such as Green Ampt or Horton’s are encouraged for modeling urban watersheds; however, these methods require site specific information regarding the geotechnical conditions.

(d) Storage Analysis:

Comprehensive analysis of the storage should be completed by the Design Engineer including a review of all storm durations up to the 24-hour event to determine the governing storm duration. In the future, the City may require continuous modeling be completed for storage analysis.

(e) Procedure:

An analysis of the post-development conditions is to be done at key points of the major and minor system for various durations of the design return period storms. This process will identify the most critical event to be used when designing the system. It should be noted that the storm duration which generates a critical event for the conveyance system may be different than the storm duration which generates a critical event for the storage facility.

(f) Presentation:

A report is required to document the design rationale used to develop the model. The report is to be included in the Stormwater Management Plan. At a minimum, the report shall include the following:

(i) An executive summary.
(ii) Type and version of the modeling software used.
(iii) All hydraulic and hydrologic parameters and assumptions.
(iv) Design storms used and/or continuous modeling data used.
(v) Summary of peak flows for each element of the system for both the major and minor storm in a table.
(vi) Summary hydrograph(s) of any storage or flow control facilities.
(vii) Post development hydrograph at the point where the flows leave the system being modeled and at the point where the flows leave the proposed development.
(viii) Pre-development major and minor storm calculations.
(ix) Comparison of pre and post-development flows and hydrographs at the point where the flows leave the proposed development.
(x) Recommendations.
(xi) Tables showing existing and future pipe information.
(xii) Drawings showing hydraulic grade line for design scenarios.
(xiii) A digital copy of the model files.
Peak Flow and Runoff Volume Control:

(a) Developments Not Upstream of a Creek, River or Wetland:

For new developments and re-developments that do not drain into a creek or river system, but discharge directly into pipes, ditches, or overland flow paths which discharge directly into the Strait of Georgia, storm water management facilities may not be required for hydraulic control. However, the Developer will be responsible for any downstream upgrades to the major or minor system extending to the nearest trunk sewer or outlet which is required as a result of the increased runoff from the development. Alternatively, the Developer may install hydraulic controls and provide storage which ensure the peak flow from the development site is maintained to pre-development conditions for the minor and majorsystems.

(b) Developments Upstream of a Creek, River, or Wetland:

For new developments and re-developments that eventually discharge into a creek, river or wetland system, controls are required to prevent erosion and shall recognize both peak flow rates and the duration of the peak flows. The objective is to limit both the magnitude and duration of post-development peak flows to that of the pre-development conditions, as much as possible.

(c) Post-Development Peak Flow and Runoff Volumes Shall be Controlled in Two Ways:

(i) Post-development 2-year and 5-year peak flows shall be controlled to 2-year and 5-year pre-development levels such that the post-development hydrographs shall emulate the pre-development hydrographs for both the 2-year and 5-year return periods. It is understood that it can be challenging to emulate existing conditions; at a minimum, the post-development hydrograph shall show that:

(a) The peak flow does not exceed the pre-development peak flow.

(b) The duration of the peak flow does not exceed the duration of the pre-development peak flow.

(ii) 6-Month, 24-Hour Storm Retained or Infiltrated Onsite:

Approximately 90% of all rainfall in BC are small rainfall events which, on most undeveloped sites, are primarily infiltrated into the soil. By incorporating rainwater best management practices, including rainwater best management practices, the majority of this rainfall can be infiltrated into the ground or retained for slow release. The rainwater management target is the 6-month, 24-hour post-development runoff volume. Research has indicated that this is consistent with 50% of the 2-year, 24-hour rainfall event volume. For Nanaimo, this equates to approximately 31mm of rainfall depth.

(iii) Care should be taken to ensure that watercourse base flows are not adversely affected by peak flow and runoff volume controls, or other hydrologic changes.
Pre-development is defined as a natural state; in most cases, a forested area should be assumed. However, if it can be shown that the land’s natural state was something other than forested, such as a meadow or rocky outcrop, it will be acceptable. Structures, parking areas, and manmade surfaces are not considered to be pre-development.

The above requirements for developments, to ensure runoff emulates the existing natural conditions, are necessary to protect the watersheds. However, the City does recognize that these targets may be challenging to achieve on some sites. Subject to the approval of the City Engineer, the City may accept Stormwater Management Plans which do not meet the targets outlined above, if the Design Engineer is able to provide evidence that:

(i) The development site has characteristics which make it challenging to meet the targets outlined above.

(ii) The intent of the above requirements has been achieved.

Water Quality Treatment Event:

The Water Quality Design Storm is considered the 6-month, 24-hour (50% of the 2-year, 24-hour) event. This event captures approximately 90% of the average annual runoff. Larger events should be bypassed around water quality treatment facilities to minimize suspension and washing through sediments.

MINOR SYSTEM

Definition:

The minor system shall be designed to convey the 1:5-year design storm. The minor system includes all drainage works that convey, detain, divert, and intercept the minor design runoff including pipes, catch basins, manholes, swales, ditches, etc., and other appurtenances designed to ultimately discharge into a major system.

Location:

The minor system shall normally be located in road right-of-way for ease of access to repair or maintain the system. Where the minor system is located in private property, the flow route shall be preserved by restrictive covenants and/or statutory right-of-way for ease of access to repair or maintain the system.

Trunk Storm Sewers:

Storm sewers 600mm in diameter or larger, or servicing an urban drainage basin in excess of 20 hectares, will be considered trunk sewers.

MAJOR SYSTEM

Definition:

The major system shall be designed to convey the 1:100 year design storm. The major system includes all drainage works that convey, detain, divert and intercept the major
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design runoff including pipes, manholes, swales, ditches, etc., and other appurtenances designed to ultimately discharge into a natural watercourse.

.2 Location:

(a) Generally, the major system shall be overland flow paths where the design flow can be conveyed in public road right-of-way and adequate watercourses. Where adequate overland major system paths cannot be established, pipes and culverts of the minor system may be enlarged to accommodate the major flow subject to approval of the City Engineer.

(b) When the major flow is accommodated by a public street, the street shall be designed to provide sufficient hydraulic capacity to handle the major flow. Planning the major drainage system shall be done simultaneously with street layout and gradient planning to define the function of the streets as part of the storm drainage system.

(c) When major flow is overland through private property, the flow route shall be protected and preserved by restrictive covenants and/or statutory right-of-way for ease of access to repair or maintain the system.

(d) Overland flow paths through private property shall be designed to minimize property damage and endangerment to public safety and have a suitable erosion protection.

(e) If no safe overland flow path exists, the storm sewer system must be designed to be the major system and sized to convey the major design storm to the outlet.

(f) Where the major flow is accommodated through the storm sewer system, additional catch basins may be required to ensure the flow can be captured by the minor system. The capability of the catch basins to accept the major flow is to be reviewed and confirmed.

.3 Discharge to Existing Watercourses:

(a) The discharge to an existing watercourse shall be designed in a way that protects the watercourse from erosion. Flow velocities exceeding 1.5m/s require an energy dissipater to reduce flow velocity to an acceptable rate.

(b) When improvements are required to a natural watercourse, design concepts which preserve and enhance the natural characteristics of the watercourse shall be employed.

.4 Flooding:

(a) The major system routing may allow for minor inconvenience such as localized flooding of streets and green spaces (parks, boulevard, landscaped areas, naturally vegetated areas, etc.), but no major damage such as damage to dwellings, significant erosion of private property, or damage to public facilities shall result from the major storm. Any allowances for minor inconvenience flooding shall be mentioned in the Stormwater Management Plan and shall be approved by the City Engineer.

(b) Full width cross-sections shall be provided showing the depth of the major flow along public streets, private property, ditches, and watercourses at typical and critical areas of the overland flow path.

(c) The major system shall be designed such that all habitable portions of buildings including basements are a minimum 0.3m above the major flow hydraulic grade line. No building shall have the bottom of its foundation less than 0.3m above the
maximum high water elevation of any storm water storage facility. In circumstances where lower building elevations are desired, the minor system may be enlarged to accommodate the major flow.

(d) Existing buildings constructed to a previous standard may not have this protection from the major system. As a result, if a lot is redeveloped, the new minimum habitable floor elevation on that lot may not be the same as the previous minimum habitable floor elevation.

(e) The grading for new developments shall ensure that the slope of the ground around structures has positive drainage away from structures.

.5 Roadway:

(a) Where the road is used to accommodate major flow, the following criteria must be considered:

(i) For local streets, the maximum depth at the crown of the road is to be 50mm.
(ii) For neighborhood collectors, minor collectors, major collectors and arterial roads, a minimum of 3.0m width of the road shall be free from flooding.
(iii) Care should be taken when designing intersections of roads which are used to convey the major storm so that flows can pass over the cross street.
(iv) Care should be taken designing the grading at road curves and at locations where the major flow path turns at intersections or at tee intersections.
(v) Cul-de-sacs which are down slope from the street will not be accepted as part of the major system unless approved by the City Engineer.
(vi) Care should be taken when designing driveways which are downhill from streets which form part of the major system. Type 2 driveway letdowns shall be avoided as shown in Standard Drawing No. CS-5A.

(b) When the street forms part of the major system, it shall be crowned and have curb and gutter capable of handling the major flows.

(c) The hydraulic capacity of a street section to convey water shall be calculated by the Manning Equation subject to the above conditions for major flows in a roadway.

7.6 PIPE DESIGN DETAILS

.1 Grades and Velocity of Stormwater in Pipes and Service Connections:

(a) The minimum design velocity for pipes shall be 1.0m/s.
(b) Where the pipe discharge velocity of the design flow exceeds 1.5m/s, into an open ditch or watercourse, provision shall be made for the installation of an energy dissipater to reduce flow velocity to the acceptable rate.
(c) There are no maximum allowable velocities; however, where velocity exceeds 3.0m/s or grades exceed 10%, the need for scour protection shall be examined and anchor blocks shall be required as per Standard Drawing No. T-8 and Standard Drawing No. T-8A.
(d) All 100mm diameter service connections shall have a minimum grade of 2%.

.2 Pipe and Service Connection Sizes:

(a) Minimum pipe diameters shall be 250mm. In residential areas, 200mm diameter may be approved by the City Engineer in the final section of a lateral sewer providing
the pipe has the required capacity and extension in the future is precluded by physical barriers or there is existing alternate pick-up of drainage from adjacent areas.
(b) Unless otherwise approved by the City Engineer, downstream pipe diameter shall be greater than or equal to upstream pipe diameter.
(c) Residential service connections shall be a minimum 100mm diameter, except service connections servicing lawn basins shall be a minimum 150mm diameter.
(d) Commercial and Industrial service connections shall be a minimum 150mm diameter.

.3 Selection of Pipe Material and Class:

The Design Engineer shall consider earth and live loading, soil conditions, and design life of the installation for determining pipe material and class. Pipe materials and brands shall be per the City of Nanaimo’s Approved Products List.

.4 Pipe Friction Factors:

Storm sewers shall be designed using the Manning Formula. The minimum ‘n’ value shall be 0.013 for all approved pipes.

.5 Pipe and Service Connection Depths:

(a) Minimum Cover:

(i) Storm sewers shall have 1.5m of cover in road right-of-way.
(ii) Storm sewers shall have 1.0m of cover in untraveled areas.
(iii) Service connections shall have 0.75m of cover.
(iv) Where minimum cover cannot be provided, an explanation of the reasons and pipe loading calculations shall be submitted with the proposed method of pipe protection to the City Engineer for approval.

(b) Where practical, service connections shall be deep enough to accommodate by gravity the lowest elevation of each lot serviced. Where it is not practical or where servicing the low elevation of the lots would require utilities in private lands, the development shall be graded in such a way which prevents overland flow from impacting neighboring structures.
(c) In addition, all existing foundation drains shall be accommodated. For vacant lots, service connections shall also be deep enough to accommodate by gravity foundation drains for future building(s) constructed to the minimum basement floor elevation as determined by the Design Engineer.
(d) Storm sewer mains shall be deep enough that all service connections accommodating surface and foundation drainage from all lots in the upstream drainage basin can be drained to the storm sewer system by gravity.

.6 Curved Pipes:

(a) Horizontal curves will be permitted where the configuration of the property lines requires curvature for a constant offset and where the design velocity exceeds 1.0m/sec.
(b) Vertical curves may be approved by the City Engineer where excessive depths or rock cuts are to be avoided or where energy dissipation is required.
(c) Radius of curvature shall be uniform throughout the curves and shall not be less than 60m or the manufacturer’s minimum pipe radius, whichever is greater. Mitre bends shall not be used unless otherwise approved by the City Engineer.

(d) Only one vertical and/or one horizontal curve shall be permitted between manholes.

.7 Location of Storm Sewer Mains and Service Connections:

(a) Storm sewer mains shall be located not less than 3.0m horizontally and 0.45m vertically from all watermains unless otherwise approved by the Provincial Department of Health. Normal storm sewer main offsets are shown in the standard drawings for roadways.

(b) If there is a significant elevation difference between the lots on opposite sides of the street, if possible, storm sewers shall be located on the low side of the street where both sides are served by the sewer. If only the high side of the street is serviced by the storm sewer, storm sewers shall be located on the high side of the street.

(c) All lots shall be provided with a storm sewer service connection, unless otherwise approved by the City Engineer. Service connections shall be located to the offsets as shown on Standard Drawing No. T-7.

(d) Storm sewer mains may be installed in a common trench with sanitary sewers provided the minimum outside pipe separation is 300mm.

.8 Utilities in Private Lands:

The following shall be considered in the design of utilities crossing private lands:

(a) The design of utilities shall avoid crossing private lands. Utilities in private lands shall require the approval of the City Engineer. Approval will only be granted where it is shown that all other options have been exhausted.

(b) Utilities following property boundaries across private lands shall generally be offset a minimum 2.0m from the property boundary.

(c) Appurtenances such as manholes, valves, etc., shall be located entirely on one property, they shall not be located on property boundaries.

(d) Utilities shall not cross private parcels in such a manner that they render the property unusable. Special consideration must be given to ensure the location of the utility crossing minimizes the limitations on the future use of the property.

(e) For a sample statutory right-of-way condition sheet, refer to Appendix C, Standard Drawing No. RW-2.

(f) For an Easement Release and Inspection Form Following the Construction of the Utility, refer to Appendix C.

(g) For minimum widths of statutory right-of-way and working widths refer to Appendix D.

.9 Service Connection Lengths:

(a) The maximum length of a storm sewer service connection measured horizontally between the storm sewer and the property line shall be 30m. Storm sewer services longer than 30m shall require approval by the City Engineer. All inspection assemblies required for service connections in excess of 30m in length shall be shown on the design drawings.

(b) For industrial, commercial, and multi-family servicing, and/or where oil interceptors are required, manholes shall be provided where the service connects with the main or at the property line regardless of the size of the service.
(c) All services 250mm in diameter or larger require manholes where the service connects with the main or at the property line. In the case of closely spaced services, every other service manhole is to be located on the service line close to the property line.

.10 Number of Service Connections per Lot:

(a) Each lot shall be serviced by one only service connection for storm drainage. Where the size of the lot or the topography makes one service connection impractical, additional service connections may be allowed subject to the approval of the City Engineer.

.11 Manholes:

(a) Distances between manholes shall not exceed 120m unless otherwise approved by the City Engineer. For pipes larger than 600mm in diameter, manhole spacing may be increased to 180m.
(b) Manholes shall be located at grade and alignment changes, at lateral size changes, at the upstream end of all lateral sewers, and either at the junctions of all lateral sewers with the main or at property line for services 250mm and larger.
(c) Cleanouts may only be used at the upstream end of lateral sewers in a temporary situation during a phased development where the future phase of the development will remove the cleanout.
(d) Outside drops shall be provided for pipe sizes 375mm or less where the difference in elevation between incoming and outgoing sewers exceed 600mm. Drops less than 600mm in elevation shall be accommodated by manhole benching. Precast manhole barrels shall be sized according to nominal inside pipe diameter and depth as detailed below:

<table>
<thead>
<tr>
<th>Pipe Size (Nominal)</th>
<th>Depth of Manhole (Top of Cover to Inv.)</th>
<th>Barrel Size (Inside Dia.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 - 375mm</td>
<td>0 - 5.9m</td>
<td>1050mm</td>
</tr>
<tr>
<td>150 – 375mm</td>
<td>6.0 – 9.0m</td>
<td>1200mm</td>
</tr>
<tr>
<td>150 – 600mm</td>
<td>9.0m or greater</td>
<td>1500mm</td>
</tr>
<tr>
<td>400 – 600mm</td>
<td>0.0 – 8.9m</td>
<td>1200mm</td>
</tr>
<tr>
<td>675 – 750mm</td>
<td>All Depths</td>
<td>1350mm</td>
</tr>
<tr>
<td>900 – 1050mm</td>
<td>All Depths</td>
<td>1500mm</td>
</tr>
</tbody>
</table>

(e) Where cast-in-place manholes are proposed, all design and construction details shall be submitted to the City Engineer for approval.

(f) Manholes shall be designed to incorporate a minimum pipe invert elevation difference of at least 25mm, in addition to the normal grade of the storm sewer, wherever a horizontal deflection exceeding 45 degrees occurs. Smaller pipe sizes shall be crown to crown with larger pipe sizes when entering manholes. For super critical flows or large pipes (>600mm diameter), the hydraulic losses through
manholes shall be calculated and the corresponding drop in inverts across the manhole shall be included in the design where appropriate.

(g) Manholes shall be located to avoid any conflict with curb and gutter or sidewalks.
(h) A watertight manhole frame and cover shall be required for all sewer manholes where flooding can occur or in areas subject to vandalism (i.e. parks, undeveloped right-of-ways, etc.).

.12 Catch Basins:

(a) Catch basins shall be provided at regular intervals along streets, at street intersections, and at all low points in the street.
(b) Catch basins located in streets shall be spaced to collect a maximum of 450m² of pavement drainage where grades do not exceed 5%. On grades over 5% the maximum area collected shall be reduced to 300m².
(c) Double catch basins are required at all low points in roads and downhill cul-de-sacs except where located along non-mountable curb which provides for installation of a single curb inlet, refer to the curb inlet standard drawing. Location requirements for the different catch basin types shall conform to the following:

(i) Curb inlet catch basins shall be used in locations along non-mountable curbed roads at all low points or in other areas where additional inlet capacity is required.
(ii) Boulevard catch basins shall be used in boulevards and easements outside of the paved road.
(iii) Lawn basins shall be used for locations on private property where, at the discretion of the City Engineer, drainage is required to be contained and prevented from flowing onto other properties.
(iv) Shallow catch basins shall be used in locations where it is not possible to provide a catch basin with a sump.

(d) Catch Basin Leads:

(i) Single basin leads shall have a minimum diameter of 200mm.
(ii) Double basin leads shall have a minimum diameter of 250mm.
(iii) Lawn basin leads shall have a minimum diameter of 150mm.
(iv) Leads over 30m shall have a minimum diameter of 250mm.
(v) Double basin leads shall be wyed together. Basins shall not be directly connected.
(vi) The desired grade for catch basin leads is 2%. Where it is impractical to obtain 2%, a catch basin lead with a 1% grade is acceptable.

.13 Surcharge:

(a) In areas of new construction, storm sewer pipes shall be designed so that the minor storm hydraulic grade line is within the pipe and the hydraulic grade line meets the requirements set out in Section 7.05 - Major System.

(b) When necessary, and subject to approval by the City Engineer, storm sewers may be permitted to temporarily discharge into existing ditches with submerged outlets, to allow future extension of the sewer at an adequate depth. In these cases, a hydraulic
gradient must be calculated and shown on the plan to ensure that no danger of flooding will result.

.14 Trench Dams:
   (a) Where there is any possibility of groundwater concentration to other utility trenches, storm sewer connections and trench dams shall be provided per Section 4.18 - Trench Dams.

.15 Subsurface Drains:
   (a) Subsurface drains will be used where a geotechnical evaluation shows a high groundwater table or an area which significant cuts into the existing ground may create the potential for a saturated condition. Subsurface drains located adjacent to roads will be extended well below the road base. The material for subsurface drains will be clear round drain rock in an envelope of approved filter material. A minimum 150mm PVC perforated pipe will be placed at the bottom of the trench.

7.7 CULVERTS

.1 General:
   (a) Generally, culverts shall be sized to suit the drainage area and shall not be smaller than upstream culverts without prior approval of the City Engineer.
   (b) Inlet and outlet structures shall be appropriately designed with energy dissipation, scour protection, erosion control and overflow protection as needed.

.2 Road Culverts:
   (a) Road culverts shall be designed to accommodate the major system. The culvert inlet may surcharge under the major storm. The surcharge at the inlet shall meet the flooding requirements of the major system as specified in Section 7.05 - Major System.
   (b) Road culverts shall be minimum 450mm diameter regardless of hydraulic capacity.
   (c) Road crossings of watercourses which are, or could be fish bearing, shall be designed to provide fish passage where possible. Open bottom culverts are preferable.

.3 Driveway Culverts:
   (a) Driveway culverts shall be designed to accommodate the minor storm with the headwater not above the crown of the pipe.
   (b) Driveway culverts shall be minimum 300mm diameter regardless of hydraulic capacity.

7.8 DITCHES (WITHIN ROAD RIGHT-OF-WAY)

(a) Ditches shall be used in road allowances where there is no curb and gutter to direct minor and major flows towards watercourses or the nearest piped system.
(b) Ditches shall be designed to promote groundwater infiltration.
(c) Ditches adjacent to travelled roadways shall not exceed 1.9m in depth.
(d) Ditches shall be trapezoidal in shape having maximum side slopes of 1-1/2 H:1V and a minimum bottom width of 450mm.
(e) The minimum grade of a ditch shall be 0.5%.
(f) The maximum velocity in an unlined ditch shall be 1.5m/s. Higher velocities may be permitted where soil conditions are suitable or where erosion protection has been provided. Excessive velocities should be avoided by using a piped system instead of ditches.
(g) On steep slopes, grade control structures may be required.

7.9 SWALES (WITHIN ROAD RIGHT-OF-WAY)

(a) Swales shall be used in road allowances where there is no curb and gutter to direct minor and major flows towards watercourses or the nearest piped system or on private property in conjunction with lot grading to protect properties from overland sheet flow.
(b) Swales shall be designed to promote groundwater infiltration.
(c) Swales shall have a minimum depth of 150mm, and a minimum width of 1.5m.
(d) The minimum grade of a swale shall be 1.0%.
(e) Swales shall not be used where the velocity exceeds 1.5m/s or on excessively steep slopes.

7.10 OPEN CHANNELS (WITHIN PRIVATE PROPERTY AND EASEMENTS)

(a) The design of open channels as part of the major or minor system shall be restricted to the following maximum velocities:
   (i) Unlined channel: 1.5m/s
   (ii) Suitably lined channel: 3m/s

(b) If the mean velocity exceeds that permissible for the particular kind of soil or is greater than 1.5m/s, the channel shall be suitably lined to protect it from erosion.
(c) The maximum depth of flow shall not exceed 300mm with a freeboard of 150mm.
(d) Side slopes on designed channels shall not exceed 3H:1V.
(e) Open channels shall be designed where possible to promote infiltration.

7.11 INLET AND OUTLET STRUCTURES

(a) Inlet and outlet structures shall be required on all storm sewer pipes and culverts. Headwater requirements shall be as per Section 7.07 - Culverts.
(b) A trash rack is required as part of all inlet structures to storm sewer pipes. Trash racks may be required on culverts at the discretion of the City Engineer.
(c) Trash rack hydraulic and structural design shall allow for passage of design flows with 50% blockage of the trash rack with debris.
(d) A safety grillage is required as part of an outlet structure from storm sewer pipes greater than 450mm in diameter or 3.0m in length. Safety grillages may be required on culverts at the discretion of the City Engineer.
(e) Pipe leaving inlet structures, where the inlet elevation significantly higher than the storm sewer, shall have a maximum grade of 5% for minimum 2.0m. After the 2.0m, the pipe grade can be adjusted with a vertical curve to attain design depth.
(f) Cast-in-place inlet and outlet structures shall be designed by a structural engineer to suit the specific site and soil conditions. Standard drawings shall be used as a guide for specific design criteria. Approved prefabricated inlet and outlet structures may be used.
The Engineer shall ensure the structures are designed to suit the existing site and soil conditions.

(g) Sandbag headwalls shall not be used except for driveway crossings or hydrant access crossing.

(h) Outlets for storm sewers having velocities in excess of 1.5m/s shall incorporate a method to dissipate the energy so that the water will not scour the receiving channel.

(i) All inlet and outlet structures shall include provisions for safe maintenance access and shall conform to WorkSafeBC requirements.

7.12 STORAGE FACILITIES

.1 General:

(a) The design of permanent storage facilities forming part of the major system shall be an integral part of the overall drainage basin plan.

(b) The design of permanent storage facilities shall consider safety and economical maintenance of operations. Storage facilities should also, where possible, be designed as multiuse facilities that include recreational, environmental and aesthetic aspects.

(c) Storage facilities shall accommodate the entire future developed tributary area.

(d) Depending on the site specific characteristics, a combination of storage and other groundwater recharge facilities may be appropriate to effectively reduce the runoff from development sites.

.2 Ownership:

(a) Single Family and Duplex Residential:

Large storage facilities servicing single family or duplex residential developments will be owned and maintained by the City. Storage facilities constructed as part of a Bare Land Strata single family or duplex residential development will be owned and operated by the Strata Corporation.

(b) Multi-Family Residential, Commercial, Industrial, and Institutional:

Storage facilities required as part of a multi-family, commercial, industrial, or institutional development will be owned and operated privately. Facilities may be underground or above ground including roof top or parking lots.

.3 Storage Facility Options:

(a) Constructed Wetland:

Constructed wetlands can be incorporated into the drainage system as a means to not only control runoff but to introduce habitat for wildlife and add a bio-filtration element to the facility that improves water quality. The use of constructed wetlands is strongly encouraged.
(b) Wet Pond:

A wet pond is a method where rainwater runoff is collected and stored for a significant amount of time. The water is usually released after the storm has ended. These may form a recreational or aesthetic facility centered on a permanent pool of water.

(c) Dry Pond:

Dry ponds are used as temporary water storage after a significant rainfall event. They are typically controlled so that frequent low flows are not detained in the dry pond. As the pond is dry for the majority of the time, dry ponds can be landscaped in a way that they can be used for other purposes.

(d) Underground Storage:

A variety of methods are available for storing rainwater underground to control flows. Underground storage that incorporates other functions is encouraged; storage tank for water re-use (landscape irrigation), groundwater recharge, and infiltration are possible options.

(e) Other Methods:

There are a variety of other ways to store rainwater onsite including rooftop storage, parking lot storage, infiltration swales, rain gardens and many others. The City of Nanaimo is open to innovative ways to store and infiltrate rainwater subject to the approval of the City Engineer.

.4 General Design Guidelines:

(a) Storage facilities shall be tailored to suit the unique characteristics of the site and shall include a geotechnical evaluation to address the groundwater table interaction, and the permeability and stability of the existing soils.

(b) Maximum grade for a dry detention pond shall be 4H:1V.

(c) Maximum wet detention pond shall be 7H:1V from the normal water level to a depth of 0.4m; steeper side slopes may be considered if the safety risks are minimized such as separating the area from the public or the pond being inaccessible due to vegetation. Slopes of 4H:1V vertical shall be used for 0.4m depth below water level to the bottom of the pond.

(d) Storage facilities shall be designed to accommodate the design storage volume with a freeboard of 300mm.

(e) Where practical, sub-surface drains shall be provided to ensure that the storage facility can be completely drained. Where subsurface drains cannot be installed, the pond shall be designed so that mobile pumping equipment may be installed and used to drain the pond.

(f) All existing and future foundation drains shall drain by gravity to the storage facility inlet pipe above the design storage level.

(g) An overflow spillway shall be provided to handle potential peak runoff from the major storm or a blockage to the outlet. Discharge shall be to the major system downstream flow path.
(h) An 8.0m buffer zone shall be provided along the top of wet ponds, dry ponds, and constructed wetlands with a minimum building set-back of 15m from the top of the storage facility.

(i) An access at least 3.0m wide shall be provided to all storage facilities for maintenance purposes. The access shall allow the passage of motor vehicles unless otherwise approved by the City Engineer.

(j) Storage facilities shall be appropriately landscaped and protected from erosion.

(k) Inlets for the storage facility shall be a form of surcharging manhole or catch basin inside the facility. Open channels in the storage facility shall not be permitted.

(l) The outlet control for storage facilities shall be designed for easy access and maintenance and shall be provided with a lock to prevent vandalism.

(m) The pond design will include a sediment removal process for control of heavy solids which may be washed to the pond during the construction period associated with the development of the contributing basin. Sediment basins will be provided at all inlet locations for continued use after completion of the subdivision development.

(n) Additional design guidelines can be found in the Department of Fisheries and Oceans Land Development Guidelines for the Protection of Aquatic Habitat.

.5 Temporary Storage Facilities:

(a) Where land development occurs in advance of completed drainage basin facilities, temporary storage facilities may be utilized on an individual basis as approved by the City Engineer.

(b) The design of temporary storage facilities shall consider the following:

(i) The temporary storage facility meets or exceeds the requirements of this section for permanent storage facilities unless otherwise noted.

(ii) All storm drainage systems discharging to the temporary storage facility can be connected to the permanent drainage works when completed and the temporary facility is abandoned.

.6 Storage Facility Outlets:

(a) The outlet of the storage facility should be designed to control the outflow as calculated in the Stormwater Management Plan.

(b) The outlet structure for a storage pond shall discharge to a point downstream which has the ability to safely and adequately accommodate the maximum discharge.

(c) Outlet structures shall be freeflow and ungated. Controls such as orifices and weirs are the preferred method of controlling the outflow. Manual controls such as gates, valves, or stop logs are discouraged. A valve will be permitted in the drain of a storage pond.

(d) Outlet structures shall conform to Section 7.11.

(e) For outlets that are not submerged, a lattice type cover over the inlet end of the outlet is preferred. A limiting velocity of 1m/s is required for the design of the lattice.

(f) Outlets shall be designed to all appropriate WorkSafeBC requirements for entry and exit.

(g) Outlet structure shall be designed to allow easy and safe access for cleaning of the inlet side during peak runoff.
7.13 RAINWATER BEST MANAGEMENT PRACTICES

.1 Introduction:

The development of previously vegetated land significantly changes the hydrological characteristics of the land by removing vegetation, changing the topography of the land, increasing impervious surfaces, and changing drainage paths. Traditionally, the increase in stormwater runoff, which is created by this development, has been mitigated through detention storage to control peak runoff and by increasing the hydraulic capacity of the drainage system. Recently, there has been progress toward considering more than just the hydraulic aspects of rainwater runoff to include aspects such as the natural hydrologic process, the overall watershed, and water quality. Some of the rainwater best management practices described in this section were developed as an attempt to mimic the natural characteristics of a watershed. Many of them promote infiltration of rainwater into the ground and provide groundwater recharge benefits in addition to rainwater runoff control. Rainwater best management practices may also be called: rainwater BMPs, stormwater source controls, low impact development BMPs, or rainwater management methods.

The use of rainwater best management practices is required wherever technically feasible for new developments and re-developments which outlet into a creek or river system. For developments that do not drain into a creek or river system, but discharge directly into pipes, ditches, or overland flow paths which discharge directly into the Strait of Georgia, rainwater best management practices may not be required for runoff volume control, but may be an effective option for stormwatter treatment.

.2 Types of Rainwater Best Management Practices:

The following are brief descriptions of various rainwater best management practices which can be applied:

(a) Infiltration Swales:

An infiltration swale is designed to accept flows from small areas of impervious surface and allow it to infiltrate into the soils below. The swale also allows larger flows to be conveyed to the minor or major drainage system.

(b) Rain Gardens:

Rain gardens are designed to have an aesthetically pleasing appeal in addition to providing water quality treatment and infiltration into the ground. The plantings are carefully selected based on the expected soil moisture conditions. Generally, rain gardens have a drain rock reservoir and a perforated drain system to collect excess water.

(c) Absorbent Landscaping:

The majority of Nanaimo’s undeveloped land contains landscapes which soak up the rainfall. Applying absorbent landscaping to development sites is an attempt to mimic this natural landscape. The minimum thickness for absorbent landscaping is 300mm.
(d) **Green Roof:**

A green roof includes a layer of growing media which supports vegetation. The application of green roofs can significantly reduce the runoff increase caused by new building construction. Green roofs must be designed with the structural considerations of the building and must comply with the BC Building Code.

(e) **Infiltration Trenches:**

An infiltration trench allows rainwater runoff to soak away into the ground. Infiltration trenches are best suited for runoff which does not require treatment, such as roof runoff. For areas where runoff requires treatment, consider pairing an infiltration trench with a rain garden.

(f) **Soak-Away Manholes:**

Soak-away manholes are similar to infiltration trenches; they allow the rainwater runoff to infiltrate into the soil through perforations in the manhole. Soak-away manholes are best suited for runoff which does not require treatment. For areas where runoff requires treatment, consider pairing a soak-away manhole with a feature which provides an aspect of treatment, such as a rain garden or infiltration swale.

(g) **Pervious Paving:**

Pervious paving allows rainfall to penetrate into the underlying soils through the paving. Care should be taken when designing pervious pavers to ensure materials used do not require special maintenance. Pervious paving should generally be restricted to low traffic areas. Where possible, other best management practices, such as rain gardens or infiltration swales are preferred to pervious paving as less maintenance is required and additional treatment benefits are realized.

(h) **Deep Groundwater Recharge:**

Deep groundwater recharge involves directly injecting stormwater into underground aquifers. Generally, injected stormwater must be treated to a high level for water quality prior to injection. Design for this practice may be highly complex and requires specialist expertise and approval by the City Engineer.

(i) **Retention:**

Retention of rainwater runoff involves storage and release of rainwater at very low rates, to mimic natural groundwater interflow rates. This is similar to detention, but the release rate is very low, at 0.25 L/s/ha. The water is released through a control orifice to the municipal minor drainage system.

(j) **Other Methods:**

The BMPs listed above are some of the more common approaches to managing rainwater runoff in ways that mimic natural systems. Other methods may be accepted on approval by the City Engineer.
.3 Application:

(a) Single Family and Duplex:

Due to the small lot size, limited oversight once developed, and potential for multiple owners and other aspects related to residential subdivisions, the application of best management practices for Single Family and Duplex developments is limited to absorbent landscaping and disconnected roof leaders or neighborhood-based solutions. It may not be appropriate to disconnect roof leaders for some development sites such as small lot developments, areas with high ground water tables, or other site-specific issues.

Best management practices other than absorbent landscaping can be integrated into each lot of the development; however, they will not form part of the calculation for reduction in runoff. Pervious driveways and patios are strongly encouraged.

(b) Multi-Family Residential, Commercial, Industrial, and Institutional:

The use of rainwater best management practices to infiltrate or retain rainwater is required for multi-family, commercial, industrial, and institutional developments in order to preserve the natural hydrologic condition as much as possible.

(c) Steep Slope Development:

Steep slope residential developments (R10 Zoning) may not be suitable for some rainwater best management practices. Developments in these areas will require specific attention to methods of retention and detention so that post-development targets can be met.

.4 Design:

(a) Detailed methodology for the design of rainwater best management practices can be found in Metro Vancouver’s “Stormwater Source Control Design Guidelines 2012”. An overview of some of the design considerations are listed below.

(b) Sizing Methods:

There are several ways to size and design rainwater best management practices. It can be complex and it is generally recommended that continuous simulation modeling be completed over an extended period of time (at least one year). Programs capable of continuous modeling shall be in accordance with Section 7.03.6(b). For sites where rainwater management best practices will be used in a series or “chain”, continuous simulation for sizing and design is required.

Alternatively, for individual facilities, rainwater management best practices can be designed using spreadsheets to calculate the water balance and size of facility, or the equations provided in Metro Vancouver’s “Stormwater Source Control Design Guidelines, 2012” can be used for facility sizing and design to meet the rainwater management target.
(c) Soil Hydraulic Conductivity:

For practices that infiltrate water into the ground, the expected rate of infiltration is described by the soil's saturated hydraulic conductivity. For planning purposes, the following hydraulic conductivity rates can be used:

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>210mm/hr</td>
</tr>
<tr>
<td>Loamy Sand</td>
<td>61mm/hr</td>
</tr>
<tr>
<td>Loam</td>
<td>13mm/hr</td>
</tr>
<tr>
<td>Silt Loam</td>
<td>6.8mm/hr</td>
</tr>
<tr>
<td>Sandy Clay Loam</td>
<td>2.3mm/hr</td>
</tr>
<tr>
<td>Sandy Clay</td>
<td>1.5mm/hr</td>
</tr>
<tr>
<td>Silty Clay</td>
<td>0.9mm/hr</td>
</tr>
<tr>
<td>Clay</td>
<td>0.6mm/hr</td>
</tr>
</tbody>
</table>

For detailed design purposes, onsite infiltration testing is required and the rates must be recommended by a Geotechnical Engineer based on field testing and analysis.

Rainwater infiltration and groundwater recharge facilities are still encouraged on sites with moderate or low soil hydraulic conductivity even though the target infiltration volume may not be able to be accommodated by the facility. Retention type facilities may be investigated to make up the difference.

(d) Groundwater:

Rainwater infiltration and groundwater recharge shall not be placed in areas with unsuitably high groundwater. The seasonally high groundwater table should be at least 600mm below the bottom of the infiltration facility.

(e) Bedrock:

Rainwater infiltration and groundwater recharge facilities may not be practical in areas where there is bedrock close to the surface. There shall be a minimum of 600mm between the bottom of the infiltration facility and bedrock. It should be noted that certain types of bedrock are highly pervious (i.e. fractured sandstone) and suitable for infiltration.

(f) Drinking Water Wells:

The design of groundwater recharge facilities shall be separated from drinking water wells and must meet all Ministry of Health guidelines for separation of wells from septic fields.

(g) Water Quality:

Water infiltrated into the ground shall be uncontaminated. Sites which present a high risk of groundwater contamination shall provide appropriate pre-treatment and spill control, if necessary, prior to infiltrating rainwater runoff. Examples of these sites include:
SECT RM W A T E R A GE

DESIGN CRITERIA
(REVISED NOVEMBER 2016)

(i) Automobile Service Yards, and
(ii) Industrial Chemical Storage Facilities.

(h) Contaminated Soils:

Sites with contaminated soils shall be reviewed by a Geotechnical Engineer and/or Hydrogeologist for suitability for rainwater infiltration into the ground.

(i) Steep Slopes and Unstable Soils:

Sites containing steep slopes, near steep slopes, or unstable soils shall be reviewed by a geotechnical engineer for suitability for rainwater infiltration and groundwater recharge facilities, but generally these facilities are prohibited in such conditions as they can saturate soils and can exacerbate slope instability. Designers should refer to the City’s Development Permit Areas, DPA 3 and DPA 5, for areas where there may be concerns for surface water control and/or subsurface infiltration. It is important that infiltrated water does not seep out in down slope areas impacting other properties. If there is a reason for concern with the suitability of proposed on-site infiltration facilities, the City Engineer may request review by a Hydrogeologist or Geotechnical Engineer.

(j) Overflows:

Rainwater best management practices shall be designed with an overflow into the minor or major drainage system.

(k) Maintenance:

The design of rainwater best management practices shall be such that the maintenance required in order for the facilities to properly operate shall be minimized. Regular maintenance which is required shall be identified in the Stormwater Management Plan.

(l) Sediment Loads:

All rainwater management best practices, other than green roofs, shall be designed in such a way that there is a simple procedure for removing sediment which does not require confined entry. Specific attention shall be paid to the construction period. Infiltration facilities shall be designed in a way which prevents sediment from entering the facility and plugging the water-soil interface.

7.14 WATER QUALITY

.1 Introduction:

(a) All stormwater management systems shall be designed in a way that prevents harmful materials from entering the natural watercourses. Methods of controlling the water quality shall be outlined in the Stormwater Management Plan Report.
.2 Treatment:

(a) High Risk Sites:

Sites which present a high risk of groundwater or receiving water contamination shall provide appropriate treatment prior to water entering the stormwater system. Examples of these sites include:

(i) Automobile Service Yards, and
(ii) Industrial Chemical Storage Facilities.

These uses may require covered areas to separate them from stormwater contact, and may require discharge to the sanitary sewer.

(b) Parking Areas:

All uncovered parking areas greater than 100m² in size shall require treatment to remove oil, total suspended solids (TSS), and other contaminants. Treatment can be achieved by draining the parking area to rainwater best management practices or by installing a mechanical method of removing the contaminants. Where possible, treatment using rainwater best management practices is preferred as they provide additional rainwater management benefits at the same time as water quality treatment.

(c) Design Requirements for Water Quality Treatment:

On sites where water quality treatment is required, including when mechanical treatment is selected (such as an oil water separator), the facilities must be designed to treat 90% of the total volume of stormwater runoff for a typical year or the 6-month, 24-hour post development flow volume which is equivalent to 31mm of rainfall per square metre of impervious area. Maintenance manuals shall be provided for all mechanical treatment facilities.

(d) Sediment:

All stormwater management systems shall be designed to minimize sediment discharges both during construction and after construction. Excess sediment is harmful to both the downstream aquatic environment and the functionality of conveyance and infiltration facilities. The systems must be designed with awareness of possible sediment sources and methods of intercepting and removing sediment before it clogs infrastructure and harms the downstream environment.

(e) Water Quality:

Treated water shall meet the British Columbia Approved Water Quality Guidelines as set out by the Water Protection and Sustainability Branch of the Ministry of Environment.
7.15  **CLIMATE CHANGE**

.1  **Rainfall Patterns:**

(a) The City of Nanaimo recognizes that our climate is changing and the change may impact the rainfall patterns which are historically seen in Nanaimo. It is not fully clear as to what impact climate change will have and requirements to accommodate climate change may be adjusted over time. However, to accommodate the expected changes in climate patterns, the design of stormwater management systems shall be conservative in nature and make allowance for climate change. Based on the Association of Professional Engineering and Geoscientists of BC guidance\(^1\) and current down scaled climate model projections from the Pacific Climate Impacts Consortium\(^2\) a 10% increase in design peak flow capacity is required to be designed into new minor system infrastructure to account for climate change. Major system flow paths and infrastructure should have a 20% increase in design peak flow capacity over the standard sizing developed from the IDF curves to mitigate the potential of major system flood increases due to climate change.

.2  **Sea Level Rise:**

(a) The City of Nanaimo recognizes that our climate is changing and the change may impact the sea levels. Development sites which are near the waterfront may be required to review and accommodate sea level rise in their development. Sea level rise is a complex problem and requirements will be established on a site by site basis; requirements to accommodate climate change may also be adjusted from time to time. For cases where exact sea level rise has not been determined, the predicted rise of 1.0m by the end of the century shall be used as a minimum.\(^3\)

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\(^1\) APEGBC, Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC, 2012, Section 3.5.3, Pg. 23 and Section H.3.1., pg. 123.


\(^3\) APEGBC, Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC, 2012, Section H5, Pg. 127.
SECTION 7 - STORMWATER MANAGEMENT
SPECIFICATIONS

7.20 SCOPE

.1 This specification refers to gravity sewer pipe and appurtenant fittings for storm sewers. Only those products approved by the City Engineer and listed in the City of Nanaimo Approved Products List will be accepted for installation.

.2 Refer to Section 4 - Trench Excavation, Bedding and Backfill for related specifications.

7.21 MATERIALS TESTING

.1 If, in the opinion of the Engineer, testing is required, the Engineer will arrange for a testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates inadequacies, additional testing may be required by the Engineer.

.2 The Contractor, as directed by the Engineer, shall supply specimens or samples for testing.

.3 The types of tests listed below may be required by the Engineer unless in the opinion of the Engineer other testing is required.

.4 Joints for storm sewer main pipe and fittings and service connection pipe and fittings shall be capable of meeting the following exfiltration tests. The Engineer may require that these tests be carried out by the Contractor or his supplier prior to acceptance of pipe on the project.

(a) Pipes in Proper Alignment:

Not fewer than 3 or more than 5 pipes selected from stock by the Engineer shall be assembled according to standard installation instructions issued by the manufacturer. With ends bulkheaded and restrained against internal pressure, the section shall be subjected to 70kPa hydrostatic pressure. Pressure shall be maintained for a period of 24 hours. There shall be no leakage at the joints.

(b) Pipes in Maximum Deflected Position:

At least 2 of the joints of the assembly shall be deflected to the maximum amount recommended by the manufacturer. 35kPa internal hydrostatic pressure shall then be applied to the test section and maintained for a period of 24 hours. Joints shall show no leakage.

(c) Pipes in Maximum Lateral Misalignment:

The test section shall be supported on blocks or otherwise so that one of the pipes is suspended freely between adjacent pipes and bears only on the jointing material. The suspended pipe shall then be loaded on the bell or coupling by a load equal to one-third of the ultimate 3-edge bearing strength required by the applicable ASTM specification, except that pipe having a laying length of more than 1.2m shall be loaded no more than the amount computed for a 1.2m length. While under this load, stressed joints shall show no leakage under 35kPa internal hydrostatic pressure.
7.22A PIPING, FITTINGS AND SERVICES

.1 The sizes and types of pipe to be used are shown on the drawings.

.2 Concrete Pipe:
   (a) Non-reinforced concrete pipe and fittings shall conform to ASTM C14M Class 3 to a maximum diameter of 600mm and shall be designed with flexible rubber gasket joints conforming to ASTM C443M.
   (b) Reinforced circular concrete pipe and fittings shall conform to ASTM C76M Class III or higher for all pipe greater than 600mm diameter and shall be designed with flexible rubber gasket joints conforming to ASTM C443M.
   (c) Pipe with chips, cracks, porous concrete, or any other defects which impair joint sealing or durability will not be accepted.

.3 Polyvinyl Chloride (PVC) Pipe (Smooth Profile):
   (a) Pipe and fittings up to 675mm diameter shall be DR35. Pipe and fittings shall have a minimum pipe stiffness of 320kPa at 5.0% deflection when tested in accordance with ASTM D2412.
   (b) Pipe and fittings shall be manufactured to the following specifications:
      100mm - 375mm dia to ASTM D3034 and CSA B182.2
      450mm - 675mm dia to ASTM F679 and CSA B182.2
   (c) Pipe and fittings shall include integral bell and spigot ends with stiffened wall section and a formed groove for a rubber gasket conforming to ASTM F477.
   (d) All PVC storm pipe shall be green in colour.

.4 Ductile Iron Pipe:
   (a) Pipe and fittings shall conform to ASTM A746 or as approved by the Engineer.

.5 Polyvinyl Chloride (PVC) Service Pipe:
   (a) All storm service inspection assemblies shall be green in colour.
   (b) Storm service connections of 100mm diameter shall be DR28 and conform to CSA B182.1. Pipe and fittings shall have elastomeric seal joints, locked in gasket, and integral bell joint features.
   (c) Storm service connections greater than 100mm diameter shall be as specified for PVC (smooth profile) mainline pipe.

.6 High Density Polyethylene (HDPE) Pipe (Smooth Profile):
   (a) Pipe shall conform to CGSB 41-GP-25M. Pipe material shall conform to ASTM D1248 Type III, Class C, Category 5, Grade PE35-10.
   (b) Minimum acceptable pipe class shall be DR26 with a hydrostatic design stress rating of 10MPa.
   (c) All pipe supplied shall bear the pipe series designation and manufacturer’s name.
SECTION 7 - STORMWATER MANAGEMENT
SPECIFICATIONS

(d) Fittings for polyethylene pipe, if required, shall be detailed and manufactured by the pipe manufacturer. Mitre bends shall be fiberglass reinforced. Pipe deflected up to manufacturer's recommended minimum radius may be used in place of fabricated mitre bends and to form the required vertical and horizontal curves. Polyethylene fittings shall have a pressure rating at least equal to that of the pipe being joined.

7.22B JOINTS

.1 Storm sewer main pipe and fittings and service connection pipe and fittings shall be jointed with a rubber gasket or other pre-formed, factory-manufactured gasket or approved material, designed for use with the specified pipe. Solvent connected joints and fittings will not be permitted.

.2 High Density Polyethylene (HDPE) Pipe (Smooth Profile) Joints:

(a) Joints shall be by thermal butt-fusion constructed in accordance with the manufacturer's specifications.
(b) Flange joints shall be used to joint long sections of butt-jointed pipe or as shown on the construction drawings.
(c) Flanges for polyethylene pipe shall be slip-on type installed in conjunction with stub ends supplied by the pipe manufacturer. The flanges shall be Class 150 meeting ANSI B16.5 drilling dimensions. Flanges shall be carbon steel.
(d) All flanged joints shall be separated by a neoprene gasket bonded to one of the flange faces. Neoprene for flange gaskets shall be 3mm thick with holes drilled for flange bolts and size equal to flange diameter.
(e) Bolts and nuts for flanges shall be stainless steel complete with isolation washers.
(f) Refer to Section 7.46 for fitting and joint installation.

7.23 SERVICE JUNCTIONS

.1 Concrete Pipe (non-reinforced and reinforced):

(a) Service connections shall be manufactured using a sanded PVC male end stub pipe with integral bell.
(b) Stub orientation may be at 45° or 90° to the centerline of the mainline pipe(either at 9 o’clock to 11 o’clock, or at 10 o’clock to 3 o’clock).
(c) Field break-in and mortar patch joints shall not be used unless approved by the City Engineer. Refer to Section 7.48 for service connection junction installation.

.2 PVC Pipe (Smooth Profile):

(a) Service connections to PVC mainline pipe shall be made with extrusion molded PVC or fabricated PVC fittings manufactured to ASTM D3034, CSA B182.1 and CSA B182.2.
(b) The use of saddles instead of manufactured wye fittings shall require approval by the City Engineer.
(c) Refer to Section 7.48 for service connection junction installation.
.3 PVC Pipe (Ribbed Profile):
   (a) Ribbed pipe shall only be used if repairing an existing ribbed pipe section.
   (b) Service connections to PVC mainline pipe shall be made with extrusion molded or fabricated PVC fittings manufactured to ASTM D3034, CSA B182.1 and CSA B182.2.
   (c) For Connections more than two pipe sizes smaller than the mainline, prefabricated service saddle connections may be approved.
   (d) Refer to Section 7.48 for service connection junction installation.

.4 High Density Polyethylene (HDPE) Pipe (Smooth Profile):
   (a) Service connections to HDPE mainline pipe shall be made with manufactured fittings, electro-fused or heat-welded to the mainline pipe. Mechanical connections, if used shall be water-tight.
   (b) Refer to Section 7.48 for service connection junction installation.

.5 High Density Polyethylene (HDPE) Pipe (Open Profile):
   (a) Service connections to HDPE mainline pipe shall be made with extrusion molded or fabricated fittings manufactured to CSA B182.1, B182.2 and B182.4.
   (b) For service connections more than two pipe sizes smaller than the mainline, prefabricated service saddle connections may be approved.
   (c) Refer to Section 7.48 for service connection junction installation.

7.24 PERFORATED DRAINS

.1 The granular material for perforated drains shall be a clear round drain rock with 100% passing 40mm and 0% passing 10mm screens.

.2 Piping shall be a minimum 150mm diameter DR28 PVC perforated pipe. A minimum of 50 perforations 5mm in diameter per linear metre of pipe shall be required for all pipe sizes.

.3 Perforations shall be located in the bottom half of the pipe only.

.4 Filter fabric shall be non-woven polyester fabric conforming to:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength (ASTM 1682)</td>
<td>250N (minimum)</td>
</tr>
<tr>
<td>Bursting Strength (ASTM D-751)</td>
<td>865kPa (minimum)</td>
</tr>
<tr>
<td>Permeability</td>
<td>$2 \times 10^{-2}$ cm/s</td>
</tr>
</tbody>
</table>
SECTION 7 - STORMWATER MANAGEMENT SPECIFICATIONS

7.25A PRECAST MANHOLE SECTIONS

.1 Unless otherwise approved, all manholes sections shall be precast reinforced concrete conforming to ASTM C478.

.2 All precast sections shall be complete with ladder rungs.

.3 0-ring rubber gaskets shall conform to ASTM C443.

.4 Refer to Section 7.51 for precast manhole sections installation.

7.25B PRECAST MANHOLE BASES

.1 Precast manhole bases shall be reinforced concrete in accordance with ASTM C-76 Class III or better.

.2 All dimensions, specifications, and installations shall conform to the requirements for cast-in-place manhole bases in accordance with Section 7.49 - Cast-In-Place Manhole Concrete Bases, Section 7.52 - Precast Manhole Bases and the Standard Drawings.

.3 Pipe alignment, grade, and invert elevations in the precast manhole bases shall conform to the construction drawings.

7.25C MANHOLE TOPS

.1 Manhole tops shall be flat slab, precast concrete. Tops shall be reinforced to meet CS600 loading requirements. Precast tops shall conform to ASTM C478 with approved offset opening for frame and cover.

7.25D MANHOLE COVERS AND FRAMES

.1 Covers and frames shall be cast iron and certified to meet CS600 loading requirements with the bearing faces of the cover to be frame machined for a non-rocking fit.

.2 Patterns, dimensions and weights shall be in accordance with the Standard Drawings. Covers shall have "CITY OF NANAIMO STORM DRAIN" permanently embossed on the covers.

.3 Standard manhole frame and cover shall conform to Standard Drawing No. SW-16 - Storm Manhole Frame and Cover.

.4 Utility chamber manhole frame and cover shall conform to Standard Drawings No. SW-17 - Utility Chamber Storm Manhole Frame, Ring and Cover.

.5 A watertight manhole frame and cover, if required, shall conform to Standard Drawing No. SW-18 - Watertight Storm Manhole Frame and Cover.

.6 Covers located in statutory right-of-way shall be permanently embossed with the additional wording "DO NOT COVER".

.7 Refer to Section 7.54 for frame and cover installation.
SECTION 7 - STORMWATER MANAGEMENT
SPECIFICATIONS

7.25E MANHOLE STEPS
.1 Steps shall conform to ASTM C478 for manhole steps and ladders and shall be a 19mm diameter aluminum alloy conforming to CSA S157.

.2 Refer to Section 7.55 for manhole steps installation.

7.25F -NOT USED- (REVISED NOVEMBER 2016)

7.26 CONCRETE
.1 The compressive field strength of concrete for manhole bases shall be not less than 20MPa at 28 days.

.2 All concrete work shall conform to Section 11 - Reinforced and Plain Concrete Works.

7.27 PRECAST CONCRETE GRADE RINGS
.1 Precast concrete grade rings conforming to ASTM C478 shall be used.

7.28 TEMPORARY CLEANOUT FRAMES AND COVERS
.1 Temporary cleanout structures may only be used at the discretion of the City Engineer where there is development phasing.

.2 Temporary cleanout frames and covers shall be as specified for storm manhole frames and covers. See Section 7.25D - Manhole Covers and Frames. (REVISED NOVEMBER 2016)

7.29 PIPE AND FITTINGS FOR DROP MANHOLE STRUCTURES
.1 Pipe and fittings for drop manhole structures shall be as specified under Section 7.22A - Piping, Fittings and Services and Section 7.22B - Joints.

.2 Refer to Section 7.56 for drop manhole structures installation.

7.30 - NOT USED -

7.31A PRECAST CATCH BASIN BARRELS AND LEADS
.1 Catch basin barrels shall be 600mm or 750mm diameter as noted on the standard drawings and shall be reinforced concrete conforming to ASTM C478, Class III.

.2 Catch basin leads shall be of the same material as the main piping and use the same type of joints, gaskets, and fittings.

.3 Leads shall be 200mm in diameter (minimum) for single basins and 250mm in diameter (minimum) for double basins, and shall be connected to sewers with manufactured wyes or tees. Leads over 30m in length shall be 250mm in diameter.
SECTION 7 - STORMWATER MANAGEMENT
SPECIFICATIONS

7.31B CATCH BASIN CASTINGS (REVISED NOVEMBER 2016)

.1 Catch basin frame and grating shall be in accordance with Standard Drawings: (REVISED NOVEMBER 2016)

   (a) SW-6 - Catch Basin Frame and Grate
   (b) SW-7 - Adjustable Catch Basin Frame and Hood
   (c) SW-8 - Boulevard Catch Basin Frame and Grate (REVISED NOVEMBER 2016)

7.32 INLET AND OUTLET STRUCTURES

.1 Concrete inlet and outlet structures shall be precast unless approved by the City Engineer. (REVISED NOVEMBER 2016)

.2 Cast-in-place concrete inlet and outlet structures shall be designed by a structural engineer. Concrete shall be as specified in Section 11.0 - Reinforced and Plain Concrete Works. (REVISED NOVEMBER 2016)

.3 The trash rack shall be pre-fabricated to match the pre-fabricated inlet or outlet structure. Custom built trash racks shall be constructed with 20mm diameter hot dipped galvanized bar. (REVISED NOVEMBER 2016)

7.33 ENERGY DISSIPATOR OUTLET STRUCTURES

.1 Energy dissipators shall be constructed of concrete and be designed to reduce runoff velocities to less than 1.5m³/s and dispose runoff evenly. (REVISED NOVEMBER 2016)

7.34 INLET AND OUTLET PROTECTIVE FENCING AND HANDRAILS

.1 Unless otherwise specified, protective fencing, and handrails including posts, pipe rails, and hardware are to be hot dip galvanized steel. Mesh shall be 50mm wire mesh, 9 gauge, hot dip galvanized, or plasticcoated.

7.35A CULVERTS

.1 Concrete pipe shall conform to Section 7.22A - Piping, Fittings and Services, clause 7.22A.2.

.2 PVC pipe shall conform to Section 7.22A - Piping, Fittings and Services, clause 7.22A.3.

.3 Ribbed PVC pipe shall only be used for driveway culverts and shall conform to CSAB1800. (REVISED NOVEMBER 2016)
SECTION 7 - STORMWATER MANAGEMENT SPECIFICATIONS

7.35B CULVERT HEADWALLS

.1 Sacks shall be 0.25 kg burlap with approximate inside dimensions of 350 x 900 mm as measured when the sack is laid flat.

.2 The compressive field strength of concrete shall not be less than 15MPa at 28 days. All concrete work shall conform to Section 11.0 - Reinforced and Plain Concrete Works.

.3 Reinforcing bars shall be 15M intermediate grade steel conforming to CSA G30.18, Grade 400.

.4 Composite material headwalls may be used for culvert headwalls at the discretion and on approval of the City Engineer.

7.36 RIPRAP

.1 Riprap shall be hard, dense, durable quarry stone, free from seams, cracks, or other structural defects, with a specific gravity of not less than 2.65.

.2 The gradation of rock sizes (mass in kg) for each class of riprap shall conform to the following table:

<table>
<thead>
<tr>
<th>Class of Riprap (Kg.)</th>
<th>Nominal Thickness of Riprap (mm)</th>
<th>Rock Gradation (Percentage Larger than given rock mass, kg.)</th>
<th>Approximate Average Dimension of Rock (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>85%</td>
<td>50%</td>
</tr>
<tr>
<td>10</td>
<td>350</td>
<td>1.0</td>
<td>10</td>
</tr>
<tr>
<td>25</td>
<td>450</td>
<td>2.5</td>
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<tr>
<td>50</td>
<td>550</td>
<td>5.0</td>
<td>50</td>
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<tr>
<td>100</td>
<td>700</td>
<td>10</td>
<td>100</td>
</tr>
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<td>250</td>
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<td>250</td>
</tr>
<tr>
<td>500</td>
<td>1200</td>
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<td>2000</td>
</tr>
<tr>
<td>4000</td>
<td>2500</td>
<td>400</td>
<td>4000</td>
</tr>
</tbody>
</table>

Example: For Class 50 Riprap

85% of riprap stones are greater than 5.0 kg.
50% of riprap stones are greater than 50 kg.
15% of riprap stones are greater than 150 kg.
7.37 MANHOLE AND TEMPORARY CLEANOUT LID MARKERS

.1 Markers are required, where manhole and temporary cleanout lids are not located within developed road right-of-way or residential properties, to indicate the location of the manholes and temporary cleanouts. These markers shall be constructed of 50 mm galvanized steel pipe painted with a minimum of two coats of yellow exterior duty paint applied in accordance with the manufacturer's recommendations and set in a concrete base. The markers shall extend 1.0m above the ground surface. The markers shall be located on site at a location, determined by the Engineer, opposite the manhole or temporary cleanout lid and the distance to the lid is to be marked in black figures on a flattened upper portion of the marker. See Standard Drawing No. SW-20 - Storm Manhole and Temporary Cleanout Marker. (REVISED NOVEMBER 2016)

7.38 SERVICE BOXES

.1 Service boxes for single storm sewer services shall be 300mm x 500mm concrete boxes complete with cast iron traffic cover marked "Storm" and concrete extension sections as required.

.2 Service boxes for twin storm sewer services shall be 425mm x 750mm concrete boxes complete with steel traffic cover marked "Storm" and concrete extension sections as required.
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

7.40 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4 - Trench Excavation, Bedding and Backfill for installation requirements.

7.40A PIPE ALIGNMENT AND GRADE

.1 The pipe shall be laid on the alignment and grade in accordance with the construction drawings. Each pipe shall be checked for line and grade as it is installed. Methods used to maintain pipe alignment and grade shall be approved by the Engineer.

.2 Unless otherwise directed by the Engineer, tolerances for pipe alignment and grade shall be:

Alignment = ± 50mm
Grade = ± 10mm

7.41 PIPE CUTTING

.1 Pipe cutting shall be done in the manner recommended by the pipe manufacturer employing tools designed for this purpose.

7.42 PIPE INSTALLATION

.1 Pipe shall be installed in strict accordance with the manufacturer’s recommended practice. Joint gaskets are required unless stated otherwise by the Engineer.

.2 Pipe shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer’s defects, or cracks exist that might prevent the proper jointing of the pipe or its operation.

.3 The open end of the pipe in the trench shall be suitably covered to prevent entrance of trench water and other material during periods when pipe is not being installed.

.4 Precautions shall be taken to ensure that displacement of the pipe in the trench does not occur through soil displacement or floatation due to the presence of trench water. Pipe that has been displaced shall be removed from the trench and relaid.

.5 Lifting holes in concrete pipe shall be plugged with prefabricated plugs in non-shrink grout, or other plugs recommended by the pipe manufacturer.

.6 The contractor shall use methods for installing pipe in an auger hole or casing pipe as described in Section 4 - Trench Excavation, Bedding and Backfill.

7.43 JOINTS AT RIGID STRUCTURES

.1 A flexible joint shall be provided at locations where the pipe is held in fixed position by a rigid support or structure. The distance from the support or structure shall depend on the diameter and type of pipe being installed and shall be in accordance with the pipe manufacturer’s recommended practice. The purpose of the flexible joint is to prevent pipe failure due to uneven support under the pipe. Approved flexible joints include rubber gasket bell and spigot connections and dresser couplings.
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

7.44 HORIZONTAL AND VERTICAL CURVES

.1 Pipe on horizontal and vertical curves shall be laid true to the curve of the radius shown on the drawings. Variations in vertical curves and grades within the allowable pipe deflection may be allowed where approved by the Engineer.

7.45 DEFLECTION

.1 The amount of pipe deflection at joints and couplings shall be the limit as specified by the manufacturer. PVC pipe shall not be deflected at joints or couplings.

7.46 FITTINGS AND JOINTS

.1 Fittings shall be installed at the locations shown on the construction drawings or as directed by the Engineer. Fittings shall be installed in accordance with the manufacturer’s specifications.

.2 High Density Polyethylene (HDPE) Pipe (Smooth Profile):

(a) Pipe shall be joined by the thermal butt fusion method.
(b) The contractor shall make arrangements to have the pipe jointing carried out by the pipe manufacturer or certified personnel, familiar with the jointing technique, using equipment and techniques specifically designed for the pipe diameter and material being jointed.
(c) Where required, flanged joints shall be used for connecting long pipe sections.
(d) The joint shall consist of a polyethylene stub end butt fused to the end of pipe and a carbon steel slip-on flange.
(e) Flanged joints and flange bolts shall be stainless steel, complete with isolation washers.
(f) Refer to Section 7.22B for joint specifications.

7.47 CONNECTIONS TO EXISTING PIPING AND APPURTENANCES

.1 All connections to existing piping, services, and appurtenances shall be made by City of Nanaimo forces unless otherwise authorized by the City Engineer.

.2 All connections to existing piping and services shall utilize a manufactured rubber gasket bell and spigot joint or dresser coupling designed for the types of pipes to be connected.

.3 The use of field joints or rubber repair couplings shall require the approval of the Engineer.

.4 Rubber repair couplings must have 4 stainless steel clamps complete with stainless steel anti shear band. Only those products approved by the City Engineer will be accepted for installation.

.5 Slip couplers shall be used on PVC pipes. Rubber repair couplings are not to be used on PVC pipes.
7.48 SERVICE CONNECTION JUNCTIONS

.1 Service connection junctions shall be installed at the locations shown on the construction drawings or as directed by the Engineer during construction.

.2 Where service connections are not installed in conjunction with the main, fittings shall be installed in the sewerline to accommodate the service connections, and caps or plugs shall be installed in the fittings. Markers shall be installed as specified in Section 7.61 - Service Connection Installation, clause 7.61.3 (i).

.3 Concrete Pipe (Reinforced and Non-reinforced):

(a) Field break-in and mortar patch joints shall not be used unless approved by the City Engineer. If approved, the following shall apply:

(i) Service connections shall be manufactured using a sanded PVC male end stub pipe with integral bell.
(ii) Break into the pipe by coring to within 40mm of the outside diameter of the service stub. All exposed reinforcing steel shall be removed.
(iii) Insert the stub into the core ensuring that no portion of the service stub protrudes past the inside of the concrete pipe wall, and the stub length shall be equivalent to the thickness of the concrete pipe wall and the length of the stub’s integral bell.
(iv) Prepare non-shrink, fast setting cementitious grout with a 3:1 sand/cement mix to a "dry pack" consistency. Pack grout tightly into the void between the stub and the pipe and mound around the stub for lateral support.
(v) Hand finish interior and exterior grout surfaces to a smooth finish.
(vi) In order to prevent damage to the field joint, allow sufficient time for grout to develop strength prior to installation of connecting pipe or backfilling.
(vii) Installation shall be inspected by the Engineer prior to backfilling.

(b) Refer to Section 7.23 for service junction specifications.

.4 PVC Pipe (Smooth Profile):

(a) Service saddle connections shall not be used unless approved by the Engineer.
(b) If approved, installation of service saddle connections shall conform to the following:

(i) Drill hole into main line pipe to the exact outside diameter of the new connection.
(ii) The use of saddles instead of manufactured wye fittings shall require approval by the City Engineer. Saddles shall be rigid PVC material complete with rubber seating gasket. Saddle to be attached to pipe with stainless steel banding straps.
(iii) Attach service saddle in accordance to the manufacturer’s specifications.

(c) Refer to 7.23 for service junction specifications.
.5 PVC Pipe (Ribbed Profile):

(a) Installation of service saddle connections shall conform to Section 7.48.4.
(b) Refer to Section 7.23 for service junction specifications.

.6 High Density Polyethylene (HDPE) Pipe (Smooth Profile):

(a) Service connections to mainline pipe using manufactured fittings shall be in strict accordance with manufacturer's instructions.
(b) Connection of HDPE service junctions to non-pressurized PVC service pipe shall be made with flexible couplings. Flexible couplings shall be manufactured from elastomeric PVC and be held in place with series 300 stainless steel worm gear clamps.
(c) Refer to Section 7.23 service junction specifications.

.7 High Density Polyethylene (HDPE) Pipe (Open Profile):

(a) Installation of service saddle connections shall conform to Section 7.48.4.
(b) Refer to 7.23 for service junction specifications.

7.49 CAST-IN-PLACE MANHOLE CONCRETE BASES (REVISED NOVEMBER 2016)

.1 All water shall be removed from the excavation prior to placing base concrete. The base shall be constructed such that the first section of a precast section can be set plumb with uniform bearing throughout its full circumference.

.2 If material in the bottom of the trench is unsuitable for support, the bottom shall be overexcavated to firm base as determined by the Engineer and backfilled to the required grade with thoroughly compacted base gravel as specified for trench bottom stabilization under the applicable section included in Section 4 - Trench Excavation, Bedding and Backfill.

.3 Where overexcavation and backfill with base gravel is not practical, special structure support shall be provided as specified for trench bottom stabilization under the applicable section included in Section 4 - Trench Excavation, Bedding and Backfill.

.4 Concrete manhole bases shall be constructed as shown on the drawings. Pipes and fittings through the manhole shall be supported on concrete blocks and the concrete base poured around the pipe to a depth of at least 150mm below the bottom of the pipe and up to the springline of the pipe. Install rubber manhole adaptor rings on all plastic pipe installed in the manhole base.

.5 Invert elevations of pipes at the manhole shall be checked by the Contractor prior to and following placement of base concrete around the pipe to ensure that all pipes are installed at the designed elevation.

.6 Variations in manhole inverts from established grade or elevations shall be corrected.
.7 Manhole channelling shall be constructed as shown on Standard Drawings or as shown on the construction drawings. Channeling shall be constructed to have a minimum 0.3m straight section before the change in direction within the manhole. *(REVISED NOVEMBER 2016)*

.8 The channels in the base of manholes shall be shaped and finished to provide smooth passage for the storm water in order to minimize head losses and deposits at bends and at junctions of channels. *(REVISED NOVEMBER 2016)*

.9 Channels shall be accurately formed. The practice of forming channels roughly to shape and finishing with cement mortar will not be permitted. The channels shall be steel trowel finished. *(REVISED NOVEMBER 2016)*

.10 Benching in manholes shall be sloped to drain. While green, the concrete benching shall be given a broom finish to produce a non-skid surface. *(REVISED NOVEMBER 2016)*

7.50 -NOT USED- *(REVISED NOVEMBER 2016)*

7.51 PRECAST MANHOLE SECTIONS

.1 Precast manhole barrel sections shall be placed plumb.

.2 Joints between the top riser and the cover slab shall be made watertight with cement mortar. Prior to placing sections, the mating face shall be thoroughly soaked with water and a layer of cement mortar shall be spread on the lower face. After sections are placed, excess mortar shall be removed and the joint made flush inside and out.

.3 Joints between precast manhole barrels must utilize o-ring gaskets and shall conform to the manufacturer’s specifications. The inside surface of the precast barrel at the o-ring joints shall be filled with cement grout to a smooth finish.

.4 Damaged o-ring manhole joints require removal and replacement of damaged manhole section. Mortar patching of damaged area, if approved by the Engineer, shall require removal of the o-ring gasket and installation as per Section 7.51.2.

.5 Refer to Section 7.25A for precast manhole section specifications.

7.52 PRECAST MANHOLE BASES

.1 Installation of precast manhole bases shall conform to Section 7.49 - Cast-In-Place Manhole Concrete Bases. *(REVISED NOVEMBER 2016)*

.2 Precast manhole bases shall be placed on 150mm thick base of 38mm drain rock. *(REVISED NOVEMBER 2016)*

.3 Plastic and concrete pipes installed in the precast manhole base shall utilize rubber manhole adaptor rings to seal the connection.

.4 Refer to 7.25B for precast manhole bases specifications.
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

7.53 CONCRETE

.1 Concrete work shall be as specified under Section 11.0 - Reinforced and Plain Concrete Works.

7.54 FRAMES AND COVERS

.1 Frames shall be set on precast concrete grade rings to bring the cast iron manhole frame up to grade as shown on the Standard Drawings. Contractor to install concrete grade rings to a minimum of 50mm thick and to a maximum of 100mm thick. The concrete grade rings shall be laid in common bond with raked mortar joints and shall be mortared inside and outside of the manhole. (REVISED NOVEMBER 2016)

(a) Fine grade elevation adjustments of frames shall be done with a minimum of 3, steel only, shims equally spaced.

.2 Manhole covers shall be installed:

(a) for unpaved areas: Covers shall have a 1.5m x 1.5m, 50mm thick asphalt apron. Covers shall be set flush with the asphalt surround.
(b) for paved areas: Covers shall be flush with pavement grade with a maximum allowed variance of 6mm lower than finished pavement. Covers shall not protrude above finished pavement.

.3 Steel manhole riser rings shall be used in easements only.

.4 The inside surface of the manhole frame shall be painted green with an enamel rust paint in accordance with the manufacturer's specifications.

.5 Refer to Section 7.25D for manhole covers and frames specifications.

7.55 MANHOLE STEPS

.1 Manhole steps shall be installed in manhole sections by the manufacturer unless circumstance dictates otherwise in which case approval must be received from the Engineer.

.2 The distance from the top of the manhole cover to the first manhole step, shall conform to WorkSafeBC requirements.

.3 All steps shall be complete with approved polyethylene anchor insulating sleeves and installed in 25mm to 26mm diameter precast or drilled holes in a manhole section.

.4 Refer to Section 7.25E for manhole steps specifications.
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

7.56 DROP MANHOLE STRUCTURES
   .1 Manhole drop structures shall be constructed as shown on Standard Drawing No. SW-14 -
   Storm Drop Manhole. *(REVISED NOVEMBER 2016)*

7.57 STUBS
   .1 Blind stub sections for connection of future sewers and service connections to the
   manholes shall be installed where shown on the construction drawings and as directed by
   the Engineer. Stubs shall be as long as the vertical depth from finish grade to the invert of
each stub. Each stub shall be plugged with a removable, watertight plug as shown on the
construction drawings. Where stubs are installed, the bottom of the manhole shall be
channeled to the stub entrance.

7.58 TEMPORARY CLEANOUTS
   .1 Temporary cleanouts shall be constructed as shown on the Standard Drawings.

7.59 -NOT USED- *(REVISED NOVEMBER 2016)*

7.60 PRECAST CATCH BASIN BARRELS AND LEADS *(REVISED NOVEMBER 2016)*
   .1 Catch basins shall be installed in accordance with the Standard Drawings.
   .2 Catch basin leads shall be installed to allow passage of video cameras and flushing
   equipment. Installation of mitred bends may be allowed to avoid pipe conflicts or insufficient
   bury. Mitre bends shall not exceed 45° and there shall be a minimum 1.0m separation
   between mitre bend hubs.
   .3 Catch basin leads taken into manholes shall be benched in the same manner as main line
   piping.
   .4 Catch basin grates are to be set 20mm below the gutter line. The gutter and blacktop are to
   be shaped to form a dish around the inlet.
   .5 Construction and finishing of catch basins shall be the same as for manholes as described
   in Section 7.54 - Frames and Covers.
   .6 Catch basin leads are to protrude 50mm into the catch basin barrel and shall be grouted
   inside and outside of the barrel in accordance with the Standard Drawings.
   .7 There shall be a 400mm minimum clearance between the outside of the catch basin barrel
   and the trench wall to allow for compaction.
   .8 Curb inlet catch basins are to be installed to be rigid once installed and the inlet hood
   remain flush with the top of the curb. *(REVISED NOVEMBER 2016)*
SECTION 7 - STORMWATER MANAGEMENT INSTALLATION

7.61 SERVICE CONNECTION INSTALLATION

.1 Location of Service Connections:
(a) Service connections are to be installed at the locations and depths as specified by the Engineer. Where the depth of the service connection exceeds 2.0m, the service shall be extended into the property the same distance as the depth of the service, up to a maximum distance of 4.0m. This shall be done during the installation of the service connection from the main to the property.

(b) At no time shall two or more storm services be coupled into one lead crossing the street or right-of-way. Each service shall have its own independent connection into the main sewer.

.2 Grade and Alignment of Service Connections:
(a) Trenches shall be excavated so that pipe can be installed in a direct line from the service connection fitting at the sewer or from a manhole to the terminus of the service. Service connections shall be installed at a grade of not less than 2% unless otherwise directed by the Engineer. Service pipe shall be installed at a uniform grade between the terminus at the property line and the junction fitting at the sewer or upper end of a service drop.

.3 Storm Sewer Service Connection Installation:
(a) Pipe shall be installed in strict accordance with the manufacturer's recommended practice.

(b) Pipe shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer's defects, or cracks exist that might prevent the proper jointing of the pipe or its operation.

(c) The Contractor shall use methods for installing pipe in an auger hole or casing pipe as shown on the construction drawings.

(d) The trench shall be excavated to provide a minimum cover of 0.75m over the service connection pipe at property line.

(e) In rock, the trench is to be extended three 3.0m into the property to facilitate future extension of the service connection.

(f) The trench bottom shall be graded to form a continuous support along the service pipe. All rocks or projections which might prove detrimental to the pipe shall be removed.

(g) Joints shall be made using the specified couplings. Glued joints shall not be made.

(h) At the terminus of each sewer service approved watertight caps suitably supported by sandbags shall be installed to prevent leakage.

(i) A 38mm x 89mm pressure treated wood marker stake shall be placed at the service terminus as shown on the drawings to facilitate future location of the service pipe. This stake shall extend from a point approximately 600mm above ground to 600mm below ground except in locations where the extension of the stake above ground surface would prove hazardous, in which case the stake shall be cut off flush with the ground surface. The stake shall be marked in an approved manner to show the depth of the service pipe invert below the top of the stake. The stakes shall be painted green to visually identify the storm sewer service connections. The Engineer will take invert elevations of the service connection assembly prior to placement of the cap by the Contractor. (REVISED NOVEMBER 2016)
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

(j) Inspection assemblies shall be installed as shown on the standard drawings.
(k) The service box shall be installed plumb with the lid 25mm above finished grade in unpaved areas and 0 - 6mm below finished grade in paved areas.

.4 Riser Service Connections:

(a) Riser service connections shall be installed as shown on Standard Drawings No. SW-21 - General Storm Service Connection Detail, Riser and Non Riser Types or Standard Drawing No. SW-22 - Commercial Areas Storm Service Connection Detail, Riser and Non Riser Types in locations shown on the construction drawings. (REVISED NOVEMBER 2016)

7.62 NOTIFICATION TO THE CITY OF NANAIMO

.1 The City of Nanaimo Works Inspector shall be given 48 hours notice of all tests.

7.62A CLEANING AND FLUSHING

.1 On completion of the sewer pipe installation, the pipes shall be cleaned to the satisfaction of the Engineer and the City of Nanaimo Public Works Inspector by power flushing with water to remove all foreign matter.

.2 Ensure that snow chains are installed at the downstream manhole so that no foreign material passes beyond downstream manhole. Flow through the system shall remain unimpeded at all times while snow chains are installed.

.3 Begin cleaning from the upstream pipe in the system and proceed downstream. Under no circumstances is the pipe cleaning process to proceed downstream until all contributing upstream pipes have been successfully cleaned and approved by the Engineer, the City of Nanaimo Public Works Inspector, or by the City of Nanaimo CCTV contract administrator.

.4 Manholes shall be cleaned after the upstream section of pipe has been successfully cleaned and approved by the Engineer, the City of Nanaimo Public Works Inspector, or by the City of Nanaimo CCTV contract administrator.

.5 Pipes shall be cleaned in the direction of flow and shall not be flushed in a backflush direction unless approved by the City Engineer, by the City of Nanaimo Public Works Inspector, or by the City of Nanaimo CCTV contract administrator.

.6 Under no circumstances shall debris pass beyond the downstream manhole. Active vacting shall remove all debris at the snow chains installed at the downstream manhole.

.7 Dispose of debris at approved dump site such as the Regional District of Nanaimo's landfill or by the CCTV contract administrator’s approved alternative.

.8 Decanting of liquid waste accumulated during debris removal is permitted at a controlled release rate, to a maximum of 8l/s, at a location approved by the City of Nanaimo CCTV contract administrator.

.9 Timeframe between cleaning and video inspection of pipeline shall not exceed 24 hrs unless approved by the City Engineer.
.10 Ensure all environmental mitigation is in accordance to current BC Ministry of Environment and Department of Fisheries and Oceans Standards.

7.63 VIDEO INSPECTING MAINS

.1 All pipe video inspection including methods of cleaning, equipment and rates of camera travel, shall be in accordance with the UK Water Research Centre’s (WRc), Sewage Rehabilitation Manual, most current edition.

.2 For gravity sewers, other than service connections, the contractor shall arrange for video inspection to check alignment, grade, and condition of the main sewer pipe including catch basin leads.

(a) Illumination depth of field shall be no less than 3 joints for standard joint and spigot pipe types to allow for pipe deflection assessments (9.0m). No dark/opaque circle shall be visible in the middle of this depth of field viewing area.

(b) Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.

(c) Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.

(d) Pan and tilt view each service connection (junction) such that the camera looks down the centreline of the service, pause for a minimum of five (5) seconds and note condition of the joint and/or pipe/service interface.

(e) Camera guides (Skids) shall not be visible at either side of the pipe during normal camera travel or during Pan & Tilt operation. Configuration of camera/guides shall be altered to alleviate this problem.

(f) CCTV push camera work shall be video captured (complete with skids for centering) from the main wye pulling back to entrance point to avoid an invert only view.

(g) A winch line shall be provided to support camera travel in steep, slippery, or relined pipe sections.

(h) Position camera lens centrally in the pipeline with a positioning tolerance of ±10% off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.

(i) Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

(j) Instantaneous travelling speed of the camera in the pipeline to be as follows:

i) 0.1m/s for pipeline of diameter less than 200mm

ii) 0.15m/s for diameters 200mm and larger but not exceeding 310mm: and

iii) 0.20m/s for diameters exceeding 310mm

.3 The inspection shall include the preparation of:

(a) a 4.7GB DVD MPEG4 video data disk. Picture size: NTSC 640x480 pixels, aspect ratio 4:3, 29.97 frames per second @ 8 megabits per second capture rate. Individual MPEG4 video files shall not exceed 1.7GB in size. DVD data disk shall be finalized after burn. (REVISED NOVEMBER 2016)

(b) a Microsoft Access database CD of the Header and Observation codes as specified by the City Engineer.
(c) a pipe condition assessment paper report.

All submitted to the Engineer.

.4 The Engineer shall review the DVD, CD, and pipe condition report and provide certification that the condition of the installed pipe is accurately recorded and the pipe installation meets the City of Nanaimo Standards and Specifications.

.5 The DVD, CD, and pipe condition report and certification shall become the property of the City of Nanaimo.

.6 Variations in line or grade of pipe, from that established by the Engineer prior to installation, and any jointing, pipe cleaning, or other deficiencies discovered during the inspection, shall be rectified. Reinspection of the pipe may be required by the Engineer at the contractor’s expense.

.7 During this test, manhole construction and invert elevations shall be checked and any variations from the established grade, drawings, or specifications, shall be rectified.

.8 If directed by the Engineer, the contractor shall arrange for a reinspection of the pipe at the contractor’s cost, for the warranty inspection one month prior to the end of the maintenance period.

.9 Video inspection and pipe condition coding shall be undertaken only by personnel with current Canadian certification by a City approved agency.

7.63A SMOKE TESTING

.1 The Engineer shall arrange for smoke testing of all installed storm mains in the presence of the City of Nanaimo Works Inspector.

.2 The Engineer shall provide as-built service location information to the City of Nanaimo works Inspector prior to smoke testing.

.3 Cross-connections noted during the smoke testing shall be corrected and the as-built information revised.

7.64 DRAINAGE DITCH CONSTRUCTION

.1 Drainage ditches shall be excavated to the line and grade shown on the construction drawings or as otherwise determined by the Engineer.

7.65 CULVERT INSTALLATION

.1 Trenches for culvert installation shall be excavated to the required depth and grade and backfilled in accordance with the requirements for storm mainlines.
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

.2 Concrete Pipe:
(a) Install pipe in accordance with Section 7.42 - Pipe Installation.

.3 Polyvinyl Chloride (PVC) Pipe:
(a) Install pipe in accordance with Section 7.42 - Pipe Installation.

7.66 CULVERT HEADWALLS

.1 Culvert headwalls shall be constructed as shown on the Standard Drawings.

.2 "Wet-mix" Sandbags:
(a) The sandbag sacks shall be wetted and filled with wet premixed concrete and folded at the top to retain the concrete at the time of placing.
(b) Immediately after being filled with concrete, sacks shall be placed and lightly tamped to conform with the slope, culvert pipe, and adjacent sacks in-place.
(c) Sacked concrete shall be laid in courses such that joints in succeeding courses are staggered. Courses shall be a minimum of ten per vertical metre. Dirt and debris shall be removed from the top of sacks before the next course is laid thereon.
(d) Prior to sacked concrete setting, courses of bags shall be tied by driving a 15M reinforcing bar vertically from top to bottom through each course so that displacement will not occur after the final set of concrete. Top of reinforcing bar shall be bent over on top.

.3 Headwalls shall be protected from heavy rainfall and from contacting water for a period of at least 24 hours after placing.

.4 Composite culvert headwalls shall be installed as per manufacturer’s recommendations and Engineer approved design drawings.

7.67 PERFORATED DRAINS

.1 Excavate trench to the lines and grades as shown on the construction drawings.

.2 Place sufficient filter fabric in the trench to provide a minimum 300mm overlap after the drain rock is placed.

.3 Place a 150mm thick layer of drain rock and install the perforated pipe. Perforations shall be installed on the bottom half of the pipe.

.4 Place drain rock to within 150mm of finished surface and surround with filter fabric.

.5 Place remaining 150mm of drain rock or, if specified, top soil to finish grade.

.6 Install all manholes as per Section 7.0 - Stormwater Management. (REVISED NOVEMBER 2016)
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

7.68 INLET AND OUTLET STRUCTURES

.1 Inlet and outlet structures shall be installed in accordance with Standard Drawings. 
(REVISED NOVEMBER 2016)

.2 Excavate to the lines and grades as shown on the construction drawings. If subgrade is
unsuitable for support as determined by the Engineer, the bottom shall be excavated and
backfilled to the required grade with road base gravel compacted to 95% modified proctor
or drain rock. (REVISED NOVEMBER 2016)

.3 Structure shall be placed on a minimum of 100mm (compacted thickness) of road base
gravel compacted to 95% modified proctor. Where groundwater is present, drainrock may
be substituted for road base gravel if approved by the Engineer.

.4 All concrete work shall be in accordance with Section 11.0 - Reinforced and Plain Concrete
Works.

7.69 RIPRAP

.1 Areas to receive riprap shall be trimmed to a uniform surface, to the grades shown on the
drawings. Before rock placement commences, loose materials shall be removed and minor
pot holes and hollows filled in with select granular sub-base, well tamped in.

.2 Geotextile material and placement, where required, shall be as shown on the drawings.

.3 At the toe of sloped riprap, larger rocks shall be placed regularly enough to form a firm
foundation, 50% thicker than the required nominal thickness.

.4 Other large rocks shall be regularly spaced. Smaller rocks shall be well positioned to form
an interlocking, even surface.

7.70 PIPE VIDEO AND MANHOLE CONDITION REPORT FORMAT

.1 Reference plans shall accompany reports with manholes labeled and inspected sections
highlighted. Manhole and pipe numbering shall conform with the construction drawings, or
if available, City of Nanaimo pipe and manhole numbers. Reports shall be submitted in
both digital and hardcopy formats.

.2 All sewer defects shall be photographed and included with the report and referenced by
numbers accordingly.

.3 The video pipe condition rating report format shall be in accordance with the UK Water
Research Centre’s (WRc), Sewerage Rehabilitation Manual, most current edition.
Structural defects shall be properly weighted with the appropriate scores assigned to them
as shown in the following table:
WRc GRADING SYSTEM

<table>
<thead>
<tr>
<th>DEFECT CODE NO.</th>
<th>TYPE OF DEFECTS</th>
<th>POINT SCORES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open Joints</td>
<td>1 to 2</td>
</tr>
<tr>
<td>2</td>
<td>Displaced Joints</td>
<td>1 to 2</td>
</tr>
<tr>
<td>3</td>
<td>Cracks</td>
<td>10 to 40</td>
</tr>
<tr>
<td>4</td>
<td>Fracture</td>
<td>40 to 80</td>
</tr>
<tr>
<td>5</td>
<td>Broken</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>Hole</td>
<td>80 to 165</td>
</tr>
<tr>
<td>7</td>
<td>Collapsed</td>
<td>165</td>
</tr>
<tr>
<td>8</td>
<td>Spalling</td>
<td>5 to 120</td>
</tr>
<tr>
<td>9</td>
<td>Wear</td>
<td>5 to 120</td>
</tr>
<tr>
<td>10</td>
<td>Deformation</td>
<td>20 to 165</td>
</tr>
</tbody>
</table>

Every video inspected sewer will be assigned a composite score when it scores under each defect category which are added as per the following table:

WRc - SEWER RATING COMPOSITE SCORES

<table>
<thead>
<tr>
<th>COMPUTER COMPOSITE GRADE</th>
<th>PEAK SCORE RANGE (SUM OF THE SCORES FROM THE ABOVE TABLE)</th>
<th>TYPICAL DEFECT DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (least defective)</td>
<td>1 to 9</td>
<td>No observable structural defects</td>
</tr>
<tr>
<td>2</td>
<td>10 to 39</td>
<td>Circumferential crack. Moderate joint defects, i.e. open joint (medium) or joint displaced (medium), spalling slight and wear slight.</td>
</tr>
<tr>
<td>3</td>
<td>40 to 79</td>
<td>Fracture with deformation &lt;5%. Longitudinal cracking or multiple cracking. Minor loss of level. More severe joint defects, i.e. open joint (large) or joint displaced (large). Spalling medium. Wear medium.</td>
</tr>
<tr>
<td>4</td>
<td>80 to 164</td>
<td>Broken, deformation up to 10% and broken fracture with deformation 5 - 10%. Multiple fractures. Serious loss of level. Spalling large. Wear large.</td>
</tr>
<tr>
<td>5 (most defective)</td>
<td>165+</td>
<td>Already collapsed. Deformation &gt;10% and broken. Extensive areas of fabric missing. Fracture with deformation &gt;10%.</td>
</tr>
</tbody>
</table>
The following additional information shall be included for each sewer section as the CCTV Title Page:

(a) Date of survey.
(b) Contractor Project Index No. (i.e. Tape No. V2-1234)
(c) Survey No.
(d) Start MH No.
(e) Finish MH No.
(f) Line ID No.
(g) Direction of Camera Travel.
(h) Street Location (Road Name or RW No.).
(i) Distance from the manhole rim to pipe invert.
(j) Length of Capture.
(k) Total of Captured CCTV.
(l) Current weather information.

.4 All pipe video inspections shall include an annotated map with the following information:

(a) Manhole and catch basin locations with labels.
(b) City of Nanaimo drawing numbers.
(c) Manhole I.D. numbers (as per the City of Nanaimo GIS numbering system).
(d) Catch basin I.D. numbers (as per the City of Nanaimo GIS numbering system).

.5 Computer database file to contain identical survey report information as the printed report exclusive of photographs. Index numbers and distance of survey information shall numerically increase. For an individual survey, whether the information is sorted by index or distance, the result will be in the same order.

.6 All pipe video inspection operators shall be thoroughly trained with current Canadian certification by a City approved agency.

.7 Manhole video inspection is not required. Manholes shall be rated as per the following table and form part of the video inspection report.
SECTION 7 - STORMWATER MANAGEMENT
INSTALLATION

MANHOLE RATING SYSTEM

<table>
<thead>
<tr>
<th>INTERNAL CONDITION GRADE</th>
<th>TYPICAL DEFECT DESCRIPTION</th>
</tr>
</thead>
</table>
| 1 (least defective)      | -No observable structural defects.  
                          | -No observable signs of infiltration. |
| 2                        | -Minor cracks, chips, spalling. |
|                          | -Signs of minor staining, but no infiltration. |
| 3                        | -Fractures, medium spalling, defective pipe/MH joints. |
|                          | -Some staining, mineral build-up and seeding infiltration. Possible infiltration through manhole cover. |
| 4                        | -Broken manhole wall, channel or riser assembly, multiple fractures, medium wear. |
|                          | -Moderate staining, mineral build-up and running infiltration. |
|                          | -Infiltration through manhole cover. |
|                          | -Manhole frame and cover cracks or broken. |
| 5 (most defective)       | -Failure in manhole wall, channel or riser assembly, multiple fractures with deformation, large wear. |
|                          | -Heavy staining, mineral build-up and gushing infiltration. |
|                          | -Surface ponding and infiltration through manhole cover. |
|                          | -Manhole frame and cover cracks or broken. |
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR FRAME & GRATE DETAILS, SEE STD DWG SW-6.
3. ALL JOINTS TO BE PRE-WETTED BEFORE MORTAR IS PLACED.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
6. CATCH BASIN LID TO MEET CS-600 LOADING.
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR FRAME & GRATE DETAILS, SEE STD DWG SW-6.
3. ALL JOINTS TO BE PRE-WETTED BEFORE MORTAR IS PLACED.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
6. CATCH BASIN LID TO MEET CS-600 LOADING.
1. This drawing shall be used in accordance with Section 7.0 of the Manual of Engineering Standards and Specifications, Latest Edition.
2. For frame & hood details, see STD DWG SW-7.
3. All joints to be pre-wetted before mortar is placed.
4. Only products listed in the City of Nanaimo Approved Products list will be accepted for installation.
5. All dimensions are millimeters unless noted otherwise.
6. Catch basin lid to meet CS-600 loading.

NOTE:
Top of hood to be flush with top of curb. Prior to casting the concrete curb, the curb inlet hood is to be permanently fixed in place by either welding in-place, or providing inserts cast into the concrete curb.

Scale: 1:15
Created: JAN 2016
Rev Date: NOV 2016
Dwg No: SW-3

NOTES:
150mm of 38mm drain rock on approved sub-grade
1:15
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR FRAME & GRATE DETAILS, SEE STD DWG SW-8.
3. ALL JOINTS TO BE PRE-WETTED BEFORE MORTAR IS PLACED.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
1. **NOTES:**
   - THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
   - ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
   - ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

**PRECAST CATCH BASIN BARREL**

- **150mm OF 38mm DRAIN ROCK ON APPROVED SUB-GRADE**
- **GROUT ALL AROUND CB LEAD, INSIDE & OUTSIDE OF BARREL**
- **CB LEAD, INSTALLED IN FACTORY KNOCK-OUT, SEE DESIGN DWGS FOR SIZE**
- **CAST IRON GRATE TO CS-600 LOADING (TR CASTINGS TR 12 OR EQUAL)**
- **BACKFILL WITH COMPACTED APPROVED NATIVE MATERIAL**

**STORM SEWER SERVICE BOX**

- **150Ø SERVICE MIN FROM HOUSE**
- **100Ø SERVICE MIN**
- **LAWN BASIN**

**ELEVATION**

- **SCALE:** 1:15
- **NOTES:**
  - IF LARGER LAWN BASIN (SW-4) IS REQ'D, THE CB LEAD TO BE 150Ø PVC TO SERVICE BOX.

**PLAN**

- **PROPERTY LINE**
- **STORM SEWER**
- **100Ø SERVICE FROM HOUSE**
- **LAWN BASIN**

**NOTES:**

- **1. SMALL LAWN BASIN ON PRIVATE PROPERTY**

**Scale:** 1:15

**Created:** JAN 2016

**Rev Date:** NOV 2016

**Dwg No:** SW-5

**CITY OF NANAIMO**

**ENGINEERING STANDARDS & SPECIFICATIONS**

November 2016 Edition
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
4. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. FOR GRATE, SEE STD DWG SW-6.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. ALL BEARING SURFACES BETWEEN FRAME, COVER AND RISER RINGS SHALL BE MACHINED FOR NON-ROCKING FIT IN ALL POSITIONS. ALLOW 1.5mm RAISED FACE IN CASTINGS FOR MACHINING.
3. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
4. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. INLET AND OUTLET GRATES TO BE WELDED AND HOT-DIP GALVANIZED TO ASTM A123/A123M.
3. GRATES TO BE EASILY LIFTED TO ALLOW ACCESS TO THE PIPE FOR CLEARING OF DEBRIS.
4. GRATES TO BE DESIGNED IN ACCORDANCE WITH SECTION 7.11.
5. IF SPECIFIED ON DESIGN DRAWINGS, GUARD RAIL TO BE INSTALLED PER STD DWG SW-12.
6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
3. THIS HEADWALL IS FOR DRIVEWAY CULVERTS AND HYDRANT ACCESS ONLY, UNLESS APPROVED BY CITY ENGINEER.
4. IF HORIZONTAL ANGLE BETWEEN THE DITCH FLOW AND CULVERT INLET OR OUTLET EXCEEDS 30°, THE HEADWALL WILL REQUIRE WING WALLS TO FUNNEL FLOW TO PREVENT EROSION TO WALLS OF THE DITCH. SEE DESIGN DRAWINGS FOR DETAILS.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

SANDBAGS FILLED WITH 15MPa CONCRETE CONCRETE, PRE-WETTED

15M PIN, c/w HOOK INSTALL SUCH THAT MIN ONE BAR IS DRIVEN THROUGH EACH SACK. ENSURE PIN IS DRIVEN ENTIRELY THROUGH BOTTOM SACK

ELEVATION
1:25

SECTION
1:25

SANDBAG HEADWALL FOR CULVERT INLETS AND OUTLETS
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
3. ALL JOINTS MITRED, WELDED ALL AROUND AND GROUND SMOOTH.
4. INSTALLATION OF CHAINLINK FENCING AS REQUIRED BY THE CITY ENGINEER.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
1. This drawing shall be used in accordance with Section 7.0 of the Manual of Engineering Standards and Specifications, latest edition.
2. For manhole benching, see STD DWG SW-15.
3. For frame & cover details, see STD DWG SW-16.
4. Only products listed in the City of Nanaimo approved products list will be accepted for installation.
5. All dimensions are millimeters unless noted otherwise.

NOTES:

**MANHOLES INSTALLED IN GRAVEL SURFACES SHALL HAVE A 50mm THICK x 1.5mØ ASPHALT APRON ON 100mm OF COMPACTED CRUSHED GRAVEL**

**PRECAST GRADE RINGS, 2 MIN. 4 MAX**

**PRECAST MANHOLE LID**

**Rungs cast into wall of barrel to conform to Worksafe BC requirements**

**Rubber manhole adapter ring for PVC pipes**

**TYPICAL SECTION**

**1:25**

**USE SHORT MANHOLE BARREL AS FORM. ENSURE TOP IS LEVEL PRIOR TO POURING CONCRETE**

**Concrete block to set manhole barrel height**

**CAST-IN-PLACE BASE**

**CAST MANHOLE BASE ON UNDISTURBED SOILS**

**PRECAST MANHOLE BARREL, SEE DESIGN FOR SIZE**

**SLOPE BENCHING 1:10**

**WHERE POSSIBLE, USE HALF PIPE SECTIONS, OR BREAK-OUT TOP HALF OF PIPE**

**Backfill with imported granular fill**

**Precast pre-benched manhole base**

**150mm of 38mm drain rock on approved sub-grade**

**Road to conform to Worksafe BC, or 500mm max**

**Concreted manhole frame to be concreted to manhole lid**

**600 min for compaction**

**Precast manhole barrel, see design for size**

**Precast grade rings, 2 min. 4 max**

**50 min 100 max**

**Road structure**

**TENTATIVE STORM MANHOLE**

**November 2016 Edition**

**Scale: 1:25**

Created: FEB 2016
Rev Date: NOV 2016
Dwg No: SW-13
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR MANHOLE DETAILS, SEE STD DWG SW-13.
3. FOR MANHOLE BENCHING, SEE STD DWG SW-15.
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

DROP MANHOLE TYPE 1
1:25

DROP MANHOLE TYPE 2
1:25

GROUT ALL AROUND, INSIDE & OUTSIDE OF BARREL
CORE HOLE IN MANHOLE BARREL

DROP PIPING TO BE 2500 MIN., EXCEPT IF MAIN IS LESS THAN 2500. DROP PIPING TO EQUAL MAIN.

38mm DRAIN ROCK
RUBBER MANHOLE ADAPTER RING FOR PVC PIPES

GROUT ALL AROUND, INSIDE & OUTSIDE OF BARREL
CORE HOLE IN MANHOLE BARREL

38mm DRAIN ROCK
DROP PIPING TO BE 2500 MIN., EXCEPT IF MAIN IS LESS THAN 2500. DROP PIPING TO EQUAL MAIN.
RUBBER MANHOLE ADAPTER RING FOR PVC PIPES
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR MANHOLE CHANNELING, REFER TO SECTION 7.49.
3. ALL CHANNELS SHALL BE FINISHED WITH A STEEL TROWEL. BENCHING (HATCHED AREAS), SHALL BE BROOM FINISHED.
4. MANHOLE COVER AND RUNG LOCATIONS SHALL BE AS SHOWN, UNLESS NOTED OTHERWISE.
5. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
6. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
REFERRING TO "CITY OF NANAIMO STORM DRAIN", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

MANUFACTURER'S SYMBOL 90 MAXIMUM DIMENSION, CIRCLE OR SQUARE

2-21Ø HOLES

PLAN

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. ALL BEARING SURFACES BETWEEN FRAME, COVER AND RISER RINGS SHALL BE MACHINED FOR NON-ROCKING FIT IN ALL POSITIONS. ALLOW 1.5mm RAISED FACE IN CASTINGS FOR MACHINING.
4. PAINT THE INSIDE SURFACE OF THE MANHOLE FRAME IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATION WITH ENAMEL RUST PAINT. COLOUR TO BE GREEN.
5. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMG APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
6. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.

FRAME AND COVER

FRAMES INSTALLED ON 600Ø BARRELS SHALL NOT HAVE RIB

STORM MANHOLE FRAME AND COVER

Engineering Standards & Specifications
November 2016 Edition
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. FOR COVER LETTERING AND BOLTING REQUIREMENTS REFER TO STD. DWG. SW-16 OR SW-18 (WATERTIGHT COVER).
4. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
5. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
APPLICATION: UNITS ARE FOR USE IN AREAS WHERE FLOODING OR HIGH TIDES ARE POSSIBLE. THIS UNIT SHALL HAVE A POSITIONING LUG IN COVER FOR EASY REPLACEMENT OF CAP SCREWS AND SHALL BE EQUIPPED WITH FOUR ONLY 190 HOLES IN FRAME FOR ANCHOR BOLTS AS SHOWN.

REFERRING TO "CITY OF NANAIMO STORM DRAIN", LETTERING SHALL BE 25 FLATTENED FACE GOTHIC WITH FACE OF LETTERS RAISED TO THE SAME LEVELS AS THE TOP OF THE RIBS (IN STATUTORY RIGHTS-OF-WAY INCLUDE THE WORDING "DO NOT COVER" ON THE MANHOLE LID)

WEIGHT OF UNIT SHOWN IS
FRAME = 113.4 kg
COVER = 56.7 kg

FURNISHED WITH:
A) FOUR 13x57 PENTA HEAD STAINLESS STEEL CAP SCREWS TO DISCOURAGE VANDALISM.
B) A 6mm THICK NEOPRENE GASKET FULLY ENCOMPASSING BOLT HOLES.
C) METAL SURFACES BETWEEN FRAME AND COVER MACHINED TO ENSURE NON ROCKING FIT IN ALL POSITIONS, ALLOW 1.5 RAISED FACE IN CASTING FOR MACHINING.
D) MANUFACTURE BOLT HOLES TO PERMIT INTERCHANGING OF COVERS BETWEEN FRAME UNITS.

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. CASTINGS SHALL BE CERTIFIED TO MEET CS-600 LOADING.
3. PAINT THE INSIDE SURFACE OF THE MANHOLE FRAME IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATION WITH ENAMEL RUST PAINT. COLOUR TO BE GREEN.
4. FRAME SHALL BE SET IN MORTAR AND BOLTED TO THE MANHOLE SLAB WITH 190 STAINLESS STEEL BOLTS, WASHERS AND NUTS.
5. THIS DRAWING TO BE READ IN ACCORDANCE WITH DRAWING SW-13.
6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. TEMPORARY CLEANOUT STRUCTURES MAY ONLY BE USED AT THE DISCRETION OF THE CITY ENGINEER WHERE THERE IS DEVELOPMENT PHASING.
3. USE WHERE NO SERVICE EXTENSION IS REQUIRED.
4. FRAME AND COVER TO STD. DWG. SW-16 OR SW-18 (WATERTIGHT COVER).
5. CLEANOUT STRUCTURES LOCATED ON GRAVEL ROADS OR SHOULDER REQUIRE A 1.5m x 1.5m HOT MIX ASPHALT APRON, 50mm THICK.
6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
MANHOLE OR TEMPORARY CLEANOUT LID MARKER WITH UPPER PORTION FLATTENED AND DISTANCE TO LID MARKED IN BLACK FIGURES.

50Ø STEEL PIPE PAINTED YELLOW

CONCRETE BASE SET IN 300Ø SECTION OF PVC PIPE.

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. FOR USE ONLY WHERE MANHOLE OR TEMPORARY CLEANOUTS ARE LOCATED OUTSIDE THE PAVED PORTION OF THE STREET.
3. THE MARKER SHALL BE LOCATED ON SITE BY THE ENGINEER WITH THE FLATTENED END AND MARKED DISTANCE FACING THE LID.
4. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:

1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.

2. WHERE DEPTH OF SERVICE AT PROPERTY LINE IS GREATER THAN 2.0m, EXTEND THE SERVICE PAST THE PROPERTY LINE EQUAL TO ITS DEPTH, TO A MAXIMUM OF 4.0m.

3. WHERE SERVICE IS INSTALLED IN ROCK, THE TRENCH IS TO EXTEND 3.0m PAST THE PROPERTY LINE.

4. STORM SEWER INSPECTION ASSEMBLY, INCLUDING PROPERTY SIDE STUB TO BE GREEN.

5. SERVICE PIPE DEPTH TO BE INSTALLED TO PROVIDE SUFFICIENT DEPTH TO SERVICE THE BASEMENT PLUMBING BY GRAVITY IN ACCORDANCE WITH THE BC PLUMBING CODE. MINIMUM COVER OF SERVICE PIPE AT PROPERTY LINE TO BE 0.75m.

6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. WHERE DEPTH OF SERVICE AT PROPERTY LINE IS GREATER THAN 2.0m, EXTEND THE SERVICE PAST THE PROPERTY LINE EQUAL TO ITS DEPTH, TO A MAXIMUM OF 4.0m.
3. WHERE SERVICE IS INSTALLED IN ROCK, THE TRENCH IS TO EXTEND 3.0m PAST THE PROPERTY LINE.
4. STORM SEWER INSPECTION ASSEMBLY, INCLUDING PROPERTY SIDE STUB TO BE GREEN.
5. SERVICE PIPE DEPTH TO BE INSTALLED TO PROVIDE SUFFICIENT DEPTH TO SERVICE THE BASEMENT PLUMBING BY GRAVITY IN ACCORDANCE WITH THE BC PLUMBING CODE. MINIMUM COVER OF SERVICE PIPE AT PROPERTY LINE TO BE 0.75m.
6. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
7. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUFACTURING STANDARDS AND SPECIFICATIONS, LATEST EDITION.

2. WHEN SERVICE BOX IS WITHIN CONCRETE DRIVEWAY, CONCRETE ADJACENT TO THE SERVICE BOX MUST BE A MINIMUM OF 150mm THICK FOR A MINIMUM DISTANCE OF 150mm AROUND THE OUTSIDE EDGES OF THE SERVICE BOX.

3. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.

4. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. ONLY PRODUCTS LISTED IN THE CITY OF NANAIMO APPROVED PRODUCTS LIST WILL BE ACCEPTED FOR INSTALLATION.
3. ALL DIMENSIONS ARE MILLIMETERS UNLESS NOTED OTHERWISE.
SHORT DURATION RAINFALL INTENSITY-DURATION FREQUENCY DATA FOR NANAIMO
(BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD 1980 - 2005 FROM CITY OF NANAIMO PUBLIC WORKS YARD)

CURVES BASED ON FORMULA: \[ T = AxT^B \]
where \( T \) = Time of Concentration (hr) and
where \( I \) = Intensity (mm/hr)

\[
\begin{align*}
A_5 &= 15.6 \\
A_{10} &= 18.3 \\
A_{25} &= 21.8 \\
A_{50} &= 24.4 \\
A_{100} &= 26.9 \\
B_5 &= -0.531 \\
B_{10} &= -0.552 \\
B_{25} &= -0.571 \\
B_{50} &= -0.582 \\
B_{100} &= -0.591 \\
\end{align*}
\]

NOTE:
Convert Time of Concentration to HOURS in above formula.

RETURN PERIODS
YEARS

NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
NOTES:
1. THIS DRAWING SHALL BE USED IN ACCORDANCE WITH SECTION 7.0 OF THE MANUAL OF ENGINEERING STANDARDS AND SPECIFICATIONS, LATEST EDITION.
2. THIS TABLE IS LIMITED FOR USE IN DRAINAGE BASINS UP TO 10km².
3. THIS TABLE DOES NOT MAKE ALLOWANCES FOR VARIATIONS IN SOIL TYPES AND MAY UNDERESTIMATE TIMES FOR PERMEABLE BASINS.

UPLAND METHOD FOR ESTIMATING TIME OF CONCENTRATION
MEASUREMENT AND PAYMENT

Pipings and Fittings 7.70
Service Junctions 7.71
Connections to Existing Piping and Appurtenances 7.72
Precast Manholes Sections 7.73
Catchbasins 7.74
Concrete Bases, Frames and Covers 7.75
Drop Structures 7.76
Stubs 7.77
Cleanouts 7.78
Additional Excavation and Backfill 7.79
Storm Sewer Service Connection Piping 7.80
Service Connection Inspection Assembly 7.81
Special Fittings 7.82
Perforated Drains 7.83
Inlet and Outlet Structures 7.84
Rip-Rap 7.85
Drainage Ditch Construction 7.86
Culvert Installation 7.87
Culvert Headwalls 7.88
Manhole and Cleanout Lid Markers 7.89
The Contractor will note that the Tendered Price for all items specified in this section will include but not be limited to the following: Please refer to Section 4 - Trench Excavation, Bedding and Backfill for further clarification of these items.

(a) materials
(b) excavation
(c) dewatering
(d) bracing & sheeting
(e) bedding
(f) pipe installation
(g) backfill with native material
(h) video inspection
(i) maintenance

The Contractor will note that payment for surface restoration and asphalt removal is paid in accordance with Section 4.76.

7.70 PIPING AND FITTINGS Section 7.42 - 7.46

Payment for piping and fittings will be made at the unit price per linear metre shown in the Tender Form for the various sizes and class of pipe. Measurement will be made horizontally along the centreline of the installed pipe, including fittings, from centre-to-centre of manholes or to the end of the pipe, whichever is applicable. This price shall include materials, excavation, dewatering, bracing and sheeting, bedding, pipe installation, backfill with native material, video inspection and maintenance, testing as specified, and all work incidental thereto except those items for which payment is specified additional to that for gravity sewer pipe.

7.71 SERVICE JUNCTIONS Section 7.48

Payment for service junctions installed in the gravity sewers will be made at the unit price shown in the Tender Form. This price shall include materials, and placement of the wye and plug or cap as required.

7.72 CONNECTIONS TO EXISTING PIPING AND APPURTENANCES Section 7.47

(a) Payment for connections to existing main piping will be made at the unit price per proposed pipe size per connection shown in the Tender Form. This price shall include materials and all work incidental thereto.

(b) Payment for connections to existing service connections will be made at the unit price per pipe size per connection shown in the Tender Form. This price shall include materials and all work incidental thereto.
7.73 **PRECAST MANHOLE SECTIONS** Section 7.51 and 7.55

Payment for manholes will be made at the unit price per vertical metre per diameter of manhole barrel shown in the Tender Form.

Measurement will be made from the lowest channel invert in the manhole to the bottom of the manhole cover slab. This price shall include materials, installation, grouting, and all work incidental thereto except those items for which payment is specified additional to that for manholes.

7.74 **CATCHBASINS** Section 7.60

Payment for catchbasins will be made at the unit price as shown in the Tender Form for the specified type of catchbasin. This price shall include materials, installation, brickwork, concrete, grouting, adjustment to grade, asphalt apron and all work incidental thereto.

7.75 **CONCRETE BASES, FRAMES AND COVERS** Sections 7.49, 7.52, 7.53 and 7.54

Payment for concrete bases or tee manholes, cover slabs, and frames and covers will be made at the unit price shown in the Tender Form. This price shall include materials, installation, brickwork, concrete channeling and grouting, adjustment to grade, asphalt apron and all work incidental thereto. Payment will be in addition to that of 7.73 above.

7.76 **DROP STRUCTURES** Section 7.56

Payment for drop structures on manholes will be made at the unit price per vertical metre of drop shown in the Tender Form. Measurement will be made between pipe inverts at the top and bottom of the drop section. This price shall include materials, installation, concrete and all work incidental thereto. Payment will be in addition to that of 7.73 above.

7.77 **STUBS** Section 7.57

Payment for stubs in manholes will be made at the unit price per linear metre for the various sizes of pipe shown in the Tender Form. This price shall include materials, grouting, installation, cap and all work incidental thereto. Payment will be in addition to that of 7.73 above.

7.78 **CLEANOUTS** Section 7.58 Standard Drawing SW-19

Payment for cleanouts will be made at the unit price shown in the Tender Form for the specified type of cleanout. This price shall include excavation, materials, installation, concrete base, concrete barrel, grouting, brickwork, frame and cover, pipe, fittings, adjustment to grade and all work incidental thereto.
7.79 **ADDITIONAL EXCAVATION AND BACKFILL**

Payment will not be made as a separate item for excavation, backfill and work applicable thereto required at any structure specified in this section. The cost of such work shall be included in the applicable prices for the various structures shown in the Tender Form.

7.80 **STORM SEWER SERVICE CONNECTION PIPING** Section 7.61.3

Payment for sewer service connection pipe will be made at the unit price per linear metre shown in the Tender Form for the various sizes of pipe. Measurement will be made horizontally along the centreline of the installed pipe from the centre of the gravity sewer main to the terminus of the service pipe or from the bend fitting in the case of riser service connections.

This price shall include materials, excavation, dewatering, bracing & sheeting, bedding, pipe installation, backfill with native material, and maintenance, testing as specified, bends, caps and other fittings, and all work incidental thereto except those items for which payment is specified additional to that for sewer service connection pipe.

7.81 **SERVICE CONNECTION INSPECTION ASSEMBLY** Section 7.61.3 (j) & (k) and 7.61.4

Standard Drawing SW-11

Payment for service connection inspection assemblies will be made at the unit price shown in the Tender Form. This price shall include installation of pipe, fittings, marker posts, concrete service box, other materials and all work incidental thereto.

7.82 **SPECIAL FITTINGS**

Removed 2017-03-15

7.83 **PERFORATED DRAINS** Section 7.67

Payment for perforated drains will be made at the unit price per linear metre shown in the Tender Form for various sizes and classes of pipe. Measurement will be made horizontally along the centreline of the installed pipe. This price shall include materials, excavation, dewatering, bracing & sheeting, bedding, pipe installation, backfill with drain rock, surround with specified filter fabric, video inspection and maintenance, and all work incidental thereto.

7.84 **INLET AND OUTLET STRUCTURES** Section 7.68

Payment for inlet and outlet structures and energy dissipator structures will be made at the unit price shown in the Tender Form for the various individual structures. This price shall include all concrete, guard rails, trash racks, grating, other materials, installation and all work incidental thereto.
7.85 **RIP-RAP**  Section 7.69

Payment for rip-rap will be made at the unit price per class per cubic metre as shown in the Tender Form. This price shall include materials, installation and all work incidental thereto.

7.86 **DRAINAGE DITCH CONSTRUCTION**  Section 7.64

Except in rock, payment for excavation of drainage ditches will be made at the unit price per linear metre shown in the Tender Form. This price shall include excavating material, placing and compacting as earth fill or rock fill, disposal of surplus material and all work incidental thereto.

Payment for rock excavation will be made by the method shown in the Tender Form - Sec. 4.71.

7.87 **CULVERT INSTALLATION**  Section 7.65

Payment for culverts will be made at the unit price per linear metre shown in the Tender Form for the various sizes of culverts. Measurement will be made horizontally along the centreline of the installed pipe. This price shall include materials, excavation, bedding, pipe installation, backfilling and all work incidental thereto.

7.88 **CULVERT HEADWALLS**  Section 7.66

Payment for culvert headwalls will be made at the unit price per headwall as shown in the Tender Form. This price shall include materials, preparation and placing of the headwall and all work incidental thereto.

7.89 **MANHOLE AND CLEANOUT LID MARKERS**  Section 7.37  Standard Drawing SW-20

Payment for manhole and cleanout lid markers will be made at the unit price shown in the Tender Form. This price shall include supply of materials, excavation, fabrication, painting, installation, backfilling and all work incidental thereto. Payment will be in addition to that of 7.73 and 7.78 above.
APPENDIX 1

Receipt Confirmation
APPENDIX 1

RECEIPT CONFIRMATION FORM

Invitation to Tender No. T-2170-2018

WESTDALE ROAD
SANITARY SEWER UPGRADE

Closing date and time: 3:00 PM, Pacific Time, Thursday, April 12, 2018

As receipt of this document and to receive any addendums for this Tender, please return form to:

CONSTRUCTION DEPARTMENT
City of Nanaimo
2020 Labieux Road
Nanaimo, BC, V2T 4M7
Email: constructioninfo@nanaimo.ca

COMPANY NAME: ________________________________________________
STREET ADDRESS: _______________________________________________
CITY/PROVINCE: _________________________________________________
POSTAL CODE: __________________________________________________
PHONE NUMBER: ________________________________________________
CONTACT PERSON: ________________________________________________
EMAIL ADDRESS: ________________________________________________
SIGNATURE: _____________________________________________________
APPENDIX 2

Asbestos Cement Pipe Safework Procedures
City of Nanaimo, Jan. 30, 2015
Asbestos Cement Pipe Safe Work Procedures

Background:

Although AC pipe will not be used in new installations, there is still a need for work to be done on existing AC pipe. Cutting into AC pipe sections may sometimes be required for repair or tying into new connections. Exposure to asbestos can occur during work performed on AC pipes.

To minimize fiber release, and prevent exposure to fibers during work activities, the following procedures are to be followed when performing work on AC pipe. All employees and contractors throughout The City of Nanaimo must understand the requirements of these procedures prior to conducting any work on AC pipe.

The following procedures are for snap cutters, handsaws, tapping machines and hand drills. The operation of hand tools with AC pipe has been determined to be a Moderate Risk Work Activity as outlined in Worksafe Regulation 6.1.

Snap cutters (roller chain cutters) consist of deep penetrating cutting wheels mounted in a chain that is wrapped around the pipe barrel. A cut is made when pressure is applied by means of a hydraulic pump or a manual ratchet depending on the size of the pipe.

Hazards:

- The use of powered disc saws (cut-off saw, K-5 saw, stihl saw, etc) MUST NOT be used to cut AC pipe. The use of such abrasive disc saws will release excessive levels of asbestos fibres into the atmosphere and cause over-exposure to employees, contractors and the public.
- Exposure to asbestos fibres can lead to grievous long term illness and death. All efforts must be made to avoid exposure to asbestos fibres. If an exposure is suspected during your shift, report this suspected exposure to the OH&S Department without delay.
- If clothing is exposed to asbestos fibres, that clothing needs to be bagged, marked and cleaned appropriately. Don't risk bringing asbestos home to your family.
- Heat Exposure is amplified during the summer months while performing this procedure due to the use of Tyvex suits. Workers and supervisors must be aware of the signs and symptoms of Hyperthermia (unsafe increase in the body’s core temperature). If the worker is feeling these signs and symptoms, they must follow decontamination procedures to exit the “Asbestos Work Zone” and take a break in a cool place while having some water.

PPE Required:
The use of disposable material is to ensure asbestos fibres that can be found in the AC pipe debris do not get transferred out of the asbestos workzone.

<table>
<thead>
<tr>
<th>PPE Required</th>
<th>Special Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ Mask Respirator with a “100” (HEPA) filter</td>
<td>Asbestos Disposal Bags</td>
</tr>
<tr>
<td>Disposable Coveralls – Impermeable protective coveralls must have a hood, and elastic seals</td>
<td>Asbestos Warning Tape</td>
</tr>
<tr>
<td>Rubber Boots - NO laces</td>
<td>Duct Tape for sealing bags.</td>
</tr>
<tr>
<td>Disposable Gloves</td>
<td>Asbestos Hazard Warning Signs</td>
</tr>
<tr>
<td>Hardhat</td>
<td></td>
</tr>
<tr>
<td>Eye Protection (Where Required)</td>
<td></td>
</tr>
<tr>
<td>Hearing Protection (Where Required)</td>
<td></td>
</tr>
</tbody>
</table>

4 “Candle Stick” style traffic delineators for creating the 4 corners of the “Asbestos Work Zone”, OR, any other suitable posts or stakes
Pre Set-Up:

- Perform pre-excavation hazard identification and risk assessment through the use of a Pre-Excavation Checklist. Keep completed checklist on site.
- Complete the appropriate WSBC NOP for work on Asbestos Containing Materials. Ensure that a copy of the NOP(A) is on site at all times.
- Ensure that the Pre-Ex is on site and utilities have been marked out before carrying out any excavations.
- Set up work zone appropriately – utilize traffic control if needed.
- Ensure all workers on site are trained and aware of the hazards which exist.
- Any workers who are going to be carrying out AC Pipe procedures need to have attended an AC Pipe Procedures safety talk.
- Ensure this procedure and the AC Pipe Exposure Control Plan are on site and that all workers have been trained in both.
- Ensure a continuous water supply is available on site.

Procedure:

- Expose AC Pipe in accordance with City of Nanaimo Excavation and Trenching Safety program.
- Create an “Asbestos Work Zone”. Use four “Candlestick” style traffic control posts as the corners of the work zone. Use “Asbestos Hazard” warning tape to create a barrier surrounding the work zone, connecting all 4 corners. The work zone barrier must keep all non protected workers 10 feet away from the work zone. Post Asbestos Warning Signs where appropriate.
- Employees entering the “Asbestos Work Zone” must be wearing the required personal protective equipment.
- Low flow water must be constantly applied to the area being cut and continued until the cutting is complete. Ensure the water is applied in sufficient quantities so that the area being cut is continuously wet and no asbestos fibres are being released.
- Operate the cutting tool in accordance with the manufacturer’s instructions and City of Nanaimo SWPs until cutting is complete. Snap Cutters are generally the preferred tool for cutting AC Pipe.
- If the use of snap cutters is impractical, other non powered hand tools may be utilized as per manufacturer’s instructions and city policies. All the same controls used for snap cutters must still be utilized (i.e. continuous flow water.
- Once the final cut has been completed, thoroughly wash the cutting equipment in the excavation with a hose using clean water to remove all AC pipe debris. Pass tools out of the excavation once they are cleaned.
- If flowing water is not available, wash the equipment in large buckets of water and dump that water into the excavation.
- There are two different options for the waste pipe:
  1) Remove from trench and dispose in asbestos waste bin:
     - Cut the pipe into short enough pieces (4 foot lengths) to fit into the Asbestos Waste Bags while still in the trench.
     - Place the pipe of piece and any visible pieces or debris into the Asbestos Waste Bag.
     - Twist the top of the bag to close it, and then fold over twisted portion and use duct tape to tape the twisted portion to the bag.
     - Place the bagged section near the edge of the “Asbestos Work Zone”.
     - Wipe down bag with a wet disposable cloth to remove any asbestos debris.
     - Place the bag into a second Asbestos Waste Bag and duct tape closed the same way.
     - Where use of Asbestos Waste Bags is not applicable (i.e. length of AC Pipe to be removed is longer than 4 feet or too large for the bag to contain) Polyethylene drop sheets can be utilized. Two layers of Polyethylene drop sheets will be placed on the edge of the trench. Once removed, the AC Pipe will be placed directly onto the
Polyethylene drop sheets. The first layer of the Polyethylene drop sheet will be used to contain the AC Pipe by wrapping around the pipe and tying the ends in a goose neck fashion and sealing with duct tape. The second layer of Polyethylene sheeting will be utilized to further contain the AC Pipe by double-wrapping the pipe and tying the ends in a goose neck fashion and sealing with duct tape. The double wrapped AC Pipe will then be labelled with an Asbestos Warning Sticker or marked appropriately with other means.

- Place the bag back of truck and dispose of in the designated Asbestos Disposal Bin at the back of the yard and advise Stores that you have done so. AC Pipe must never be left in the back of a truck overnight.

2) Leave in trench whole:
- If the trench is large enough to leave the AC Pipe section in the trench, this is another option. However, this practice is discouraged as the remaining AC Pipe must now be marked on the City of Nanaimo Asbestos Inventory and an exposure control plan must be implemented for future work in the area.
- Cut AC Pipe into sections small enough to either fit into Asbestos Waste Bags or small enough to be able to wrap poly around it.
- Place the AC Pipe section into an Asbestos Waste Bag and seal in a goose neck fashion with duct tape. Place that bagged piece into a second bag and seal in the same fashion.
- If section is too big to fit into Asbestos Waste Bag, wrap with poly and mark the poly wrap with Asbestos Hazard Stickers.
- Place “Asbestos Hazard” warning tape over the waste pipe during back fill.
- Forward location of buried and marked AC Pipe to OH&S and Public Works for placement into the Asbestos Inventory.
- When backfilling, bury asbestos hazard tape 2 feet below grade above the waste pipe.

Post Procedure/Take Down

1.) Decontaminate equipment:
- Once the final cut has been completed, thoroughly wash the cutting equipment in the excavation with clean, low pressure water to remove all AC pipe debris.
- Wash down excavator bucket and thumb with low flow water to remove all AC pipe debris and asbestos fibers.
- Remove all cleaned tools from the excavation.

2.) Decontamination of all workers handling asbestos (other than last worker to decontaminate)
- Proceed to where the wash station/ asbestos & asbestos waste bag is
- Thoroughly wash off boots & hard hat with low flow water.
- Remove gloves (first aid method turning inside out) and place in the asbestos waste bag
- Remove Tyvek and gently place in Asbestos Waste Bag
- Wash face and any exposed hair & hands with water and rag/ wet wipes
- Remove respirator cartridges and place into asbestos waste bag
- Thoroughly clean safety glasses & respirator with a disposable wet cloth/ wet wipes
- Throw away all clothes/ wet wipes into asbestos waste bag
- Step out of Asbestos Work Zone

3.) Last person out of excavation to decontaminate
- Take down barrier and dispose of tape in asbestos waste bag
- Proceed to where the wash station/ asbestos waste bag is
- Thoroughly wash off boots & hard hat
- Remove gloves (first aid method turning inside out) and place in the asbestos waste bag
- Remove Tyvek and gently place in asbestos waste bag
- Thoroughly clean safety glasses & respirator with a disposable wet cloth/ wet wipes
- Put all disposable clothes/ wet wipes in asbestos waste bag
- With respirator still on:
4.) Backfill excavation as per usual procedures.

Other Considerations

1. Specific Respirator Maintenance
   - Clean respirator by washing with respirator wipes
   - Rinse in clean, warm water
   - Wipe dry and hang to complete drying
   - Visually inspect inhalation and exhalation valve before replacing

2. Contingency Plan – Spill/ Split Double Bag or Poly Wrap
   The section is to be used in the event a bag breaks open, a wrapped asbestos containing pipe is dropped or the double poly breaks open or other small spill of pre-bagged asbestos containing material.
   - **Immediately soak down the contents** with low flow water and barricade the area that the spill has occurred to keep unprotected workers and public out of area:
     - Create an “Asbestos Work Zone”. Use four “Candlestick” style traffic control posts as the corners of the work zone. Use “Asbestos Hazard” warning tape to create a barrier surrounding the work zone, connecting all 4 corners. The work zone barrier must keep all non protected workers 10 feet away from the work zone. Post Asbestos Warning Signs where appropriate.
     - Employees entering the “Asbestos Work Zone” must be wearing the required personal protective equipment.
   - If workers are not already in Tyvek and other required PPE or workers with Tyvek and all other required PPE are unavailable
     - If workers are not available have workers **don all appropriate** personal protective equipment required for Moderate Risk Asbestos Procedures.

- **Rewrap the Asbestos**:
  - **Small Debris** - Use the double bagging procedure:
    - Place the pipe of piece and any visible pieces or debris into the Asbestos Waste Bag.
    - Twist the top of the bag to close it, and then fold over twisted portion and use duct tape to tape the twisted portion to the bag.
    - Place the bagged section near the edge of the “Asbestos Work Zone”.
    - Wipe down bag with a wet disposable cloth to remove any asbestos debris.
    - Place the bag into a second Asbestos Waste Bag and duct tape closed the same way.
- **Large Debris:**
  - Wrap the first layer of poly over the pipe like a present and tape into position.
  - Wipe down 1st layer with damp cloth to eliminate any fibers.
  - Wrap the second layer of poly over the pipe (again like a present) and tape down.
  - Apply asbestos hazard labels
  - Dispose of in bin with other double wrapped AC Pipe

- In addition to the above:
  - **If contents were spilled on soil:**
    - Ensure a layer of top soil is removed with the asbestos debris to minimize future exposure.
    - Utilizing a flat faced spade style shovel, dig horizontally deep enough under the surface to capture all of the fibers that may have been collected within the surface soils.
    - Gently place each shovel full into an Asbestos Waste Bag.
    - Seal bag as per “Small Debris” procedures above.
    - Decontaminate shovel with running water prior to removing from “Asbestos Work Zone”

  - **If contents were spilled on asphalt, concrete or other hard surface:**
    - Hepa vac contents up using DOP tested hepa vacuum
    - Wet wipe the area with disposable wet rags
    - Dispose of rags in double bag

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**Created:** 2010-Mar-08 Created by: Jason Duchak
**Revised:** 2015-Jan-30 Revised by: Jason Duchak
Asbestos Cement Pipe Safe Work Procedures

Background:

Although AC pipe will not be used in new installations, there is still a need for work to be done on existing AC pipe. Cutting into AC pipe sections may sometimes be required for repair or tying into new connections. Exposure to asbestos can occur during work performed on AC pipes.

To minimize fiber release, and prevent exposure to fibers during work activities, the following procedures are to be followed when performing work on AC pipe. All employees and contractors throughout The City of Nanaimo must understand the requirements of these procedures prior to conducting any work on AC pipe.

The following procedures are for snap cutters, handsaws, tapping machines and hand drills. The operation of hand tools with AC pipe has been determined to be a Moderate Risk Work Activity as outlined in Worksafe Regulation 6.1.

Snap cutters (roller chain cutters) consist of deep penetrating cutting wheels mounted in a chain that is wrapped around the pipe barrel. A cut is made when pressure is applied by means of a hydraulic pump or a manual ratchet depending on the size of the pipe.

Hazards:

- The use of powered disc saws (cut-off saw, K-5 saw, stihl saw, etc) MUST NOT be used to cut AC pipe. The use of such abrasive disc saws will release excessive levels of asbestos fibres into the atmosphere and cause over-exposure to employees, contractors and the public.
- Exposure to asbestos fibres can lead to grievous long term illness and death. All efforts must be made to avoid exposure to asbestos fibres. If an exposure is suspected during your shift, report this suspected exposure to the OH&S Department without delay.
- If clothing is exposed to asbestos fibres, that clothing needs to be bagged, marked and cleaned appropriately. Don’t risk bringing asbestos home to your family.
- Heat Exposure is amplified during the summer months while performing this procedure due to the use of Tyvex suits. Workers and supervisors must be aware of the signs and symptoms of Hyperthermia (unsafe increase in the body’s core temperature). If the worker is feeling these signs and symptoms, they must follow decontamination procedures to exit the “Asbestos Work Zone” and take a break in a cool place while having some water.

PPE Required:
The use of disposable material is to ensure asbestos fibres that can be found in the AC pipe debris do not get transferred out of the asbestos workzone.

| ½ Mask Respirator with a “100” (HEPA) filter | Disposable Coveralls – Impermeable protective coveralls must have a hood, and elastic seals |
| Rubber Boots - NO laces | Disposable Gloves |
| Eye Protection (Where Required) | Hardhat |
| Hearing Protection (Where Required) |

Special Equipment Required:

| Asbestos Disposal Bags | Asbestos Warning Tape |
| Snap Cutters or other non powered hand tools | Duct Tape for sealing bags |
| Asbestos Hazard Warning Signs |
| 4 “Candle Stick” style traffic delineators for creating the 4 corners of the “Asbestos Work Zone”, OR, any other suitable posts or stakes |
Pre Set-Up:

- Perform pre-excavation hazard identification and risk assessment through the use of a Pre-Excavation Checklist. Keep completed checklist on site.
- Complete the appropriate WSBC NOP for work on Asbestos Containing Materials. Ensure that a copy of the NOP(A) is on site at all times.
- Ensure that the Pre-Ex is on site and utilities have been marked out before carrying out any excavations.
- Set up work zone appropriately – utilize traffic control if needed.
- Ensure all workers on site are trained and aware of the hazards which exist.
- Any workers who are going to be carrying out AC Pipe procedures need to have attended an AC Pipe Procedures safety talk.
- Ensure this procedure and the AC Pipe Exposure Control Plan are on site and that all workers have been trained in both.
- Ensure a continuous water supply is available on site.

Procedure:

- Expose AC Pipe in accordance with City of Nanaimo Excavation and Trenching Safety program.
- Create an “Asbestos Work Zone”. Use four “Candlestick” style traffic control posts as the corners of the work zone. Use “Asbestos Hazard” warning tape to create a barrier surrounding the work zone, connecting all 4 corners. The work zone barrier must keep all non protected workers 10 feet away from the work zone. Post Asbestos Warning Signs where appropriate.
- Employees entering the “Asbestos Work Zone” must be wearing the required personal protective equipment.
- Low flow water must be constantly applied to the area being cut and continued until the cutting is complete. Ensure the water is applied in sufficient quantities so that the area being cut is continuously wet and no asbestos fibres are being released.
- Operate the cutting tool in accordance with the manufacturer’s instructions and City of Nanaimo SWPs until cutting is complete. Snap Cutters are generally the preferred tool for cutting AC Pipe.
- If the use of snap cutters is impractical, other non powered hand tools may be utilized as per manufacturer’s instructions and city policies. All the same controls used for snap cutters must still be utilized (i.e. continuous flow water.
- Once the final cut has been completed, thoroughly wash the cutting equipment in the excavation with a hose using clean water to remove all AC pipe debris. Pass tools out of the excavation once they are cleaned.
- If flowing water is not available, wash the equipment in large buckets of water and dump that water into the excavation.
- There are two different options for the waste pipe:
  1) Remove from trench and dispose in asbestos waste bin:
     - Cut the pipe into short enough pieces (4 foot lengths) to fit into the Asbestos Waste Bags while still in the trench.
     - Place the pipe of piece and any visible pieces or debris into the Asbestos Waste Bag.
     - Twist the top of the bag to close it, and then fold over twisted portion and use duct tape to tape the twisted portion to the bag.
     - Place the bagged section near the edge of the “Asbestos Work Zone”.
     - Wipe down bag with a wet disposable cloth to remove any asbestos debris.
     - Place the bag into a second Asbestos Waste Bag and duct tape closed the same way.
     - Where use of Asbestos Waste Bags is not applicable (i.e. length of AC Pipe to be removed is longer than 4 feet or too large for the bag to contain) Polyethylene drop sheets can be utilized. Two layers of Polyethylene drop sheets will be placed on the edge of the trench. Once removed, the AC Pipe will be placed directly onto the
Polyethylene drop sheets. The first layer of the Polyethylene drop sheet will be used to contain the AC Pipe by wrapping around the pipe and tying the ends in a goose neck fashion and sealing with duct tape. The second layer of Polyethylene sheeting will be utilized to further contain the AC Pipe by double-wrapping the pipe and tying the ends in a goose neck fashion and sealing with duct tape. The double wrapped AC Pipe will then be labelled with an Asbestos Warning Sticker or marked appropriately with other means.

- Place the bag back of truck and dispose of in the designated Asbestos Disposal Bin at the back of the yard and advise Stores that you have done so. AC Pipe must never be left in the back of a truck overnight.

2) Leave in trench whole:
- If the trench is large enough to leave the AC Pipe section in the trench, this is another option. However, this practice is discouraged as the remaining AC Pipe must now be marked on the City of Nanaimo Asbestos Inventory and an exposure control plan must be implemented for future work in the area.
- Cut AC Pipe into sections small enough to either fit into Asbestos Waste Bags or small enough to be able to wrap poly around it.
- Place the AC Pipe section into an Asbestos Waste Bag and seal in a goose neck fashion with duct tape. Place that bagged piece into a second bag and seal in the same fashion.
- If section is too big to fit into Asbestos Waste Bag, wrap with poly and mark the poly wrap with Asbestos Hazard Stickers.
- Place “Asbestos Hazard” warning tape over the waste pipe during back fill.
- Forward location of buried and marked AC Pipe to OH&S and Public Works for placement into the Asbestos Inventory.
- When backfilling, bury asbestos hazard tape 2 feet below grade above the waste pipe.

Post Procedure/Take Down

1.) Decontaminate equipment:
- Once the final cut has been completed, thoroughly wash the cutting equipment in the excavation with clean, low pressure water to remove all AC pipe debris.
- Wash down excavator bucket and thumb with low flow water to remove all AC pipe debris and asbestos fibers.
- Remove all cleaned tools from the excavation.

2.) Decontamination of all workers handling asbestos (other than last worker to decontaminate)
- Proceed to where the wash station/ asbestos & asbestos waste bag is
  Thoroughly wash off boots & hard hat with low flow water.
- Remove gloves (first aid method turning inside out) and place in the asbestos waste bag
- Remove Tyvek and gently place in Asbestos Waste Bag
- Wash face and any exposed hair & hands with water and rag/ wet wipes
- Remove respirator cartridges and place into asbestos waste bag
- Thoroughly clean safety glasses & respirator with a disposable wet cloth/ wet wipes
- Throw away all clothes/ wet wipes into asbestos waste bag
- Step out of Asbestos Work Zone

3.) Last person out of excavation to decontaminate
- Take down barrier and dispose of tape in asbestos waste bag
- Proceed to where the wash station/ asbestos waste bag is
- Thoroughly wash off boots & hard hat
- Remove gloves (first aid method turning inside out) and place in the asbestos waste bag
- Remove Tyvek and gently place in asbestos waste bag
- Thoroughly clean safety glasses & respirator with a disposable wet cloth/ wet wipes
- Put all disposable clothes/ wet wipes in asbestos waste bag
- With respirator still on:
o Wash respirator, face and any exposed hair & hands with water and rag/ wet wipes
o Gently twist the Asbestos Waste Bag closed (Do NOT squish out the air) and then fold over twisted portion (goose neck) and duct tape closed.

o Wipe down the outside of the asbestos waste bag and place aside momentarily
o Remove cartridges and place into second asbestos waste bag
o Remove respirator, wipe down and set aside.

o Place first asbestos waste bag into second asbestos waste bag (has your respirator cartridges already in it)

o Twist the top of the bag to close it, and then fold over twisted portion and use duct tape to tape the twisted portion to the bag

o Place asbestos waste bags into bin with rest of double wrapped AC Pipe

4.) Backfill excavation as per usual procedures.

Other Considerations

1. Specific Respirator Maintenance
   • Clean respirator by washing with respirator wipes
   • Rinse in clean, warm water
   • Wipe dry and hang to complete drying
   • Visually inspect inhalation and exhalation valve before replacing

2. Contingency Plan – Spill/ Split Double Bag or Poly Wrap
   The section is to be used in the event a bag breaks open, a wrapped asbestos containing pipe is dropped or the double poly breaks open or other small spill of pre-bagged asbestos containing material.

   • Immediately soak down the contents with low flow water and barricade the area that the spill has occurred to keep unprotected workers and public out of area:
     o Create an “Asbestos Work Zone”.  Use four “Candlestick” style traffic control posts as the corners of the work zone. Use “Asbestos Hazard” warning tape to create a barrier surrounding the work zone, connecting all 4 corners. The work zone barrier must keep all non protected workers 10 feet away from the work zone. Post Asbestos Warning Signs where appropriate.
     o Employees entering the “Asbestos Work Zone” must be wearing the required personal protective equipment.

   • If workers are not already in Tyvek and other required PPE or workers with Tyvek and all other required PPE are unavailable ➔ Have workers don all appropriate personal protective equipment required for Moderate Risk Asbestos Procedures.

   • Rewrap the Asbestos:

     o Small Debris - Use the double bagging procedure:
       ▪ Place the pipe of piece and any visible pieces or debris into the Asbestos Waste Bag.
       ▪ Twist the top of the bag to close it, and then fold over twisted portion and use duct tape to tape the twisted portion to the bag.
       ▪ Place the bagged section near the edge of the “Asbestos Work Zone”.
       ▪ Wipe down bag with a wet disposable cloth to remove any asbestos debris.
       ▪ Place the bag into a second Asbestos Waste Bag and duct tape closed the same way.
• **Large Debris:**
  - Wrap the first layer of poly over the pipe like a present and tape into position.
  - Wipe down 1st layer with damp cloth to eliminate any fibers.
  - Wrap the second layer of poly over the pipe (again like a present) and tape down.
  - Apply asbestos hazard labels
  - Dispose of in bin with other double wrapped AC Pipe

• In addition to the above:
  o If contents were **spilled on soil:**
    - Ensure a layer of top soil is removed with the asbestos debris to minimize future exposure.
      - Utilizing a flat faced spade style shovel, dig horizontally deep enough under the surface to capture all of the fibers that may have been collected within the surface soils.
      - Gently place each shovel full into an Asbestos Waste Bag.
      - Seal bag as per “Small Debris” procedures above.
      - Decontaminate shovel with running water prior to removing from “Asbestos Work Zone”
  o If contents were **spilled on asphalt, concrete or other hard surface:**
    - Hepa vac contents up using DOP tested hepa vacuum
    - Wet wipe the area with disposable wet rags
    - Dispose of rags in double bag
APPENDIX 3

MoTI Traffic Control Standards
SECTION 194
TRAFFIC MANAGEMENT FOR WORK ZONES

PART A – GENERAL

194.01 General – Traffic management requirements will be as specified herein and as specified in the Special Provisions or by the Ministry Representative.

The Contractor’s Traffic Management Plan, Construction Schedule and its provisions for traffic control and safety will be based on providing safe passage through the Work Zone for all road users (i.e. cyclists, pedestrians and motorists). The Contractor will at all times make provisions for traffic through the Site to a sufficiently high standard to ensure the safety of the workers on the Project, the safety and the convenience of the travelling public, driver expectancy, and the protection of the Work Area. The Contractor will supply and maintain all traffic control devices and personnel necessary to provide all traffic control.

The Contractor’s accommodation for pedestrian, bicycle and vehicular traffic, and proposed traffic control procedures for each work operation will require approval by the Ministry Representative prior to the start of that operation.

Any one or more of the advance warning area, transition area, buffer space and termination area of the work zone may be outside the Limits of Construction, but this will in no way diminish the Contractor’s responsibility to meet the requirements of the Traffic Management Plan.

194.02 Definitions – For purposes of this Section, the following general terms are defined in the Traffic Management Manual for Work on Roadways:

- Traffic Management Strategy
- Traffic Management Plan
- Traffic Control Plan
- Incident Management Plan
- Public Information Plan
- Implementation Plan

In addition, the following terms are used in this Section and defined below:

“Work Activity Area” refers to an area that contains the work activity and is closed to traffic and set aside for the exclusive occupation by workers, equipment and construction materials. Work areas may remain fixed in location or may move as work progresses.

“Work Zone” as defined in the Traffic Control Manual for Work on Roadways.

“Construction speed zone” as defined in the Traffic Management Manual for Work on Roadways.

194.03 Standard Documents – Traffic Management Plans shall be developed in accordance with standards defined in the latest version of the following documents:

- MoT Traffic Management Manual for Work on Roadways (TMM)
- MoT Electrical and Traffic Engineering Manual and all current Technical Bulletins
- TAC Geometric Design Guide of Canadian Roads
- MoT Supplement to TAC Geometric Guide
- Workers’ Compensation Board (WCB) Regulation

All Ministry Publications listed above can be purchased from:

GOVERNMENT PUBLICATION SERVICES
MINISTRY OF MANAGEMENT SERVICES
PO BOX 9452 STN PROV GOVT
VICTORIA BC V8W 9V7
www.Publications.gov.bc.ca
Email: QPPublications@.gov.bc.ca
PHONE: 1-800-663-6105
FAX: (250) 387-1120

194.04 Traffic Control Supervisor – The Contractor will designate a Traffic Manager who has the Contractor's authority to respond to traffic control requirements and who will provide surveillance of traffic conditions through the Work Zone. This person or qualified designate will be available at all times, both when the Contractor is working and during weekends or other periods when the Contractor's forces are not active on the Project, to respond to calls from the police and from representatives of the Ministry concerning damage or deficiencies in the traffic control devices and the passage for traffic through the Work Zone.

The traffic control supervisor shall meet the requirements of the TMM and WCB Regulation and shall not be the Contractor’s site superintendent.

194.05 Compliance with Acts and Regulations – The Contractor shall comply with the requirements of any legislation, Regulations and by-laws as are in force for the regulation of traffic or use of any road upon or over which it is necessary to carry out work or to haul materials or things.
SECTION 194

PART B – PLANNING AND SCHEDULING


The Special Provisions or the Ministry Representative will specify the Traffic Management Strategy and required documentation for the Traffic Management Plan.

The Traffic Management Plan will be fully integrated with the Contractor’s plan and schedule for carrying out the work, comply with the requirements of the TMM, the Traffic Management Strategies listed below, and with the provisions of the Contract.

194.12 Traffic Management Plan Review – The Ministry Representative may review the Contractor’s Traffic Management Plan for general conformance with the requirements of the Special Provisions and the Contract for sufficiency of detail to provide a complete and unambiguous traffic control layout. No review or change requested by the Ministry Representative in any way relieves the Contractor of any its responsibilities for ensuring safe and adequate traffic management. No work that effects traffic will be permitted until the Ministry Representative accepts the Traffic Management Plan.

Where the TMM shows a choice of traffic control layouts for a given specific situation, the Ministry Representative may request the Contractor to use an alternative layout which is acceptable.

The following time periods are required for plan review and acceptance unless otherwise specified in the Special Provisions or by the Ministry Representative:

- A Traffic Control Plan shall be submitted to the Ministry Representative for review at least fifteen (15) working days prior to the start of any Works effecting traffic flows. The following conditions shall apply:
  - Any plan modifications shall be submitted to the Ministry Representative for review at least ten (10) working days prior to any changes being made in the field.
  - A staged plan shall be submitted to the Ministry Representative for review at least ten (10) working days prior to implementation of a new stage.
- The Implementation Plan, if required, shall be submitted to the Ministry Representative for review at least fifteen (15) working days prior to the start of any Works effecting traffic flows.
- The Public Information Plan, if required, shall be submitted to the Ministry Representative for review at least fifteen (15) working days prior to the start of any Works effecting traffic flows.

TRAFFIC MANAGEMENT FOR WORK ZONES

- The Incident Management Plan, if required, shall be submitted to the Ministry Representative for review at least fifteen (15) working days prior to the start of any Works effecting traffic flows.

PART C TRAFFIC MANGEMENT OPERATIONAL DETAILS

194.21 Speed Zones – Reduction in speed limits may take several forms as defined in the TMM 2.7. Construction speed zones within the Project will be determined at the discretion of the Road Authority or as specified in the Special Provisions.

The Contractor's work plan, Construction Schedule and its provisions for traffic control and safety will include references to the reduced posted speeds referred to in Subsection 194.21.

The location and length of posted speed reduction zones shall be adjusted daily, or more frequently as appropriate to the Work, to provide the shortest reduced speed zone practical. For example, on a resurfacing project, the reduced speed limit would usually be invoked around active operations such as milling, priming, paving, and, if necessary, at access points to pits and the plant, but will not generally be acceptable for areas of the Site used only for haul.

194.22 Use of Channelizing Devices and Taper Rates – Traffic cones, tubular markers, drums, barricades or other channelizing devices shall be used in the following circumstances to channelize traffic:

- a) from one lane to another or for merging traffic where a reduction in the number of lanes must be effected
- b) around a hazard on the travelled way
- c) through an area of unfinished construction where the intended traffic lanes are not self-evident
- d) at any other location where, in the Ministry Representative's opinion, channelizing will ensure the safe passage of public traffic.

Minimum taper rates and spacing between devices shall be as shown in TMM.

194.23 Equipment on the Travelled Way – When working on the travelled way, equipment shall be placed in such a position as to present a minimum of interference and hazard to the travelling public. Equipment units shall be kept as close together as working conditions will permit and preferably on the same side of the travelled way. Equipment shall not be left overnight on the travelled way but shall be located so as to avoid the possibility of an accident.

194.24 Roadway Configuration – The Contractor shall arrange to keep interconnected lanes of the highway open...
SECTION 194

194.27 Detours — Where detours or diversions are required for the execution of the work or deemed necessary by the Ministry Representative, the Contractor shall provide well graded, gravelled detours or temporary roads to facilitate the passage of traffic around the restricted construction area. The Contractor shall be responsible for signs, maintenance of same and maintenance of the detour or temporary road. The Contractor shall consider the condition of the pavement used for detours and its impact on the safety and function of the detour. Milled surfaces upon which traffic is to run shall be clean and allow adequate drainage.

The minimum design requirements for any detours will be specified in the Special Provisions or by the Ministry Representative.

Where the anticipated detour or diversion extends beyond the existing road surface, the Contractor will submit an engineering design to the Ministry Representative for review, a minimum of fourteen (14) days in advance of building the detour. The engineering design will include the design speed, the horizontal and vertical geometry, plus evidence that the design vehicle is accommodated for all movements and that all the requirements of this Contract are satisfied.

Where the anticipated deviation is minor, the Contractor may apply to the Ministry Representative, in writing, for approval to proceed without a formal design. Such approval does not relieve the Contractor of any of its responsibilities for provision of a safe site.

194.28 Access to Property — During operations the Contractor shall provide and maintain reasonable road access and egress to property fronting along or in the vicinity of the work unless other reasonable means of road access exists. The Ministry Representative will be the sole judge of what may be deemed reasonable road access.

194.29 Winter Lay-Up — In the event that the Work is stopped due to winter conditions, the Site is to be left in a condition as specified in the Special Provisions or as deemed acceptable by the Ministry Representative.

194.30 Delays — All major and minor delays to the travelling public will be determined by the Ministry Representative.

The Contractor will monitor the queue lengths created by any delay to the flow of traffic. Traffic must be cleared prior to starting another delay unless authorized by the Ministry Representative. If the Ministry Representative determines that the traffic delays are excessive, the Contractor shall immediately cease construction activities and make all the travel lanes available to traffic as quickly as possible. Resumption of roadway operations shall be permitted as traffic levels dictate and upon approval by the Ministry Representative.

PART D – TRAFFIC CONTROL DEVICES

194.41 Portable Traffic Signals — Portable traffic signals, in accordance with Section 5.7 of the Traffic Management Manual for Work on Roadways, may be used to provide bi-directional traffic control. Portable traffic signals are used primarily on longer term work zones. Typically, a pair of signals is set up at the perimeter of a roadway construction site.

Each signal unit shall have at least two signal heads for each approach and shall be positioned so that at least one signal head is overhead and one is side-mounted. Each signal head shall have a 3 lamp (red, yellow, green) signal display.

The use of portable traffic signals falls into two categories:

1. Category 1 is a fixed time signal used for short duration work in low speed environments of ≤60 km/h, and where advance warning flashers are
not required. A traffic engineer is not required to prepare the timing sheet for the signal.

2. Category 2 is an actuated or fixed time signal used for long duration work, and/or in high speed environments ≥70 km/h, and/or where advance warning flashers are required. A Traffic Engineer is required to prepare the timing sheet for the signal.

The Contractor shall submit a request for the use of portable traffic signals to the Ministry Representative that includes:

- The site layout
- Anticipated volumes
- Requirements for advance warning signs
- The category of portable traffic signal proposed
- Proposed signal timing plan(s)

The approval for the installation of the signals will be determined by the Ministry Representative.

If the proposed traffic signal installation is approved by the Ministry Representative, the Contractor shall:

- Implement any portable traffic signals in accordance with the Traffic Management Manual for Work on Roadways
- For category 2 signals, prepare a traffic signal timing plan, signed and sealed by a Traffic Engineer registered with the APEGBC
- Supply and install all traffic controller equipment
- Supply power
- Operate and maintain the signals

Traffic controller technology used shall comply with industry standard practice and shall have

- Manual override to hold the signal in green
- A conflict monitoring mechanism that will ensure both signals in a pair cannot show green simultaneously
- Ability to revert to flashing red mode if a fault is detected

Where the work activity impacts the operation of an existing signal, the Contractor must submit a written notification to the Ministry Representative a minimum of ten (10) days in advance of the disruption to the signal.

194.42 Pilot Cars – The use of pilot cars may be warranted where public traffic must use a particularly complex or lengthy route through a work area. Pilot cars shall be operated in conjunction with Traffic Control Persons or Portable Traffic Signals stationed at each end of the restricted section. When required, the Contractor shall provide sufficient pilot cars, as required, to keep a steady and controlled flow of traffic moving around or through the construction area.

Pilot cars shall be equipped with the following:

a) A sign or signs with minimum 200 mm letters, designating the vehicle as a pilot car, and showing the message in both directions. Signs shall be retroreflective or illuminated during the hours when headlights must be used. Signs shall not be displayed when the vehicle is not being used for piloting.

b) A 360 degree rotating yellow warning light must be mounted on the roof so as to be clearly visible from both directions. The flashing light shall be in use for both day and night piloting.

194.43 Use of Traffic Control Persons (TCP) – It is generally expected that TCP and/or Portable Traffic Signals will be required in the following situations:

a) when public traffic is required to pass working vehicles or equipment which may block all or part of the travelled roadway.

b) when it is necessary to institute a one-way traffic system through a construction area or other blockage where traffic volumes are heavy, approach speeds are high, and a traffic signal system is not in use.

c) in high volume areas where temporary protection is required while other traffic control devices (barricades, cones, signs, etc.) are being erected or taken down.

d) for emergency protection when other traffic control devices are not readily available.

e) in all situations, where adequate protection for workers, working equipment and public traffic is not provided by other traffic control devices.

194.44 Traffic Signs – All standard signs, new and replacement, shall meet current Ministry specifications. The Ministry Specifications for Standard Highway Sign Materials, Fabrication and Supply are located on our Ministry web page at:


Prior to the commencement of work the Contractor shall supply all posts, hardware and equipment required for the proper installation and maintenance of the project (C-035) signs. The Contractor shall place the signs as indicated in the TMM or as directed by the Ministry Representative.

Upon completion of the project the Contractor shall remove the C-035 signs when directed by the Ministry Representative. The removal of the signs shall also include the backfilling, compacting and dressing of the
postholes to the satisfaction of the Ministry Representative.

The signs shall be erected in advance of all highway and bridge construction projects whether undertaken by contract or day labour. The signs may be omitted at the direction of the Ministry Representative if the project is not in public view.

The Contractor shall supply and maintain all necessary signs and traffic control devices required by this specification and the TMM or as ordered by the Ministry Representative. All signs and devices used must conform to the standards detailed in this manual.

194.45 Barricades, Lights, Delineators, Traffic Lines – The Contractor shall provide, erect and maintain all types of temporary marker devices including traffic line marking tape, barricades, fences, delineators, amber flashing lights, in order to ensure safety to the workers and the general public. These devices shall be as required by the Special Provisions and the TCM, or as directed by the Ministry Representative.

Flashing amber lights, if deemed necessary by the Ministry Representative, are used for extra night time effectiveness and the batteries of the flashing lights shall be checked each day.

Battery operated flashing lights, if two-faced, and if used to mark the right hand edge of a travelled lane, must have one face covered so that the light is not visible to traffic travelling in the other direction. Flashing lights having two faces showing in opposite directions may be used only if it is necessary that the obstruction or lane edge being marked be seen from both directions of travel. They should not be used in a line of delineators through an area of incomplete construction except where traffic must be diverted and a specific hazard exists.

Temporary road construction lighting installations shall be positioned as shown in FIGURE 1: Positioning of Temporary Lighting Adjacent to a Highway to minimize glare and resulting impaired driver vision. Lights shall be aimed away from any approaching traffic and at an angle of less than 45 degrees above vertical. Where lights cannot be located as shown then temporary glare screens shall be used to shield the traffic from the light source. These glare screens shall be metal or an opaque plastic material designed to shield the lighting from the eyes of the driver.

The Contractor shall be responsible for the application and removal of all temporary pavement marking and reflective devices. When traffic lanes have to be redefined for Long Duration Work, the Contractor shall eradicate all redundant temporary or pavement markings that are not required for the intended traffic patterns.

Class I and Class II standard barricades are illustrated in the TMM. Temporary delineator posts shall be as shown on Drawing SP194.02. In speed zones of 50 km/h or less, the minimum height of traffic cones shall be 450 mm. Where the maximum speed limit is over 50 km/h, the minimum height of cones shall be 700 mm.

194.46 Dynamic Message Signs – The use of dynamic message signs (DMS) may be specified in the Special Provisions or by the Ministry Representative. Each sign must be portable. When in operation, the DMS shall be a minimum of two (2) metres from the bottom of the sign display to the road surface, and shall be level and capable of pivoting for sighting purposes. The specifications of the sign are as follows:

- **Sign unit:** Yellow/Orange LED display
- **Sign display:** 3 lines with 8 characters per line
- **Character size:** 450mm (18 inches)
- **Character matrix:** 5 x 7
- **Remote dial-up access:** By cellular phone or equivalent

A full matrix sign may be used given that it has the display parameters noted above.

The Contractor is responsible for the DMS including but not limited to bringing the signs to the Project, moving and setting-up, providing storage as required including moving the signs into and out of storage, maintaining the signs in full operating condition, ensuring the correct message is being displayed, damage to or loss of the signs and returning the signs to the supplier. The Contractor shall provide to the Ministry Representative with a description of the messages displayed and the procedures of how the messages on the DMS will be changed when the Contractor is on and off site.
PART E – GENERAL MAINTENANCE

194.51 Maintenance – The Contractor shall be responsible for the continuing maintenance of all traffic control devices in use as follows:

a) Signs, etc., not applying to existing conditions shall be removed or covered. If covered, such as after sundown or during periods when work is suspended, the covering shall be placed over the sign so as to totally obliterate the message thereon. Where operations are carried out in stages, only those devices or signs, which apply to the current stage, are to be left in place or uncovered.

b) Signs shall be checked daily for legibility, damage, suitability and location. Dirty, damaged, unsuitable or misplaced signs shall be cleaned repaired or replaced. Signs and delineators with a reflective surface shall be cleaned as frequently as necessary to ensure full reflectivity. As considerable damage may be inflicted on signs and devices during a weekend, the Contractor shall conduct a check for replacement or repairs before the rush hour on Monday morning. Similarly, high traffic volume and recreational routes shall be checked during the weekend or at any other time that works is not in progress.

During hours when headlights are required, signs that are not retroreflective shall be illuminated. After sundown all signs shall be checked for visibility and those that cannot be seen clearly shall be adjusted or replaced.

PART F – PAYMENT

194.61 Payment – The cost of all Traffic Management requirements, including the provision of pilot cars, all flagging and traffic control equipment, and personnel covered in this Section and the Contract Documents, or as ordered by the Ministry Representative, will be considered to be included in the unit prices bid for the applicable work of the Contract unless otherwise specified in the Special Provisions.

However, where pilot cars and traffic control persons are included as bid items in the Contract Documents, a record of the days and hours that each pilot car and/or traffic control person was employed shall be submitted daily by the Contractor for verification and approval of the Ministry Representative. In such event the overtime “hours worked” by traffic control persons in accordance with the current union shall be expressed in equivalent straight-time “hours earned” for payment at the rate bid. Pilot cars will be paid for at the all found rate bid in the Schedule for the actual number of hours operated as such.
APPENDIX 4

Bayshore Park
Location Map
The City of Nanaimo does not warrant or guarantee the accuracy or completeness of the information. You are encouraged to verify the accuracy of the information against copies of actual plans. If there is a conflict between this information and information contained in any other records of the City of Nanaimo or documents that may be prepared by or delivered to the City of Nanaimo, the City of Nanaimo reserves the right to rely in all cases upon the record which it considers to be the most accurate and complete.

Legend
- Railways Detail
- Parcel Hooks
- Mobile Homes
- Airspace Parcels
- Water Lease
- Strata Buildings
- Strata Lots
- Bare Land Strata
- Strata Parcels
- Land Parcels
- Roads
- Political Boundaries
  - City
  - Indian Reserve
- Rivers
- Streams
- Lakes
- Ponds
- Rivers
- Wetlands
- City Owned Parks
- Other Open Space

Bayshore Park

BAYSHORE PARK LOCATION MAP 1:2,883
APPENDIX 5

Westdale Road
Sanitary Sewer Flow Monitoring Station
Westdale #29

Flame opening
20 cm

Home made insert

Initial Chain of Accuracy Checks

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<th>Check</th>
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<th>Value 2</th>
<th>Initial</th>
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*All Times to be in PST
*All Distance to be in feet
*All Flow to be in gpm/second
Photo 1: Above ground features of flow monitoring station looking due east

Photo 2: Interior of Flow monitoring station manhole showing flume, ultrasonic level and telemetry conduit.